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MICRO PROJECT REPORT ON

Automatic Object Counter for Industrial Counting System

SUBMITTED BY:

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1. Introduction:

In today's fast-moving industrial world, automation plays a key role in improving productivity and efficiency. Counting objects manually is time-consuming, prone to human error, and inefficient in large-scale production environments.

This project — *Automatic Object Counter for Industrial Counting System* — uses an Infrared (IR) sensor and 8051 microcontroller to automatically detect and count objects passing through a conveyor-like path. Each time an object passes in front of the IR sensor, it is detected, and the count is incremented automatically and displayed on an LCD screen.

This system can be applied in bottle filling plants, packaging industries, and manufacturing lines, where real-time counting is necessary for process control and inventory management.

2. Sustainable Development Goals (SDGs):

This project supports the following **United Nations Sustainable Development Goals (SDGs):**

- **Goal 9: Industry, Innovation, and Infrastructure**
  The project promotes industrial automation and innovation through simple, cost-effective counting solutions.

- **Goal 12: Responsible Consumption and Production**
  By enabling accurate object counting, it ensures resource-efficient manufacturing and minimizes waste.

- **Goal 8: Decent Work and Economic Growth**
  Automation reduces repetitive manual labor, allowing workers to focus on higher-level tasks, improving productivity and workplace safety.

3. Literature Review:

In the field of industrial automation, **automatic object counting** has been a significant research area for improving productivity and operational efficiency. Various approaches have been proposed by researchers to achieve precise object detection and counting mechanisms using different sensors and microcontrollers.

A. Gupta et al. (2020), IR sensors are cost-effective and highly reliable for short-range detection applications. Their research demonstrated that the accuracy of counting systems can reach above 98% when properly calibrated with microcontrollers like the AT89C51 [1].

S. Patel and R. Mehta (2021) explored microcontroller-based counting systems using infrared and ultrasonic sensors, comparing their response times and interference levels. They concluded that IR sensors provide faster response for low-cost automation setups [2].

R. Sharma et al. (2022) introduced an advanced version of object counters integrated with conveyor control systems, enabling synchronized counting and automatic halting when the limit is reached [3].

M. Kumar and V. Raj (2023) presented a low-cost embedded design using 8051 microcontrollers for packaging industries. Their design focused on modular software development using the Keil IDE and Proteus simulation for testing without hardware dependency [4].

From the literature, it is clear that using the **8051 microcontroller** in combination with **IR sensors** offers a reliable, low-power, and economical solution for industrial counting systems. This project builds upon these foundations to provide a real-time counting solution suitable for small to medium-scale industrial environments.

References:

1. A. Gupta, P. Jain, "Low-Cost IR-Based Object Counting System Using 8051 Microcontroller," *IJERT Journal of Embedded Systems*, Vol. 9, Issue 2, 2020.
2. S. Patel, R. Mehta, "Comparative Study of Ultrasonic and Infrared Object Counting Systems," *IEEE Sensors Applications Symposium*, 2021.
3. R. Sharma, D. K. Singh, "Conveyor-Based Smart Counting and Sorting System Using Microcontrollers," *IJRTE*, Vol. 10, No. 4, 2022.
4. M. Kumar, V. Raj, "Embedded Design for Industrial Automation Using 8051 and Proteus," *IJSTE Journal of Advanced Engineering Technology*, Vol. 8, Issue 1, 2023.

4.Proposed Work:

The project "Automatic Object Counter for Industrial Counting System" is designed to detect and count moving objects automatically using an IR sensor and 8051 microcontroller. It provides a simple, low-cost solution for industrial automation where objects need to be counted accurately without human involvement.

System Overview

The system works on the principle of infrared beam interruption. The IR sensor continuously emits an IR beam, and when an object passes through it, the beam is interrupted, causing the sensor output to change from HIGH to LOW. The 8051 microcontroller detects this change, increments a counter, and updates the value on a 16x2 LCD display. An LED indicator glows briefly each time an object is detected, confirming proper operation.

Hardware Components

- 8051 Microcontroller (AT89C51): Main controller that processes sensor input and updates the LCD.
- IR Sensor Module: Detects passing objects by sensing the interruption of the IR beam.
- 16x2 LCD Display: Shows the real-time count of objects detected.
- LED Indicator: Lights up whenever an object is detected.
- Power Supply (5V DC): Provides stable voltage to all components.

Working Principle

When power is applied, the LCD shows a welcome message and then switches to counting mode. As each object crosses the IR beam, the sensor output goes LOW, signaling the microcontroller. The counter increases by one, and the updated count is displayed on the LCD. A delay in the code ensures each object is counted only once, avoiding false counts.

Software Implementation

The program is written in Embedded C using Keil µVision, and simulated in Proteus. The microcontroller initializes the LCD, continuously monitors the IR sensor input, and updates the display in real time whenever an object is detected.

