Robot for Executing Physics Inspired Path Planned

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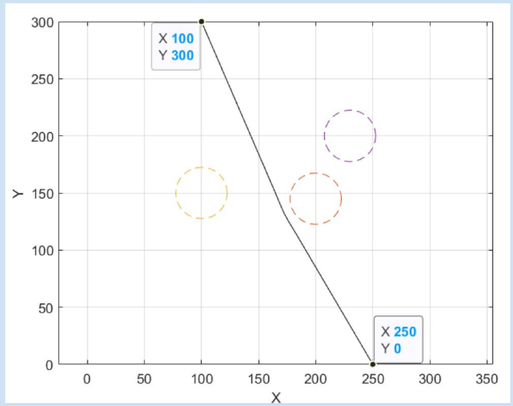
Overview

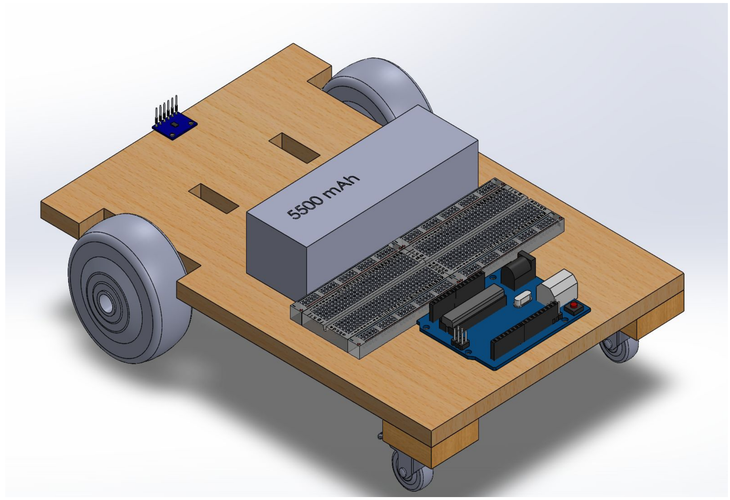
Design an autonomous robot that can track a predetermined collision-free path in a 2D environment.

- self-contained and self-sufficient
- follow the path with a 10% maximum error
- a budget of $750
- 1 quarter project

Design parameters

- 2D environment:3mx3m
- obstacles diameter:30cm
- robot dimension:20cmx30cm
- robot weight <3kg
- Vmax:0.75m/s
- Power:24W,12W/motor
- 44 min battery lifetime with 5.5Ah battery





Final design

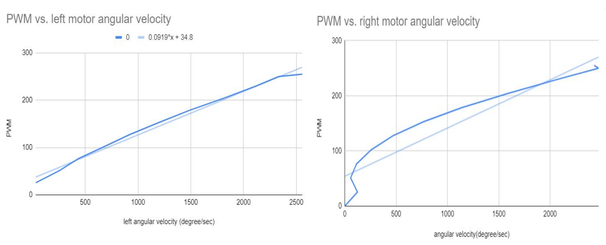
- **Differential Drive**

two motors to supply power and control steering

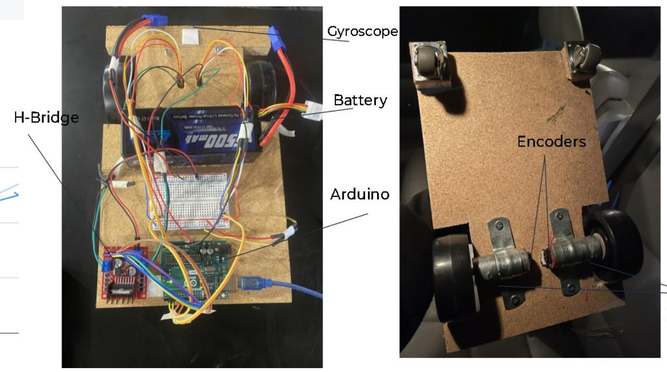
- **Feedback control**

-determine position from MPU6050 output
-calculate desired steering angle
-calculate angular velocities to make the turn
-convert angular velocity to PWM

Motor Calibration



Final Robot Prototype



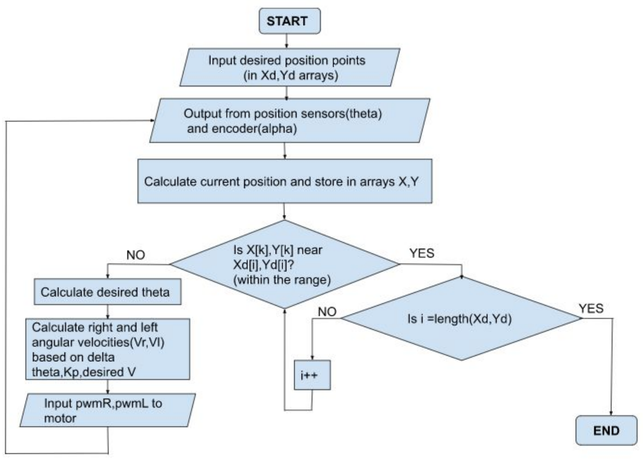
Mechanical Performance

- all components fit tightly
- axis of rotation line up
- 4 tire all touches the ground
- Movability
- Tires turn freely

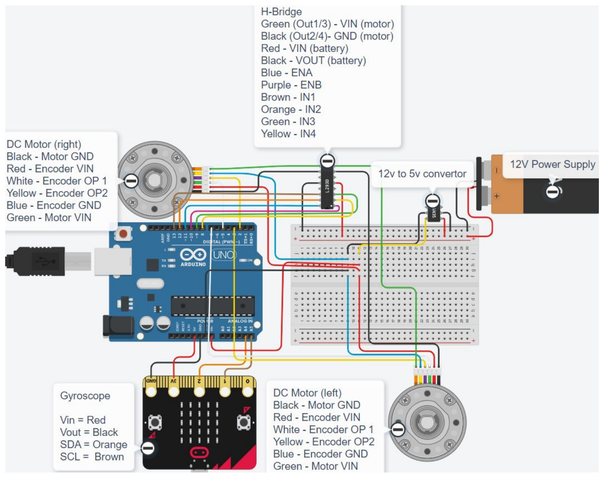
Hardware Performance

Encoder: measure 5m distance error within 10cm
Motor:left motor has linear relationship between PWM and angular velocity, the right motor didn't
Gyro:static error within 0.06 degrees after calibration

Code Flowchart



Wiring Diagram



Results

- The robot can move at different speed
- Code can command robot to turn at different angles
- This project serves as a proof of concept for the path planner and the robot, and could be further developed in the future.

Future improvement

- Finalize key parameters
- Spend more time during testing phase
- Ensure four wheels touch ground and robot can move straight when motors rotate at same angular velocity
- reduce robot size and weight
- improve algorithm and tune control parameters to reach optimal performance