ECGR4161/5196 – Lecture 6 – June 14, 2012

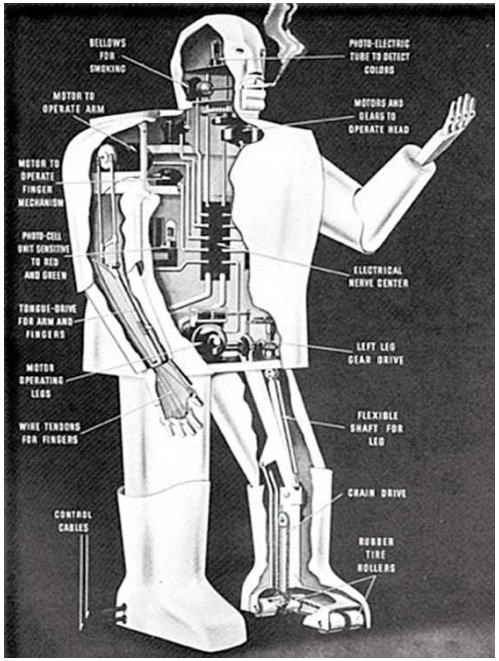
Today:

- Presentations - Robots
- Wheel calculation
- Exam preparation
- Lab time

Elektro – The Motoman of the Future

- Built by Westinghouse Corp. in 1937
- Showcased at the New York World's Fair
- Able to talk, walk, smoke, and blow up balloons
- Mostly used as a promo to sell appliances

http://davidszondy.com/future/robot/elektro3.htm



http://www.rps.psu.edu/probing/robots.html

- 7 ft. tall, 265 lbs., hollow aluminum frame
- Voice-activated
- Record player used to store responses
- Photoelectric tubes for eyes
- Bellows used as "lungs"
- Elektro in action:

http://www.youtube.com/watch?v=T35A3g_GvSg#t=01m16s

STANLEY: The DARPA Grand Challenge

Volkswagen Touareg R5

- Diesel-powered
- Four wheel drive
- Electronic steering control
- Custom roof rack

Environment Sensor Group

- Five SICK laser range finders
- Color Camera
- Two 24 GHz RADAR sensor

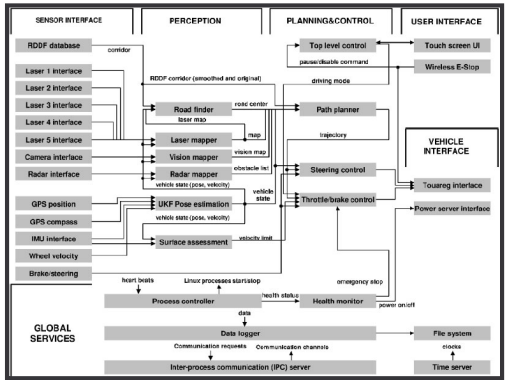
Positioning Sensor Group

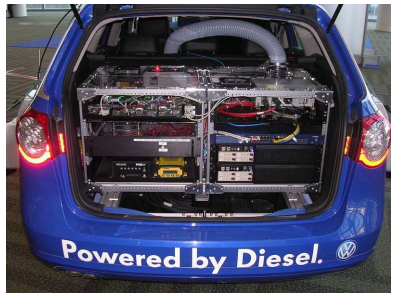
- GPS Antennae
  - GPS positioning system
  - Two GPS compass
  - Inertial measurement unit

Computing System

- Six Pentium M computers
- Gigabit Ethernet switch
- Custom Interface – Actuators
- 500 W power requirement

Software Architecture





http://www.getrobo.com/getrobo_blog/2007/09/post-1.html

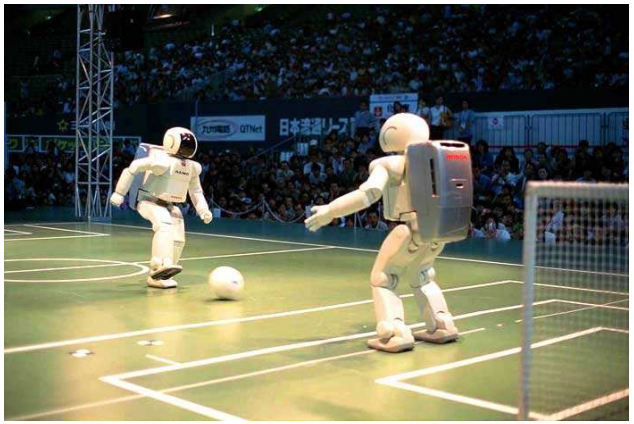
http://www-robotics.usc.edu/~maja/teaching/cs584/papers/thrun-stanley05.pdf

