MINI PROJECT / ELECTRONIC DESIGN WORKSHOP

[EC 681]

A Mini Project Report on

OBSTACLE AVOIDING ROBOT WITHOUT ARDUINO

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In partial fulfillment of the requirements for the award of the degree of
**BACHELOR OF TECHNOLOGY in
ELECTRONICS & TELE-COMMUNICATION ENGINEERING**

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CERTIFICATE

This is to certify that the project entitled **OBSTACLE AVOIDING ROBOT WITHOUT ARDUINO** is a bonafide work, carried out by **Mr. Sk Mofiz Hossain (17632322011), Mr. Abisekh Dey (17632322013), Miss. Ripa Ghosh (17632322012), Miss. Kalyani Bhandari (17632322014)** in partial fulfillment for the award of Bachelor of Technology in Electronics and Tele-Communication Engineering of Maulana Abul Kalam Azad University of Technology, West Bengal during the year 2023 – 2024. It is certified that all the corrections/suggestions indicated for the internal assessment have been incorporated in the report, deposited in the departmental library. The project report has been approved as it satisfies the academic requirements in respect of project work, prescribed for the said degree.

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ABSTRACT

This project focuses on the design and implementation of an obstacle-avoiding robot without utilizing Arduino microcontrollers. The objective is to create a cost-effective and resource-efficient robotic system capable of navigating its environment autonomously.

The outcomes of this project include a fully functional obstacle-avoiding robot that demonstrates the feasibility of creating autonomous robotic systems without relying on popular microcontroller platforms like Arduino. The project's findings contribute to the exploration of alternative hardware solutions for robotics enthusiasts and researchers seeking cost-effective and versatile designs.
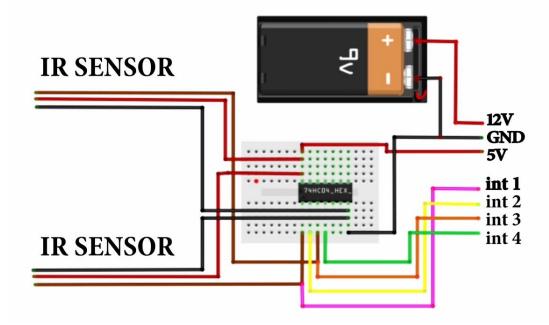
PROJECT MODEL
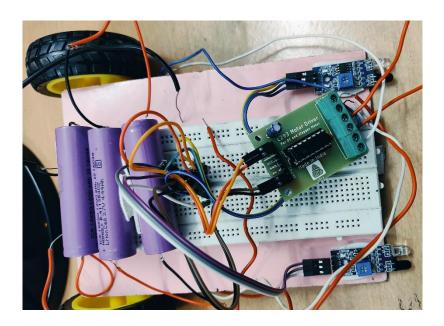# &
CIRCUIT DIAGRAM

Fig 2: Circuit Diagram

Fig 1: OARWA Project Model (a)

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INTRODUCTION

The evolution of autonomous robots has significantly transformed various industries, enhancing efficiency and safety in environments ranging from warehouses to healthcare facilities. Central to the autonomy of these robots is their ability to navigate complex environments without human intervention, a task that involves robust obstacle detection and avoidance systems. While many projects rely on Arduino platforms due to their ease of use and extensive community support, exploring alternative microcontroller solutions can offer unique advantages in terms of processing power, flexibility, and customization.

This project aims to develop an obstacle-avoiding robot using a microcontroller-based system that does not depend on Arduino. Instead, we employ a more versatile Dual Motor IC (L293D) or a similar platform that provides enhanced computational capabilities and integration options. The primary objective is to design a robot that can efficiently detect and navigate around obstacles in real-time using a combination of ultrasonic sensors, infrared sensors.

