Concept Design Review

RASC-AL RoboOps Competition

Team 11: Hexcavator

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Inspiration

The Task

- Planetary Rover
- Capable of collecting rock samples
- Controlled over 3G/4G network
- Limited size and weight
- Handle various terrain

The Solution

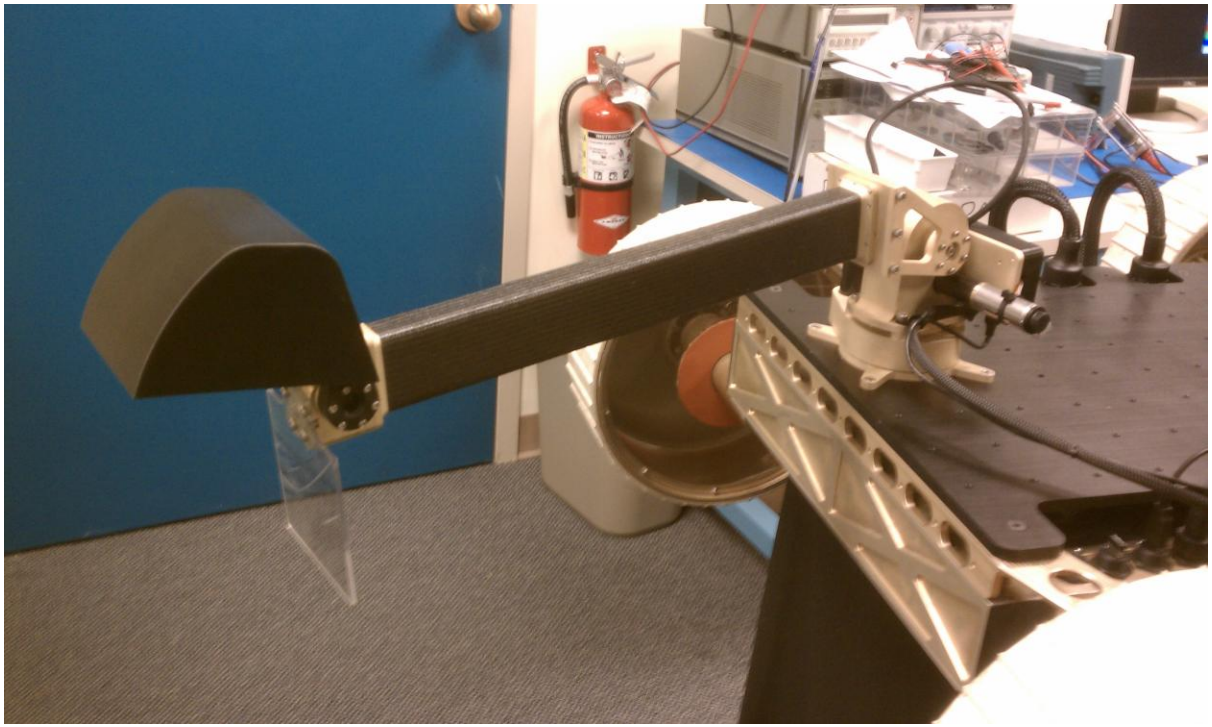
- Hexapedal Design
  - XRL
- On-Board Computing
- Arm/Claw

Robotic Arms and Grippers

- Successful designs from 2012 competition
  - Worcester Polytechnic Institute
  - California Institute of Technology
  - University of Maryland