Honda ASIMO Autonomous Robot

- Avoid Objects
- Walk Over Uneven Terrain
- Voice Recognition
- People like Extrimities
- Hopping and Jumping

http://en.wikipedia.org/wiki/File:Honda_ASIMO_Walking_Stairs.JPG

http://www.geeky-gadgets.com/hondas-new-asimo-robot-in-action-videos-08-11-2011/



http://oneoman.com/2011/11/08/honda-shows-smarter-asimo-robot-that-hops-applying-technology-to-help-in-nuclear-crisis/

Robot Ostrich (FastRunner)

The Robot Ostrich(FastRunner) is a bipedal robot, which was developed at IHMC. FastRunner is a fast, extremely efficient and be able to maintain a high speed while being self-stabilizing. But this project is still under developing.

- Can achieve 20, 30 even 50 mph
- One actuator per leg
- Recovers itself from small step down disturbances
- Reaching 22mph in less than 6s
- Lightweight
- Open-loop stable

[Photo: IHMC]

da Vinci Robotic Surgery System

J. Scot Collins

A robotic surgical system made, developed by Intuitive Surgical and designed to facilitate complex surgery using a minimally invasive approach

- Controlled by doctor, seated, in the same room at console.
  - Not autonomous
  - Actuation by pulleys, gears, motors, etc..
- Benefits
  - Quicker recovery
  - Filters out hand tremors
  - More degrees of freedom than human wrist, 7 total.
- Drawbacks
  - Cost
  - Learning curve

Images/Video: http://www.davincisurgery.com
http://www.youtube.com/watch?v=C17-bGquIjI

Information: http://www.hmutx.com/davinci.php
http://en.wikipedia.org/wiki/Da_Vinci_Surgical_System

Sony QRIO (Quest for cuRIOsity)

MOTION & POWER

- 38 Joints & servo motors.
- 12V Lithium Ion pack, 1 hour battery life
- Can run at 23 cm/s

SENSORS

- 2 CCD cameras
- 7 Microphones
- 3 Accelerometer, 1 in torso 2 in the feet.

CONTROL & COMMUNICATION

- 1 Speaker
- 3 Microprocessor with 64Mb memory each.