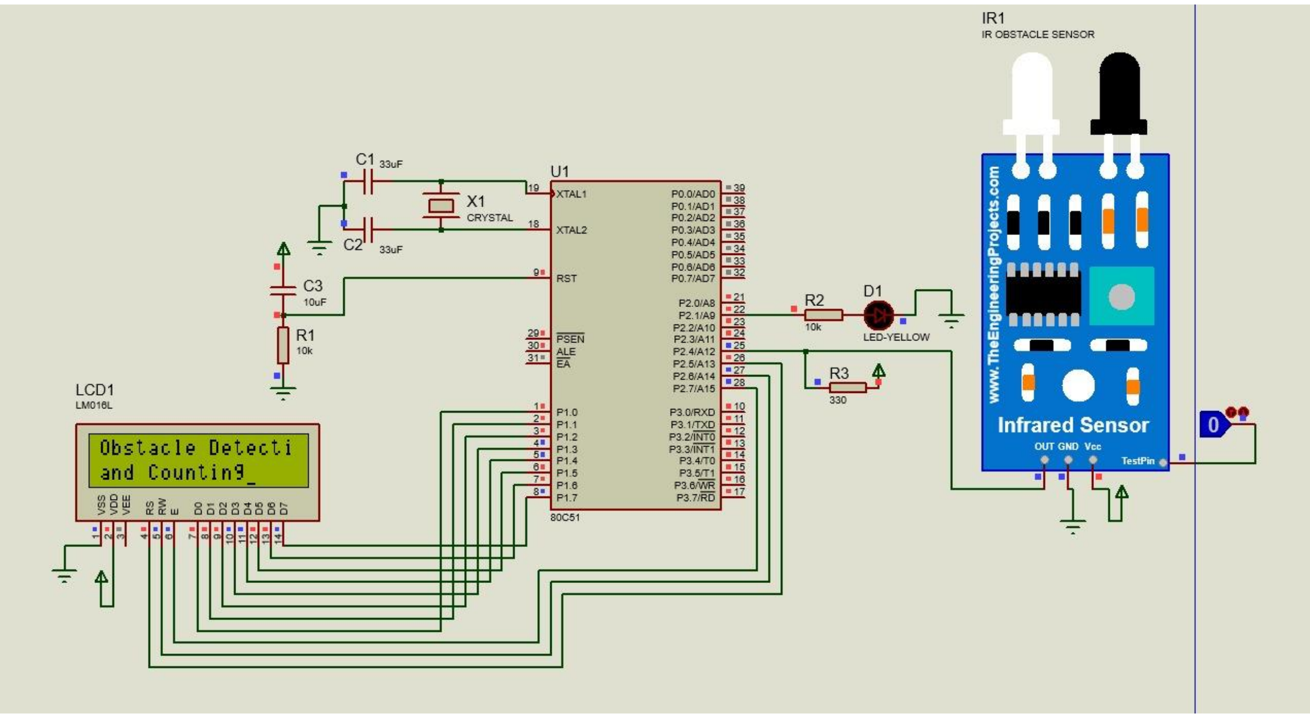
Advantages

- Accurate and reliable counting
- Low-cost, compact, and easy to implement
- Low power consumption
- Scalable for industrial applications
-

Applications

- Industrial production and packaging lines
- Bottle filling and labeling stations
- Entry or people counting systems

5 .Simulation Diagram:



5.1 Description

The simulation of the Automatic Object Counter for Industrial Counting System is performed using Proteus 8 Professional. The circuit consists of an 8051 microcontroller (AT89C51), IR sensor module, 16x2 LCD display, LED indicator, and a 5V DC power supply.

The simulation demonstrates how the system detects and counts objects automatically. When an object passes in front of the IR sensor, the sensor output changes from HIGH to LOW, which is detected by the microcontroller. The microcontroller then increments the counter and updates the count value on the LCD display. The LED glows each time an object is detected, providing a visual indication.

The simulation validates the correct working of both hardware and software components before real-time hardware implementation.

5.2 Main Connections in the Simulation

The main circuit connections in the simulation are as follows:

- **IR Sensor Output → P2.4 (Pin 14):**
  Connected to detect the presence of objects and send signals to the microcontroller.
- **LED Indicator → P2.1 (Pin 11):**
  Connected to indicate when an object is detected (LED glows on detection).
- **LCD Display (16x2):**
  - Data Pins (D0–D7) → Port 1 (P1.0–P1.7)
  - Control Pins:
    - RS → P2.5 (Pin 15)
    - RW → P2.6 (Pin 16)
    - EN → P2.7 (Pin 17)

    Displays the object count and system messages in real time.
- **Power Supply (5V DC):**
  Powers the entire circuit including the LCD, IR sensor, and microcontroller.
- **Crystal Oscillator (12 MHz):**
  Connected between XTAL1 and XTAL2 (Pins 18 and 19) to provide clock frequency for the microcontroller.
- **Reset Circuit:**
  A resistor-capacitor (RC) network is connected to the RESET pin (Pin 9) to initialize the microcontroller on startup.

