Ceilbot final presentation

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2. Safety
3. Power transmission
4. Rail structure in the ceiling
5. Doorway solutions
6. Power Source
7. Manipulators
8. Pneumatic cylinders
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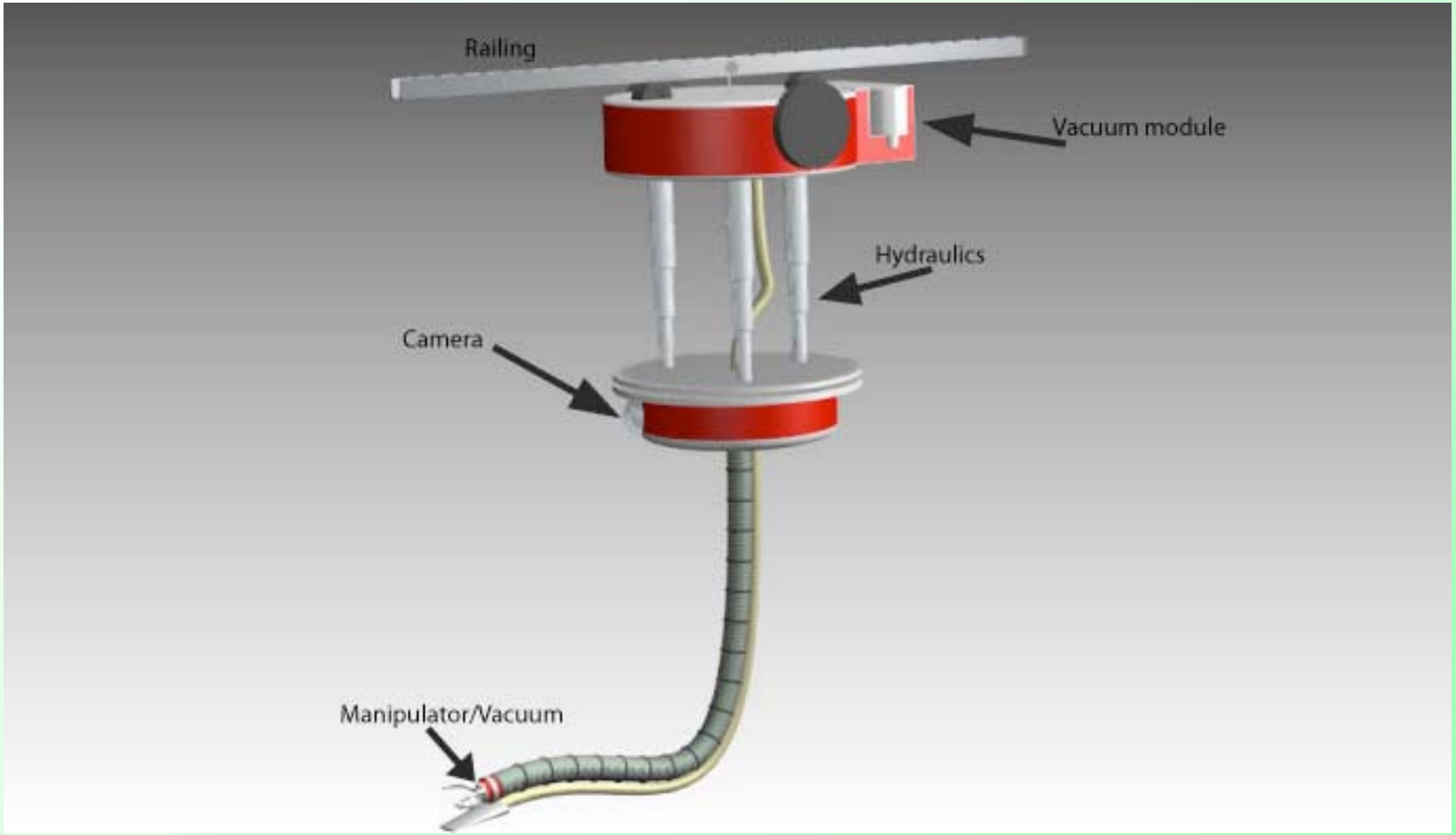
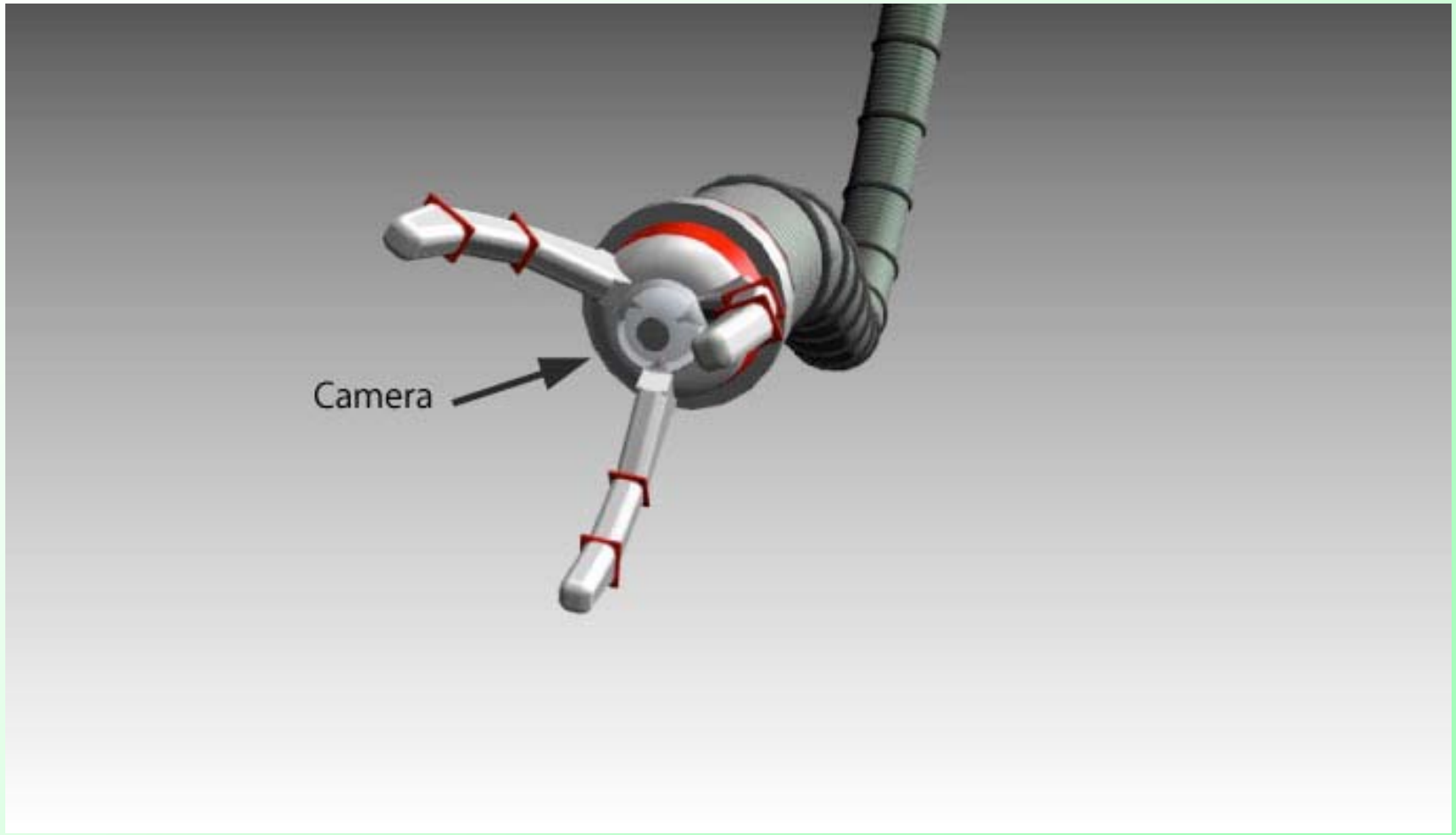
Tasks/Features