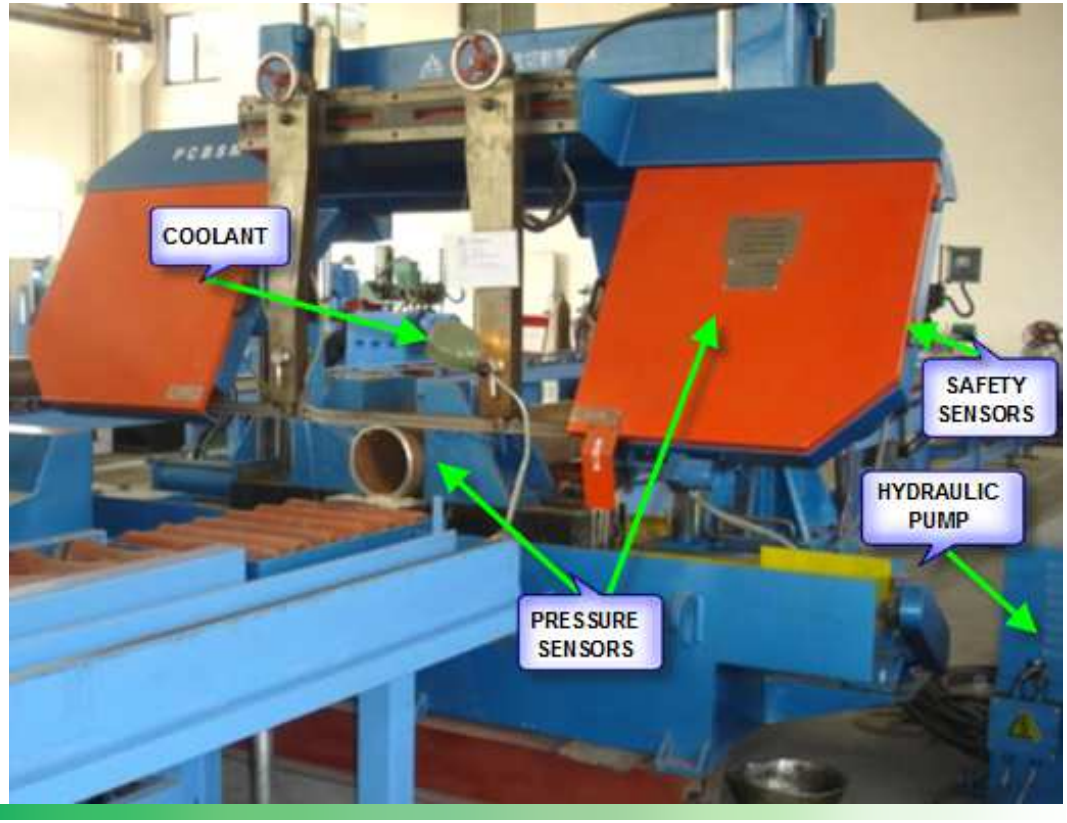
1

(1)http://preview.turbosquid.com/Preview/2012/05/30__11_10_14/Sony_Qrio_Robot_Static_000.jpg57231851-d6c2-444a-adbb-fc126691833fLarge.jpg

Autonomous saw

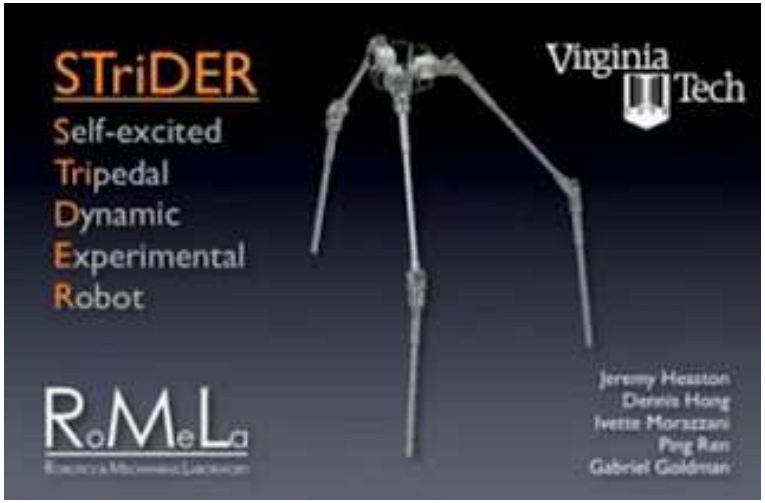
- **Inputs:** Pressure sensors, touch sensors, position sensors, position sensor, safety sensors, Variable Frequency Drive (VFD) speed feedback (4-20 mA) for saw blade
- **Outputs:** Open/Close clamps command, Raise/Lower saw, Move pipe Forward/Backward, coolant pump On/Off, saw blade speed command (4-20 mA)
- **Controller**: Allen Bradley Programmable Logic Controller (PLC)
- **Application:** Cut long pipes into specified length. Tolerance is +/- 0.005 in.
- **Sequence:**
  1. Select length and press Start
  2. Close rear clamps
  3. Close front clamps
  4. Lower saw and cut
  5. Retract pipe
  6. Raise saw and open front clamps
  7. Index pipe
  8. Close from clamps
  9. Repeat the sequence until end of pipe

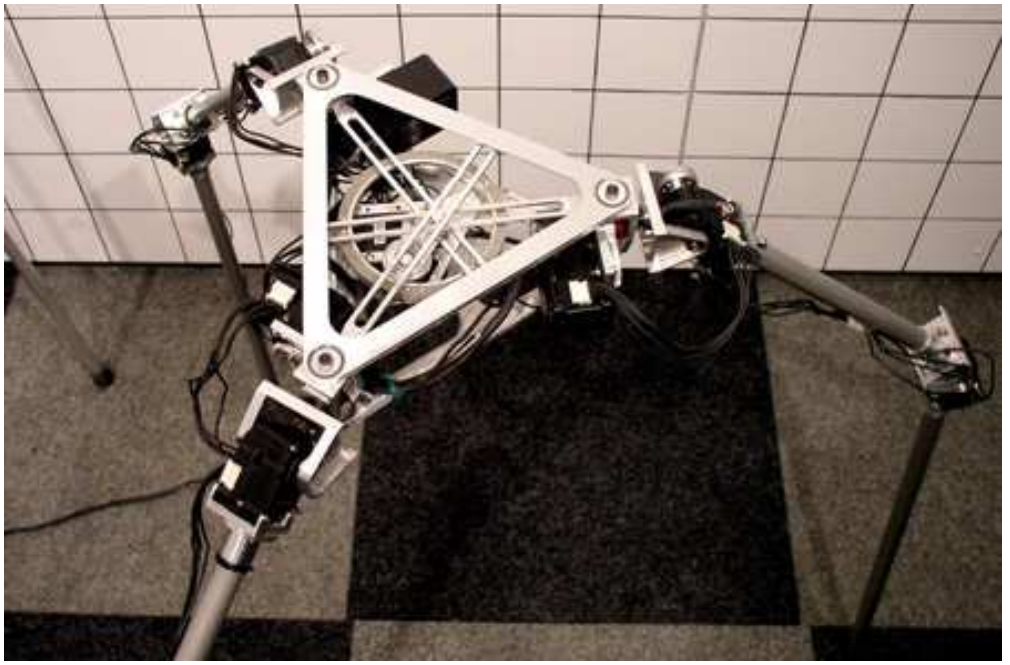
http://www.google.com/imgres?q=pipe+cutting+saw+machine&um=1&hl=en&biw=1024&bih=562&tbm=isch&tbnid=WliuZzoKoLVvgM:&imgrefurl=http://www.ecvv.com/product/1872085.html&docid=OFdWWiTxazEgzM&imgurl=http://upload.ecvv.com/upload/Product/20093/China_Highly_efficient_Pipe_Cutting_Band_Saw_Machine20093111546170.jpg&w=1024&h=768&ei=-NTgT4KvK8ry0gHP0oG3Dg&zoom=1



