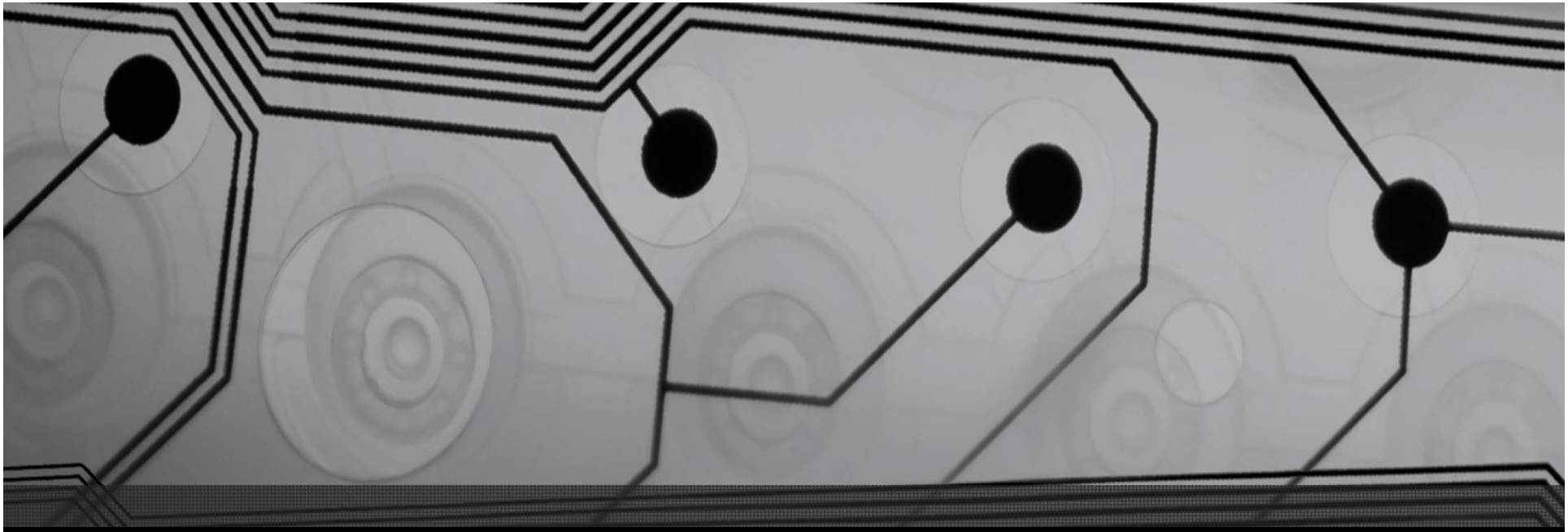
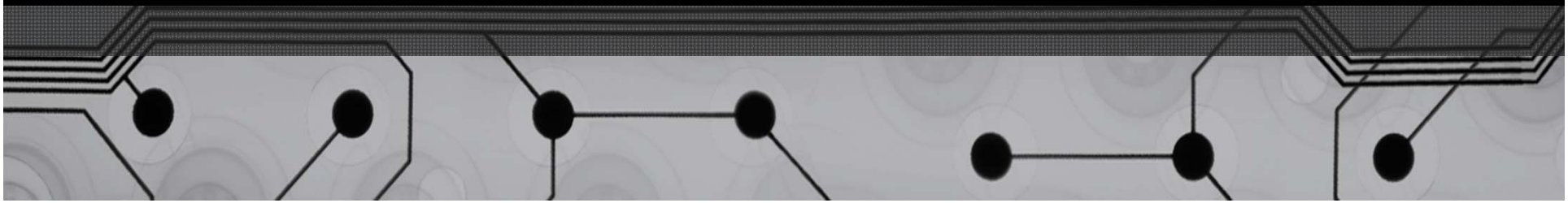


Robocon 2014

Indian Institute of Technology Kanpur

Project Coordinators:
Abhishek Sharma [11030]
Dhrupal R Shah [11250]

Project Guide:
Prof Bhaskar Dasgupta
Head, Mechatronics Lab
Mechanical Engineering, IIT Kanpur



Problem Statement: Robocon 2014

Parent Robot: Objective

- Manoeuvring in a large arena from one zone to another zone
- Picking and placing child robot in different orientations and locations in these zones
- Pushing a swing with child robot
- Pushing a see-saw with child robot on one side

Child Robot: Objective

- Autonomously traversing from one pole to another in a pole walk zone arranged with poles arranged in a specific orientation

Parent Robot: The Challenge

- Dimensions: should fit in a 1000mm cube before start and in a cube of 1500mm cube after start
- Locomotion: actuators + wheels
- Gripping child robot
- Design: degrees of freedom, swing pushing, see saw pushing
- Control System

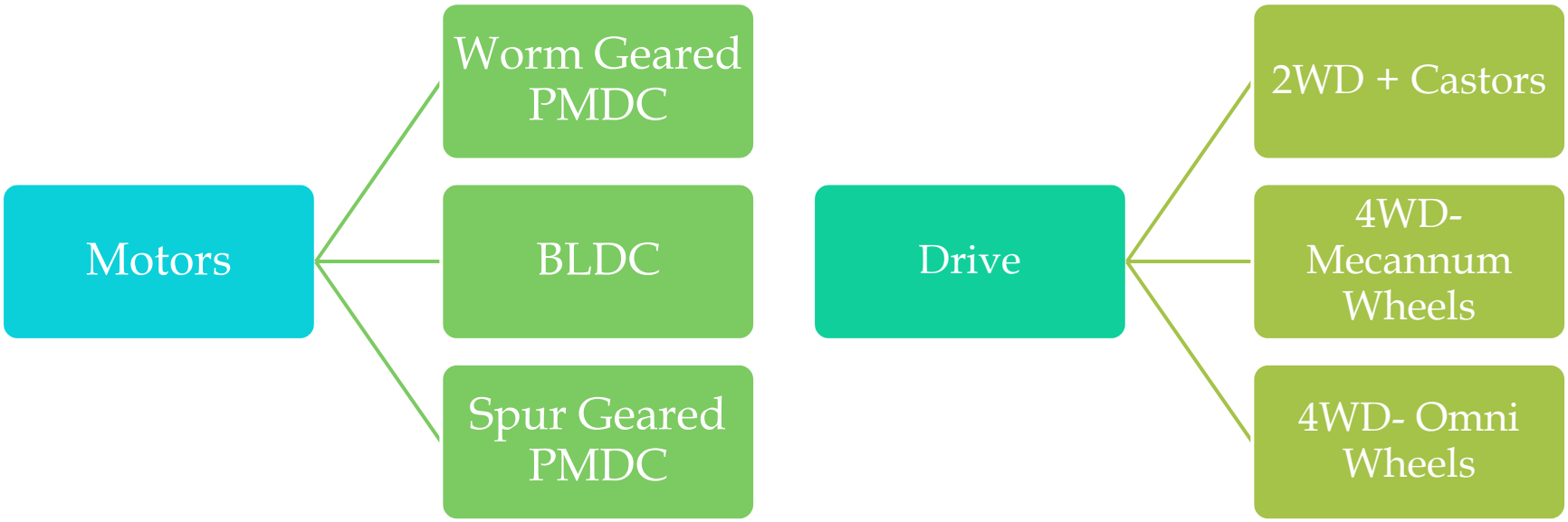
Child Robot: The Challenge

- Dimensions: should fit in a 500mm cube
- Gripping poles, sustaining weight
- Design: degrees of freedom, mechanisms
- Interaction with Parent Robot
- Gripping by Parent Robot
- Control System
- Programming

Brain Storming
and
Designing

Parent robot: Tackling challenges

Parent Robot: Locomotion



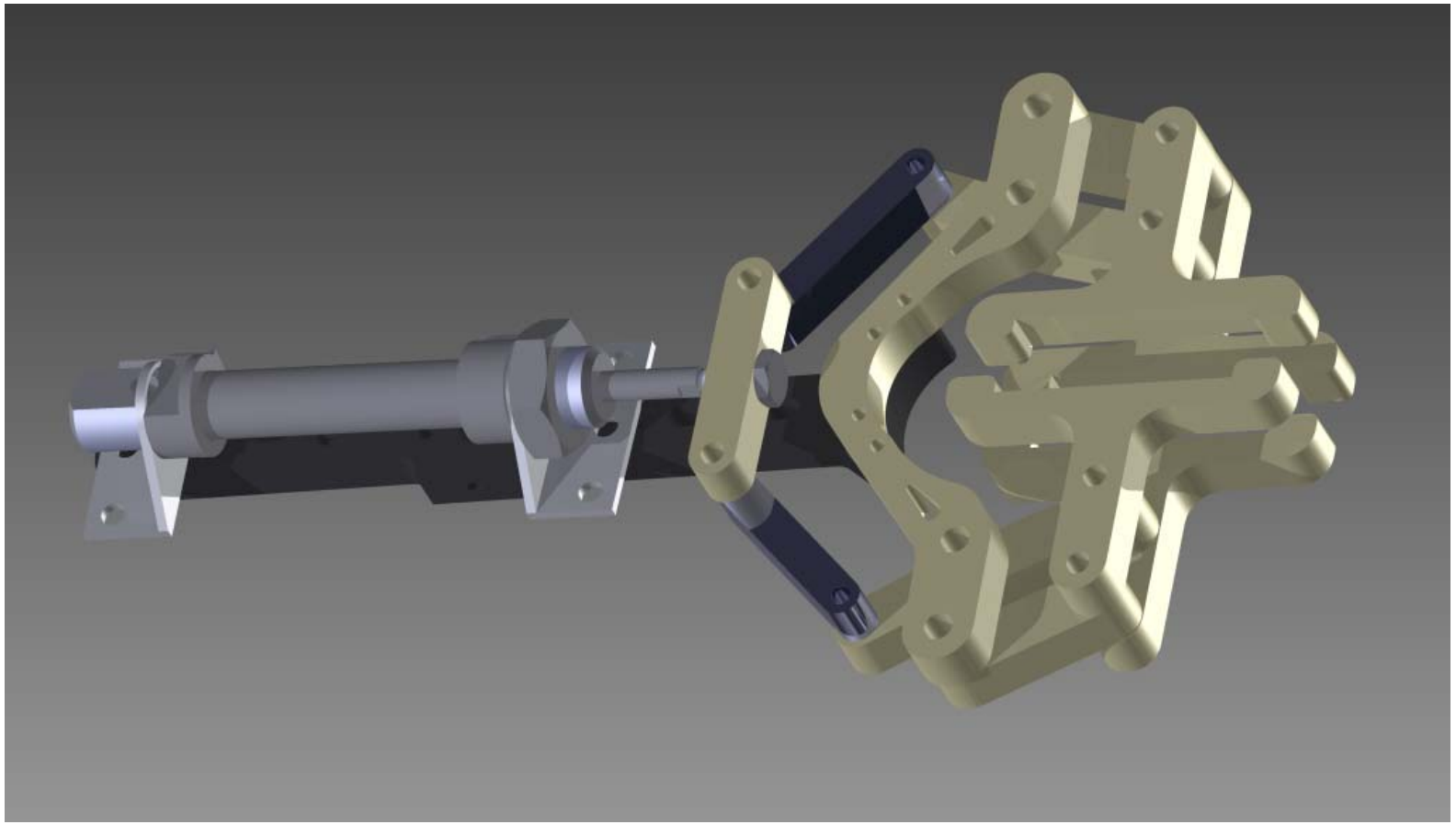
Parent Robot: Motors

Worm Geared Permanent Magnet DC Motor	Brushless DC Motor	Spur Geared Permanent Magnet DC Motor
• High Torque • High no load current • Low RPMs • Too heavy • Moderate cost • Easily available in India	• High Torque • Nominal no load current • Desirable RPMs • Very light • Very expensive • Manufactured outside India	• High Torque • Nominal no load current • Desirable RPMs • Moderate weight • Moderate cost • Easily available in India