5.3 Working in Simulation

1. **Initialization Stage:**
   When the simulation starts, the LCD displays the message:
   “Obstacle Detection and Counting”, indicating system initialization.
2. **Counting Mode:**
   After initialization, the LCD displays:
   “IR Object Count” and **“Count: 0”**.
   The system now waits for objects to pass in front of the IR sensor.
3. **Object Detection:**
   When an object interrupts the IR beam, the sensor output becomes LOW. The microcontroller detects this transition, increments the internal counter, and displays the updated count on the LCD (e.g., “Count: 01”, “Count: 02”, etc.).
4. **Visual Indication:**
   The LED connected to Port 2.1 lights up each time an object is detected, giving immediate feedback.
5. **Continuous Operation:**
   The process repeats for every object passing through the sensor’s field,

and the count continues to increase sequentially.

Simulation Results

- The system correctly displays the initial title and switches to counting mode.
- Each object passing through the IR beam increases the count by one.
- The LED flashes for every detection event.
- The LCD display updates instantly with accurate count values.

6. Output and Result :-

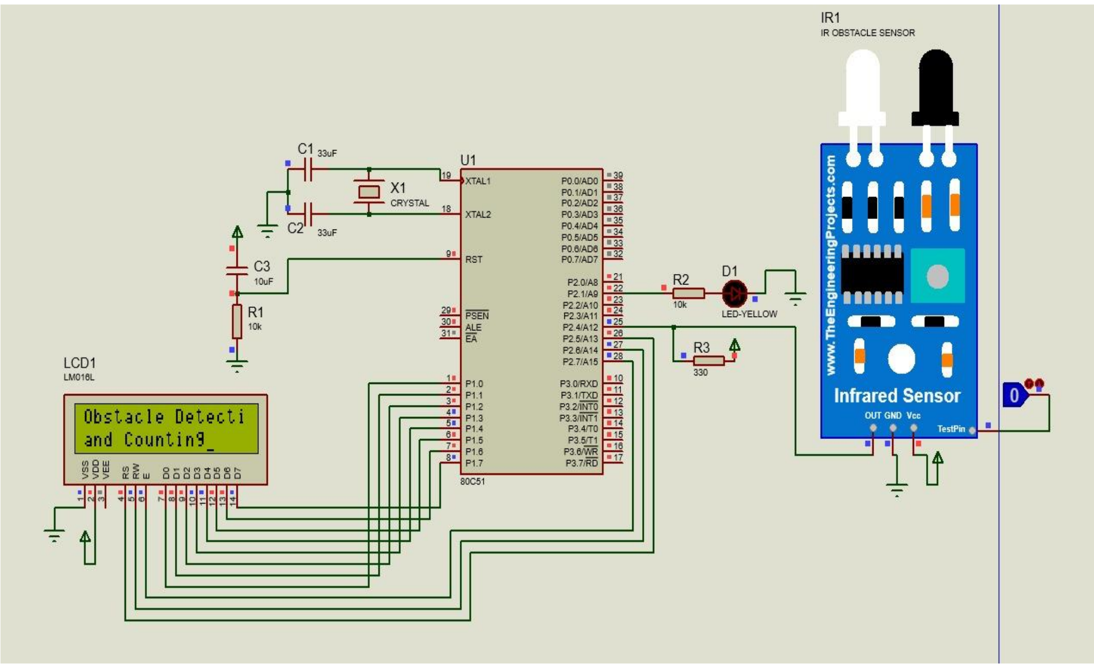


Figure 1: Output Display of “Obstacle Detection and Counting”

