Nuevo – Line-Following Robot

Team LPPS-1

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Nuevo – Line-Following Robot (LFR)

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1. Introduction

What is a Line-Following Robot (LFR)?

A **Line-Following Robot (LFR)** is an autonomous vehicle designed to follow a pre-defined path, usually a black or white line on a contrasting surface. These robots use infrared (IR) sensors to continuously detect the position of the track and adjust their movement accordingly. LFRs are widely used in industrial automation, warehouse logistics, material transportation, and robotics competitions due to their ability to navigate independently with minimal human intervention.

About Nuevo

Nuevo is a high-speed, precision-driven LFR built for **efficiency, stability, and adaptability**. Unlike traditional LFRs that rely on **PID (Proportional-Integral-Derivative) control**, Nuevo follows a **custom logic-based approach** that enables faster and more stable movement without unnecessary oscillations.

The robot features a sturdy **25 cm x 15 cm acrylic chassis**, carefully designed for optimized weight distribution and smooth motion. It is powered by **four TT motors**, allowing it to accelerate quickly and maintain speed through curves. A **five-sensor IR array** ensures accurate track detection and real-time adjustments.

Wireless Speed Control – Future Upgrade

Nuevo is equipped with an **HC-05 Bluetooth module** for **future wireless speed control implementation**. While this feature has not yet been activated, the necessary hardware is already installed, allowing future development. Once implemented, users will be able to remotely adjust the robot's speed via a mobile application, making it adaptable to different track conditions and competition requirements.

With its high-performance motion system, efficient logic-based navigation, and potential for future enhancements, Nuevo serves as an ideal platform for advanced robotics research, competitions, and industrial applications.

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2. Robot Design

2.1. Dimensions & Structure

Nuevo is designed to be compact yet **sturdy**, ensuring **effortless maneuverability and stability** at high speeds.

- **Base Material:** Acrylic sheet
- **Length:** 25 cm
- **Width:** 15 cm
- **Height:** 5 cm

The **low-profile design** keeps the center of gravity low, preventing it from tipping over during sharp turns. The **acrylic chassis** is lightweight yet strong, providing a solid foundation for motors, sensors, and electronics.

2.2. Chassis Features

- Pre-drilled mounting holes for precise placement of motors, sensors, and electronics
- Even weight distribution to prevent unnecessary skidding
- Compact form factor for navigating tight corners with ease

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3. Components List

Component	Quantity	Purpose
TB6612FNG Motor Driver	1x	Controls the speed and direction of motors.
Arduino Nano	1x	The brain of the robot, processing sensor inputs and motor control.
2200mAh 30C 11.7V LiPo	1x	Power for the motors and electronics
Push Buttons	2x	One for calibration, one to start the robot.
On/Off Switch	1x	Main power switch for the system.
Breadboards	2x	Used for prototyping and connections.
Vero Board	1x	Permanent circuit connections for reliability.
Acrylic RC Car Sheet	1x	Base of the robot.
TT Motors	4x	Motors.
TCRT5000 5-Channel Array	1x	Detects the track using infrared sensors.
HC-05 Bluetooth Module	1x	Installed for future wireless speed control functionality.
LM2596 DC to DC Buck Converter	1x	Regulates voltage from the battery to safe levels.
Jumper Wires (Male & Female)	Various	Used for connections between components.
Header Pins (Male & Female)	Various	Used for battery and component connections.

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4. Wiring and Circuit Connections

Nuevo's wiring is kept simple and efficient, ensuring minimal interference while maintaining optimal performance.

4.1. Arduino Nano to TB6612FNG Motor Driver

Arduino Nano	TB6612FNG
D5	PWMA
D8	AIN1
D7	AIN2
D12	STBY
D9	BIN1
D10	BIN2
D11	PWMB
5V	VCC
GND	GND

4.2. TB6612FNG to TT Motors

TB6612FNG	Motors
A01	Left Motor +
A02	Left Motor -
B01	Right Motor +
B02	Right Motor -
VM	Battery

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4.3. Arduino Nano to Calibration & Start Buttons

Arduino Nano	Push Button(s)
D2	Calibration Button
D3	Start Button
GND	Common Ground

4.4. Arduino Nano to TCRT5000 5-Sensor Array

Arduino Nano	TCRT-5000 Array
A0	Sensor 1
A1	Sensor 2
A2	Sensor 3
A3	Sensor 4
A4	Sensor 5
5V	VCC
GND	GND

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5. Line-Following Algorithm & Control System

Nuevo follows a custom **logic-based algorithm** instead of traditional PID control, ensuring faster response times and smoother motion.

5.1. Sensor Data Processing

Nuevo continuously monitors its five infrared sensors to determine its position on the track.

- If the center sensor detects the black line → **Move forward**
- If the left-side sensors detect the line → **Turn left**
- If the right-side sensors detect the line → **Turn right**
- If all sensors detect white → **Rotate to recover the track**

This quick decision-making allows the robot to react immediately to track changes, preventing overshooting or drifting.

6. Wireless Speed Control System (Future Upgrade)

Nuevo is designed to **support wireless speed control** using the HC-05 Bluetooth module, but this feature has not been implemented yet. The necessary hardware is installed, allowing for future development.