- Tasks:
  - Organizing missplaced objects
  - Vacuuming
  - Cleaning windows
  - Giving water for plants
  - Finding and bringing objects to the operator
- Features:
  - Trunk maipulator
  - Modular
  - Object indicating
  - Wireless system
  - Remote access from either phone or web-based application


Railing
Vacuum module
Hydraulics
Camera
Manipulator/Vacuum

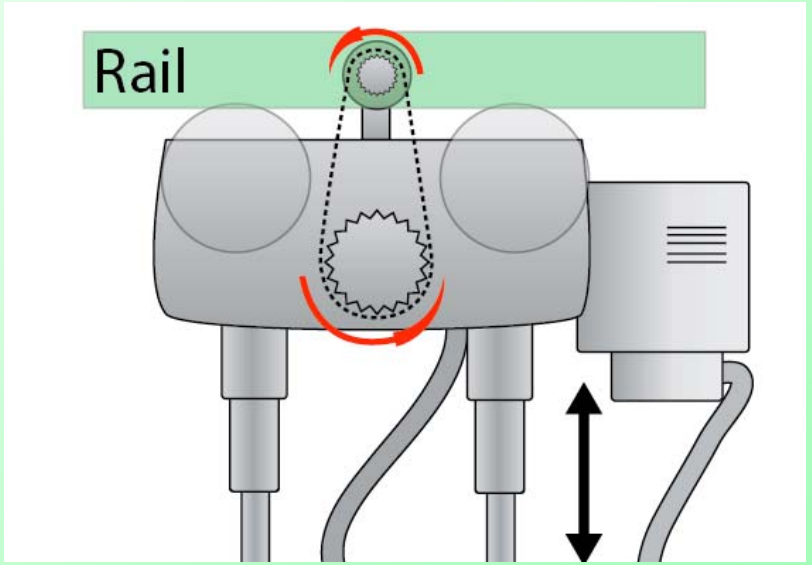

Camera

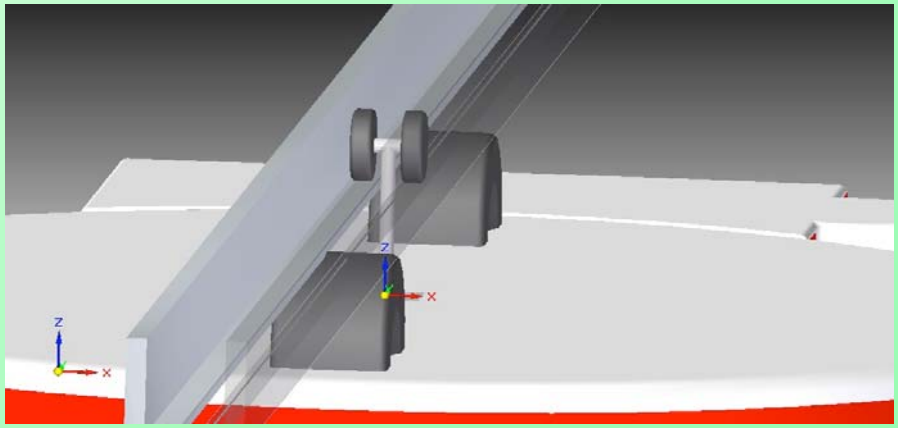
Safety

- Avoiding squeezing and collisions
  - Safety zones around humans
  - Monitoring trunk's position
  - Route-planning
- Minimizing damage in collision
  - Force-feedback
  - Safety protocol while still running
- Wireless protocol designed for real-time-control
  - Redundancy and reliability
- Confirming grip on manipulated objects
  - Avoiding dropping
- Programming
  - Real-time safety-thread
  - Danger assesment model

Power transmission

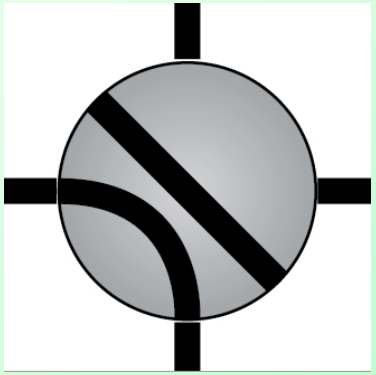
- One driving wheel
  - supporing structure big enough to be able transmit enough power and contain all the necessary parts
- Trade-in between size of the support structure and the rail