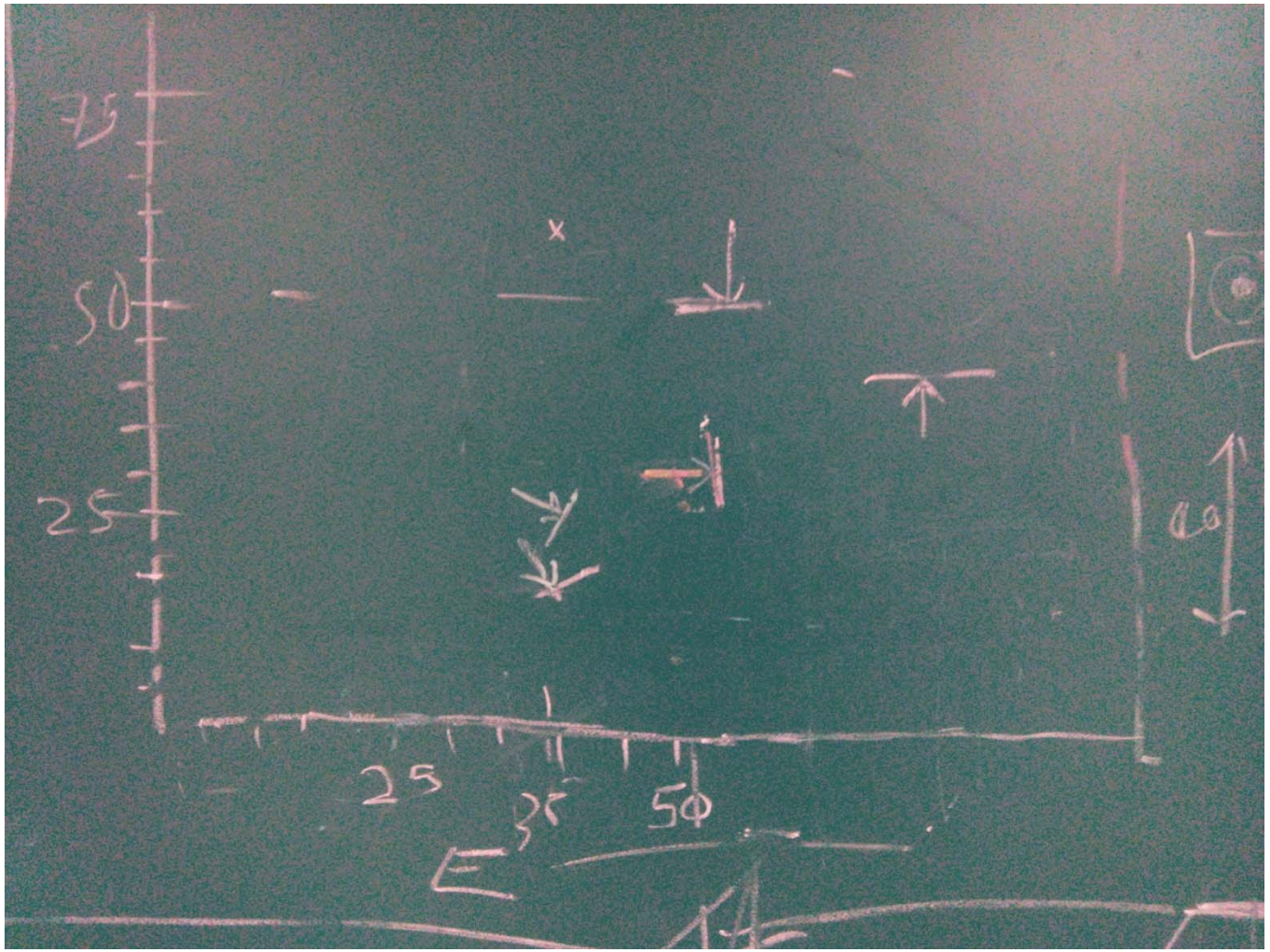
Parent Robot: Drive

2 Wheel Drive+ Castor Wheels	4 Wheel Drive: Mecannum Wheels	4 Wheel Drive: Omni Wheels
• Nominal power consumption • Cheapest option • Worst maneuverability	• About 3 times more power consumption • Costliest option • Good maneuverability	• Power consumption nearly same as 2WD with castors • Nominal cost • Best maneuverability

Parent Robot: Gripper



Parent Robot: Design Requirements



Parent Robot: Design Requirements

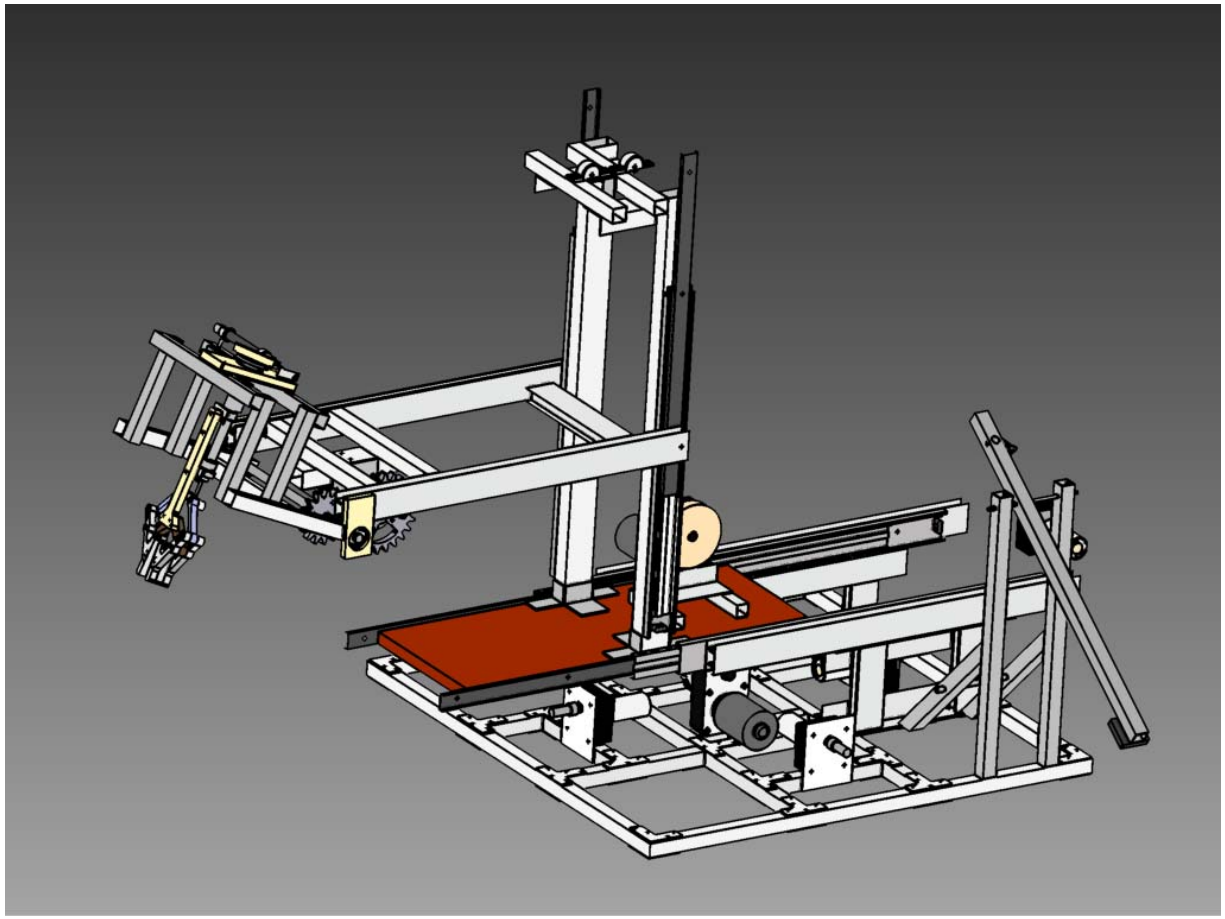
TASKS	HEIGHT(mm)	EXTENTION(mm)	ORIENTATION FROM VERTICAL AXIS
SEASAW	170	380	90
DURING PLAY	560	380	90
SWING	400	700	90
POLE WALKING	300	350	0

Table 1.1: Design requirements to be fulfilled by the bot

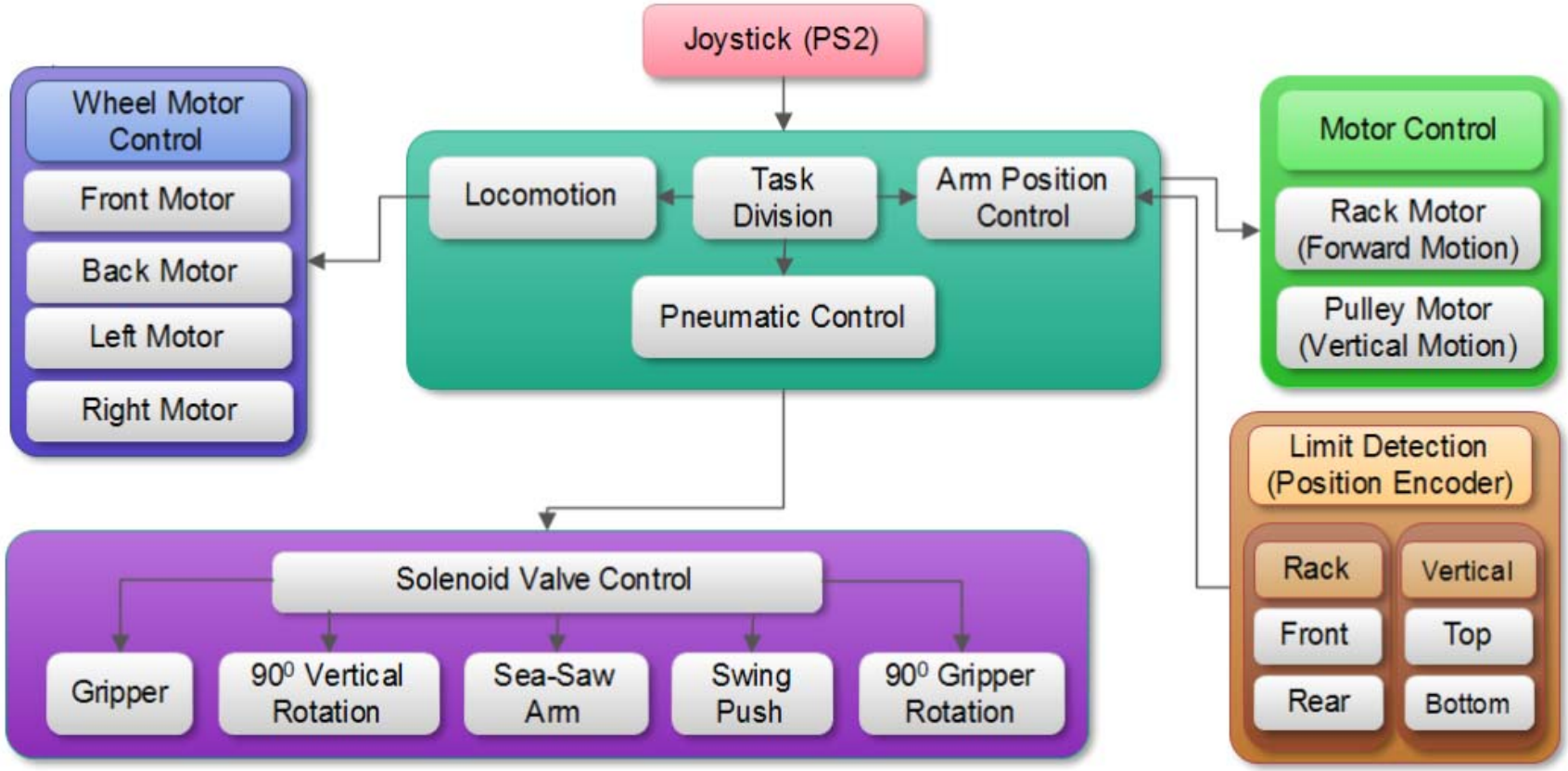
Parent Robot: Design Requirements

- See saw pushing:
  - Planned to use pneumatic actuators
  - Orientation? Mechanism?
- Swing pushing:
  - Planned to use pneumatic actuators
  - Force? Stroke length?