COMPONENTS

No.	Name	Quantity
1	L293D IC	1
2	SINGLE STRAND WIRE	COUPLE/ BUNCH
3	DC BO MOTOR (12V)	2
4	IC 7404	1
5	BREAD BOARD(SMALL)	1
6	IR SENSOR	2
7	WHEEL(BIG)	2
8	WHEEL(SMALL)	1

APPARATUS

1. Power supply
2. Connection wires
3. Multimeter

COMPONENTS DESCRIPTION

⊕ L293D IC: -

The L293D is a popular quadruple high-current half-H driver IC used for driving inductive loads such as relays, solenoids, DC and stepping motors. Here's a brief overview of its key features and how it works.

Fig 3: L293D IC

➢ **Technical Specifications**

1. Dual H-Bridge Motor Driver: The L293D contains two H-bridge drivers that can drive two DC motors or one stepper motor.
2. High Current Output: Each channel can provide up to 600mA of continuous current with a peak current of 1.2A per channel.
3. Wide Supply Voltage Range: It operates from 4.5V to 36V, making it suitable for a variety of motors.
4. Thermal Shutdown: Includes thermal protection to prevent the IC from overheating.
5. Internal Clamp Diodes: Protects the IC from back EMF generated by inductive loads.
6. Separate Logic and Motor Supply Pins: Allows different voltage levels for the logic circuitry and the motor drivers.

➢ **Pin Configuration**

The L293D is typically available in a 16-pin dual in-line package (DIP). Here's a summary of the pinout:

1. Pin 1 (Enable 1-2): Enables the first H-bridge. When high, the first H-bridge is enabled.

2. Pin 2 (Input 1): Controls the state of the first half of the first H-bridge.

3. Pin 3 (Output 1): Output to the motor connected to the first half of the first H-bridge.

4. Pin 4 (GND): Ground.

5. Pin 5 (GND): Ground.

6. Pin 6 (Output 2): Output to the motor connected to the second half of the first H-bridge.

7. Pin 7 (Input 2): Controls the state of the second half of the first H-bridge.

8. Pin 8 (Vcc2): Supply voltage for the motors (motor voltage).

9. Pin 9 (Enable 3-4): Enables the second H-bridge. When high, the second H-bridge is enabled.

10. Pin 10 (Input 3): Controls the state of the first half of the second H-bridge.

11. Pin 11 (Output 3): Output to the motor connected to the first half of the second H-   bridge.

12. Pin 12 (GND): Ground.

13. Pin 13 (GND): Ground.

14. Pin 14 (Output 4): Output to the motor connected to the second half of the second H-bridge.

15. Pin 15 (Input 4): Controls the state of the second half of the second H-bridge.

16. Pin 16 (Vcc1): Supply voltage for the logic circuitry.

Fig 4: L293d Dual Motor Driver IC Pin Configuration

➢ **Basic Operation:**
To control a motor using the L293D, you connect the motor to the output pins (pins 3 and 6 for the first motor, and pins 11 and 14 for the second motor). By applying high or low signals to the input pins (pins 2 and 7 for the first motor, and pins 10 and 15 for the second motor), you can control the direction of the motor.

- Forward: Set Input 1 high and Input 2 low.
- Reverse: Set Input 1 low and Input 2 high.
- Stop: Set both inputs either high or low.

➢ **Applications:**

- Robotics: To control the movement of robots.
- Automation: For driving various actuators in automation systems
- Remote-Controlled Vehicles: For motor control in RC cars, boats, and planes.

⯀ SINGLE STRAND WIRE: -

Often referred to as solid wire, consists of a single, solid piece of metal wire, typically copper or aluminum. This type of wire is commonly used in applications where rigidity and simplicity are desired. Solid wire has lower resistance and is ideal for use in fixed positions where the wire will not be subject to bending or movement. It's often used in building wiring, breadboards for electronic projects, and in situations where connections are permanent.
Here are some key points about single strand wire:

1. **Construction:** Made of a single, solid piece of metal.

2. **Materials:** Typically, copper or aluminum, but can also be made from other conductive metals.

Fig 5: Single Strand Wire

3. **Applications:** Used in house wiring, circuit boards, and electrical components where movement is minimal.