STriDER

- Developed by RoMeLa (Robotics & Mechanisms Laboratory at Virginia Tech)
- Three points of contact with the ground. Utilizes novel locomotive design.





http://www.ted.com/talks/dennis_hong_my_seven_species_of_robot.html

Ranger Walking Robot

2005

- 39 steps/12 m in 26.5 secs (2)

2006

- 2,868 steps/1003m±20m in 40 mins

2008

- 27,724 steps/9.07km in 5.5 hrs

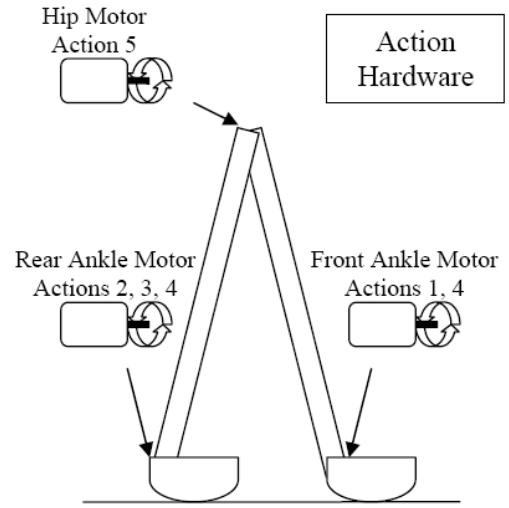
2010

- 65,185 steps/23km in 10.68 hrs

2011

- 186,076 steps/65.24 km in 30.81 hrs

(7)



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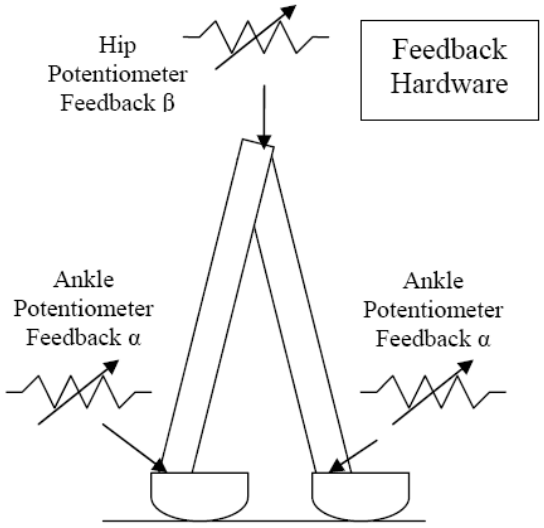

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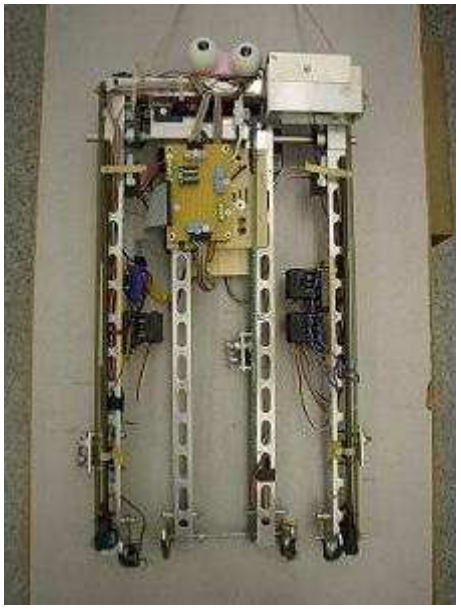