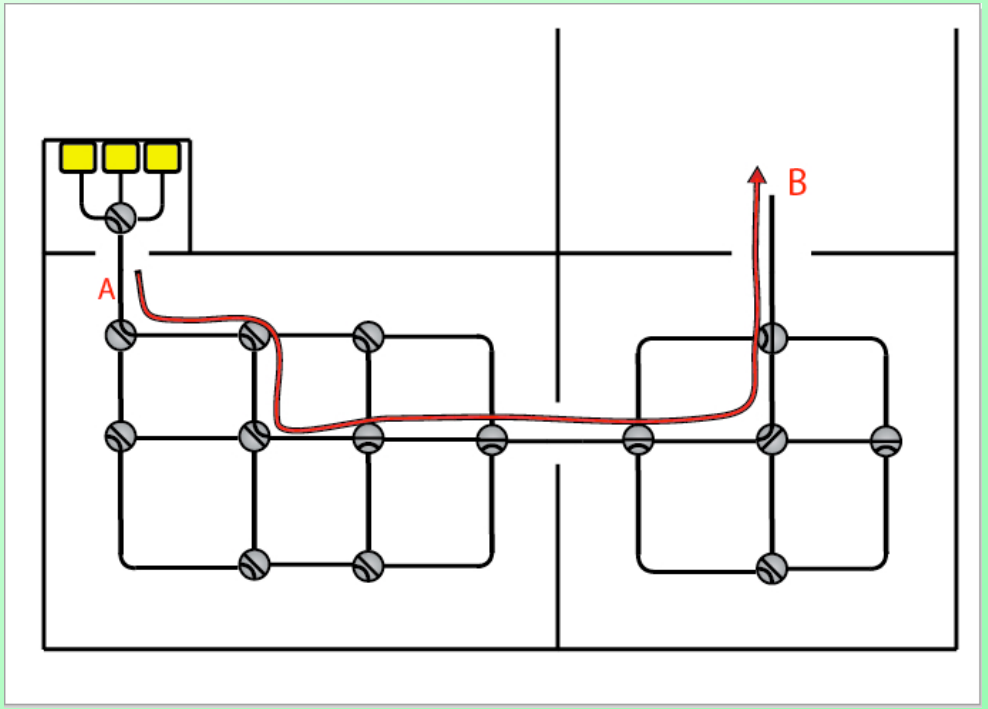




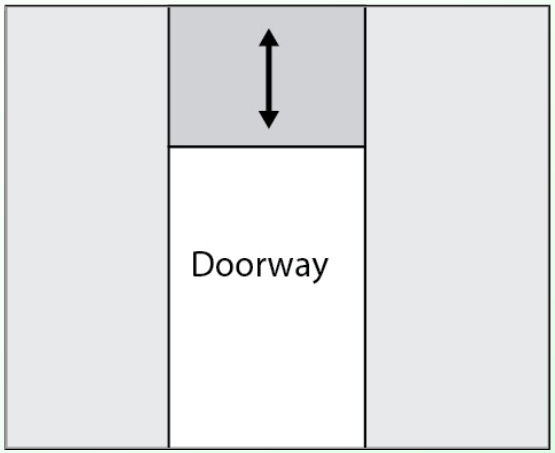
Rail structure in the ceiling

- Turntables with two parts
  - path can be formed beforehand

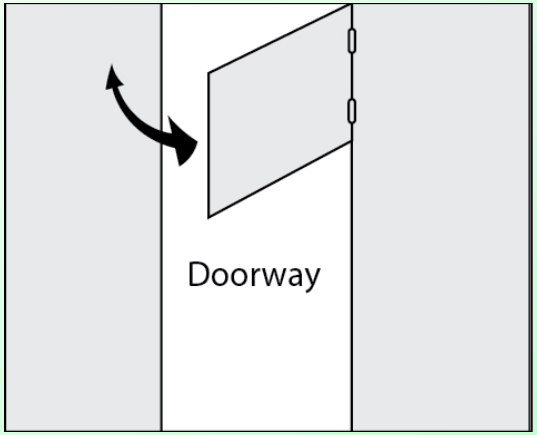




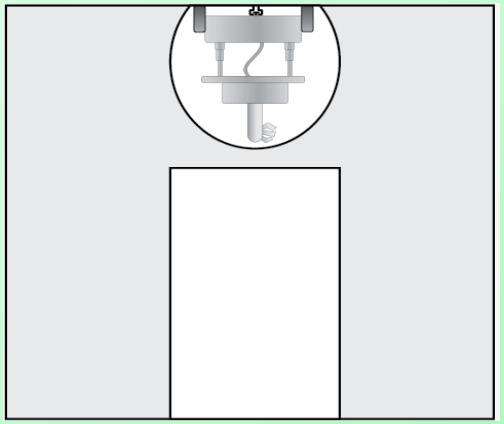
Doorway solutions



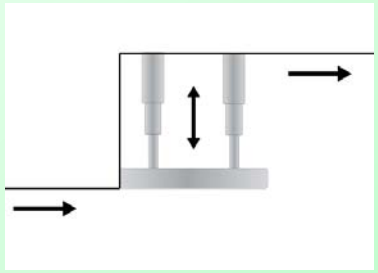
Rising archway
- Most structure changes to house
- Most esthetic