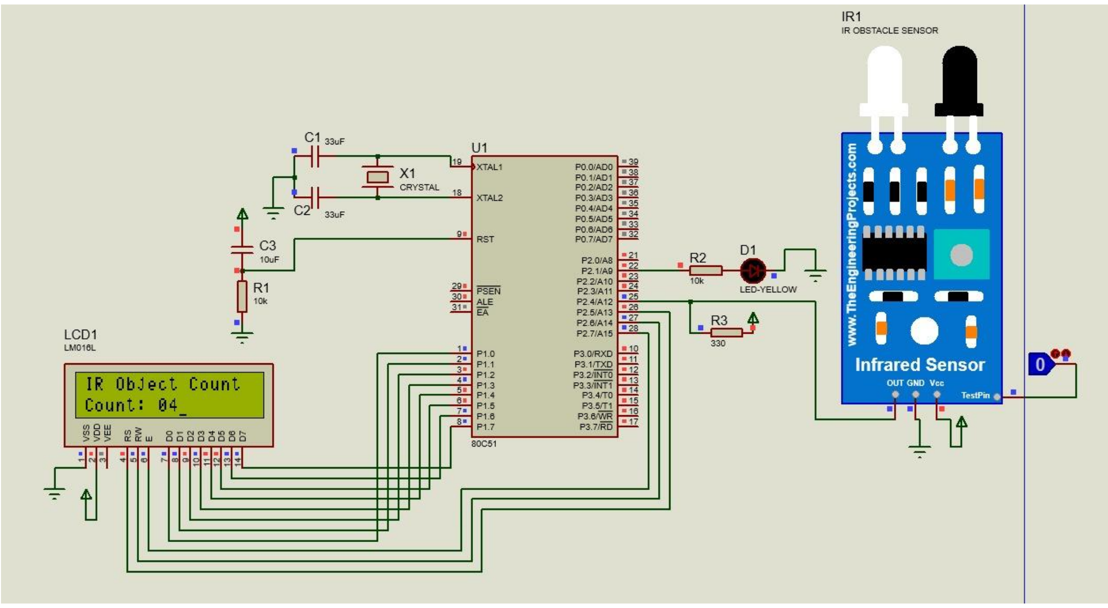


Figure 2: Output Display of “IR Object Count: 04”

Description

After successful simulation in Proteus 8 Professional, the "Automatic Object Counter for Industrial Counting System" was tested to verify the accurate detection and counting of objects using the IR sensor and 8051 microcontroller. When the system is powered ON, the LCD displays the message "Obstacle Detection and Counting", indicating that the circuit has been initialized successfully. As soon as any object passes in front of the IR sensor, the microcontroller receives a LOW signal from the sensor and increments the counter value by one.

The updated count is displayed on the 16×2 LCD in real-time. Simultaneously, an LED indicator glows to confirm the detection event. The simulation clearly shows both the initialization and live counting stages of operation.

Observed Output Results

Condition	Sensor output(Logic)	Microcontroller Action	LCD Display Output	LED Status
No Object Detected	HIGH	Waits in idle state	"IR Object Count / Count: 0"	OFF
Object Detected (1st)	LOW	Increments Counter	"Count: 1"	ON
Object Detected (2nd)	LOW	Increments Counter Again	"Count: 2"	ON
Continuous Detection	Alternating HIGH / LOW	Real-time Counting	"Count: n" (updated)	ON

Working Observation

- When no object is present, the IR sensor continuously transmits an infrared beam, and the LCD remains at "Count: 0".
- When an object passes through the sensor beam, the output changes to LOW, triggering the microcontroller to increase the count by one.
- The LED indicator turns ON momentarily to confirm that detection occurred.
- As more objects pass the sensor, the counter increases sequentially — e.g., Count: 1, Count: 2, Count: 3, etc.
- The microcontroller uses a delay loop to avoid false multiple counts for one object.
- The LCD updates instantly, showing stable and accurate counting results throughout the simulation.

Result Analysis
The simulation results confirmed that:

The IR sensor effectively detected each passing object.

The 8051 microcontroller accurately processed sensor input and maintained an error-free count

The LCD display clearly showed the counting process in real time.

The LED indicator provided immediate visual confirmation for each detection

The system remained stable and reliable even for multiple rapid detections.

7. Working:

• Microcontroller & Power Supply
Controller:
The core of the circuit is the **AT89C51 microcontroller (U1)** from the 8051 family, which controls the overall operation of the system. It reads input from the **IR sensor**, processes the signal, increments the counter, and sends display data to the **16×2 LCD**.

Power:
The circuit is powered by a **+5V DC regulated power supply**. The **VCC pin (Pin 40)** of the microcontroller provides operating voltage, while **Pin 20 (GND)** is connected to ground. This same 5V supply also powers the LCD and IR sensor module.

• Reset Circuit
A **reset circuit** consisting of a **10 µF capacitor (C3)** and a **10 kΩ resistor (R1)** is connected to the **RESET pin (Pin 9)** of the microcontroller. This ensures the controller starts from a known initial state whenever the system is powered ON or reset manually.
A momentary push button can also be included to trigger a manual reset if needed, allowing the program to restart the counting operation from zero.

• Oscillator Circuit
The **crystal oscillator (X1)** with a frequency of **12 MHz**, along with two **33 pF capacitors (C1 and C2)**, is connected to pins **XTAL1 (Pin 18)** and **XTAL2 (Pin 19)**.

This oscillator provides the clock pulses necessary for the internal timing and operation of the microcontroller. The stable clock signal ensures accurate counting and proper execution of delays in the program.

• IR Sensor Interface

An **Infrared (IR) sensor module** is used to detect the presence of an object. It consists of an IR transmitter and receiver pair — the transmitter emits infrared rays, and the receiver detects the reflected rays from a nearby object.

The **sensor output pin** is connected to **Port 2, Pin 4 (P2.4)** of the microcontroller. When an object passes in front of the sensor, the beam is interrupted, and the sensor output goes LOW, signaling the microcontroller to increment the count.

• LCD Interface

The **16×2 LCD display (LCD1)** is used to show messages and the number of objects counted.

