INTER-IIT TECH MEET
05-07 JAN 2018

IITB Mars Rover Team

Indian Institute of Technology, Bombay

6th INTER-IIT TECH MEET
IIT MADRAS
5-7 January 2018

Introduction

The IITB Mars Rover Team was established in 2012 with the objective of working towards building technologies for manned missions to Mars, and inspiring the youth towards space exploration. The current focus of the team is towards building interplanetary rover prototypes for future manned missions to Mars. We have built 5 rover prototypes & are working on the 6th one for Univ. Rover Challenge 2018.

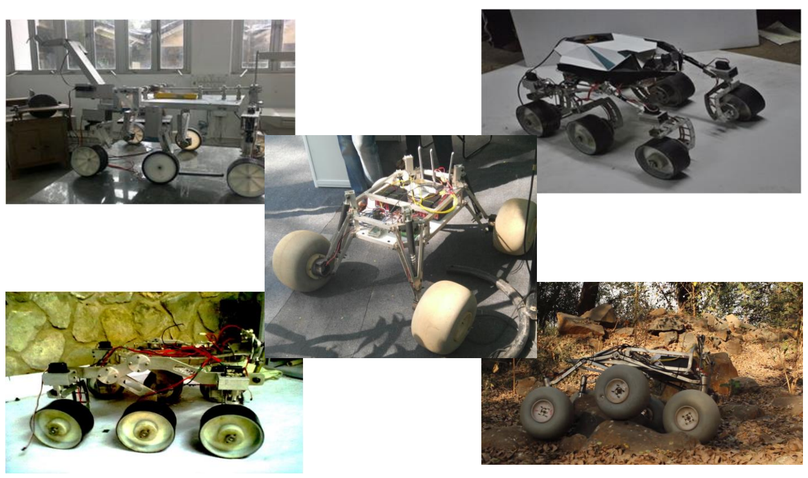


Figure 1: Rover Prototypes over the Years

The team comprises of 32 students from various disciplines and years of study, and is divided according to the major systems of the rover. The team broadly comprises of 3 subsystems:

- Mechanical Subsystem
- Electrical Subsystem
- Bio-science Subsystem

There is significant overlap among various subsystems and most of the team members work in multiple areas across different sub-systems. There are students from IDC (Industrial Design Center) as well in the team to guide us on extrinsic design aspects of the rover.

Design

The current rover prototype incorporates a 4 wheeled double wishbone suspension design with differential steering. This design was arrived at after months of literature review & critical analysis of all possible designs, scrutinizing factors such as weight limits, simplicity, cost efficiency, ease of controlling & time constraints. The mechanical designing was done on SolidWorks & ANSYS. The robotic arm is designed to support payload of 10kg while providing accuracy required to toggle switches. We have decided to use actuators in our design, giving us better controllability, since our last design with DC motors was tough to control, owing to it being a non linear control system.