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References

1. http://ruina.tam.cornell.edu/research/topics/locomotion_and_robotics/ranger/Ranger2011/index.html
2. http://ruina.tam.cornell.edu/research/topics/locomotion_and_robotics/ranger/marathon_walker/report.pdf
3. http://ruina.tam.cornell.edu/research/topics/locomotion_and_robotics/ranger/ranger2006.php
4. http://ruina.tam.cornell.edu/research/topics/locomotion_and_robotics/ranger/ranger2008.php
5. http://ruina.tam.cornell.edu/research/topics/locomotion_and_robotics/ranger/Ranger2010/
6. http://ruina.tam.cornell.edu/research/topics/locomotion_and_robotics/ranger/marathon_walker/index.php
7. http://ruina.tam.cornell.edu/research/topics/locomotion_and_robotics/ranger/Ranger2011/pictures/DSCF3674.JPG

Legged Squad Support Systems (AlphaDog)

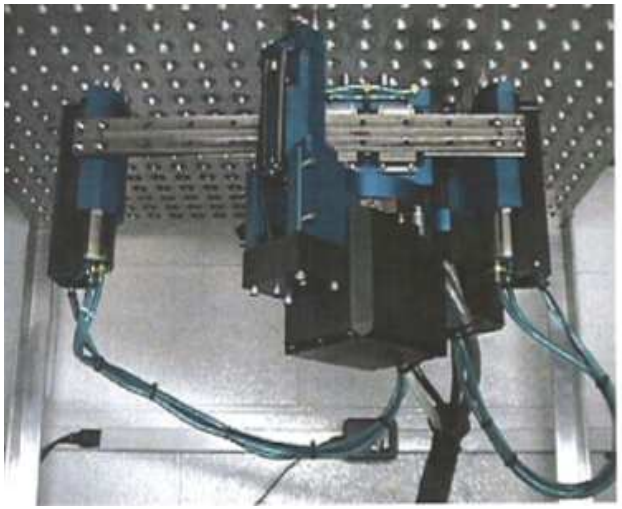
- Robot that is able to a follow a soldier anywhere he/she can go.
  - Three settings: leader-follower tight, leader-follower corridor, and go-to-waypoint.
- Carries up to 400 lbs of gear for soldiers.
- For missions up to 20 miles and/or 24 hours.
- Mobile power source.

- Inputs and Sensors Used:
  - LIDAR
  - Camera
  - GPS
  - Gyro
  - Microphone (upgrade)

http://www.bostondynamics.com/robot_ls3.html

Pegasys: Westinghouse Nuclear Robot

- Tubesheet Walker for Steam Generator inspecting at a Nuclear Power Plant
- Reduced radiation exposure
- Lightweight, Safer, Quick setup and installation
- Designed for RSG-type programs



Pegasys Robot, Steam Generator
Source: Westinghouse Electric Company (used w/ permission)