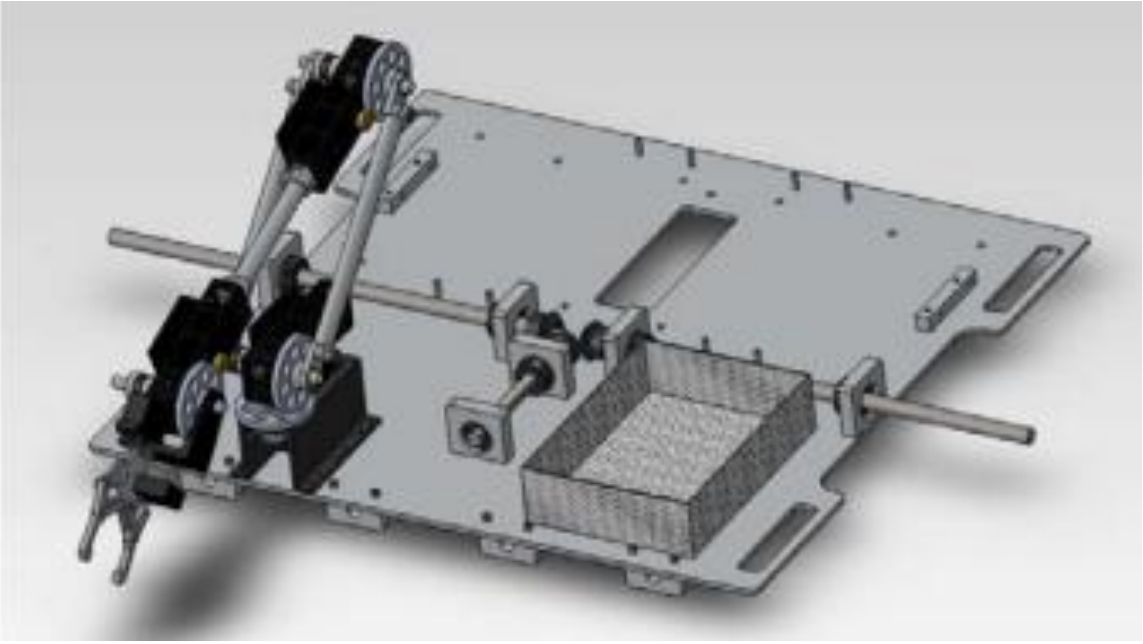
Worcester Polytechnic Institute

- Overview
  - 4 DOF
- Pros/Cons



California Institute of Technology

- Overview
  - 6 DOF
- Pros/Cons

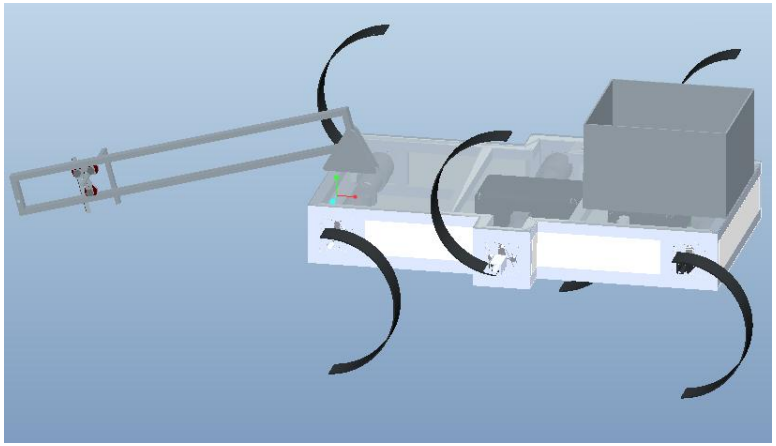


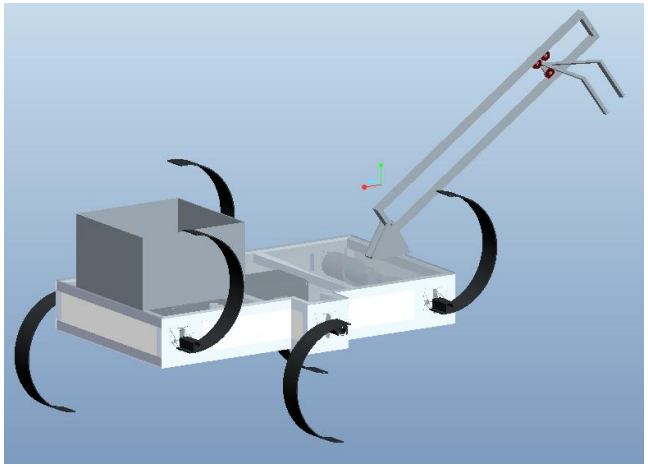
University of Maryland

- Overview
  - 4 DOF
- Pros/Cons

Arm Concept 1 - Pulley

Pros:
- Adjustable reach
- Operates in 3 planes
- Can use almost any claw design
- Bucket will not interfere with ground clearance





Cons:
- Pulley system open to elements
- Complex control (4 inputs required)
- May require front end extension of the frame

