MARS ROTARY ROVER

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Project Summary

The objective and purpose of this project is directed towards increasing the success and longevity of the Mars Rover on future NASA Missions to Mars. The intent of this objective is to build a Rover with greater mechanical functionality and adaptability to the challenges of operating in the Mars environment. The primary areas of development focus are with respect to LiDAR sensor data acquisition, modular chassis reorientation, and independent motor control.

The LiDAR-based Obstacle Detection System implements a modified LiDAR sensor to conduct 3-D mapping and coverage in the airless environment of Mars. The function of this sub-system is to retrieve and interpolate sensor values in order to successfully maneuver the rover within its immediate surroundings and to circumvent obstacles on its path. This sensor has been physically modified to acquire data in the 3-D plane. We have accomplished data acquisition through a Raspberry Pi 3 in conjunction with appropriate LiDAR Sensor ROS packages.

This realized model employs a reorientation mechanism by utilizing motors at the axles to better maneuver over elevated obstacles, and benefits from a greater degree of articulation over irregular surfaces. These auxiliary motors are attached at three terminating points on the chassis to appropriately reconfigure the Mars Rover in a rollover situation. The Rover can currently communicate through a phone application by employing a Bluetooth module to remotely accomplish forward or reverse motion.

Problem and Need

The current Rover designs are slow, not adaptive to the environment, and cannot reorient themselves. In order to rectify this, hardware and software mechanisms are needed that will allow for faster near bound obstacle detection to improve maneuverability and self-reorientation

Significance

NASA is currently implementing a four-phase plan to Mars, with the goal of landing humans on Mars by 2030. The work that we are doing, as a team, is significant and relevant to the Rovers and Landers which are a major component of this new mission. This next generation of Rovers will be responsible for more than just acting as a mobile science laboratory; they will also serve as scouts and conduct mapping functions on Mars in preparation for the incoming astronauts.

Goal

The overarching goal of this project is to build a robust Mars Rover that is capable of tackling the rough terrain of the Mars environment and can reliably circumnavigate obstacles in its path.

Customer/User Analysis

The intended end user(s) for the Mars Rotary Rover would encompass members of the Mars 2020 Rover Team as part of the planned launch of the Mars Exploration Program.

Deliverables

The final deliverable for this project is an operable Mars Rover that is capable of functioning autonomously and able to reconfigure itself from a rollover situation through the use of independent ancillary motors fixed to three points on the chassis.

Terminal Objective

The Rover should be able to traverse a path around simulated obstacles such as crevasses and outcroppings without user intervention, and appropriately reconfigure itself from a rollover situation.
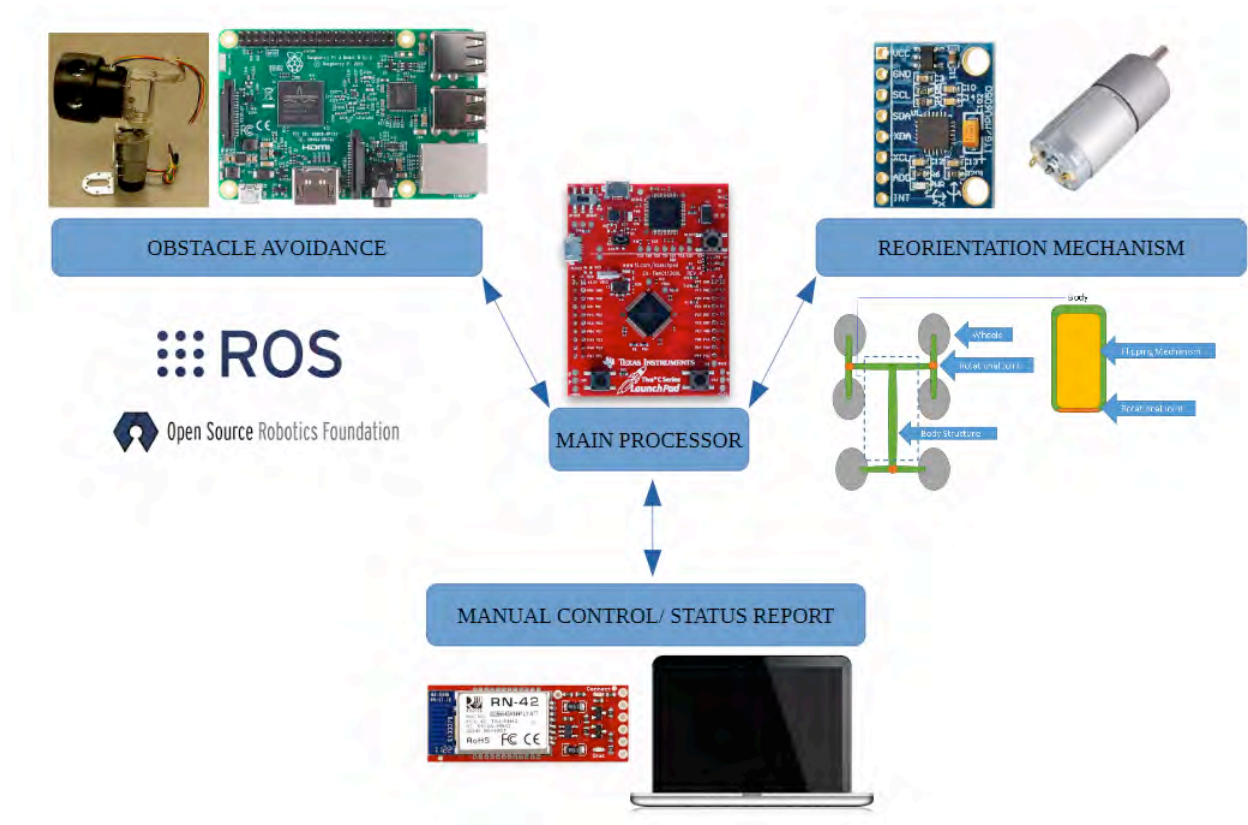
Overview Diagram

Fig. 1. Overview diagram for the final Mars Rover prototype including the various sub-systems