Maze Navigation with Pololu 3π+ 2040

Robotics – CS549AH1

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Introduction:

This project aims to develop a microPython program to connect an analog range sensor to the Pololu 3pi robot and utilize it for collision warning and maze navigation. The project utilizes a Sharp GP2Y0A60SZLF Analog Distance Sensor interfaced with the Pololu controller. The primary goal is to enable the robot to detect obstacles using the sensor and adjust its movement to navigate through a maze.

Implementation Details:

- Sensor Integration: The analog distance sensor is connected to the RP2040 Pico controller, utilizing one of its ADC channels. This allows for converting analog readings into digital signals, facilitating obstacle detection.
- Motor Control: The Pololu 3pi robot library controls the robot's movement. Forward movement is initiated with a predefined speed, and left turns are executed by controlling the motor speeds accordingly.
- Collision Detection: To detect obstacles, the program continuously reads the analog value from the sensor. If the reading surpasses a predefined threshold (30000), it initiates a left turn. Additionally, a feature is implemented where if the robot gets stuck due to an obstacle, it automatically reverses for a short period before attempting to obtain a new sensor reading.
- Feedback and Display: The robot provides feedback using RGB LEDs, a buzzer, and an OLED display. LED colors indicate different states (e.g., red for forward movement, green for turning left), the buzzer provides audible alerts, and the OLED display shows status messages (e.g., "Moving forward", "Turning Left").

Maze Navigation:

- The program is designed to enable the robot to navigate through a maze autonomously. It continuously reads sensor data and adjusts its movement based on the detected obstacles. Left turns are made when an obstacle is detected, allowing the robot to explore different paths.
- The implementation includes a safety feature where if the robot halts due to an obstacle, it momentarily reverses to reevaluate its surroundings before continuing its forward motion. This enhances the robot's ability to overcome barriers and navigate complex environments efficiently.

Conclusion:

The developed microPython program successfully integrates an analog range sensor with the Pololu 3pi robot for collision detection and maze navigation. The robot demonstrates autonomous navigation capabilities by utilizing sensor data and intelligent movement algorithms. Adding the reverse maneuver when encountering obstacles enhances the robot's resilience in challenging environments, enabling it to explore mazes effectively.

Future Enhancements:

- Further optimization of movement algorithms for smoother navigation.
- Integration of additional sensors for more comprehensive environmental perception.
- Implementation of advanced path planning algorithms to optimize maze traversal efficiency.

The project lays the foundation for developing intelligent robotic systems capable of autonomous navigation and obstacle avoidance.

References:

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