Arm Concept 2 – Manipulator

Arm Concept 3 – Planar Arm

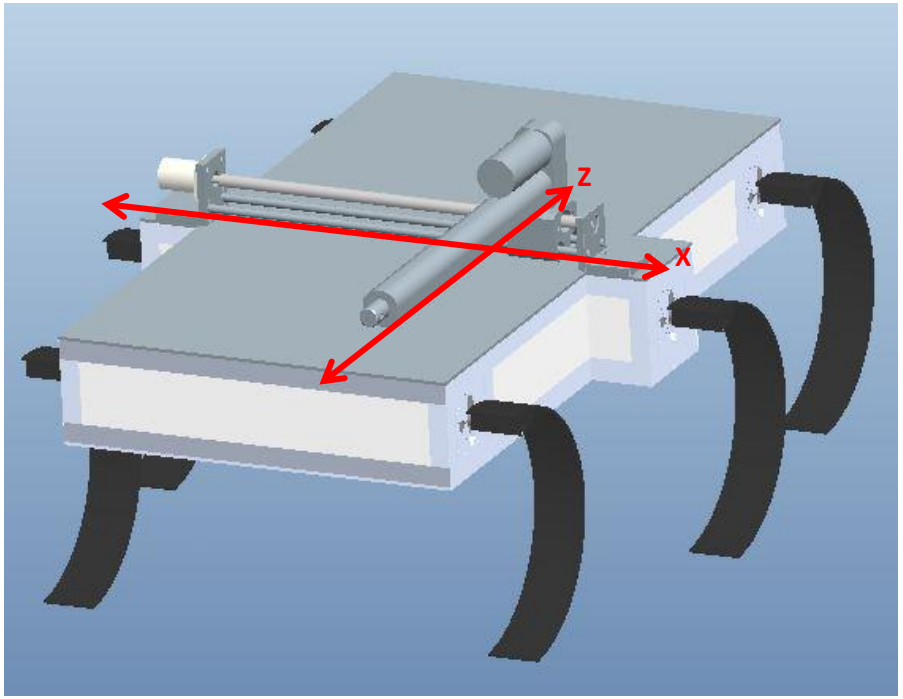
Claw movement is purely planar, vertical adjustments made using legs

Pros:

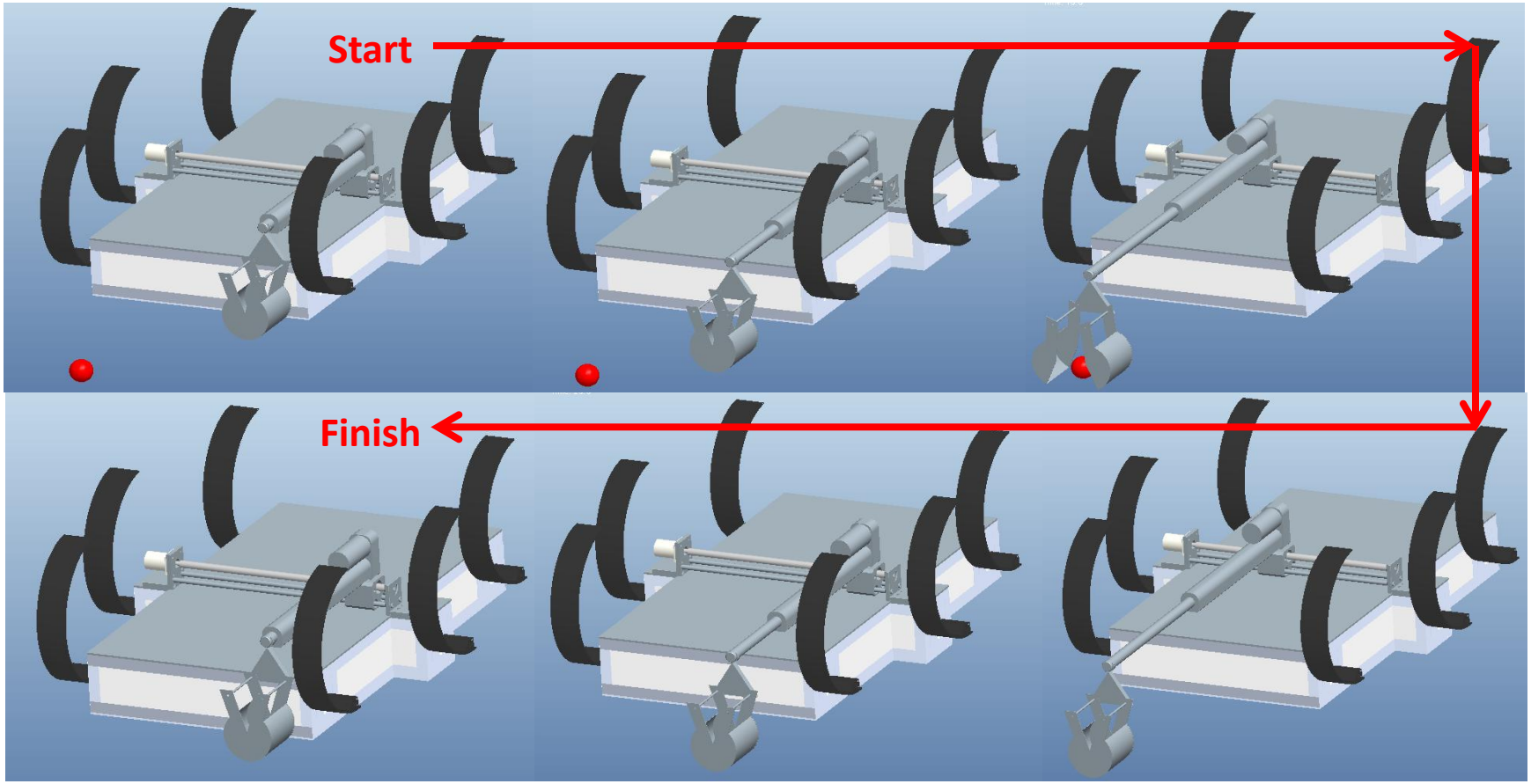
- 3 Motors/Actuators
  - Simple to control and construct
  - Cheap
- Keeps center of gravity low
- Compact