- **Data lines (D0–D7)** of the LCD are connected to **Port 1 (P1.0–P1.7)** of the microcontroller.
- **Control pins:**
  - **RS → P2.5**, used to select command or data mode
  - **RW → P2.6**, used for read/write operations
  - **EN → P2.7**, used to enable the LCD to latch data

A **10kΩ variable resistor (VR1)** is connected to the **VEE pin** to adjust the LCD contrast.

Power (VDD) and ground (VSS) pins of the LCD are connected to +5V and GND respectively.

• LED Indicator

A **yellow LED (D1)** is connected to **Port 2, Pin 1 (P2.1)** through a **330Ω resistor (R3)**.

The LED glows whenever an object is detected, giving a visual indication of the counting process. It turns OFF automatically when no object is present.

• Working Process

1. When the circuit is powered ON, the microcontroller initializes all peripherals and displays **"Obstacle Detection and Counting"** on the LCD.
2. The system then enters counting mode, showing **"IR Object Count"** and **"Count: 0"** initially.
3. Each time an object passes in front of the IR sensor, the output of the sensor goes LOW.
4. The microcontroller detects this transition, increments the counter variable, and updates the LCD display with the new count.
5. The LED connected to **P2.1** lights up briefly whenever detection occurs.

6. The process continues continuously, counting every object accurately as it passes the sensor beam.

8. Objective:

Main Objective

The main objective of this project is to design and implement a low-cost, automatic object counting system that can detect, count, and display the number of objects passing in front of a sensor in real time, using the AT89C51 microcontroller and infrared (IR) sensor module.

This project focuses on industrial automation where continuous counting of products or materials is required, such as in production lines, packaging units, or conveyor-based systems.

Specific Objectives

1. To automatically detect and count objects passing through a path using an IR sensor based on beam interruption technique.
2. To design an embedded system using the AT89C51 microcontroller that receives the sensor signal, processes it, and performs accurate counting operations.
3. To display the total count clearly and continuously on a 16×2 LCD screen, ensuring real-time monitoring for operators.
4. To implement LED indication for visual feedback whenever an object is detected, confirming successful sensing.
5. To develop an energy-efficient, compact, and low-cost design suitable for small-scale industrial and educational automation applications.
6. To test and validate the system through simulation in Proteus and ensure that the counting operation works reliably under different conditions (varying object speed and distance).

9. Source Code

```
#include <reg51.h>

#define lcd P1
sbit led = P2^1;
sbit IR = P2^4;
sbit rs = P2^5;
```

```c
sbit rw = P2^6;
sbit e  = P2^7;

void cmd(unsigned char);
void lcddata(unsigned char);
void delay(unsigned int);
void lcd_string(char *);
void lcd_num(unsigned int);

unsigned int count = 0;   // Object counter variable

void main() {
    cmd(0x38);  // LCD 2 lines, 5x7 matrix
    cmd(0x0E);  // Display on, cursor blinking
    cmd(0x06);  // Auto increment cursor
    cmd(0x01);  // Clear display
    cmd(0x80);  // Set cursor to first line

    // --- Display Title ---
    lcd_string("Obstacle Detection");
    cmd(0xC0);  // Move to second line
    lcd_string("and Counting");
    delay(500); // Delay to display title for a few seconds

    // --- Clear screen and display main interface ---
    cmd(0x01);   // Clear display
    cmd(0x80);   // Move cursor to first line
    lcd_string("IR Object Count");
    delay(100);
    cmd(0xC0);   // Move to 2nd line
    lcd_string("Count: 0");
    delay(100);

    while(1) {
        if(IR == 0) {   // Object detected (active LOW sensor)
            count++;    // Increment object count
            led = 1;    // Turn ON LED

            cmd(0xC0);  // Move to 2nd line
            lcd_string("Count: ");
            lcd_num(count);  // Display count value
            delay(200);

            while(IR == 0); // Wait until object moves away (to avoid multiple counts)
```

```
        } else {
            led = 0; // LED off when no object
        }
    }
}

// Send command to LCD
void cmd(unsigned char a) {
    lcd = a;
    rs = 0;
    rw = 0;
    e = 1;
    delay(2);
    e = 0;
}

// Send data to LCD
void lcddata(unsigned char a) {
    lcd = a;
    rs = 1;
    rw = 0;
    e = 1;
    delay(2);
    e = 0;
}

// Display a string on LCD
void lcd_string(char *s) {
    while(*s) {
        lcddata(*s++);
    }
}

// Display a number on LCD
void lcd_num(unsigned int num) {
    unsigned int a, b, c, d, e;
    a = num / 10000;
    b = (num / 1000) % 10;
    c = (num / 100) % 10;
    d = (num / 10) % 10;
    e = num % 10;

    if(a != 0) lcddata(a + 48);
    if(a != 0 || b != 0) lcddata(b + 48);
```

```
    if(a != 0 || b != 0 || c != 0) lcddata(c + 48);
    lcddata(d + 48);
    lcddata(e + 48);
}

// Delay function
void delay(unsigned int t) {
    unsigned int i, j;
    for(i = 0; i < t; i++)
        for(j = 0; j < 1275; j++);
}
```