Parent Robot: Design

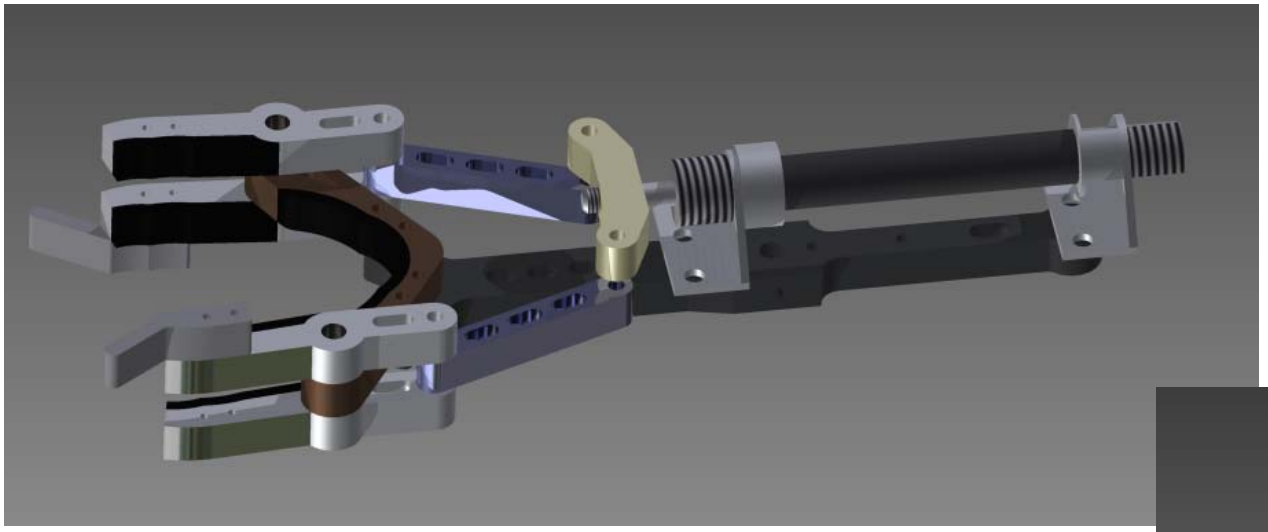


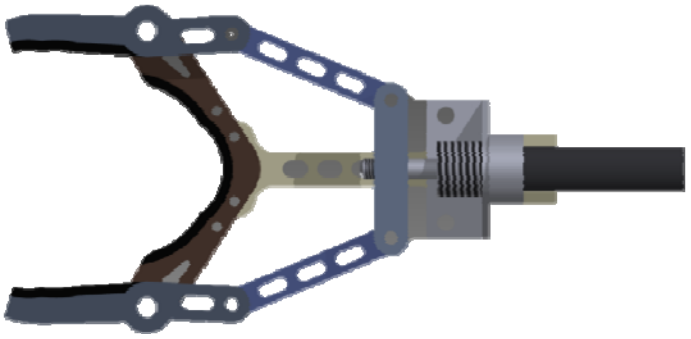
Parent Robot: Control System



CHILD ROBOT: TACKLING CHALLENGES

Child Robot: Gripper





Child Robot: Gripper Calculations

Serial No.	Link Lengths (mm)		Angles (32mm)		Angles (50mm)		Force Constant (32mm)		Force Constant (50mm)	
	Pneumatic	Pneumatic2Claw	θ	θ+ϕ	θ	θ+ϕ	Theo	Exp	Theo	Exp
1	30	30					Not Possible			
2	30	40					Not Possible			
3	30	50	19.2	39.9	41.6	96.6	1.95		1.50	
4	30	60	38.1	58.8	51.4	106.3	1.39		1.23	
5	40	30					Not Possible			
6	40	40					Not Possible			
7	40	50	32.4	53.2	49.6	104.5	1.49		1.27	
8	40	60	45.3	66	57.3	112.3	1.29		1.10	
9	50	30					Not Possible			
10	50	40					Not Possible			
11	50	50	41.9	62.6	56.8	111.6	1.33		1.11	
12	50	60	51.7	72.5	62.9	117.9	1.22		0.99	

$$\text{Force Constant} = \frac{\sin(\theta+\phi)}{\sin\theta}$$

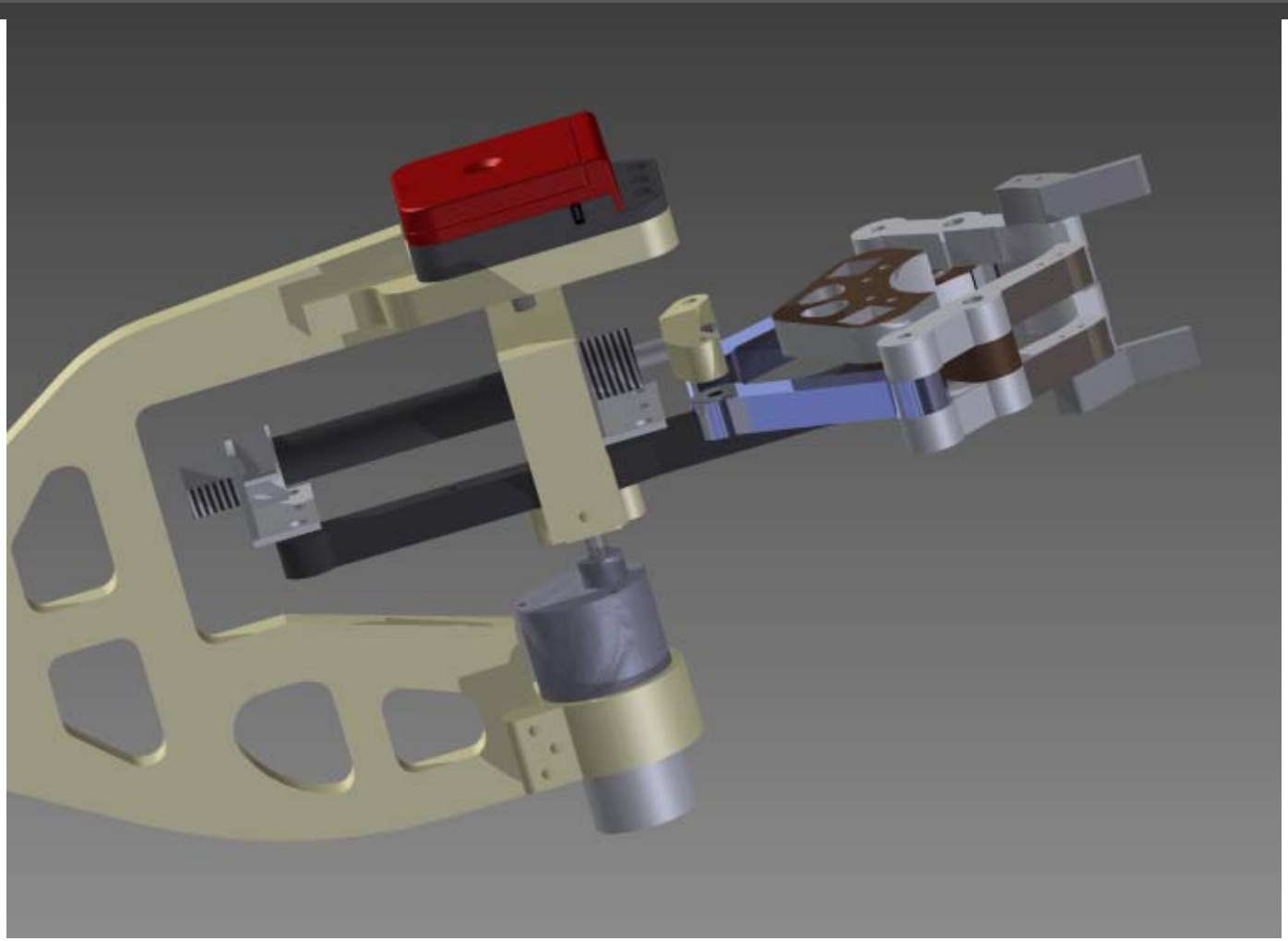
$$T = \eta_t T_. = \frac{\eta_t F r \sin(\theta+\phi)}{2\sin\theta}$$