Ballbots

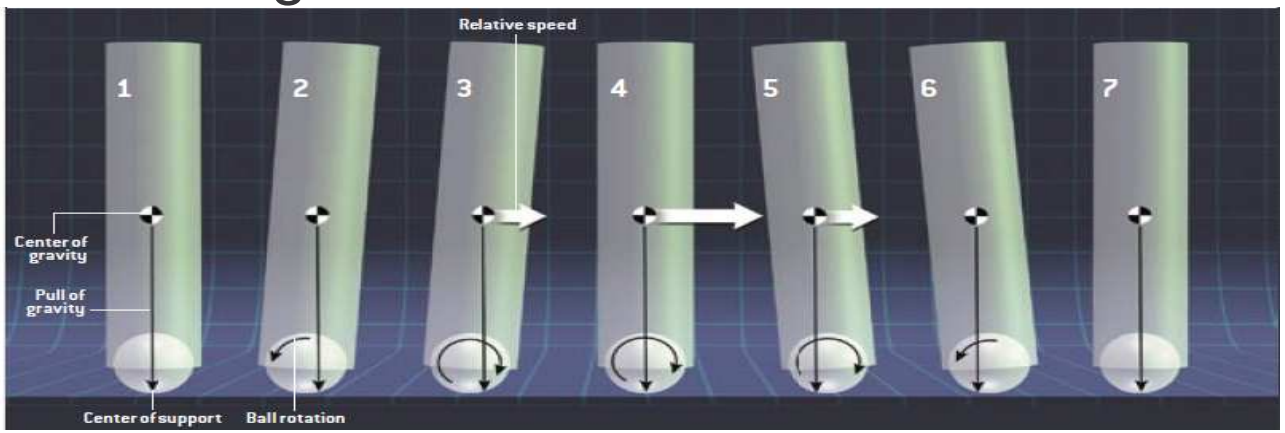
- Sensors

  Gyroscope

  Optical encoders

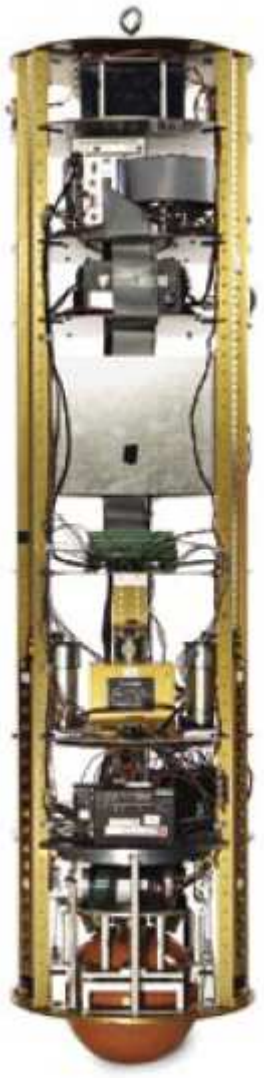
  Angular motion sensors

- Travelling from A to B



- http://www.youtube.com/watch?v=39zeZwlVaN0

  [http://www.cs.virginia.edu/~robins/Ballbots.pdf]



Pipe Traversing Robot

PATENT PENDING

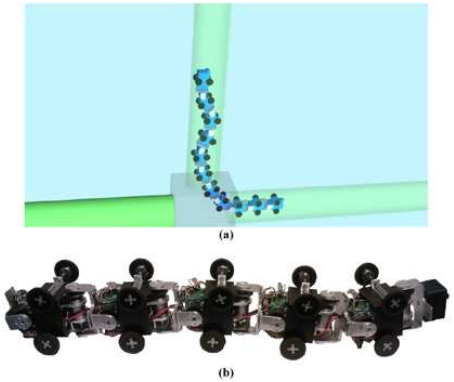
Common Applications:

- Detecting cracks in industrial pipes
- Cleaning horizontal ventilation systems

Common Designs:

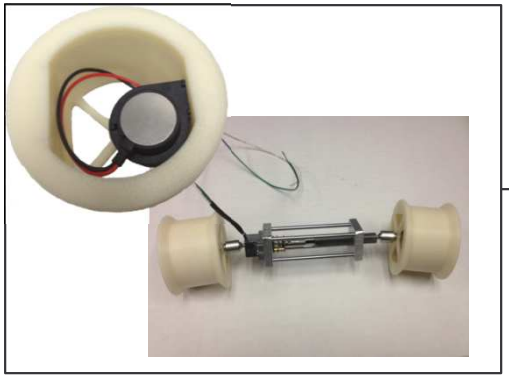
http://www.genomicon.com/

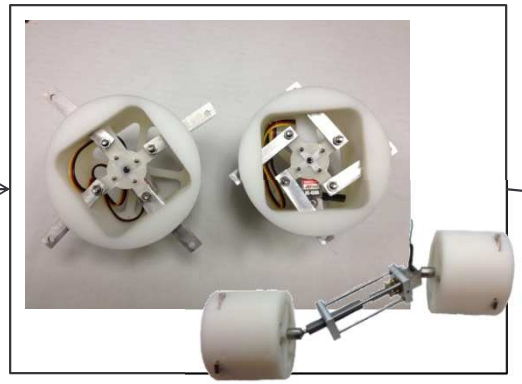
http://www.bbsteamatic.com



http://spie.org/x34544.xml

New Purpose: traverse and clean Dryer Ventilation systems
New Design:





Linear Motion Device Beta:
http://www.youtube.com/watch?v=1btjbMVNvlA&feature=plcp

iRobot Roomba

Features of the Roomba 500:

- Dirt Detect
- Wall Follow
- Cliff Detection
- Light-Touch Bumper
- Soft-Touch Bumper
- Escape Behavior
- Anti-Tangle Technology