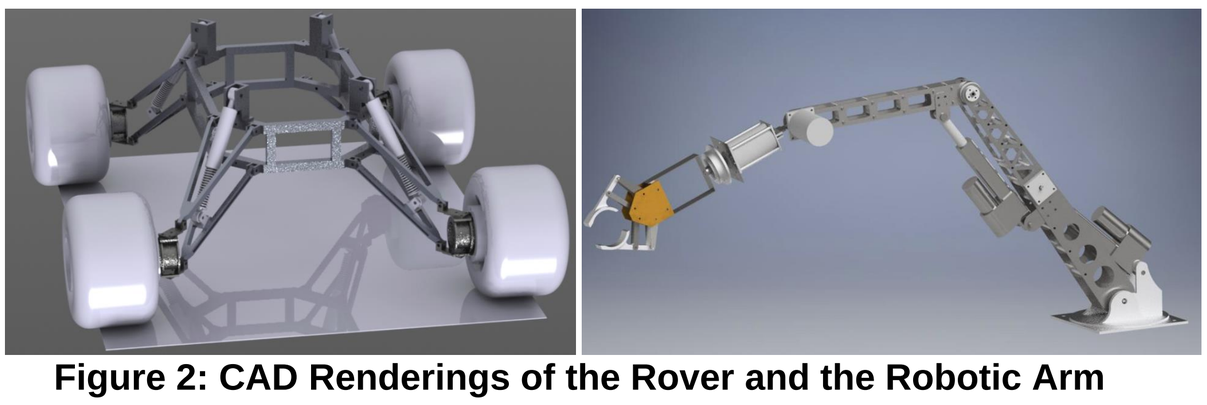


Figure 2: CAD Renderings of the Rover and the Robotic Arm

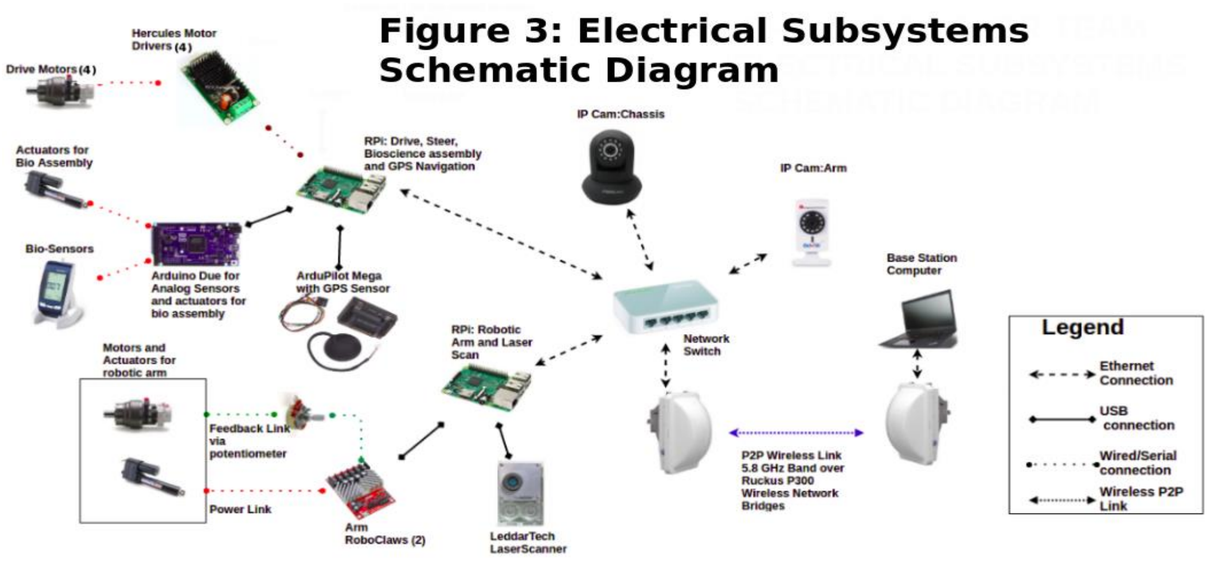
The Electrical subsystems design has been modular & has reduced the point of failures by minimising the number of hardware components & wired connections. This design approach has also helped us counter redundancy by focussing on newer technologies, viz. powering up devices using PoE splitters, getting orientation of the rover using inbuilt sensors of Android & streaming Android phone's camera over RTSP, effectively converting it to an IP camera.

The Bioscience subsystem design involves designing bio-assembly to drill and collect soil samples, utilize on-board bio-sensors to determine optimal places to collect soil samples from & designing experiments to test for presence of organic substances in them.

Implementation

The current prototype is manufactured using conventional materials such as aluminium & stainless steel. We have also used nylon & acrylic where feasible. Advanced materials like carbon fibre & composites were also researched upon, but were deemed not feasible due to time & cost constraints.

We have deployed codes for differential steer & Inverse Kinematics algorithm for the arm joints, with Type II control over wrist & gripper motors for fine corrections. The control is done using joystick & a Base Station GUI has also been developed using RQT to assist in the same. The codes to stream cameras, interface with bio-sensors, steer the rover & control the arm have been integrated as ROS packages. We use RPi as our primary on board computer, and plan to use NUC in future. The codes written for autonomous operation have been simulated on Gazebo, using Leddar to detect obstacles.



We plan on using Archimedes screw mechanism to collect soil samples for bio science task. Also, we plan on making a fibre-optic based spectrometer to detect traces of H_20, along with bio sensors like DHT-11 & MQ-4. We are also in process of strategizing cyanobacteria tests for life detection.

Outreach and Future Plans

Apart from technical work on the rover, we are involved in numerous educational outreach programs, such as Aviation Day & TechConnect. We look to motivate the students towards space research & spread awareness about Martian exploration via them.

Figure 4: The Rover being Exhibited at TechConnect at IITB

In the future, we also plan to expand the team beyond rovers, and cover other aspects of interplanetary missions such as astrobiology, artificial habitats & research on Martian environment. We aim to be at the forefront of space exploration and work in close collaboration with national & international space agencies. Also, we have realised that the rover can be used extensively in agriculture and defence sector, a sample usage being to clear out Anti-Tank mines.

Acknowledgements

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