Child Robot: Gripper in Action

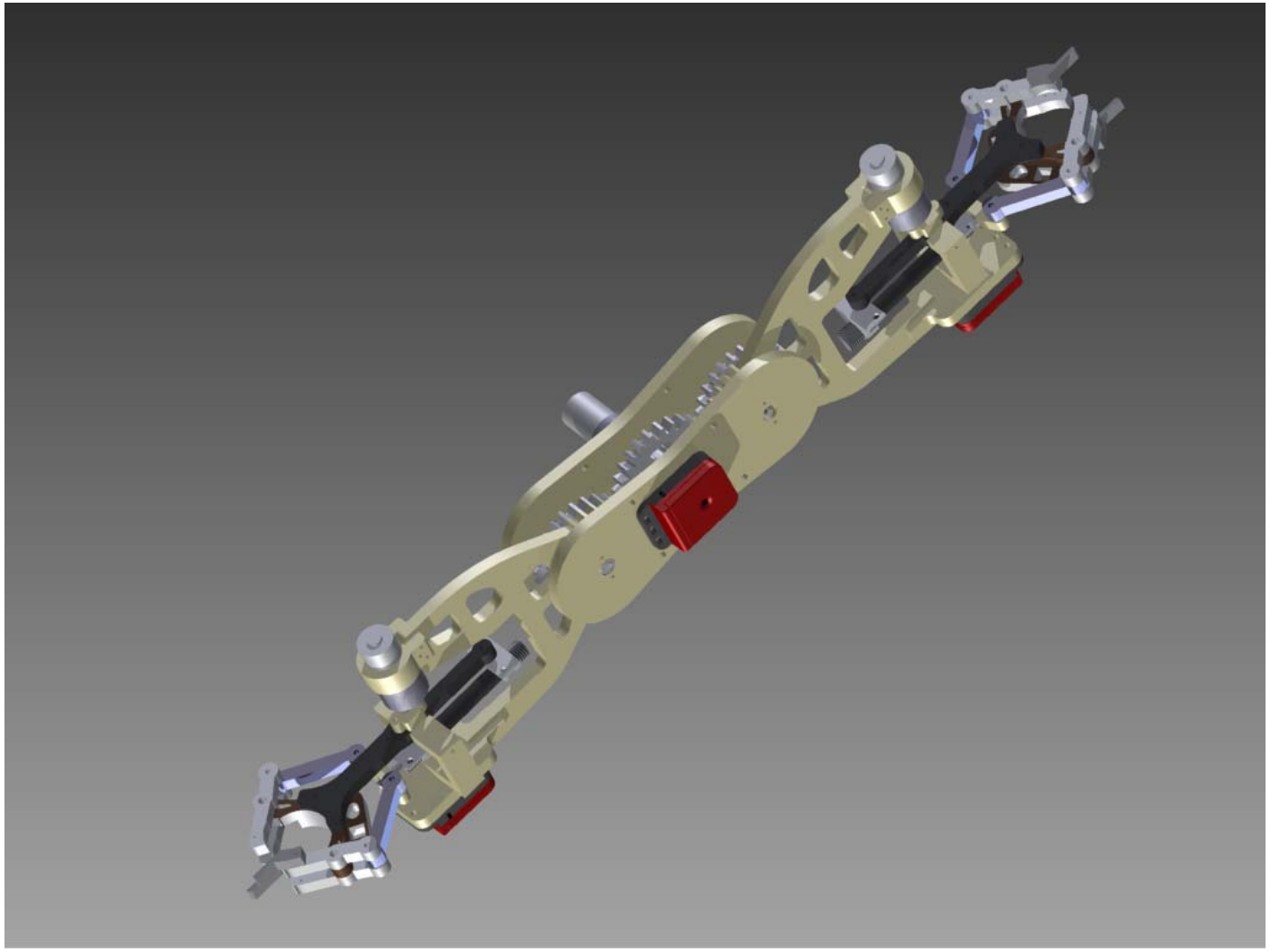
Figure: Gripper Version 1- Load testing

Load = 3.9 Kg
Minimum pressure at piston = 40 Psi

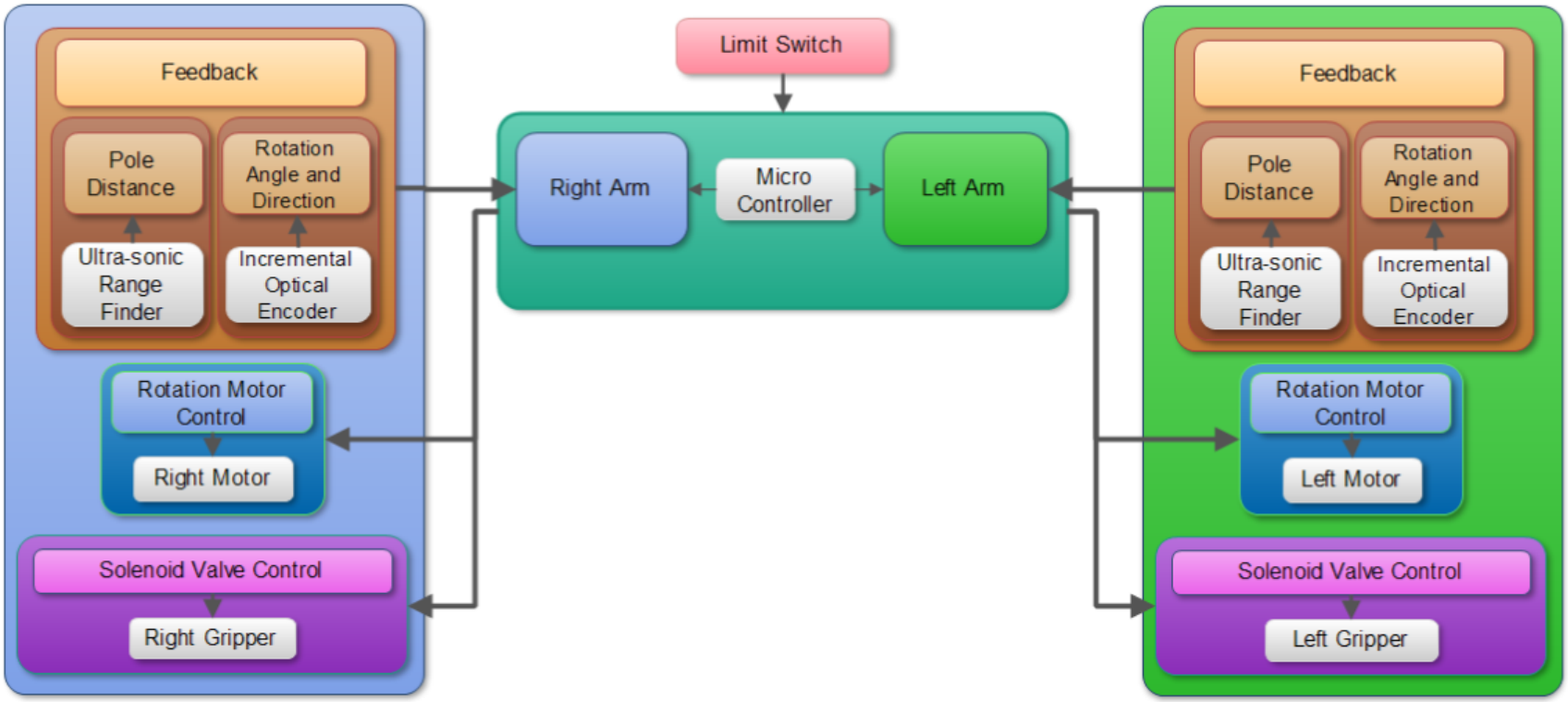
Child Robot: Gripper Module



Child Robot: Design

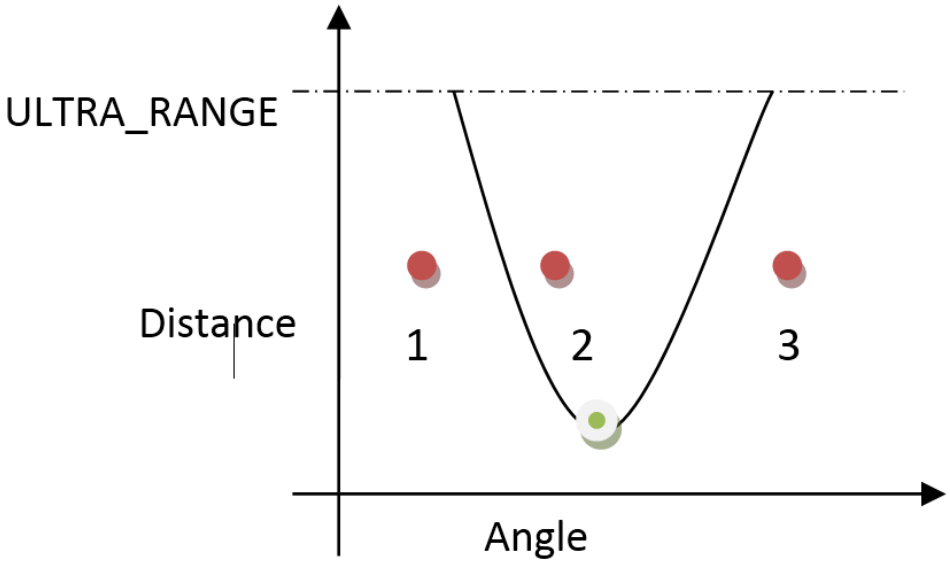


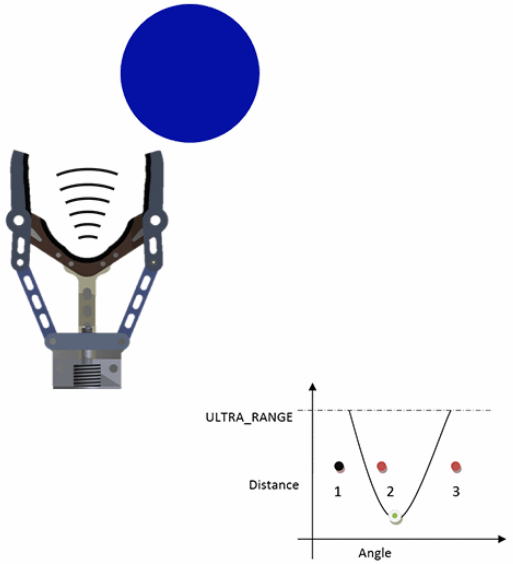
Child Robot: Control System



Child Robot: Programming

Child Robot: Pole Searching





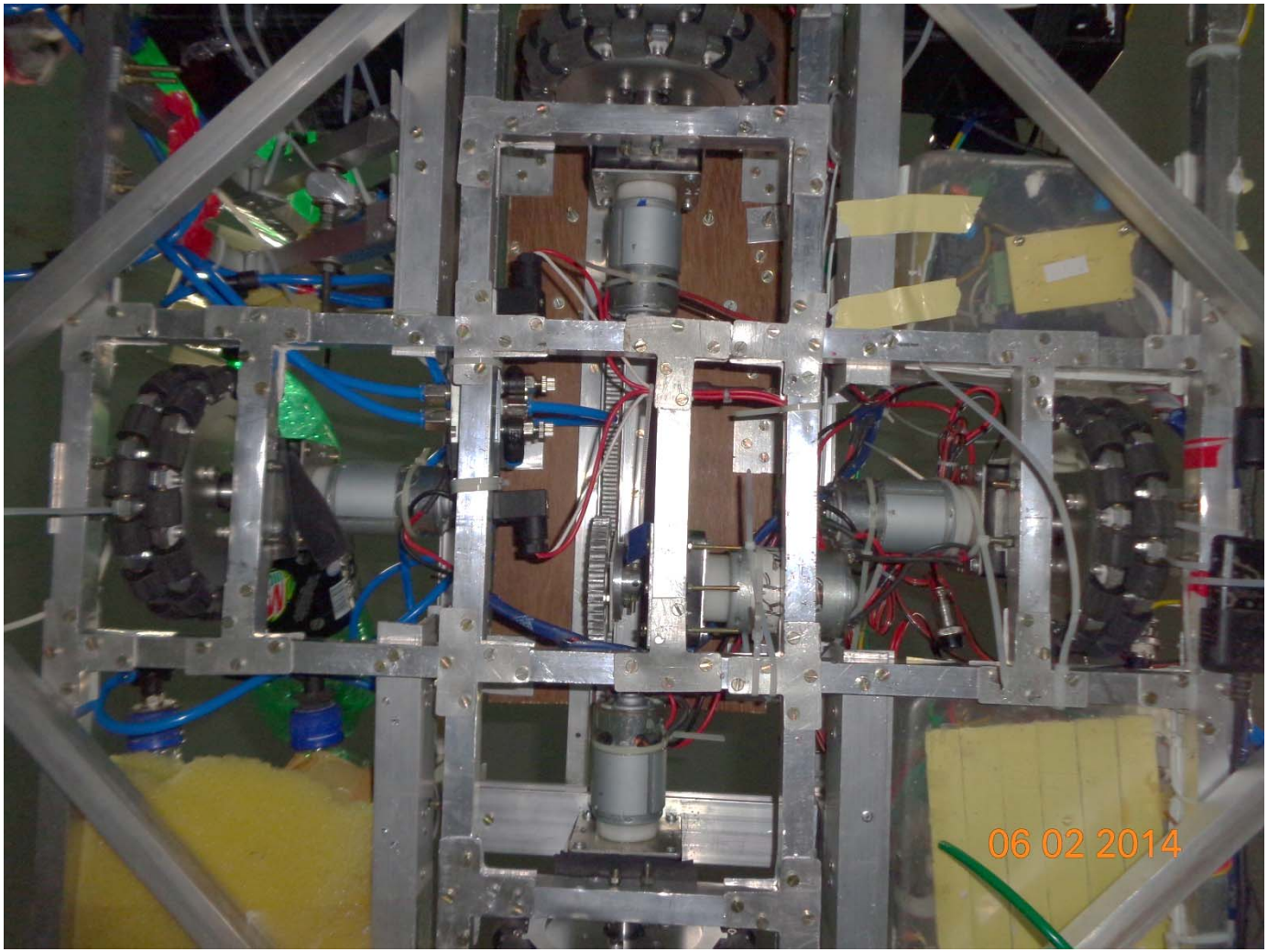
Gripper comes in position 1: Pole is outside the Ultrasonic sensor range

- Possible initial starting points.
- Minimum distance orientation.