Cons:

- Requires front-mounted box
- High leg control precision required



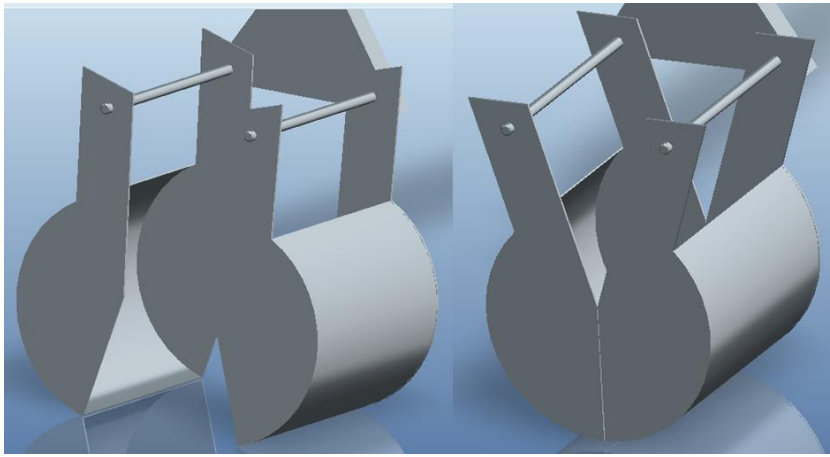
Arm Concept 3 – Planar Arm



Gripper Concept 1 – Pincer

Gripper Concept 2 - Scoop

Gripper Concept 3 – Hybrid



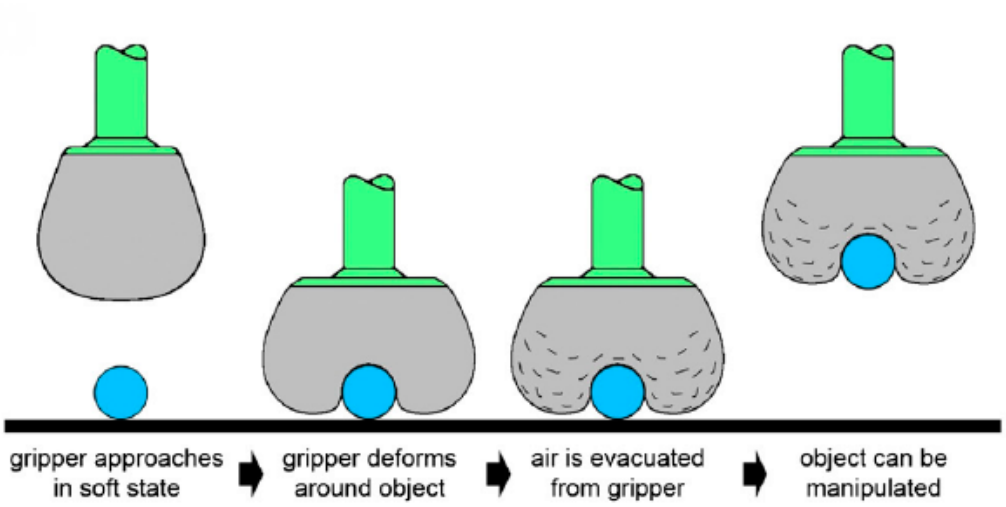
Gripper Concept 4 – Universal Jamming

Pros:

- Can easily grip any shaped object
- Does not require specific orientation to the object being lifted
- Inexpensive and simple to make