4. **Advantages:** Lower resistance compared to stranded wire, easier to handle for fixe installations, and simpler to connect to screw terminals.

5. **Disadvantages:** Less flexible, prone to breakage if frequently bent or flexed, and not suitable for applications involving a lot of movement.
Single strand wire is a fundamental component in electrical and electronic systems, valued its simplicity and effectiveness in certain types of installations.

✚ DC BO MOTOR (12V): -

A DC BO motor (Battery Operated motor) is a type of DC motor commonly used in robotics and DIY electronics projects. These motors are known for their ease of use, low cost, and simple operation, making them ideal for hobbyists and educational purposes. Here are some key points about DC BO motors:

Fig 6: DC BO Motor (12V)

1. **Construction:** DC BO motors typically have a plastic housing and gears that reduce the motor's speed while increasing torque. This makes them suitable for driving wheels or other mechanical parts in small robots or vehicles.

2. **Voltage and Current:** They usually operate at low voltages, typically between 3V to 12V, making them compatible with standard battery packs used in electronics projects.

3. **Control:** These motors can be easily controlled using H-bridge circuits, motor drivers, or microcontrollers such as Arduino or Raspberry Pi. The speed of the motor can be adjusted using Pulse Width Modulation (PWM).

4. **Applications:** DC BO motors are widely used in small robotic vehicles, automated systems, model trains, and other DIY electronics projects where simple, reliable motion is needed.

5. **Varieties:** They come in various configurations, including different gear ratios, sizes, and mounting options to suit various project needs.

The technical specifications of a typical DC BO (Battery Operated) motor can vary depending on the specific model and manufacturer. However, here are the common specifications you might find for a standard BO motor:

1. Voltage Range: 3V to 12V DC.
2. Current Consumption: 70mA to 250mA (no load), up to 1.5A (stall current).
3. RPM (Rotations Per Minute): Varies by gear ratio, commonly available in 30, 60, 100, 200, and 300 RPM at 6V.
4. Torque:
     - Low RPM motors can provide higher torque.
     - Typical torque ranges from 1 kg-cm to 5 kg-cm, depending on the RPM and gear ratio.
5. Gearbox: Plastic or metal gearbox for speed reduction and torque increase.
6. Shaft Diameter: Typically, 6mm with a flat section for better grip with wheels or other attachments.

7. Shaft Length: Around 10-15mm.

8. Dimensions: Generally, around 70mm x 23mm x 18mm for the motor housing.

9. Weight: Approximately 30-50 grams.

10. Mounting Holes: Standard mounting holes for easy attachment to various chassis or frames.

➢ **Example Specifications for a BO Motor with 100 RPM at 6V:**

- Operating Voltage: 3-12V DC
- No Load Current: ~120mA
- Stall Current: ~1.5A
- No Load Speed: 100 RPM at 6V
- Stall Torque: 2.5 kg-cm
- Gear Ratio: 1:48
- Motor Diameter: 24mm
- Motor Length: 70mm
- Shaft Type: D-shaped

These specifications can vary, so it's essential to refer to the datasheet provided by the manufacturer for the exact specifications of the motor you are using.

↓ IC 7404: -

The IC 7404 is a Hex Inverter, part of the 7400 series of TTL (Transistor-Transistor Logic) integrated circuits. It contains six independent inverter gates, each of which performs a logical NOT operation. Here are the key specifications and features of the IC 7404.

Fig 7: IC 7404

➢ **Technical Specifications: -**

1. Operating Voltage: Typically, 5V (standard for TTL logic circuits)

2. Logic Levels:
- Input Low Voltage: Max 0.8V.
- Input High Voltage: Min 2V.
- Output Low Voltage: Max 0.4V.
- Output High Voltage: Min 2.4V.

