**Title of Your Mini Lab Project**

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**MINI LAB PROJECT REPORT**

This Report Presented in Partial Fulfillment of the course **CSE221 Electronic Devices And Circuits Lab in the Computer Science and Engineering Department**



### DAFFODIL INTERNATIONAL UNIVERSITY

**Dhaka, Bangladesh**

**Date Update**

## DECLARATION

We hereby declare that this lab project has been done by us under the supervision of Shoumik Debnath,Lecturer, Department of Computer Science and Engineering, Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere as lab projects.

**Submitted To:**

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## COURSE & PROGRAM OUTCOME

The following course have course outcomes as following:.

Table 1: Course Outcome Statements

|  |  |
| --- | --- |
| **CO’s** | **Statements** |
| CO1 | Able to solve computing problems using programming concepts and learn the basic  concept of ACM Problem solving techniques. |
| CO2 | Able to apply fundamental programming elements including: variable, use of data types and data structures, decision structures, loop structures, pointer, string, console, file IO, and functions. |
| CO3 | Able to specify the problem requirements, analyze the problem, design the algorithm  to solve the problem and implement with the help of programming language. |
| CO4 | Able to apply the knowledge of programing and problem solving in practical project |

Table 2: Mapping of CO, PO, Blooms, KP and CEP

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **CO** | **PO** | **Blooms** | **KP** | **CEP** |
| CO1 | PO1 | C1, C2 | KP3 | EP1, EP3 |
| CO2 | PO2 | C2 | KP3 | EP1, EP3 |
| CO3 | PO3 | C4, A1 | KP3 | EP1, EP2 |
| CO4 | PO3 | C3, C6, A3,  P3 | KP4 | EP1, EP3 |

The mapping justification of this table is provided in section **4.3.1**, **4.3.2** and **4.3.3**.

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**Chapter 1**

# Introduction

### Introduction

In the modern world, automation and robotics are becoming increasingly important, especially in the areas of safety and efficiency. One of the essential components in such systems is the ability to detect obstacles or nearby objects without human intervention. The Obstacle Detector Circuit plays a crucial role in this domain by using **Infrared (IR) sensors** to detect objects within a certain range. When an obstacle is detected, the circuit activates an LED to visually signal its presence.

This project explores the design and implementation of a basic obstacle detection circuit using IR modules. It serves as a fundamental building block for more advanced automation systems such as automatic doors, robotic cars, and intelligent security devices. The purpose of this project is not only to develop a working prototype but also to understand how IR-based proximity sensors function in real-world scenarios.

### Motivation

The motivation behind this project stems from the growing demand for intelligent systems that can interact with their environment. Obstacle detection is a core function in robotics, automation, and safety-critical applications. Building a simple obstacle detector using IR sensors provides an excellent opportunity to understand the principles of sensor technology, signal processing, and circuit design.

By working on this project, we aim to gain hands-on experience in creating practical circuits that respond to real-world physical events. The project also encourages learning through experimentation and troubleshooting, which are essential skills for any engineering student. Furthermore, this type of system has practical applications in areas such as autonomous vehicles, smart doors, and home security — making it both an educational and relevant project.

### Objectives

used to activate an output device such as an LED. Another objective is to develop practical skills in building electronic circuits, integrating sensors with basic components, and managing power supplies effectively. Additionally, this project provides an opportunity to enhance our ability to test, debug, and improve simple hardware-based systems.

### Feasibility Study

Obstacle detection systems are widely used in modern automation and robotics applications, and numerous research studies and DIY projects have been developed based on similar principles. IR sensor-based obstacle detection is a cost-effective and reliable solution for short-range sensing, commonly used in smart vehicles, automatic doors, and line-following robots. Several open-source electronics platforms, like Arduino and Raspberry Pi, support IR-based detection systems, but this project focuses on implementing the circuit using basic components only, making it suitable for beginners. The feasibility of the project is high, as all required components like IR sensors, resistors, LEDs, and power sources are affordable, easily available, and can be assembled with basic tools and knowledge. Moreover, the circuit can be tested and demonstrated in a simple lab environment without requiring advanced equipment.

### Gap Analysis

While various obstacle detection systems are already available in the market and in academic projects, many of them rely on complex microcontroller-based designs or advanced technologies like ultrasonic sensors, LiDAR, or camera-based systems. These solutions, although effective, can be costly and require a deeper understanding of programming and hardware integration. There exists a gap in creating a simple, low-cost, and beginner-friendly obstacle detection circuit that can be built without microcontrollers or advanced tools. This project aims to bridge that gap by providing a basic infrared (IR) sensor-based obstacle detector using discrete components. It helps beginners understand the core concept of obstacle detection without getting overwhelmed by complex systems, making it ideal for foundational learning and experimentation.