Cons:

- Can be damaged by sharp objects
- Will pick up objects adjacent to target object
- Cannot provide precision gripping



Camera Concept 1 – Internet Protocol

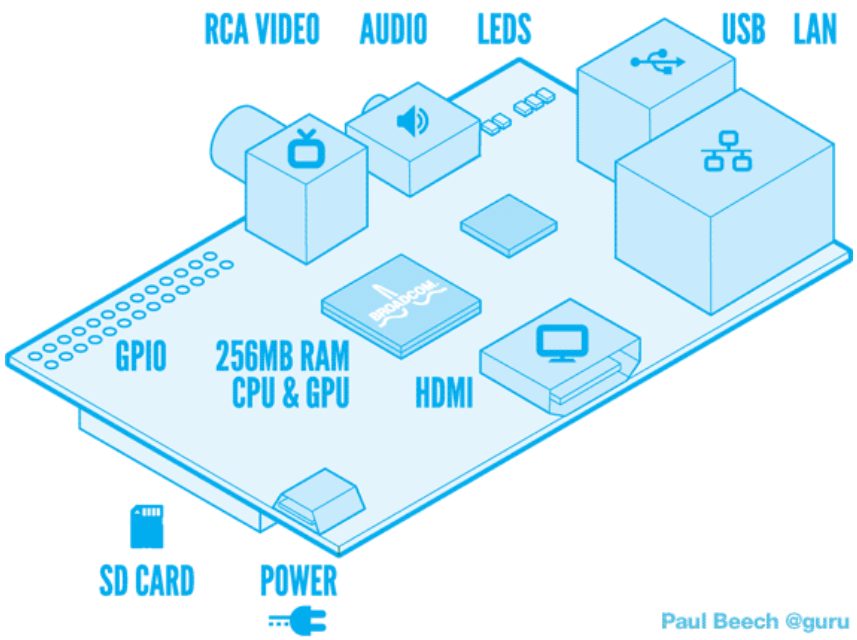
- Pan/tilt features
- Standalone Video Streaming
- Outdoor Use

Camera Concept 2 – Web Cam

- Requires Onboard Computer
- Less Networking
- Cheaper

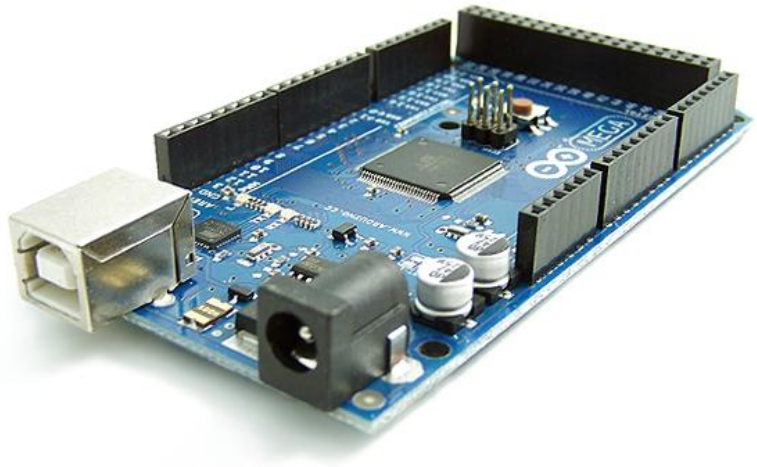
Single Board Computer

- Ex. Raspberry Pi
  - Onboard computer for video/communication
  - Not enough GPIO for motor control
  - Verified peripherals
    - Includes
      - USB 3G dongles
      - Powered USB hubs
      - USB Webcams



Microcontroller Units (MCU)

- Ex. Arduino
  - Pros
    - Easy to use library
    - Plenty of GPIO pins
    - PWM, I2C, SPI
    - WiFi Enabled
  - Cons
    - No video/image processing
    - 16 MHz CLK
    - Slow PWM frequency



ITX Motherboard

- Pros
  - Full Desktop Computer
    - Processing power
    - Video/image processing
- Cons
  - All Communications are protocols (PCIe, USB, etc.)
  - Expensive Components
    - CPU, RAM, Power Supply, etc.
  - Power Consumption

Computer Concept Selection

	Cost	Power Consumption	Wireless Communication	Computing Power
Raspberry Pi	$35	3.5W	USB 3G/4G, USB WiFi, SSH	N/A
Arduino	$50	~1mW	WiFi	16 MIPS
ITX	$200	150W*	Same as Pi	128,000 MIPS**

Works Cited

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