10. Conclusion

The Automatic Object Counter for Industrial Counting System was successfully designed and simulated. The IR sensor effectively detected each passing object, and the 8051 microcontroller accurately counted and displayed the results on the LCD.
The project demonstrates how embedded systems can be used to automate industrial processes efficiently. With further enhancements, this setup can be expanded into a full-scale industrial conveyor automation system

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AUTOMATIC OBJECT COUNTER FOR INDUSTRIAL COUNTING SYSTEM

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ABSTRACT

Infrared (IR) sensors are integral components in modern embedded systems, enabling automation and intelligent decision-making across a wide range of applications, including robotics, security, and industrial monitoring. When integrated with an 8051 microcontroller, IR sensors enable contactless object detection, movement tracking, and process automation at a low cost. This paper explores the working principle, interfacing techniques, software implementation, and practical applications of IR sensors using the 8051 microcontroller. The paper also includes circuit explanations, algorithmic flow, and experimental observations to provide a complete understanding of the interface.

Keywords: IR Sensor, 8051 Microcontroller, Obstacle Detection, Automation, Embedded Systems.

I. INTRODUCTION

The integration of sensors and microcontrollers has driven significant progress in the field of embedded systems and automation. Sensors act as the human senses of machines, providing real-time data about environmental conditions. Among various sensor types, infrared sensors stand out due to their non-contact detection ability, low power consumption, and affordability.

The 8051 microcontroller, developed by Intel, remains one of the most popular and versatile controllers for educational, research, and small-scale industrial applications. Its simple instruction set, wide availability, and flexible input/output ports make it an ideal platform for interfacing various sensors.

This paper focuses on developing and analyzing a system in which an IR sensor is connected to an 8051 microcontroller to detect the presence of objects. Such interfacing is essential for applications like obstacle detection in robots, automatic door systems, counting mechanisms, and security alarms.

II. LITERATURE REVIEW

Several researchers and practitioners have contributed to developing IR sensor-based systems and microcontroller applications.

- **Mazidi and Mazidi (2000)** introduced fundamental interfacing methods for 8051 microcontrollers, laying the foundation for sensor-based applications.
- **Ayala (2004)** discussed programming techniques and architecture, helping students understand real-time embedded system development.
- **Bhupesh & Nikhil (2020)** proposed an obstacle detection system using IR sensors, demonstrating how reflection intensity can trigger microcontroller responses.
- **Gupta et al. (2018)** presented a robotic vehicle controlled via IR sensing and showed how simple hardware configurations can enable automation without expensive equipment.
- **Kumar et al. (2022)** enhanced object detection accuracy using multiple IR sensors connected to a single microcontroller for coverage extension.

From these studies, it is evident that IR sensors are a reliable and cost-effective solution for object detection and automation. However, integration accuracy depends on circuit design, programming logic, and signal conditioning.

III. OBJECTIVE OF THE STUDY

The main objectives of this research are:

1. To understand the working principle of an IR sensor and its characteristics.
2. To design and implement an interfacing circuit between the IR sensor and the 8051 microcontroller.
3. To develop a program for detecting objects and activating output devices.
4. To analyze system performance in terms of reliability and response time.
5. To explore potential real-world applications of the interfaced system.

IV. PRINCIPLE OF OPERATION OF IR SENSOR

Infrared sensors operate on the principle of emission and detection of infrared radiation. The system includes two key parts:

- **Transmitter (IR LED):** Emits infrared radiation that cannot be seen by the human eye.
- **Receiver (Photodiode/Phototransistor):** Detects reflected infrared light and converts it into an electrical signal.

When no object is present, the emitted IR rays travel away from the receiver. When an object appears, the rays reflect and are detected, producing a change in voltage level at the sensor's output. This signal is interpreted as a digital "1" or "0" by the microcontroller.

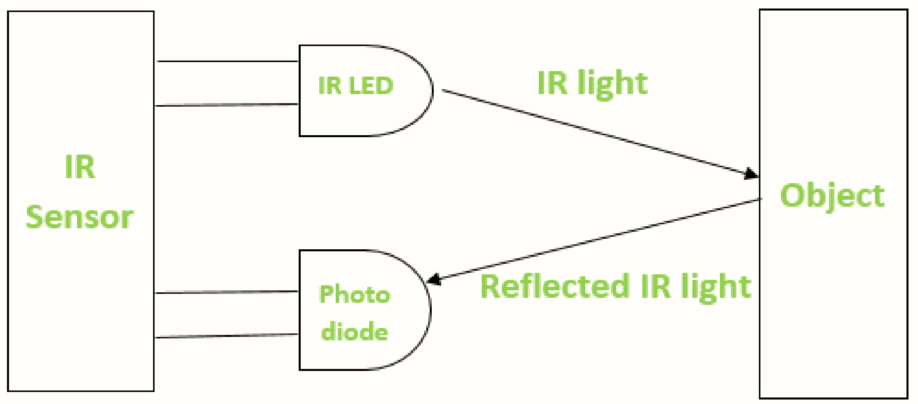

Figure 1: Block Diagram of IR Sensor Working Principle

Table 1: General Specifications of IR Sensor Module

Parameter	Typical Value
Operating Voltage	3.3 V – 5 V DC
Detection Range	10 – 30 cm
Output Type	Digital or Analog
Response Time	< 1 ms
Power Consumption	< 50 mW