Turning archway
- Can be operated using robots manipulator



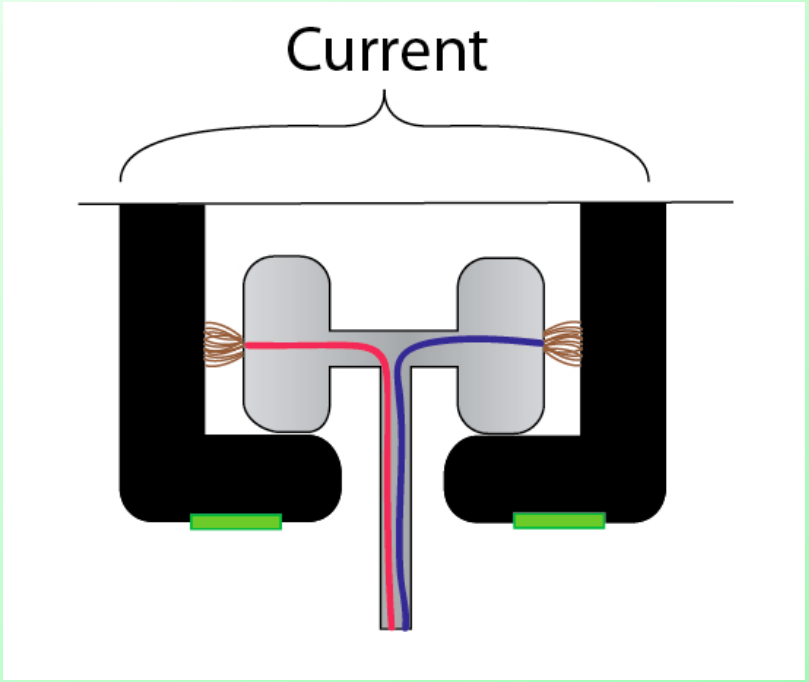
Oval doorway
- Easiest to build



Lifts
- Expensive and slow on doorways
- Neccessary on level changes

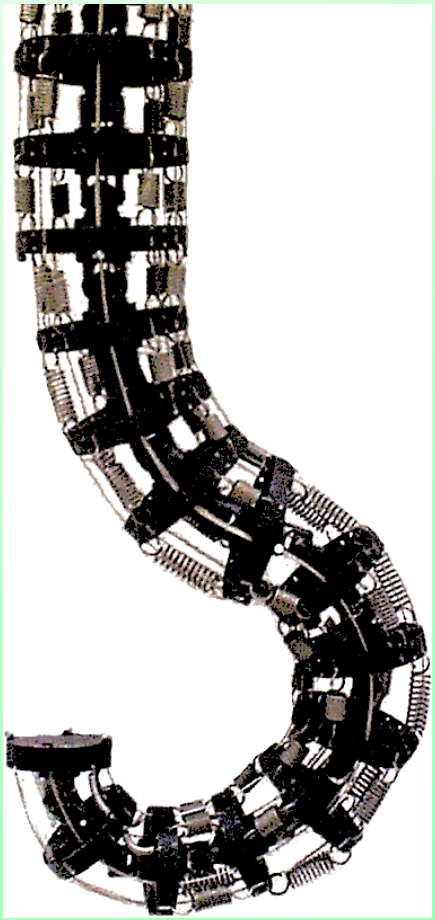
Power source

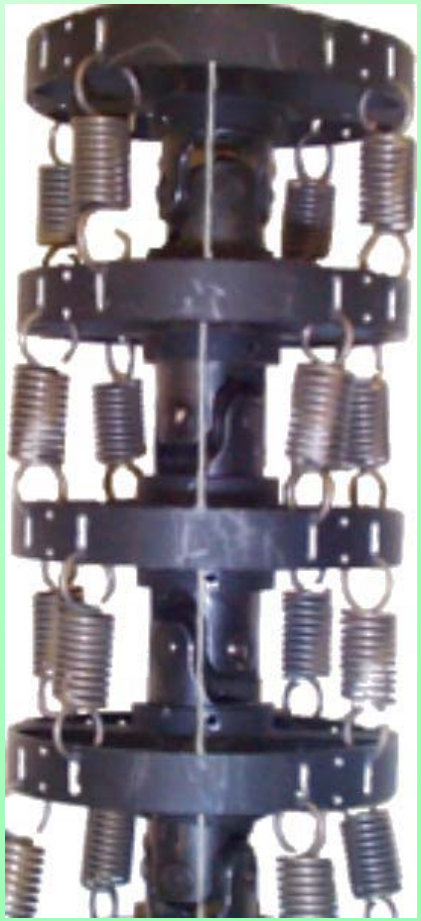
- Electricity:
  - for motor driving tires
  - Small battery for emergencies
- Pressure:
  - for trunk
  - for hydraulics
  - possibly for vacuum
  - Pressure source
    - compressor on board
      - might be heavy and loud



Elephant's Trunk manipulator

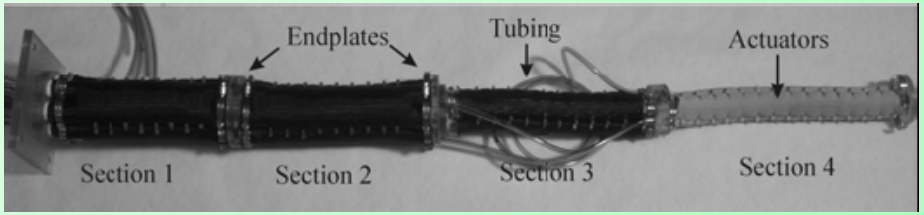
