Florida Tech Mars Rover Robotic Arm and Controls Systems

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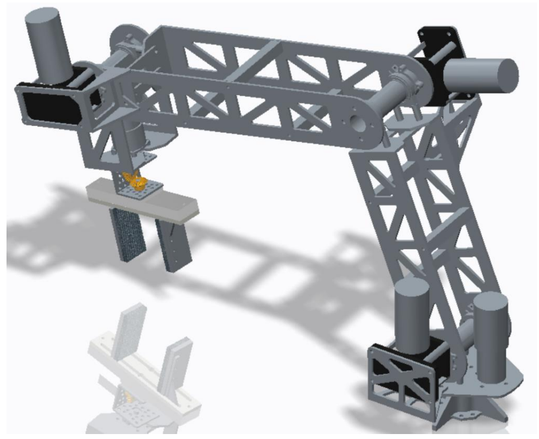
Robotic Arm

Design Criteria

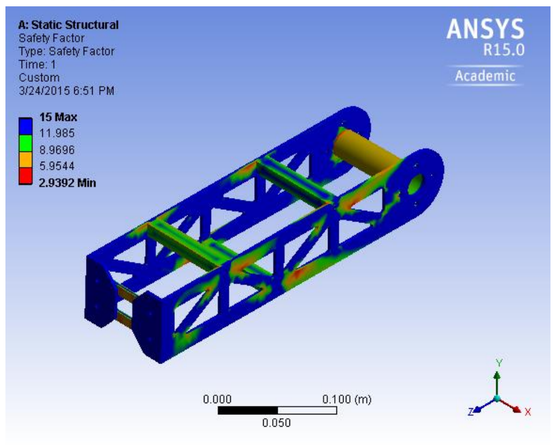
- Robotic arm must be able to lift a maximum load of 5 Kg
- The robotic arm must be able to reach anywhere between ground level and a meter above ground level
- The robotic arm must have the ability to grasp and actuate various objects of different geometries and materials with a maximum grasping size of 5 cm in diameter
- The robotic arm must be able to collect a sample of a minimum weight of 5 grams that is a minimum of 5 cm or deeper below ground level

Specifications



- **Mobility:** 360º yaw & 135º pitch at shoulder, 250º pitch at elbow, 180º pitch and 720º roll at wrist, 6.5 cm stroke at end effector
- **Maximum payload:** 20 Kg at a moment arm of 1 m
- **Approximate size:** 1.2 m x 0.23 m x 0.15 m
- **Total weight:** 4.8 Kg
- Six DOF robotic arm with four joints and a parallel jaw gripper end effector each actuated by a DC gearmotor
- Three interchangeable grippers for end effector: flat and cylindrical rubber grippers, and 3D printed digging scoops
- Rigid hollow aluminum truss structure to withstand loads with a light weight design for a structural net weight of 2.16 Kg

Analysis and Results



Each structural component was analyzed using hand calculations and computer aided simulation. Each arm component has a minimum factor of safety of 2.5 in order to achieve the reliability necessary for competition.

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Controls System

Design Criteria

- Communication should transmit up to 1km distance with no guaranteed line of sight
- The Rover needs to be remotely controlled from an isolated ground station with no direct visual
- The Control station must receive images from the cameras with a minimum resolution of 720p
- Two onboard cameras must provide visual to operate the arm and maneuver the rover

Hardware

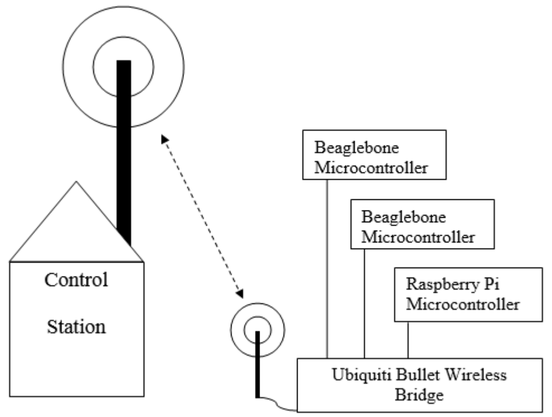
- The Rover makes use of three microcomputers; two BeagleBone Blacks and one Raspberry Pi
- The Raspberry Pi processes imaging, and the BeagleBones process motor controls for the arm and the rover as well as providing telemetry

Raspberry Pi:
- **Serial Camera**
- **Moisture Sensor**
- **pH Sensor**

BeagleBone (1):
- **3x Dual channel EMC**
- **IMU**
- **GPS**

BeagleBone (2):
- **1x Quad channel EMC**
- **1x Dual channel EMC**
- **2x IMU**
- **Sentech Camera**

Communications



The communications system is laid out so that the wireless bridge on board the rover is connected to the three microcontrollers through a switch.

Software

Our front-end will be using **Foundation 5** + **jQuery**

jQuery
write less, do more.

Dynamic Updates will be performed by the React JS, which will talk to back-end

React

Our Back-end will collect and distribute the information. "The Hub"

node
Microsoft

All the software used for this system are the most advanced available in the industry.

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