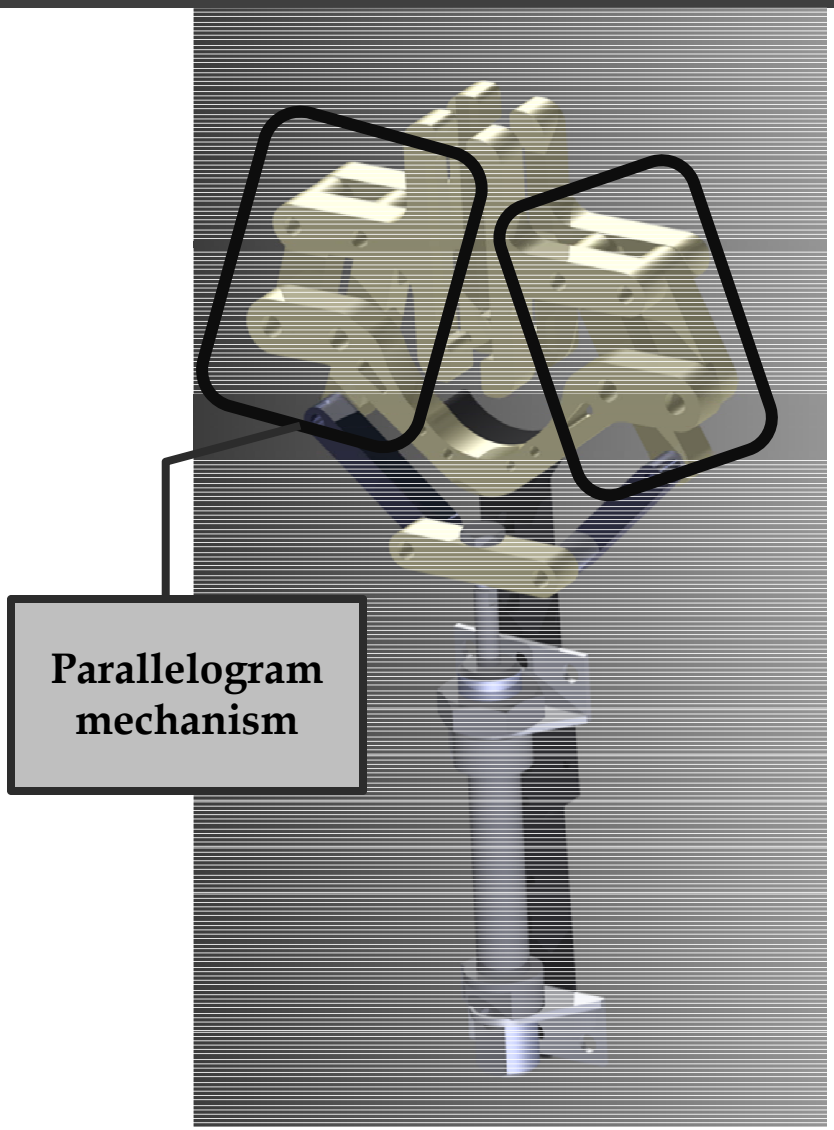
Fabrication and Development

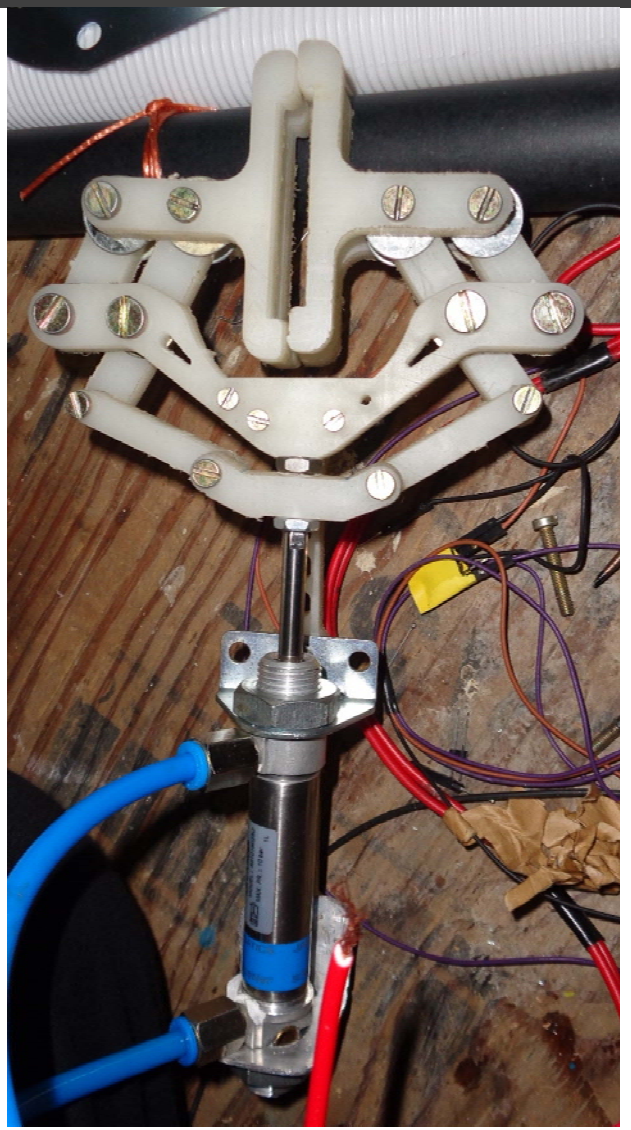
PARENT ROBOT

Parent Robot: Locomotion



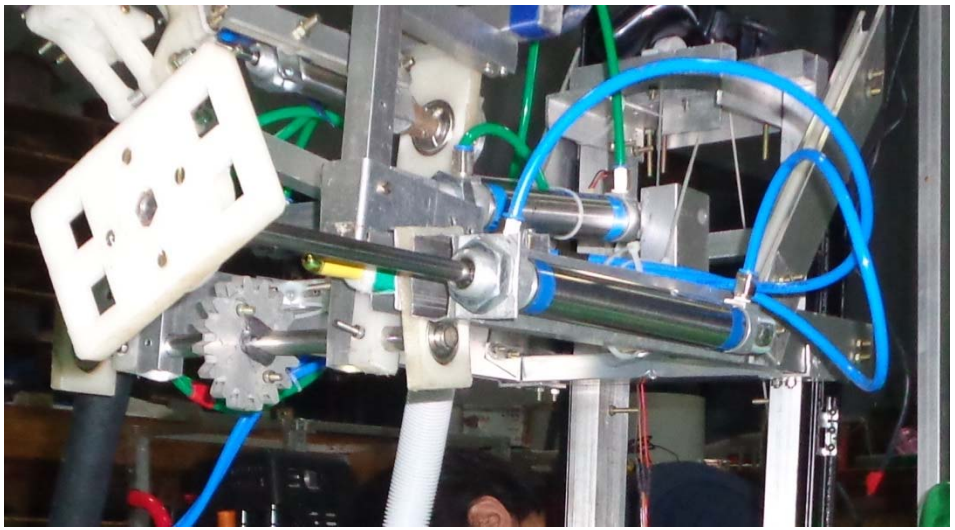
Parent Robot: Gripper





Parent Robot: See Saw & Swing Task

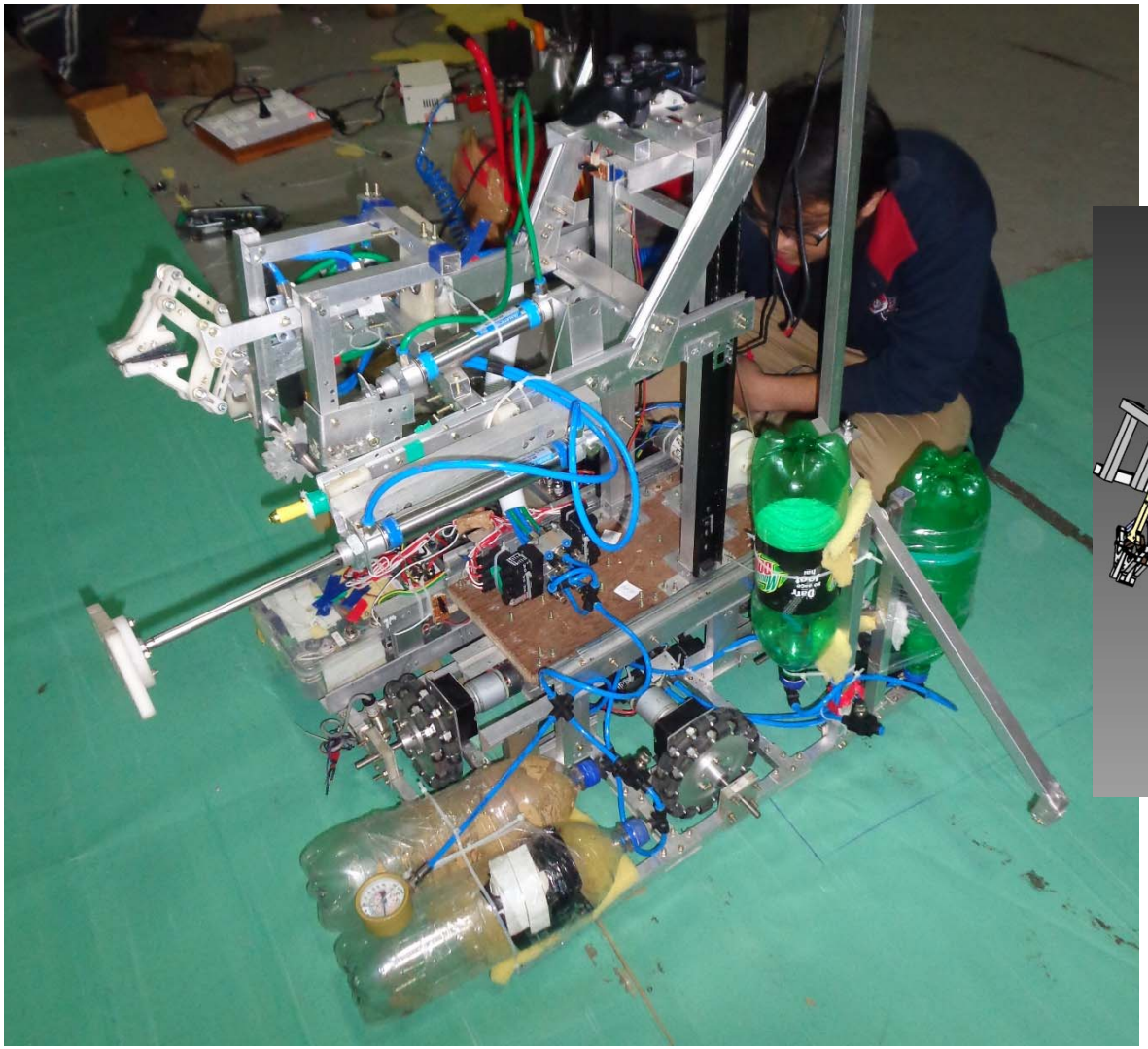
Lever Arm mechanism

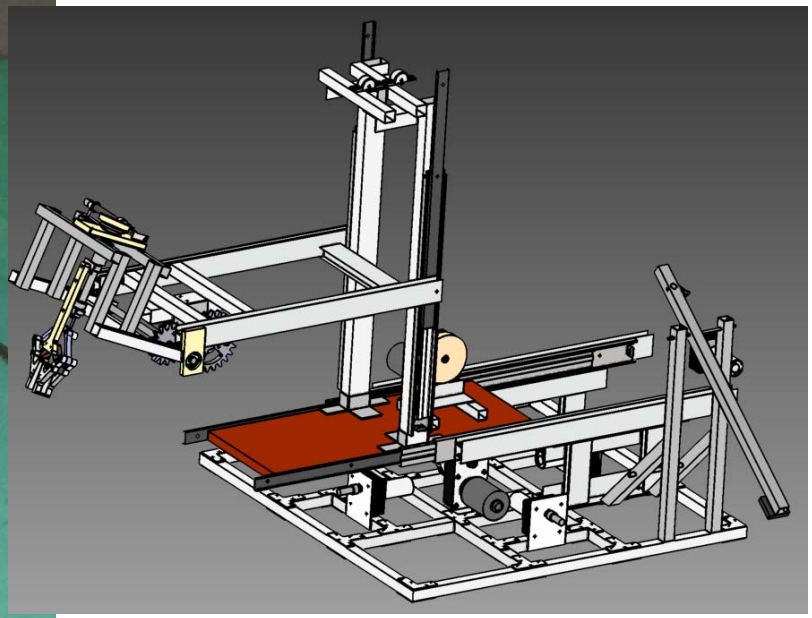


Swing Pushing Mechanism

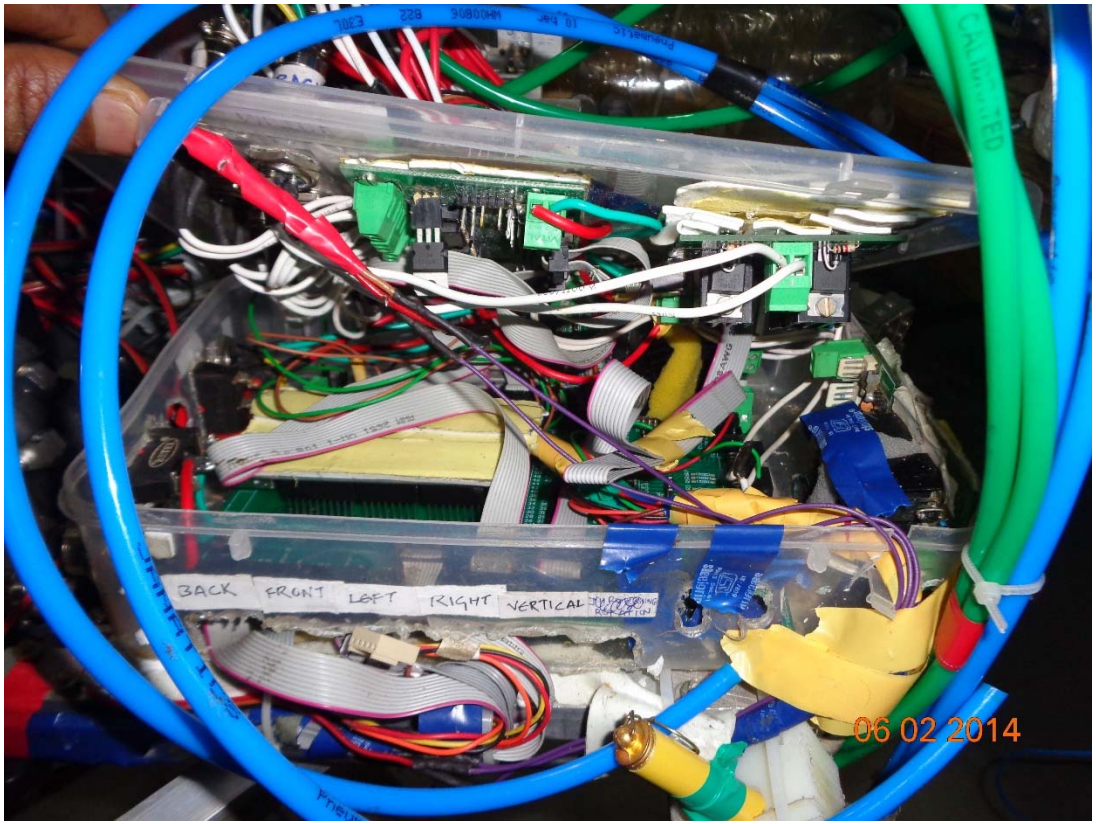
See saw pushing mechanism

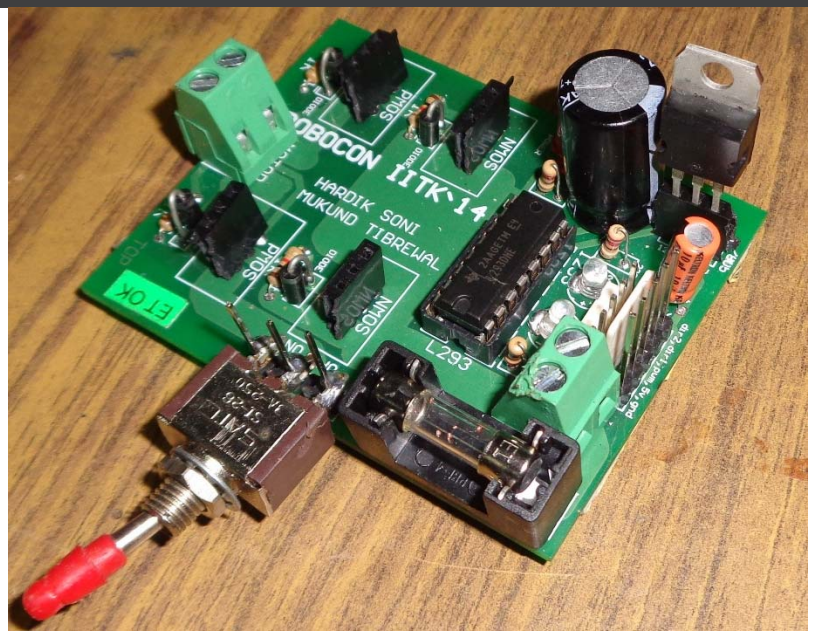
Parent Robot: Reality vs Design

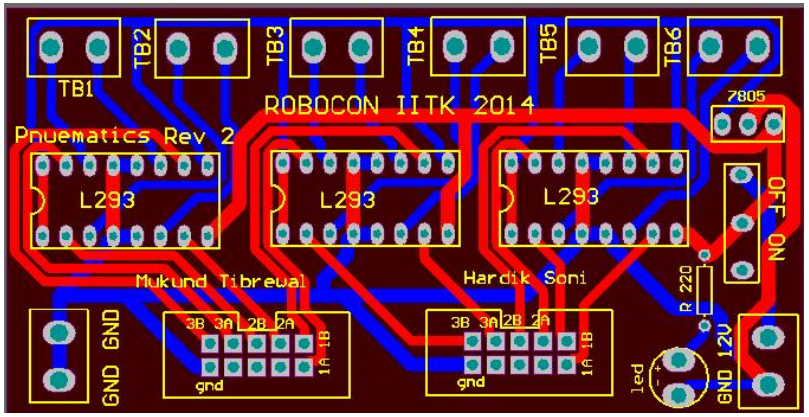




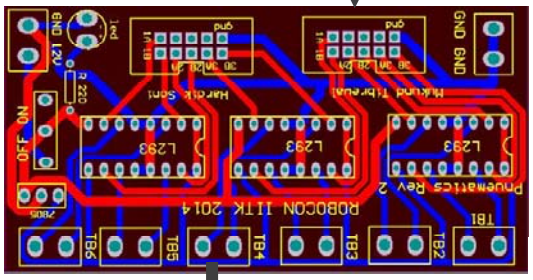
Parent Robot: Electronics

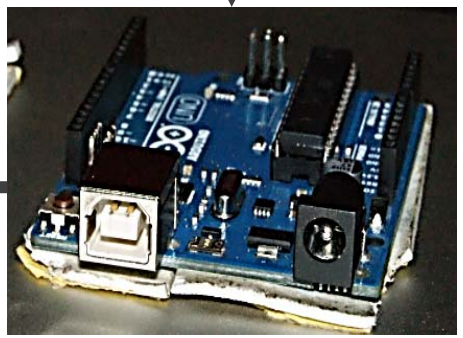


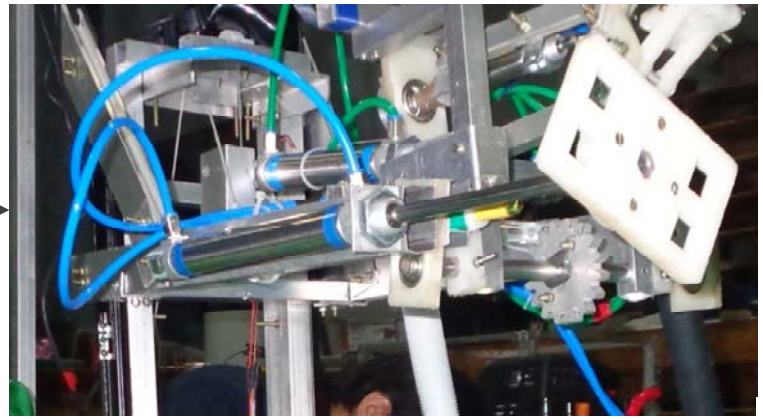




Pneumatics Control

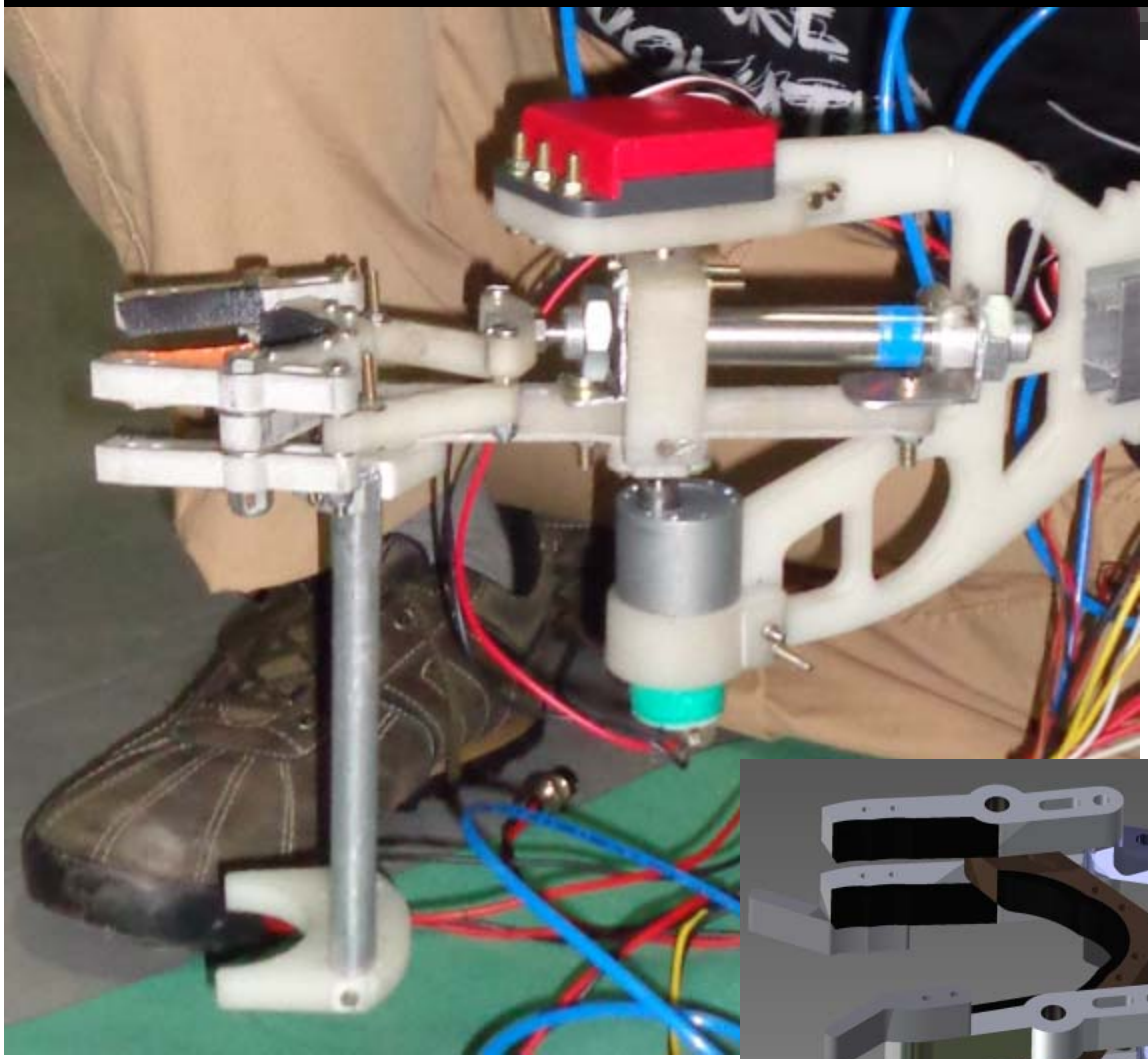


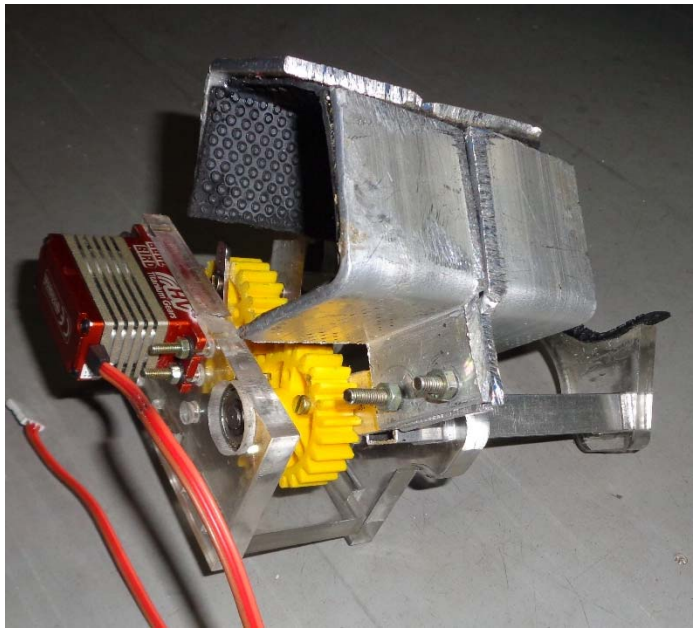