- Four sections with 2 DOF actuated with cable servo system = 8 actuable DOF
- Each section is based on four links serial connected by four 2 DOF joints
- Elastic connections between each joint thus coupling all the joints
- Total 32 kinematic DOF

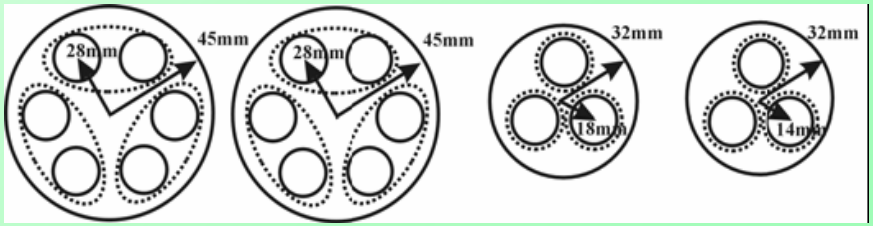




OctArm Continuum manipulator

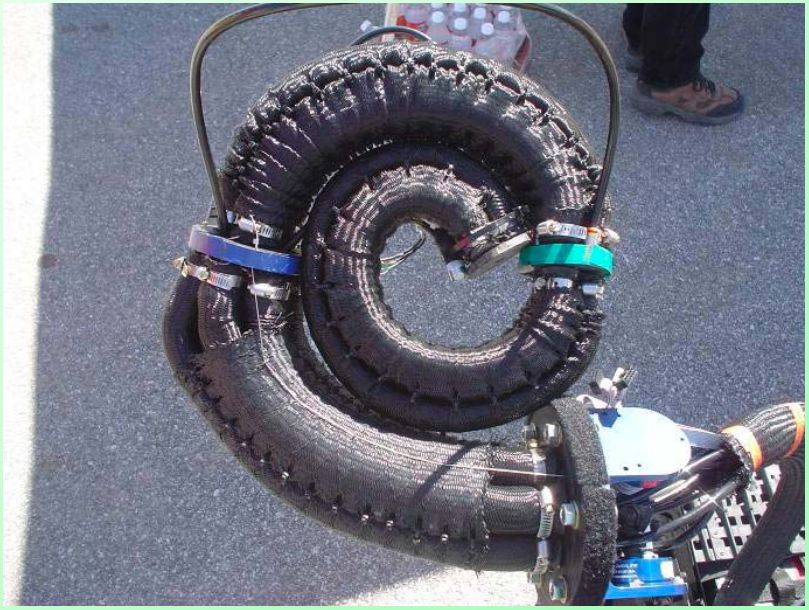
- first 2 sections with 6 control channels and last two with 2 control channels
- Six actuator design
  - o located at large radius
  - o higher stiffness and load capacity
- Three actuators
  - o closely-spaced actuators
  - o high curvature