### Project Outcome

The outcome of this project is a fully functional obstacle detection circuit that can successfully identify nearby objects using infrared (IR) sensors and provide a visual indication through an LED. The system demonstrates how IR modules work in detecting reflected signals from obstacles and how the output can be used to trigger external components. Through this project, we have gained practical experience in sensor integration, circuit design, and hardware troubleshooting. Additionally, the circuit can be used as a foundation for more advanced projects such as automated vehicles or security systems. The project outcome also includes a better understanding of how simple electronic systems can solve real-world problems effectively.

**Chapter 2**

# Proposed Methodology/Architecture

This chapter outlines the overall design approach, system components, and methodology used to build the obstacle detection circuit. It includes a requirement overview, system design with a block diagram, and the project planning details.

### Requirement Analysis & Design Specification

### The obstacle detector circuit consists of essential components such as IR sensors, resistors, LEDs, and a power supply. The IR sensor acts as the primary input device, which emits and receives infrared light. When an object reflects the IR signal back to the sensor, it triggers an output. The output is connected to an LED which lights up when an obstacle is detected. The system operates on a low-voltage DC power source, making it suitable for battery operation and portable use.

#### Overview

The **Obstacle Detector Circuit** is a basic electronic system designed to detect nearby objects without physical contact. It primarily uses **Infrared (IR) sensor modules** that emit and receive IR signals to identify the presence of obstacles. When an object comes within the detection range of the IR sensor, the reflected infrared light is detected by the receiver, which then changes the output state of the sensor. This output can be used to trigger indicators such as **LEDs**, buzzers, or further control actions in automation systems.

This type of circuit is commonly used in **robotics, automation, and safety applications**, where detecting the presence of objects is crucial. The simplicity, low cost, and efficiency of IR-based obstacle detection make it ideal for educational and prototyping purposes.

#### Proposed Methodology/ System Design

The system design is straightforward. An IR module is used to detect nearby obstacles. When the sensor detects a reflection, it sends a high or low logic signal (depending on the sensor configuration) to the output pin. This output is connected to an LED through a current-limiting resistor. When an obstacle is detected, the LED turns on, indicating the presence of the object.

#### UI Design

#### A diagram of a wiring diagram AI-generated content may be incorrect.

#### Fig:Circuit Diagram

### Overall Project Plan

The project was carried out in several steps. First, the required components were gathered and tested individually. Then, the IR module was connected to the LED circuit on a breadboard. After successful testing, the system was assembled as a complete unit. Each component was tested during integration to ensure functionality, and the final prototype was demonstrated in a controlled environment with different obstacles.

**Chapter 3**

# Implementation and Results

This chapter outlines the practical implementation of the Obstacle Detector Circuit and presents the outcomes observed during testing. It describes the step-by-step assembly process, the testing method, and the results obtained under different conditions.

### Implementation

### The circuit was implemented on a breadboard using two IR sensor modules, two LEDs, and a 5V DC power supply. Each IR sensor was connected such that its OUT pin controlled an LED through a current-limiting resistor. When an obstacle was placed in front of a sensor, the IR beam reflected back, changing the sensor’s output and turning on the corresponding LED.

### Performance Analysis

This section evaluates the performance of the obstacle detector circuit based on its responsiveness, accuracy, reliability, and environmental limitations.

The obstacle detector circuit demonstrated reliable detection of nearby objects within a typical range of **5 to 10 cm.** The use of IR sensors allowed for **non-contact detection**, with LEDs providing immediate visual feedback upon obstacle detection. The response time was effectively **instantaneous,** showing no noticeable delay between obstacle presence and LED activation.

### Results and Discussion

This section presents the results obtained during the testing phase of the obstacle detector circuit and provides an analysis of those results in relation to the circuit's performance, limitations, and practical implications.

**Results:**

During testing, the circuit behaved as expected under controlled indoor lighting conditions. When an object came within the detection range of approximately 5–10 cm from the IR sensor, the LED indicator turned ON. When the object was removed, the LED turned OFF. This confirmed the correct functioning of the IR sensor and output response.

**Chapter 4**

# Engineering Standards and Mapping

This chapter highlights how the Obstacle Detector Circuit aligns with engineering standards, impacts society and the environment, and meets complex problem-solving and program outcomes. It also includes project management analysis and team-based work contributions.

### Impact on Society, Environment and Sustainability

### This section discusses the broader implications of the project on human life, ethical considerations, and sustainable practices.

#### Impact on Life

#### The obstacle detection circuit enhances safety and efficiency by preventing collisions in automation systems, robotics, and assistive devices, particularly for the elderly and differently-abled.

#### Impact on Society & Environment

#### IR-based obstacle detection contributes to smarter systems in transportation and robotics, promoting safety. Since it is low-power and non-toxic, it has minimal environmental impact.

#### Ethical Aspects

#### The project uses safe, commercially available components with no harmful emissions. It promotes open access to basic engineering learning, making it ethically sound for educational use.

#### Sustainability Plan

The project uses reusable and low-power components, ensuring long-term sustainability. Sensors and LEDs have long life cycles and minimal maintenance needs, making them eco-friendly for scalable applications.

### Project Management and Team Work

This section evaluates the budgeting and teamwork involved in executing the project.