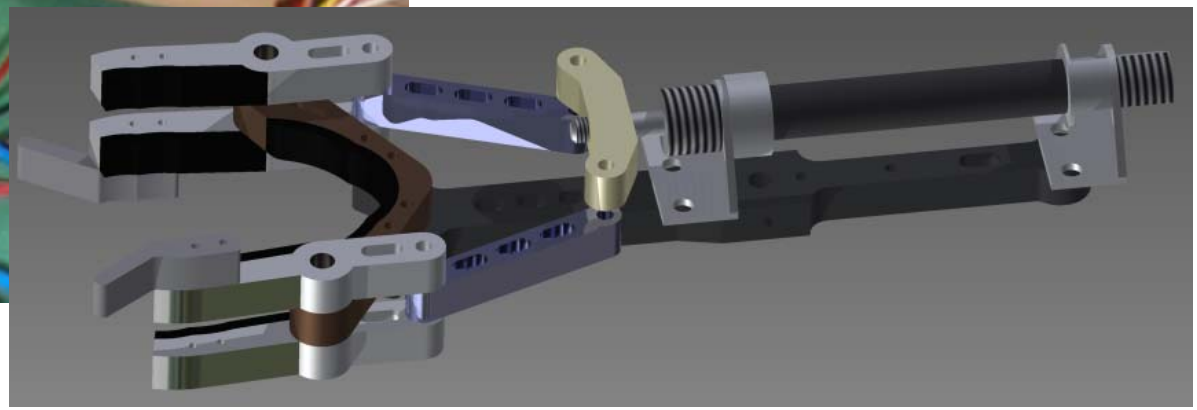


CHILD ROBOT

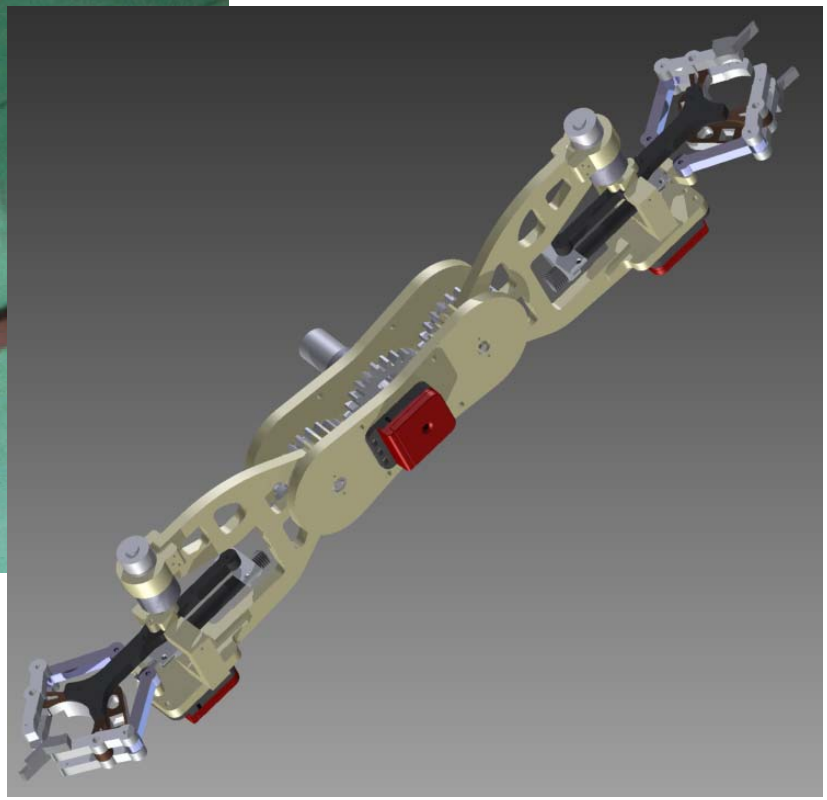
Child Robot: Gripper Module





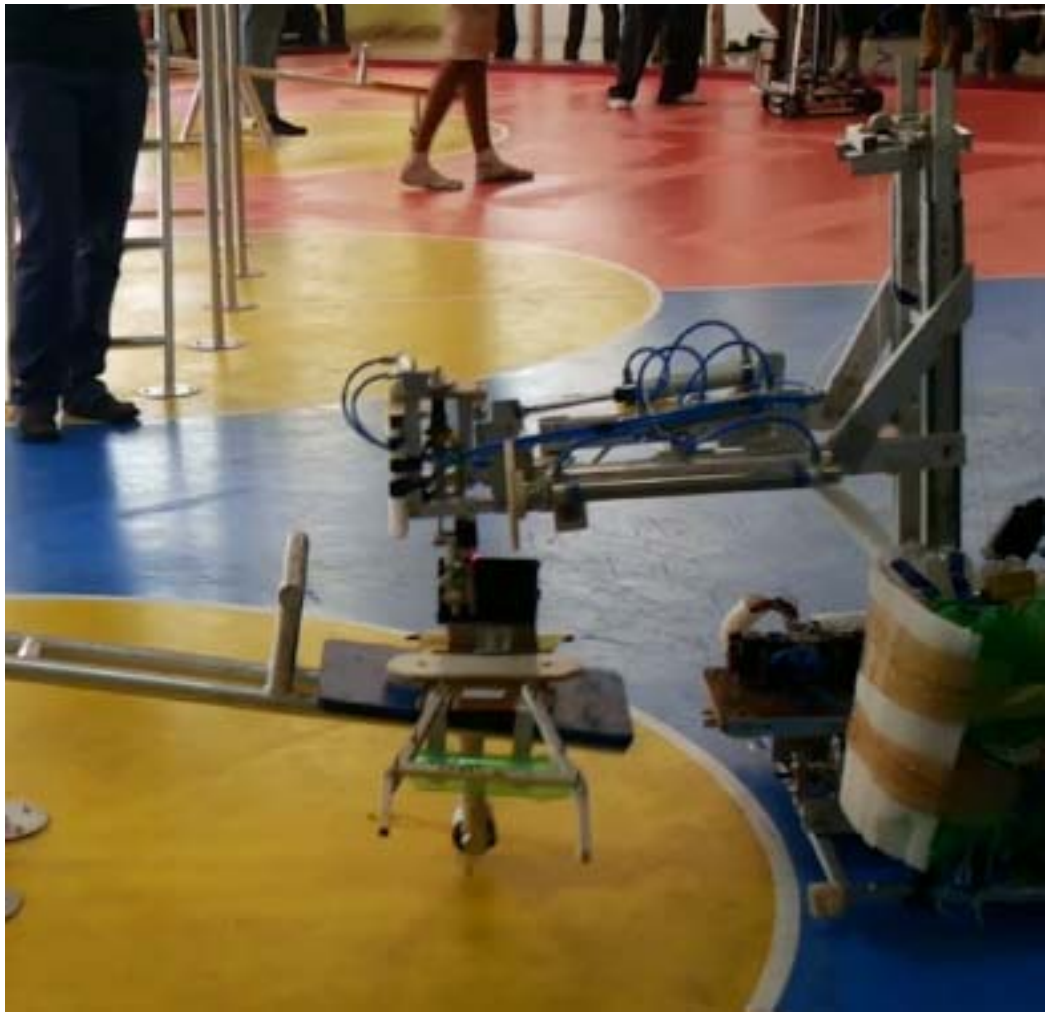


Child Robot: Design

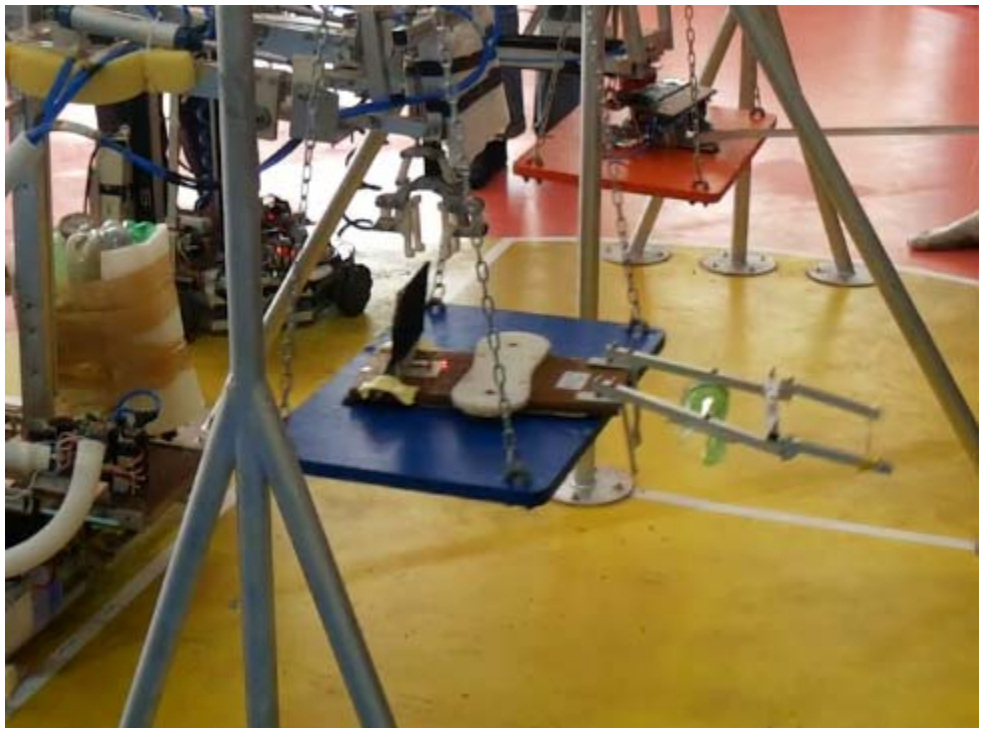


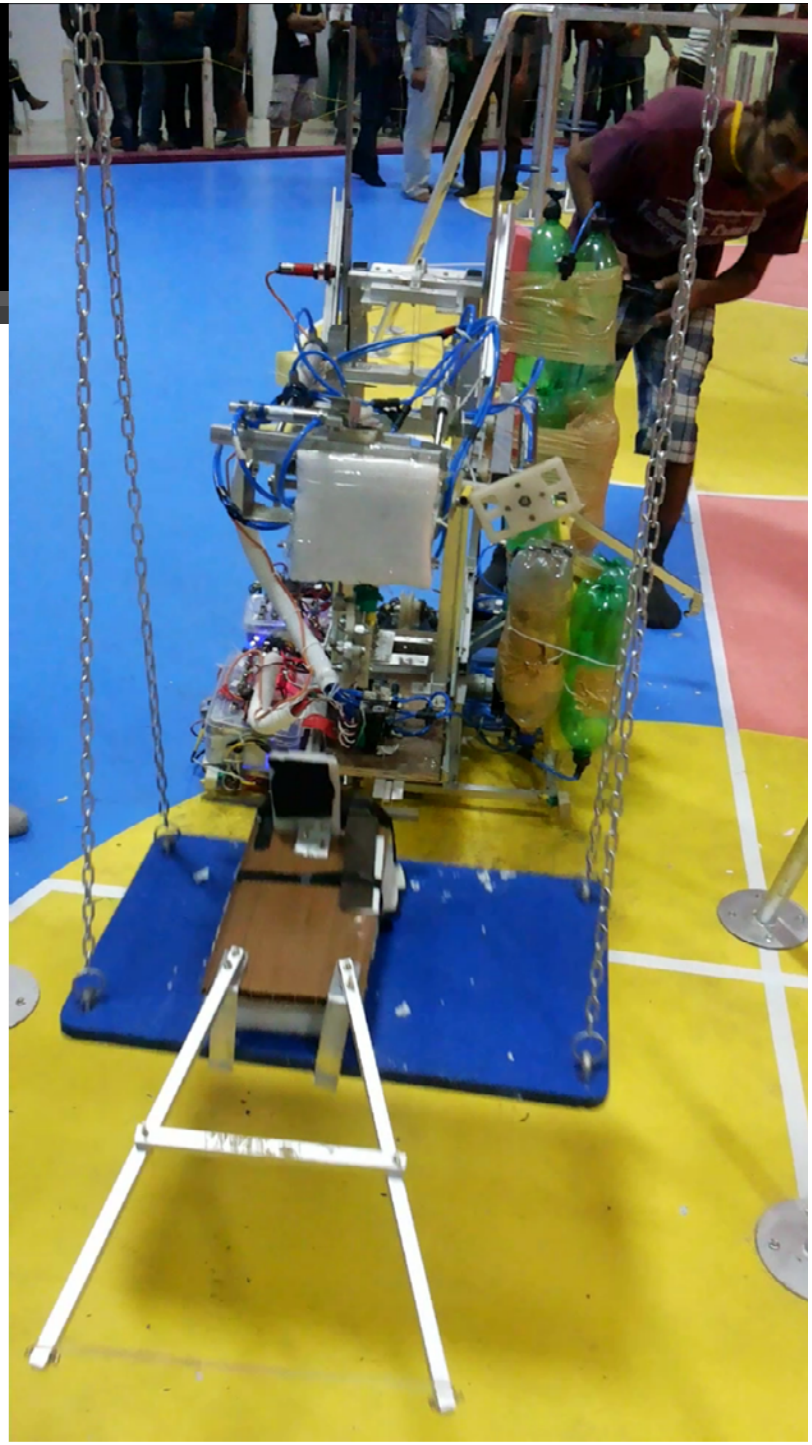
Results
and
Our Performance

Parent Robot: Sea-Saw

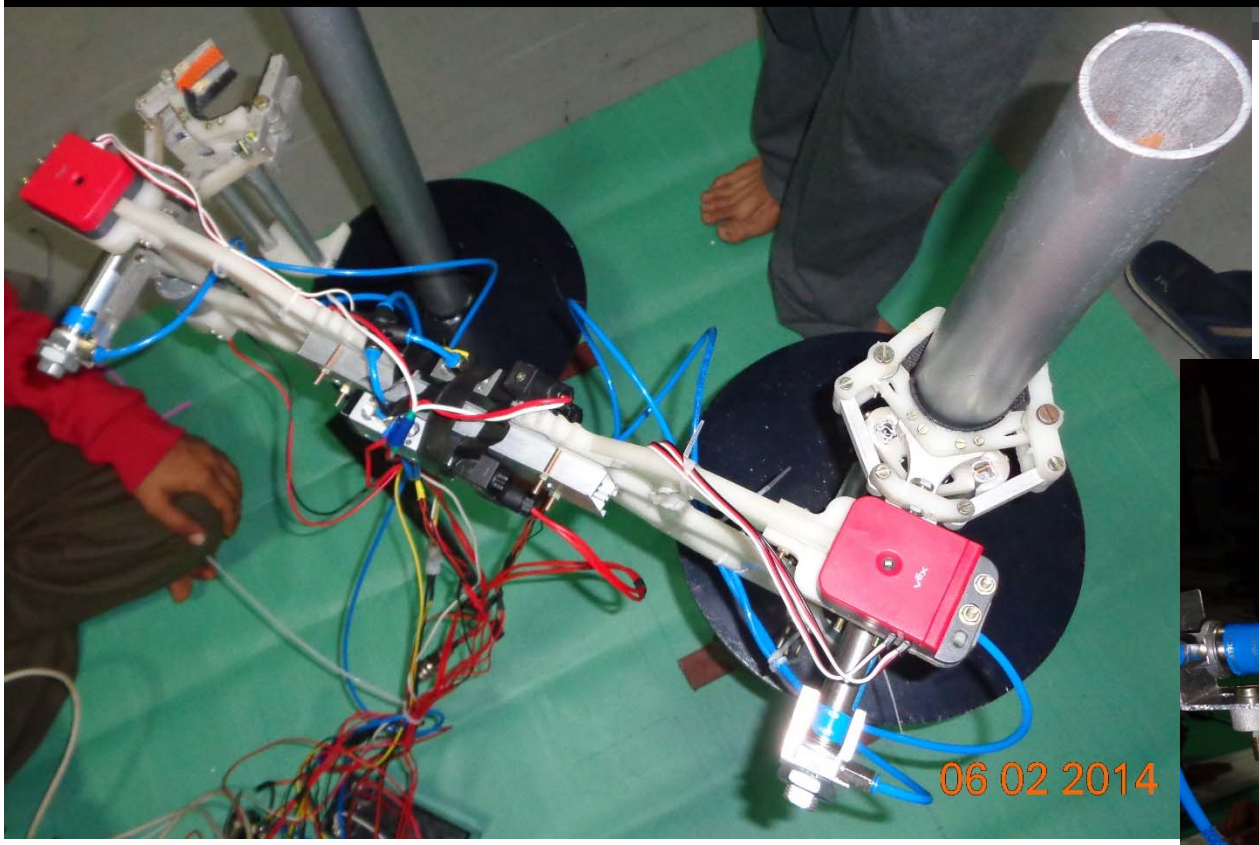


Parent Robot: Swing





Parent Robot: Pole Walk



Parent Robot: Pole Walk

The Game

Best Innovative Design Award

ROBOCON

ABU Asia-Pacific Robot Contest 2014 Pune, INDIA

CERTIFICATE OF APPRECIATION

BEST INNOVATIVE DESIGN

Doordarshan India and MIT Academy of Engineering, Pune has been co hosting the prestigious ROBOCON India since 2005. This contest gives a platform to engineering students across India to showcase their skills in robotics.

