Mars Rover Design Challenge

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Problem Definition

Design an autonomous rover capable of independently navigating Mars-like terrain to reach a predetermined destination without relying on external assistance or influence. This challenge was crafted by the Colorado Space Grant Consortium (COSGC) in partnership with NASA, inviting colleges throughout the state to participate. The aim of this challenge is to foster collaboration and hands-on learning experiences among students. Trilateration with ultrasonic sensors was tested in the main design.

Design Requirements

- **Mass:** Division 1 (Goal <1.5 kg) Division 2 (< 4 kg)
- **Size:** About the size of a cat
- **Navigation:** No GPS navigation allowed, must use autonomous navigation to maneuver around obstacles and rough terrain
- **Environmentally Friendly:** Must not be harmful to the environment
- **Cost:** Final unit < $500

Design Evaluation

The design was based on the 6-wheeled Mars Perseverance rover. The rover's body was constructed from repurposed materials, with the chassis made of PVC and the electronics housed in a plastic tub. The motor driver used was the ITB-2, and both the driver and navigation systems were controlled by an ESP32-Pico. Power was supplied by two 6V 6000mAh batteries. The rover was tested in sandy environments on straight aways and over obstacles, and beacon was tested with stand alone receiver.

Design

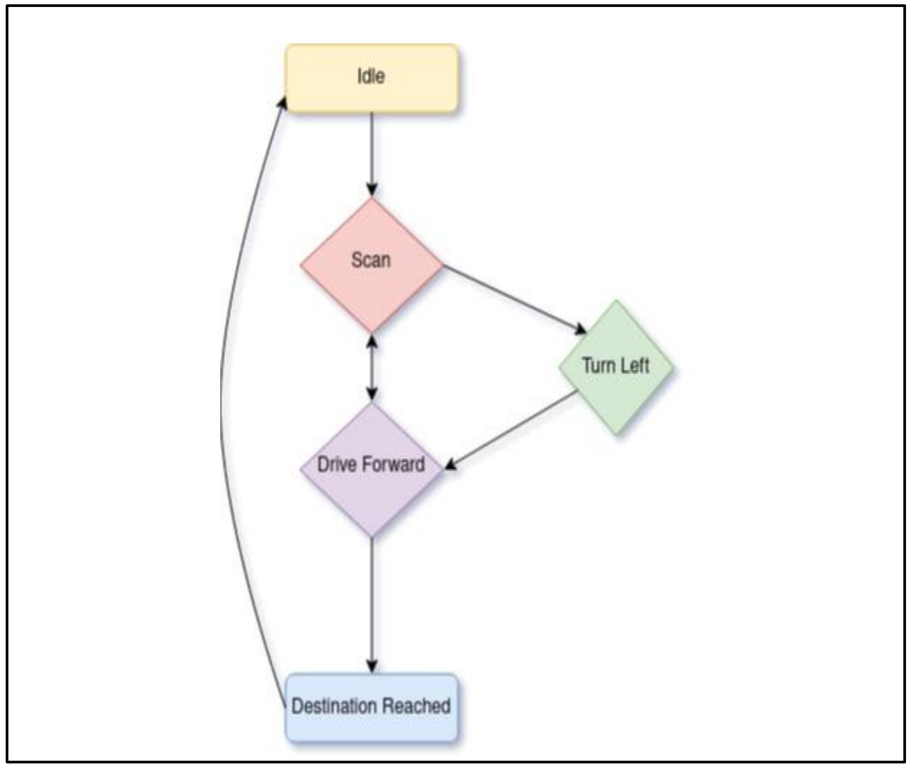

Figure 1: State diagram for code implemented on an ESP 32 Pico-kit

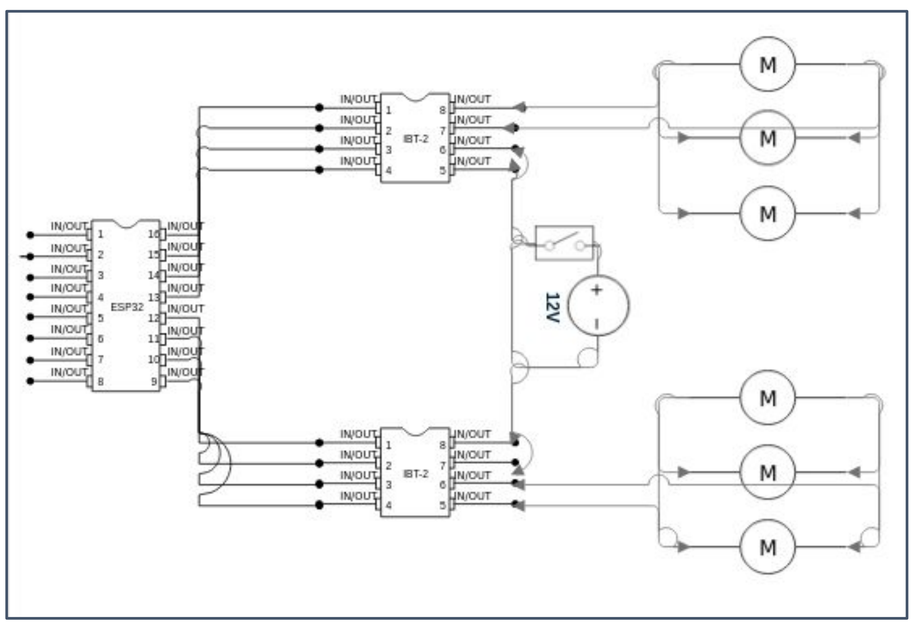

Figure 2: Wiring diagram for Mars rover.

Robot

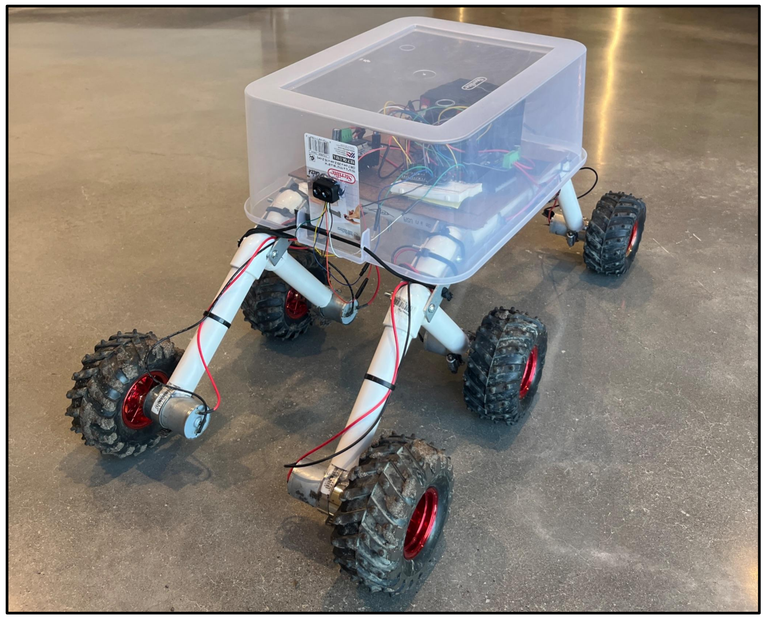

Figure 3: Image of six-wheel drive Mars rover.

Conclusions and Next Steps

While our rover was successful overall, our progress was not without a few drawbacks. Our rugged design performed well in the sand and rocks, successfully completing 5 out of the 6 course designs. However, our design also made maneuvering through the Mars-like terrain difficult. Our navigation systems also encountered difficulties. Although our beacon was able to assess distance, additional time was needed to properly design an effective system to guide the robot to its destination. We also faced challenges with the LiDAR system, as intense sunlight causes false readings.

The next steps for the rover entail redesigning the chassis to enhance navigational capabilities, focus on improving the beacon system for navigation and conducting additional tests on the LiDAR and other potential solutions for local navigation.

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