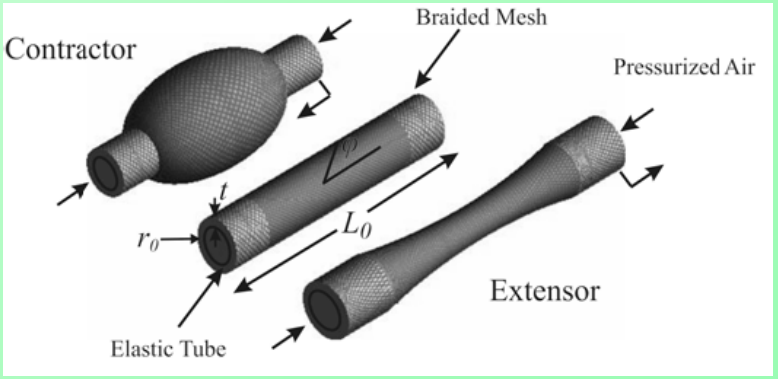




OctArm Continuum manipulator

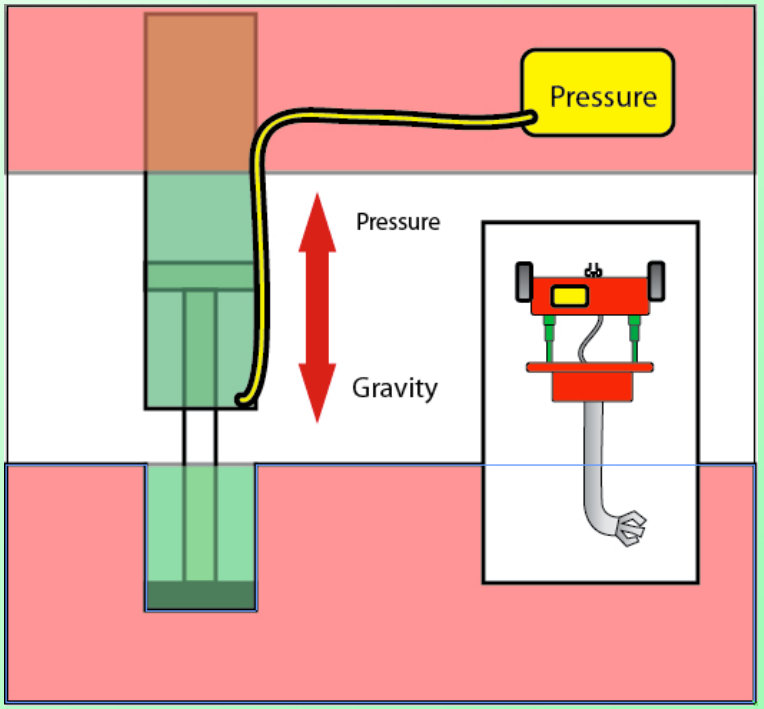
- Air muscle actuators maximum pressure 8,27 bar
  - Consturcted by covering latex tubing with double helical weave, plastic mesh sheath.





Pneumatic cylinders

- Pressure determines the size
- Three required for stiffness
- Can only double its length
  - Blind spots



Summary/Issues

- Trunk
  - o Pressure trunk
    - High torque capacity
    - Only one motor
  - o Servo Trunk
    - Accurate position control
- Ceiling structure
- Object mapping and recognition open