6.1. Planned Bluetooth Control Implementation

- A mobile app will allow users to adjust motor speeds wirelessly.
- The Arduino Nano will receive speed values from the mobile device.
- Motor speeds will be updated in real-time using PWM (Pulse Width Modulation) signals.

Although this feature is not yet functional, it represents a major upgrade path for the project, enabling dynamic speed adjustments based on track conditions.

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7. Future Upgrades & Applications

7.1. Performance Enhancements

- Wireless speed control implementation
- Dynamic speed adjustments based on curve sharpness
- More refined logic for smoother cornering and faster lap times

7.2. Hardware Improvements

- Lightweight alternative materials to improve efficiency
- Stronger motor mounts for better stability

7.3. AI-Driven Navigation (Future Scope)

- Implementing AI-based decision-making for complex paths
- Combining computer vision with infrared sensors for better navigation

7.4. Real-World Applications

- Autonomous material transport in warehouses
- Automated floor-cleaning robots
- lndustrial assembly line automation

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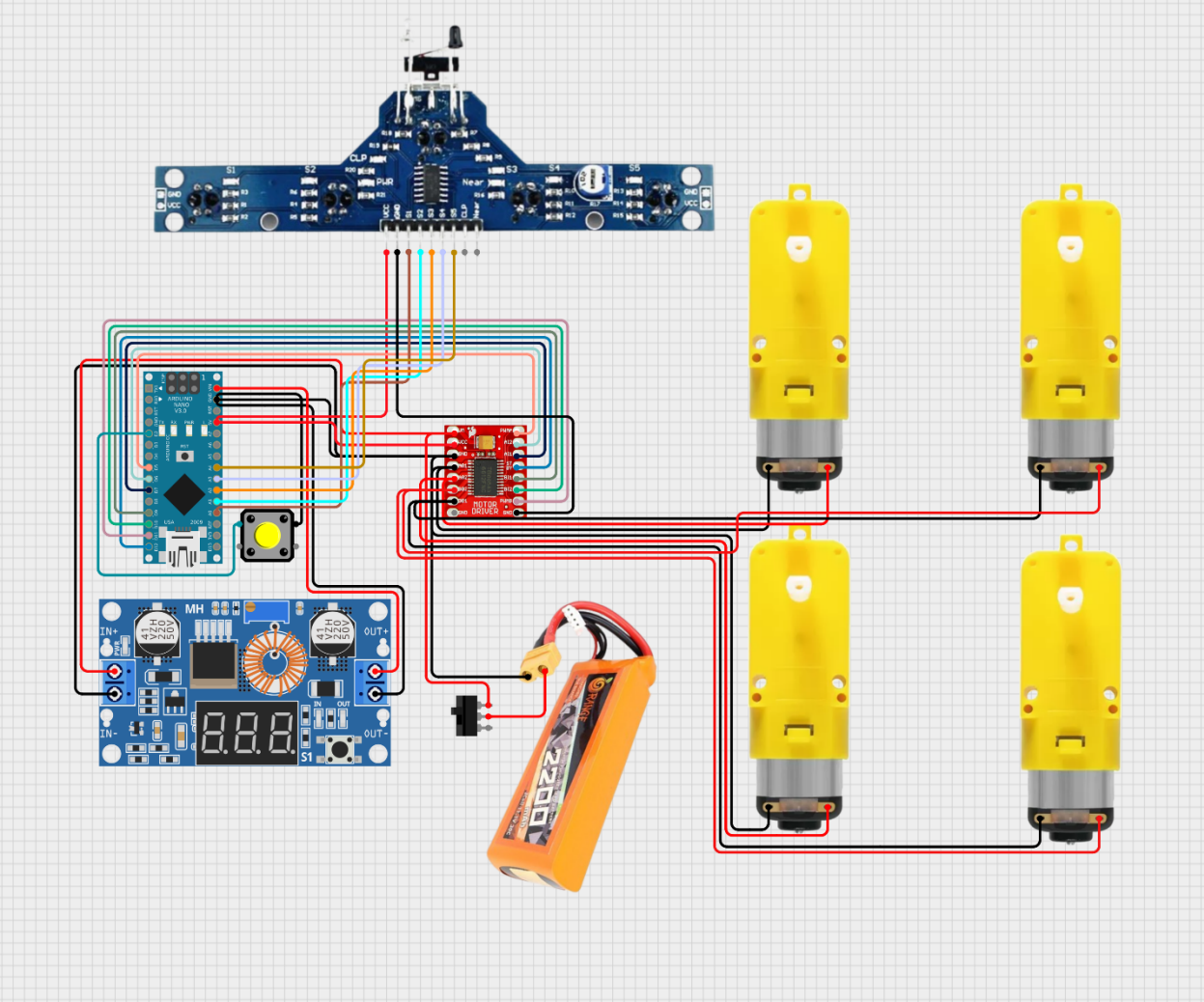
8. Circuit Diagram



9. Conclusion

Nuevo is an efficient, logic-driven Line-Following Robot designed for fast and stable autonomous navigation. With real-time speed control (future upgrade), optimized track-following algorithms, and a sturdy yet lightweight chassis, it's built for high performance in competitive environments. The project serves as a foundation for further research in autonomous robotics and industrial automation.