#### ****Cost Analysis Table****

| **Component** | **Quantity** | **Unit Price (BDT)** | **Total (BDT)** |
| --- | --- | --- | --- |
| IR Sensor Module | 2 | 100 | 200 |
| LEDs | 2 | 5 | 10 |
| Resistors | 4 | 2 | 8 |
| Breadboard | 1 | 120 | 120 |
| Jumper Wires | Set | 50 | 50 |
| Power Supply | 1 | 150 | 150 |
| **Total** |  |  | **538 BDT** |

### Complex Engineering Problem

### This section maps how the obstacle detection system meets educational and engineering outcomes.

#### Mapping of Program Outcome

In this section, provide a mapping of the problem and provided solution with targeted Program Outcomes (PO’s).

Table 4.1: Justification of Program Outcomes

|  |  |
| --- | --- |
| **PO’s** | **Justification** |
| PO1 | |  | | --- | |  |  |  | | --- | | Applies basic science and engineering principles in sensor-based circuit design. | |
| PO2 | Identifies and formulates the obstacle detection problem and provides a practical solution. |
| PO3 | |  | | --- | |  |  |  | | --- | | Demonstrates the ability to design a system and interpret test results  . | |

#### Complex Problem Solving

This section identifies how the obstacle detector circuit addresses elements of complex engineering problem-solving. It uses a structured framework to evaluate the nature of the problem and the extent of analysis involved in the solution. The mapping is based on established engineering problem criteria such as knowledge depth, requirements, and stakeholder impactChapter 4. Engineering Standards and Mapping

**4.3. Complex Engineering Problem**

This section maps how the obstacle detector circuit addresses the characteristics of complex engineering problems. It evaluates how the solution aligns with Program Outcomes (POs), complex problem-solving profiles, and engineering activity classifications.

Table 4.2: Mapping with complex problem solving.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **EP1**  Dept of Knowledge | **EP2**  Range of Conflicting Requirements | **EP3**  Depth of Analysis | **EP4**  Familiarity of Issues | **EP5**  Extent of Applicable Codes | **EP6**  Extent  Of Stakeholder Involvement | **EP7**  Inter- dependence |
| |  | | --- | |  |   High   |  | | --- | |  | | High | High | Medium | High | High | High |

#### Engineering Activities

In this section, provide a mapping with engineering activities. For each mapping add subsections to put rationale (Use Table [4.3).](#_bookmark31)

Table 4.3: Mapping with complex engineering activities.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **EA1**  Range of resources | **EA2**  Level of Interaction | **EA3**  Innovation | **EA4**  Consequences for society and  environment | **EA5**  Familiarity |
| *High* | *Medium* | Medium | Medium | Low |

**Chapter 5**

# Conclusion

This chapter summarizes the overall outcome of the obstacle detector circuit project. It highlights the core findings, discusses the limitations encountered during implementation, and provides suggestions for future improvement and development**.**

### Summary

### The Obstacle Detector Circuit was successfully designed and implemented using IR sensor modules and basic electronic components. The system effectively detects nearby objects and activates an LED indicator in real time. The project met its primary objective of demonstrating simple obstacle detection using a cost-effective, non-contact method suitable for small-scale automation or educational purposes. All key aspects—including circuit design, testing, and analysis—were completed within the project timeline and budget.

### Limitation

### While the circuit achieved its intended functionality, a few limitations were observed:

### Limited detection range (approximately 5–10 cm), making it unsuitable for long-range applications.

### Performance degradation under direct sunlight, due to IR interference.

### Reduced accuracy with dark or matte surfaces, which reflect less infrared light.

### No programmable logic (e.g., microcontroller) included, limiting versatility and adaptability.

### Not scalable for multi-sensor or complex environments without significant modifications.

### Future Work

To improve and expand upon this project, the following enhancements are recommended:

* Integration of a microcontroller (e.g., Arduino or ESP32) for programmable control and extended features like sound alerts or motor control.
* Use of multiple sensors for 360° obstacle detection or coverage over a wider area.
* Implementation of adaptive sensitivity control to improve performance in varied lighting conditions.
* Addition of wireless communication modules (e.g., Bluetooth or Wi-Fi) to enable remote monitoring or IoT-based obstacle detection.
* Deployment on robotic platforms for applications in smart automation, line-following robots, or collision-avoidance systems.

# References

[1] Jon Kleinberg and Eva Tardos. *Algorithm design*. Pearson Education India, 2006.

This project introduces an Obstacle Detector Circuit using IR modules. The system detects obstacles using infrared technology and provides output through an LED indicator.

The motivation behind this project is to explore basic obstacle detection using cost-effective IR sensors, which can be implemented in robotics and automation.

- Build a simple IR-based obstacle detection system.  
- Understand basic sensor integration with output indicators.  
- Analyze response time and sensitivity of the system.

The outcome is a working prototype that successfully detects nearby obstacles using IR sensors and provides a visual indication using an LED.

[Figure: Obstacle Detector Circuit – IR Module based]