Sensors: Bump Sensor, Ultrasonic Sensor, IR Sensor, Walls/Objects Sensors

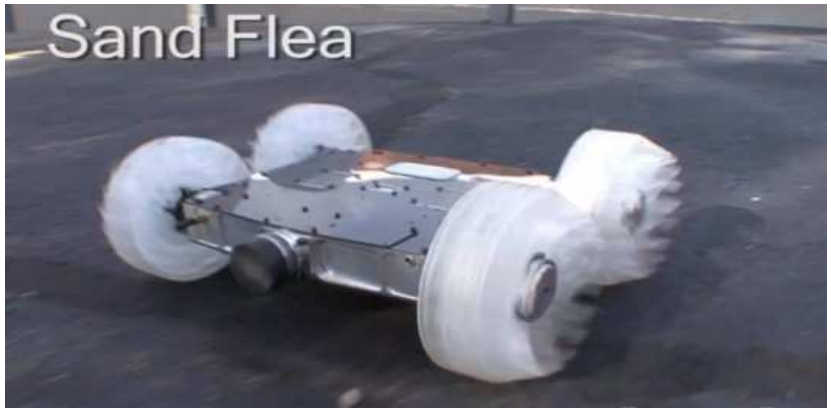
Algorithm designed by MIT

http://dailylifehri.files.wordpress.com/2011/04/roomba_cat.jpg

http://http://www.irobot.com/us/robots/home/roomba.aspx
http://punkrockor.wordpress.com/2010/06/08/roomba-algorithms/

Sand Flea

By Alex Moster



- 11lb robot
- Also can be remotely controlled
- Can jump 30ft in the air
- Internal stabilization system
- https://www.youtube.com/watch?v=6b4ZZQkcNEo

Stanley

- Autonomous vehicle created by the Stanford Racing Team to compete in the 2005 DARPA Grand Challenge that uses programed reasoning and artificial intelligence to plan its future path.
- The body of a Volkswagen Touareg was used because of its extensive integrated computer system.
- Used five LIDAR sensors that were mounted on the roof to build a 3D map of its surroundings.
- Six 1.6GHz Intel Pentium M based computers in the trunk running Linux.
- Over 100,000 lines of code were written to give the robot power to analyze its LIDAR data in order to maneuver around obstacles and to achieve its desired position.

http://thefutureofthings.com/articles/1001/darpas-urban-challenge-2007.html

R.O.B. (Robotic Operating Buddy)

- Accessory for the NES released in July 1985 as the "Family Computer Robot".
- R.O.B. receives up to 6 commands via optical flashes from TV screen.

Figure 1: http://en.wikipedia.org/wiki/R.O.B.

Specifications:

- Operates on (4) AA Batteries
- 9.5" Height x 6" Width
- Head Movement Range: 45 degrees tilt up/down
- Arm Movement Range: 240 degrees left/right (5 stopping points), 7 cm/2.75in up/down (six stopping points), 7 cm/2.75 in between hands when open
- 5 accessory slots around hexagonal base

http://www.youtube.com/watch?v=08VrKFI6vJ8

ROBONOVA

- ROBONOVA-1 is a fully programmable and customizable humanoid robot
- Utilizes 16 digital servos to move in almost anyway you can imagine!


[4]

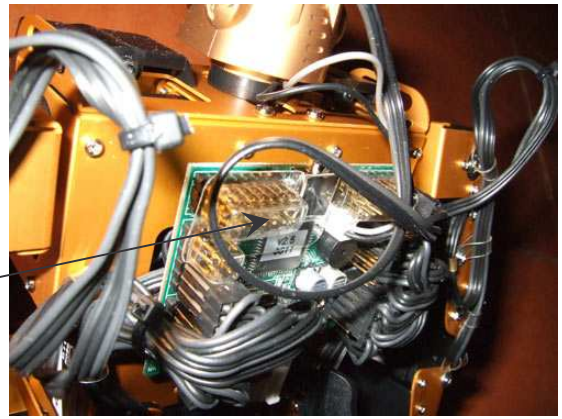
- ROBONOVA has ATMega128L Microcontroller with 64k of onboard EEPROM
- Can be expanded to include peripherals such as sonar, light, gyro, and sound sensors


[1]


[2]

ROBONOVA has 16 degrees of freedom!

Has 40 ports on post connectors, of which 24 are servo ports and 8 A/D converters


[3]

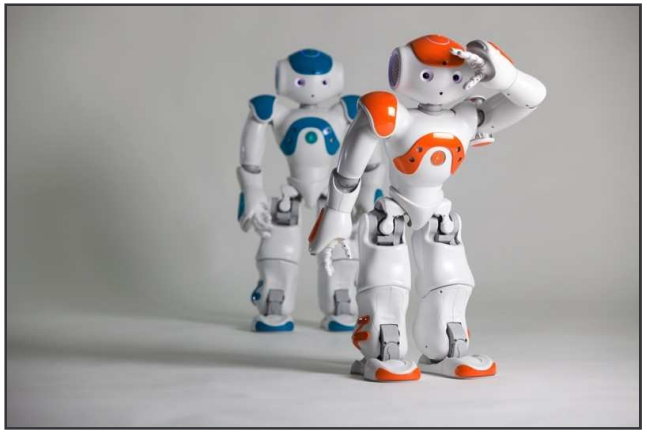
- Can be yours today for 48 easy payments of $19.99!