V. OVERVIEW OF 8051 MICROCONTROLLER

The **8051** is an 8-bit microcontroller with a Harvard architecture, consisting of separate memory spaces for program and data. It features 128 bytes of RAM, 4 KB of ROM, and 32 I/O pins distributed across four ports (P0 – P3).

Key Features:

- 8-bit CPU with 16-bit address bus
- Four I/O ports for interfacing peripherals
- Two 16-bit timers/counters
- Full-duplex UART for serial communication
- Boolean processor for bit-level operations

The 8051 is well suited for sensor applications because it allows direct port-level access for digital input and output signals.

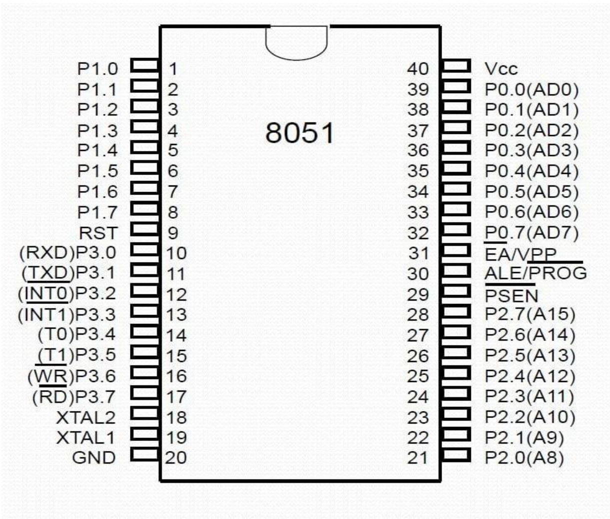

Figure 2: 8051 Microcontroller Pin Configuration

VI. INTERFACING CIRCUIT DESCRIPTION

The interfacing of the IR sensor with the 8051 microcontroller involves connecting the sensor's output to one of the microcontroller's port pins. When the sensor detects an object, it changes its output voltage, which the 8051 reads as a logic "0" or "1".

Connections:

- IR Sensor VCC → +5 V
- IR Sensor GND → Ground
- IR Sensor OUT → P1.0 of 8051
- LED (with 330 Ω resistor) → P2.0 of 8051

Table 2: Hardware Components Used

	Quantity	Description
8051 Microcontroller	1	Main controller
IR Sensor Module	1	Object detection
10 kΩ Resistor	2	Pull-up configuration
LED	1	Visual output
Buzzer	1	Audio output
Breadboard & Jumper Wires	–	Prototyping setup

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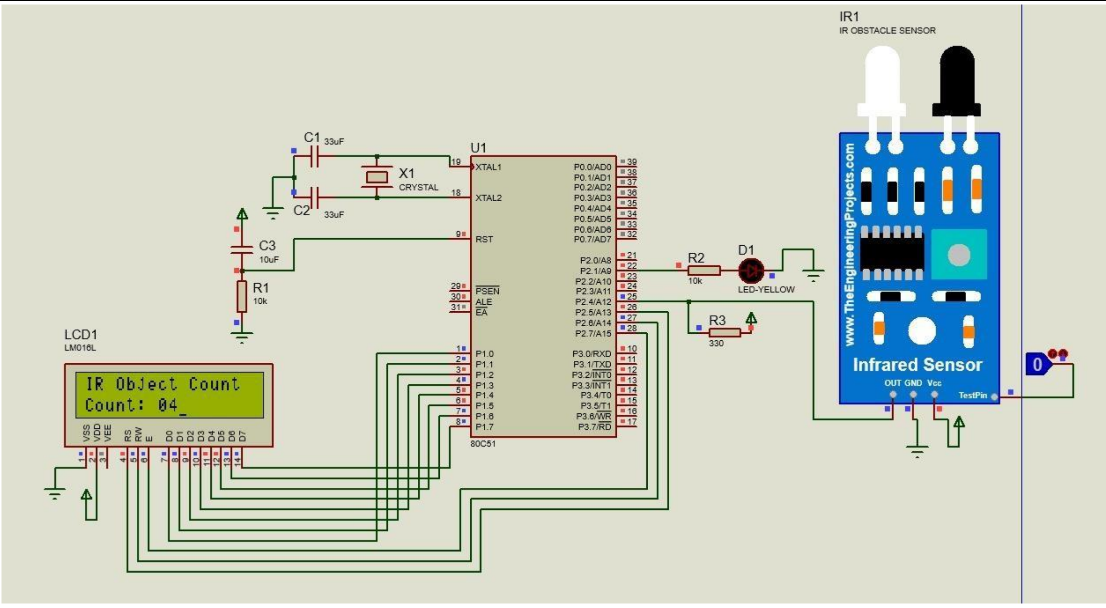