3. Propagation Delay: Approximately 10 ns (depends on supply voltage and load capacitance).

4. Current Consumption:
- Input Current: ~1.6mA per input when low.
- Output Current: Max 16mA per output when high.

5. Power Consumption: Low power consumption typical of TTL ICs.

6. Package: Available in DIP-14, SOIC-14, and other package types.

➢ Pin Configuration (DIP-14 package):

- Pin 1: Input A (Inverter 1)
- Pin 2: Output Y (Inverter 1)
- Pin 3: Input A (Inverter 2)
- Pin 4: Output Y (Inverter 2)
- Pin 5: Input A (Inverter 3)
- Pin 6: Output Y (Inverter 3)
- Pin 7: Ground (GND)
- Pin 8: Output Y (Inverter 4)
- Pin 9: Input A (Inverter 4)
- Pin 10: Output Y (Inverter 5)
- Pin 11: Input A (Inverter 5)
- Pin 12: Output Y (Inverter 6)
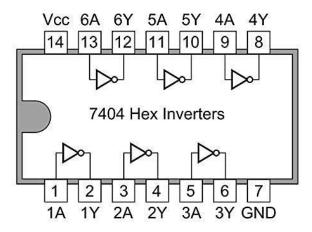- Pin 13: Input A (Inverter 6)
- Pin 14: Supply Voltage (VCC)

Fig 8: 7404 Pin Configuration

➢ Features:
- Hex Inverter: Contains six independents NOT gates.
- TTL Compatible: Designed for TTL logic level operation.
- High Speed: Fast switching times typical of TTL circuits.
- Standard Pinout: Common pin configuration for easy integration.

➢ Applications:
- Signal Inversion: Inverting logic levels in digital circuits.
- Waveform Generation: Creating inverted signals in waveform generation circuits.
- Logic Level Conversion: Converting logic levels between different parts of a circuit.
- Basic Logic Operations: Used in various logic gate combinations and digital systems.
  The IC 7404 is widely used in digital electronics due to its simplicity and ease of use
  in performing basic NOT operations.

⊕ BREADBOARD: -

A breadboard is a reusable prototyping tool for electronics, featuring a grid of interconnected holes for component insertion. It facilitates quick circuit assembly without soldering, ideal for experimenting and testing circuit designs. Breadboards have terminal strips for power and ground connections, bus strips for common connections, and rows of interconnected holes for component placement. Jumper wires are used to create electrical connections between components and terminals. They offer a visual layout for easy circuit organization, making it simple to modify and iterate designs. While great for rapid prototyping and experimentation, breadboards have limitations in current handling and long-term durability.
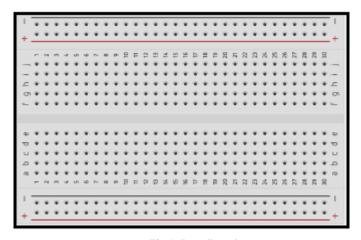
Fig 9: Breadboard

⊕ IR SENSOR: -

An IR (Infrared) sensor is an electronic device that emits and/or detects infrared radiation to sense certain aspects of its surroundings. IR sensors are commonly used in various applications such as object detection, proximity sensing, and remote controls. Here are the main components, types, and uses of IR sensors:

Fig 10: IR Sensor

➢ **Components Of an IR Sensor:**
1. IR Emitter: A diode (typically an LED) that emits infrared light.
2. IR Receiver: A photodiode or phototransistor that detects the IR light emitted by the IR emitter.
3. Signal Processor: Electronics that process the signal received by the IR receiver and produce an output based on the detection of IR light.

➢ **Types of IR Sensors:**
Active IR Sensors: These sensors emit and detect IR radiation. They consist of both an IR emitter and receiver. They are commonly used for proximity sensing and object detection.
Passive IR Sensors (PIR Sensors): These sensors do not emit IR radiation but detect the infrared radiation emitted by objects in their field of view. They are often used in motion detectors.

➢ **Working Principle:**
-Active IR Sensor: When an object comes within the sensor's range, the IR light emitted by the IR LED reflects off the object and is detected by the IR receiver. The sensor then processes this signal to determine the presence of an object.
-Passive IR Sensor: The sensor detects changes in infrared radiation in its environment. When a warm object (like a human) moves within its field of view, it causes a change in the IR radiation detected, triggering the sensor.

