

# TRIBHUVAN UNIVERSITY INSTITUTE OF ENGINEERING THAPATHALI CAMPUS

**A Project Report On Line Follower**

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# ABSTRACT

This project report outlines the design and realization of a line following robot(LFR) using an arduino and multiple Infrared(IR) Sensors. The LFR is engineered to autonomously track and follow Line (White or Black) by calibrating sensors to distinguish the white and black line surfaces. Key functionalities include real-time corner detection and movement, adaptive motion planning. The report comprehensively discusses project objectives, system features, technical analysis of Arduino programming and sensor integration, methodological approaches, practical challenges encountered, conclusive findings, and a comprehensive reference list. Future improvements are proposed to advance the LFR's performance and expand its applicability in various dynamic environments.

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## INTRODUCTION

Creating a line-following robot with Arduino and three IR sensors is an intriguing project. Unlike normally found examples that might use fewer sensors or more complex sensor arrays, this project utilizes a three-sensor configuration to enhance accuracy and robustness in line detection. This approach provides better discrimination between the line and the surrounding surface, allowing for smoother and more reliable navigation. IR sensors can detect the contrast between the line and the floor, and use that data to guide the robot along the intended path.

## MATERIALS AND COMPONENTS

* Arduino UNO board ×1
* Infrared (IR) line follower sensor module ×2
* L298N motor driver ×1
* Robot chassis (ply)
* BO motors ×2
* Wheels ×2
* Li-po battery 3s 11.1v
* jumper wires

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## SYSTEM DESIGN

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## METHODOLOGY

1. A **plywood chassis** of dimensions 20 cm x 15 cm (length x breadth) was used.
2. **Two BO motors** were symmetrically placed onto the plywood.
3. A single wire was taken from each short-circuited point to power the respective side's motors.
4. These wires were then connected to the terminals of the **L298N motor driver**.
5. The **Arduino Uno** was programmed with the necessary control code.
6. Connections were established between the **Arduino Uno** and the **L298N motor driver**.
7. An **11.1V Li-po battery** was connected directly to the 12V terminal of the L298N.
8. The L298N's 5V regulated output was supplied to a **breadboard**.
9. The **Arduino Uno** and the **two IR line follower sensors** were powered using the 5V and GND pins from the breadboard.
10. The output pins of the IR sensors were connected to the **digital input pins of the Arduino**.
11. A **cardboard sensor holder** was glued to the front of the chassis, ensuring proper positioning of the two IR sensors for line detection.
12. A caster wheel was glued in front of the chassis for smooth turns.
13. Finally, all electronic boards were secured onto the chassis using **a hot glue gun**.

## Libraries Used

* No specific external libraries are typically required for basic IR line following with Arduino, as direct digital reads are often sufficient.

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## Testing And Calibration

#### Initial Testing

Basic tests were performed to ensure all components worked properly. For example, motor drivers were tested using hard-coded signals to verify their functionality. Similarly, the IR sensors were checked individually to confirm they could reliably distinguish between the line and the background surface.

#### Calibration

Calibration of the IR line follower sensors was crucial to define the optimal threshold for line detection for refining the digital read logic in the code to ensure the sensors accurately registered the presence or absence of the line under varying lighting conditions. Motor speed was also controlled to ensure smooth and accurate tracking of the line, preventing overshooting or erratic movements.

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## PERFORMANCE EVALUATION

While the robot was tested, we found that it occasionally faced difficulty in consistently following lines with sharp turns or those that were faded/thin. So, a limitation of this design is that the sensors, while effective for standard lines, might struggle with less distinct or abrupt path changes. We also observed some jittering in movements on certain surfaces.

## FUTURE ENHANCEMENTS

We can explore using more advanced line-following sensor arrays with a greater number of IR sensors (e.g., 5 or 8 sensors) for improved accuracy and the ability to handle more complex line patterns and sharper turns.

Implementing PID (Proportional-Integral-Derivative) control for motor speed and steering can significantly improve the robot's line-following precision and reduce jittering.

The wheels seemed to skid on smoother surfaces; using other good quality rubber wheels with better grip could improve traction and stability.

This robot can be scaled up with a more robust chassis and powerful motors to serve as a platform for automated material transport in controlled environments.

## DISCUSSION AND CONCLUSION

The journey of building this line-following robot was quite interesting. It was a very exciting project in which I learned about the practical uses of various electronic components and fundamental robotics principles. It provided a valuable learning experience in sensor integration, motor control, and basic autonomous navigation.

### References

<https://www.arduinogeek.com/2023/02/LineFollowerRobot.html>

<https://circuitdigest.com/microcontroller-projects/arduino-uno-line-follower-robot>