Figure 3: Circuit Diagram for IR Sensor Interfacing

VII. ALGORITHM

The system follows a simple logic-based algorithm:

1. Initialize all ports.
2. Set output devices (LED/Buzzer) to OFF state.
3. Continuously read input from the IR sensor.
4. If sensor detects an object → activate output device.
5. Else → keep output device OFF.
6. Repeat the loop indefinitely.

VIII. SOFTWARE IMPLEMENTATION

The code for the 8051 is written in Embedded C and compiled using Keil µVision software. After compilation, the hex file is uploaded to the microcontroller using a flash programmer.

```
#include <reg51.h>
#define lcd P1
sbit led = P2^1;
sbit IR = P2^4;
sbit rs = P2^5;
sbit rw = P2^6;
sbit e  = P2^7;
void cmd(unsigned char);
void lcddata(unsigned char);
void delay(unsigned int);
void lcd_string(char *);
void lcd_num(unsigned int);
unsigned int count = 0;   // Object counter variable
void main() {
```

```
cmd(0x38);  // LCD 2 lines, 5x7 matrix
cmd(0x0E);  // Display on, cursor blinking
cmd(0x06);  // Auto increment cursor
cmd(0x01);  // Clear display
cmd(0x80);  // Set cursor to first line
// --- Display Title ---
lcd_string("Obstacle Detection");
cmd(0xC0);  // Move to second line
lcd_string("and Counting");
delay(500); // Delay to display title for a few seconds
// --- Clear screen and display main interface ---
cmd(0x01);   // Clear display
cmd(0x80);   // Move cursor to first line
lcd_string("IR Object Count");
delay(100);
cmd(0xC0);   // Move to 2nd line
lcd_string("Count: 0");
delay(100);
while(1) {
if(IR == 0) {   // Object detected (active LOW sensor)
count++;   // Increment object count
led = 1;    // Turn ON LED
cmd(0xC0);  // Move to 2nd line
lcd_string("Count: ");
lcd_num(count);  // Display count value
delay(200);
while(IR == 0); // Wait until object moves away (to avoid multiple counts)
} else {
led = 0; // LED off when no object
}
}
}
// Send command to LCD
void cmd(unsigned char a) {
lcd = a;
rs = 0;
rw = 0;
e = 1;
delay(2);
```

```
e = 0;
}
// Send data to LCD
void lcddata(unsigned char a) {
lcd = a;
rs = 1;
rw = 0;
e = 1;
delay(2);
e = 0;
}
// Display a string on LCD
void lcd_string(char *s) {
while(*s) {
lcddata(*s++);
}
}
// Display a number on LCD
void lcd_num(unsigned int num) {
unsigned int a, b, c, d, e;
a = num / 10000;
b = (num / 1000) % 10;
c = (num / 100) % 10;
d = (num / 10) % 10;
e = num % 10;
if(a != 0) lcddata(a + 48);
if(a != 0 || b != 0) lcddata(b + 48);
if(a != 0 || b != 0 || c != 0) lcddata(c + 48);
lcddata(d + 48);
lcddata(e + 48);
}
// Delay function
void delay(unsigned int t) {
unsigned int i, j;
for(i = 0; i < t; i++)
for(j = 0; j < 1275; j++);
}
```

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IX. EXPERIMENTAL SETUP AND RESULTS

The prototype was built on a breadboard and tested using an 8051 development board. An LED was used to indicate detection events. The system was tested under different ambient lighting and object distances.

Table 3: Experimental Observations

Object Distance (cm)	Sensor Output (Logic)	LED Status	Detection Accuracy (%)
5 cm	Low	ON	100 %
10 cm	Low	ON	98 %
15 cm	High	OFF	0 %
20 cm	High	OFF	0 %

The results confirm that the IR sensor performs best within a 10 cm range. Beyond this distance, reflection intensity decreases, reducing accuracy. The system responded with negligible latency, proving its suitability for real-time applications.

X. CONCLUSION

This study successfully demonstrates the interfacing of an IR sensor with the 8051 microcontroller. The developed system is reliable, responsive, and economical, suitable for educational experiments and practical automation projects. The results show that IR-based sensing, combined with the flexibility of the 8051, provides an effective platform for embedded system development.

Further research may explore integrating IR sensors with wireless modules (e.g., Bluetooth or Wi-Fi) for remote monitoring and control applications.

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