➢ **Technical Specifications:**
- Operating Voltage: Typically, 3V to 5V for standard modules.
- Range: Depends on the type and design, commonly from a few centimeters to several meters.
- Detection Angle: Varies but often around 35-45 degrees for PIR sensors.
- Output: Can be analog (varying voltage) or digital (binary signal).

➢ **Applications:**
Proximity Sensors: Used in automatic doors, obstacle detection in robots, and smartphones.
Remote Controls: Commonly used in TV and other home appliance remote controls.
Motion Detectors: Used in security systems to detect movement.
Line-following Robots: Used to detect lines and guide the robot along a path.
Optical Encoders: Used in rotary and linear encoders to detect position.

➢ **Example Circuit:**
An example of a simple active IR sensor circuit includes an IR LED, a photodiode, and an operational amplifier:
- IR LED: Connected to a current-limiting resistor and power supply.
- Photodiode: Placed to detect reflected IR light, connected to an operational amplifier.
- Operational Amplifier: Amplifies the signal from the photodiode and outputs a detectable signal (high/low) based on the presence of an object.

➢ **Typical IR Sensor Module:**
A common IR sensor module like the one used for obstacle detection in robots usually includes:
- IR Emitter: An IR LED.
- IR Receiver: A photodiode or phototransistor.
- Comparator: To convert the analog signal from the receiver to a digital output.
- Potentiometer: For adjusting sensitivity.
- Output Pins: For connection to microcontrollers or other circuits.

IR sensors are versatile and essential components in many modern electronic systems, providing simple yet effective solutions for non-contact sensing and remote control.

✚ WHEELS: -

When selecting wheels for an electronic project, such as a small robot or a DIY vehicle, several factors need to be considered to ensure optimal performance and compatibility with the rest of the components. Here's a guide to help you choose the right wheels for your electronic project:

Key Considerations:
Size (Diameter and Width):

Diameter: Determines the ground clearance and speed. Larger wheels provide higher clearance and potentially higher speeds but may reduce torque.
Width: Affects the stability and grip. Wider wheels offer better stability and traction, especially on uneven surfaces.

Material:

Rubber: Offers good traction and is ideal for indoor and outdoor use. Rubber wheels provide better grip on various surfaces.
Plastic: Lightweight and suitable for indoor use or smooth surfaces. Less traction compared to rubber.
Foam: Lightweight with moderate grip, often used in lightweight robots or drones.

Fig 11: Wheels

🍁 WORKING PRINCIPLE: -

Creating an obstacle-avoiding robot without Arduino using an L293D IC, which in turn drives the motors. Sensor processes the input (like infrared or ultrasonic) to detect obstacles and send commands to the L293D to maneuver the robot accordingly. Wiring and programming the microcontroller will be necessary for this setup
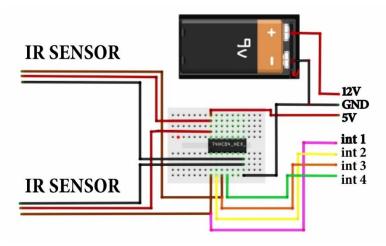

Fig 12: Circuit Diagram

1. **L293D IC Driver:** This integrated circuit is commonly used to control DC motors. It can drive two motors bidirectionally, making it suitable for controlling the movement of your robot.

2. **NOT Gate (Inverter):** The NOT gate can be used to invert the output of the IR proximity sensor. This means when an obstacle is detected, the output will be inverted, signaling the robot to change direction.

3. **DC Motors (BO Motors):** These motors will drive the wheels of the robot. By controlling the speed and direction of each motor, you can maneuver the robot to avoid obstacles.

4. **IR Proximity Sensor:** This sensor will detect obstacles in the path of the robot. When an obstacle is detected, it will send a signal to the NOT gate.

