Problem Statement

The design was specific for the Colorado Space Grant Consortium (COSGC), to compete in the 2024 Robotics Challenge. This team explored autonomous movement using legs, time of flight and RGB sensing. The design focused on autonomous movement capable of navigating and traversing mars like terrain and utilizing embedded systems libraries and hardware to communicate and initiate decision making at the robotic level.

State Machine

- **State 0: Idle**
  - Delaying 5000 mS
  - Verifying Lidar Works
  - Returning a Color value and Lidar Distance

- **State 1: Forward Motion**
  - Motor Systems Engage for 10000ms (10s)
  - Lidar records data
  - RGB Sensors records data

- **State 2: Obstacle Avoidance**
  - Motor Systems Engage left and right to avoid obstacles
  - Completes a 10s sprint around obstacles or over
  - Motor system corrects for left or right turns

- **State 3: Course completed**
  - Delay motors for 100s, objective reached
  - Completion occurs if RGB set value detected or 50 cycles of state is completed

Design Iterations and Testing

**Iteration 1**
- Acrylic chassis.
- 3D printed PLA legs and brackets.
- Six DC motors, and driver chip.
- One 12V battery pack powering motors and ESP32.
- TEST: 3D printer motor shafts are easily stripped by the motor.

**Iteration 2**
- Chassis made from plastic
- Six stepper motors on PLA brackets, connected to new driver chips.
- 3D printed PLA golden legs and front plate to hold Lidar and RGB.
- Strong metal couplings hold the legs.
- TEST: Stepper motors aren’t strong enough, sensors work fine.

**Iteration 3**
- Reinstalled original DC motors.
- Replaced back legs with tires for added strength.
- TEST: Finished one obstacle course on the tile floor in the lab.
- SAND TEST: Still can’t walk in the sand, there could be a weight issue.

Final Iteration
- Plastic sheet chassis, with added middle plate for center motors.
- No tires, all six legs are installed.
- New motor driver chip distributes power evenly to DC motors.
- Lidar and RGB still working.
- TEST: Successful traversing terrain.

Conclusions

- Next iterations will involve less hot glue and stronger DC motors (with encoders).
- Future designs will have more structural integrity, featuring side panels and a top piece.
- Slight sensor placement changes are needed for the code to operate efficiently.
- Very successful design, considering all the rapid prototyping and time constraints.

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