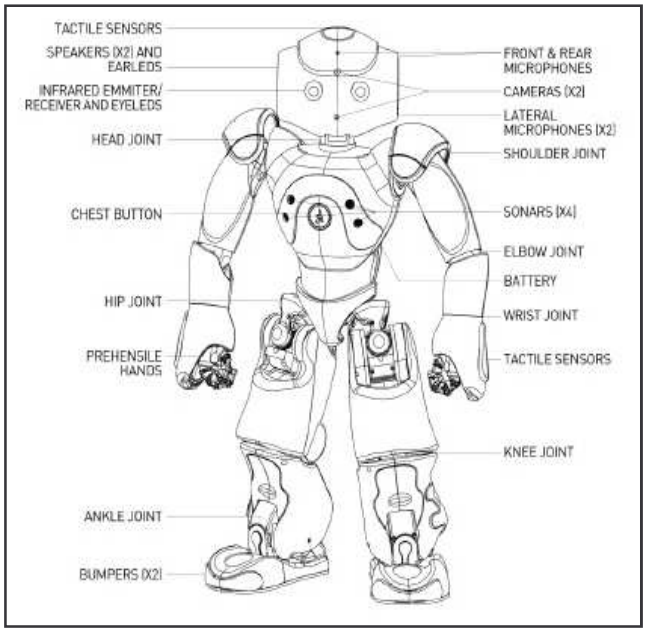
Demo Video: http://www.youtube.com/watch?v=yr-zX8AXKqE&feature=player_embedded

References:
[1] & [4] (2011). *ROBONOVA-I (Ready-To-Walk)*. (2011). [Web Photo]. Retrieved from http://www.robonova.de/store/product.php?productid=16136&cat=2&page=1
[2] (2012). *Cool RC Robot Toys*. . (2012). [Web Photo]. Retrieved from http://rcvehicles.about.com/od/rcgadgets/tp/RC_Robots.01.htm.
[3] (2012). *ROBONOVA-I – humanoid robot Kit (unassembled)*. (2012). [Web Photo]. Retrieved from http://robosavvy.com/store/product_info.php/products_id/79

Nao Robot

- Onboard computer powered by 1.6 GHz Intel Atom processor.
- 2 HD cam, 4 microphones, 2 speakers.
- Tactile and 4 sonar sensors among others.
- 21 to 25 DoF
- Has 27 6-watt/hr battery for 1.5 or more hr. of autonomy.
- Connectivity: Ethernet and Wi-Fi.
- Features: Omnidirectional walking, whole body motion, fall manager system, object, face and, sound recognition, up to 9 languages.
- Price: $16,000.00.





http://www.robotshop.com/productinfo.aspx?pc=RB-Ald-01

SAFFiR (Shipboard Firefighting Robot)

- Designed to navigate autonomously through ships
- Uses vision, gas sensors, and IR camera
- Extinguishes fires using PEAT grenades
- Designed to work as part of a team

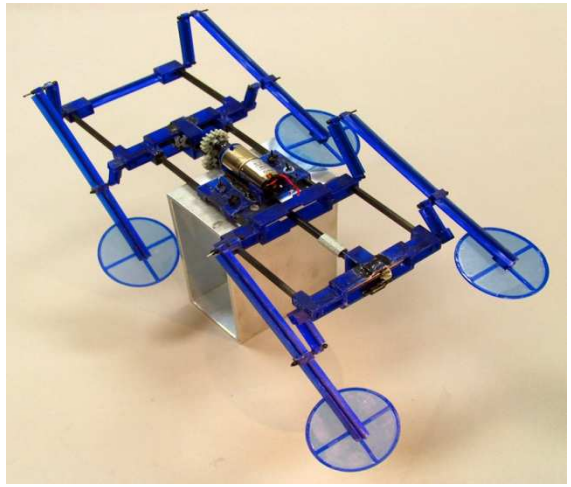
The Chess Terminator

The chess terminator was built to allow true chess competition against a robot. Previously most chess playing "robots" did not actually move the piece or press the button on the clock to signify a turn ending. The board used incorporates sensors in each piece to determine where all the pieces are.

http://www.gizmag.com/chess-terminator-robot-takes-on-kramnik-in-match/16996/picture/124697/

Water Running Robot

- Can run on top of the water
- Modeled after the lizard
- 1.5 m/s
- 5-10 Hz stepping motion per leg
- Four Factors that allow the robot to run on water
  - Body Mass
  - Length
  - Speed
  - Shape of foot



http://nanolab.me.cmu.edu/projects/waterrunner/