Here's a basic outline of how the components could work together:

- The IR proximity sensor continuously scans the area in front of the robot.
- If an obstacle is detected, the sensor sends a signal to the NOT gate.
- The NOT gate inverts the signal, indicating to the L293D IC driver that an obstacle is present.
- The L293D IC driver then changes the direction of the motors, causing the robot to turn away from the obstacle.
- Once the obstacle is no longer detected, the sensor's signal returns to its normal state, and the robot resumes its forward movement.

This setup provides a simple yet effective obstacle avoidance mechanism without the need for an Arduino.

✚ ADVANTAGES & DISADVANTAGES: -

An abstract avoiding robot without Arduino, using a proximity sensor and an L293D driver, offers simplicity and cost-effectiveness.

➢ **Advantages of The Circuit: -**

1. **Simplicity:** It's easier to build and program compared to more complex systems involving microcontrollers like Arduino.

2. **Cost-effective:** Since it doesn't require an Arduino board, it can be cheaper to build.

3. **Real-time response:** It can react quickly to proximity changes due to the direct connection between the sensor and the motor driver of budgets and skill levels.

➢ **Disadvantages of The Circuit: -**

1. **Limited functionality:** Without an Arduino, the robot's capabilities are limited to simple tasks such as obstacle avoidance.

2. **Scalability:** It may be difficult to add additional features or sensors without the flexibility of a microcontroller like Arduino.

3. **Less flexibility:** Programming options are limited compared to using a microcontroller, potentially restricting the robot's adaptability to different environments or tasks.

FUTURE SCOPE

1. **Industrial Settings:** To navigate around machinery and avoid collisions in factories or warehouses.

2. **Home Assistance:** Helping individuals with mobility issues navigate their homes safely, avoiding obstacles.

3. **Healthcare:** Assisting patients in hospitals or nursing homes by avoiding obstacles in corridors and rooms.

4. **Autonomous Vehicles:** Implementing abstract avoidance algorithms to prevent accidents on the road.

5. **Search and Rescue Operations:** Navigating through debris and obstacles in disaster areas to locate survivors safely.

6. **Agriculture:** Assisting in farm operations by avoiding obstacles while tending crops or livestock.

7. **Space Exploration:** Supporting autonomous rovers in navigating challenging terrains on other planets.

8. **Military Applications:** Utilizing abstract avoidance techniques for reconnaissance drones or robotic vehicles in hostile environments.

COST ESTIMATION

No.	Name Of Components	NO. of Quantity	Price
1	L293D IC	**1**	65
2	SINGLE STRAND WIRE	**COUPLE/ BUNCH**	30
3	DC BO MOTOR (12V)	**2**	200
4	IC 7404	**1**	15
5	BREAD BOARD(SMALL)	**1**	41
6	IR SENSOR	**2**	38
7	WHEEL(BIG)	**2**	44
	TOTAL		433

CONCLUSION

Creating an obstacle-avoiding robot without Arduino, using an L293D motor driver, NOT gate, and IR proximity sensor, offers an intriguing challenge with rewarding outcomes. This design relies on basic electronic components and logic circuits to achieve autonomous navigation, showcasing the fusion of simplicity and effectiveness in robotics.

The foundation of this project lies in understanding the functionalities of each component and integrating them seamlessly. The L293D motor driver serves as the bridge between the microcontroller and the motors, enabling precise control over the robot's movements. Its dual H-bridge configuration allows bidirectional control of two DC motors, crucial for forward, backward, and turning motions.

In conjunction with the motor driver, the IR proximity sensor plays a pivotal role in detecting obstacles in the robot's path. By emitting infrared radiation and analyzing the reflected signal, the sensor can determine the distance to nearby objects. This real-time data is indispensable for the robot to make informed decisions regarding its movement.

The integration of these components forms the core of the obstacle-avoiding mechanism. As the robot navigates its environment, it continuously scans for obstacles using the IR proximity sensor. Upon detection, the sensor triggers the NOT gate, which promptly adjusts the motor driver's inputs, guiding the robot away from the obstruction.

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