The International ROBOCON is hosted by the Asia Pacific Broadcasting Union (ABU) in a different country each year. The winner of ROBOCON India represents India at the International ROBOCON.

ROBOCON is an innovative and intellectual contest for budding engineers. Participation in this activity is an end to end competitive experience from concept design of a system of robots programmed to perform to themes declared by the host country of the International ROBOCON in a high precision technical contest area.

The theme for International ROBOCON 2014 is " A salute to parenthood".

We would like to place on record our appreciation of your team for the BEST INNOVATIVE DESIGN of ROBOT of ROBOCON India 2014.

We appreciate your capabilities in resource optimization, excellent teamwork, innovative spirit and creativity, task oriented performance and coordination which has led you to earn this award in this prestigious contest.

We wish you the very best in your future endeavors.

Dr. Y J Bhalerao
Chief Coordinator
ROBOCON 2014

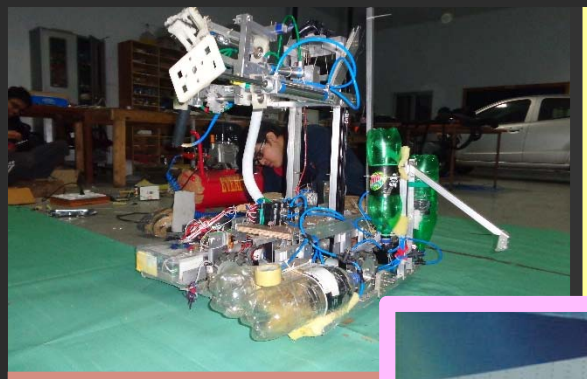
Dr. Sunil Karad
Chief Convener
ROBOCON 2014

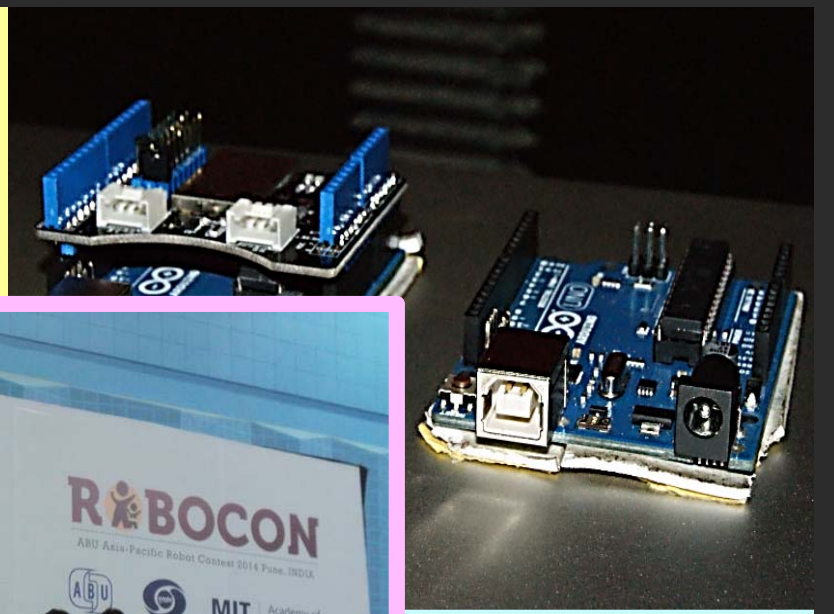
Mr. Mukesh Sharma
Additional Director General
Doordarshan India

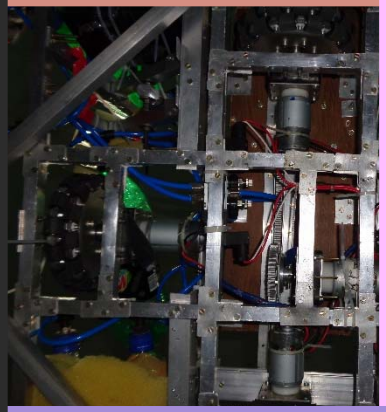
Prof. Dr. Vishwanath D. Karad
Founder, Executive President &
Managing Trustee
MAEER'S MIT group of institutions, Pune

ABU

MIT | Academy of Engineering





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ABU Asia-Pacific Robot Contest 2014 Pune, INDIA
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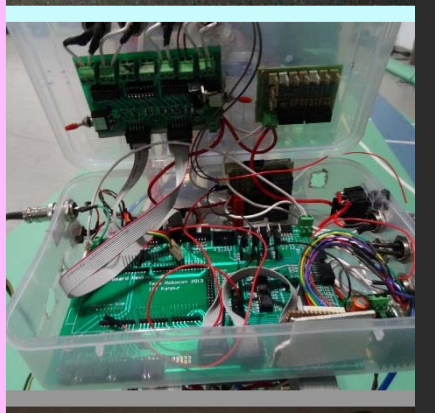

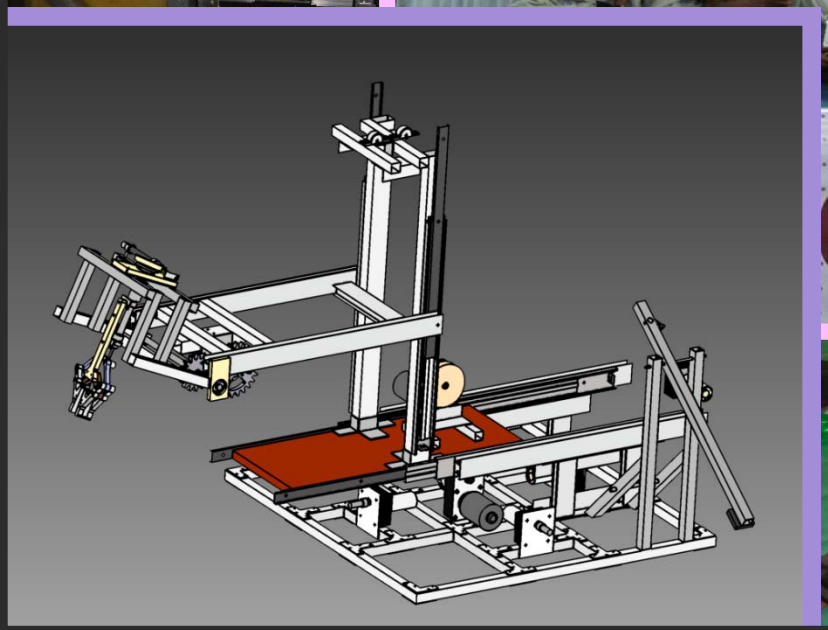

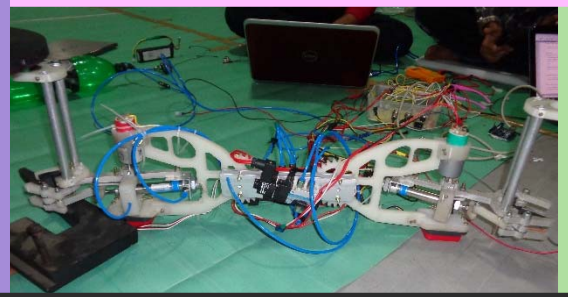

Thank You