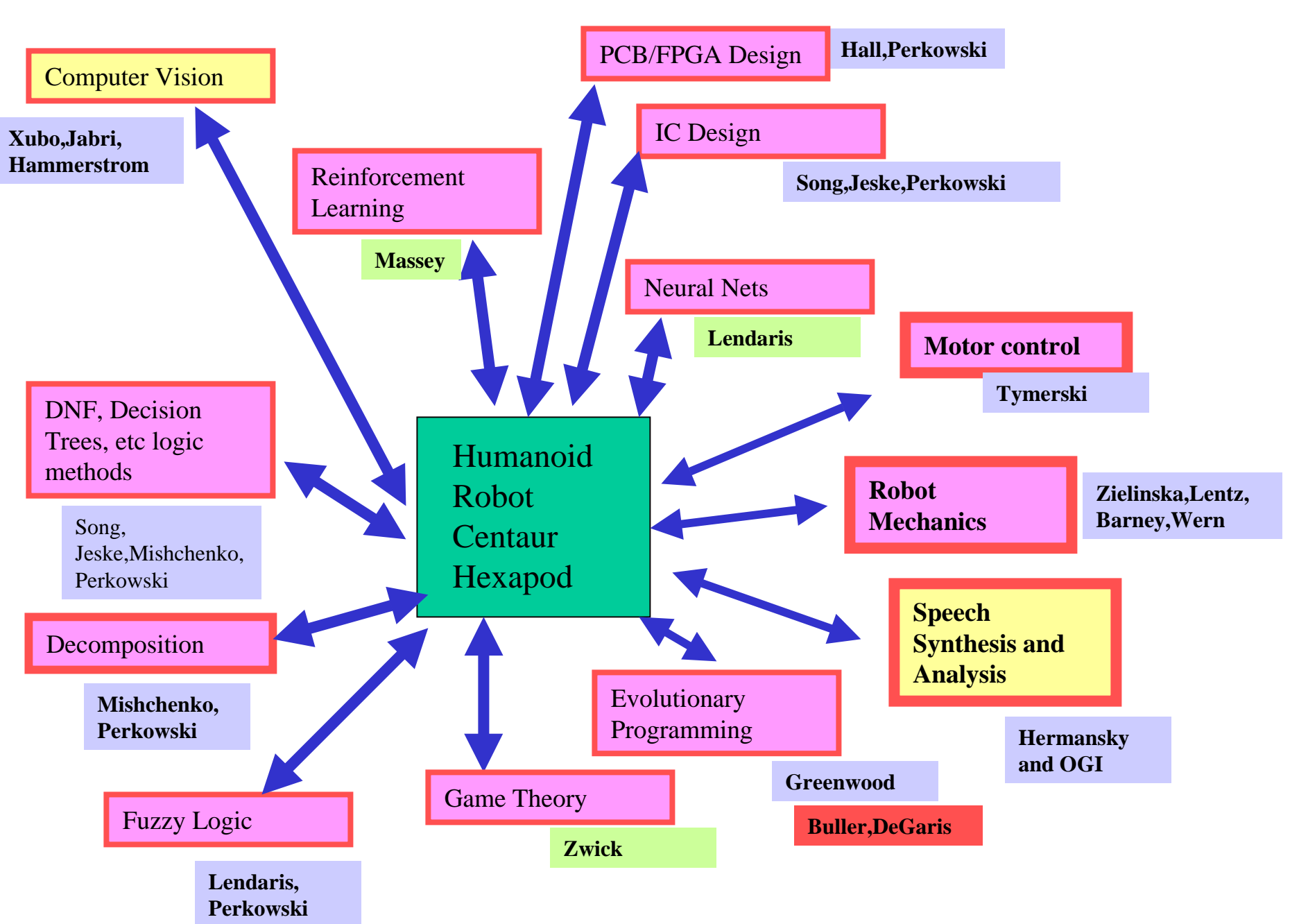


PSU Centaur Hexapod Project

- Integrate an advanced robot that will be **new** in comparison with all robots in the world
 - Reasoning by analogy
 - Learning using Logic Synthesis methods
 - Learning using Data Mining methods
 - Imitation and Interaction
 - Use FPGAs and FPAAAs
- Use faculty expertise
- High-school, undergraduate, graduate classes
- External collaborations with top groups

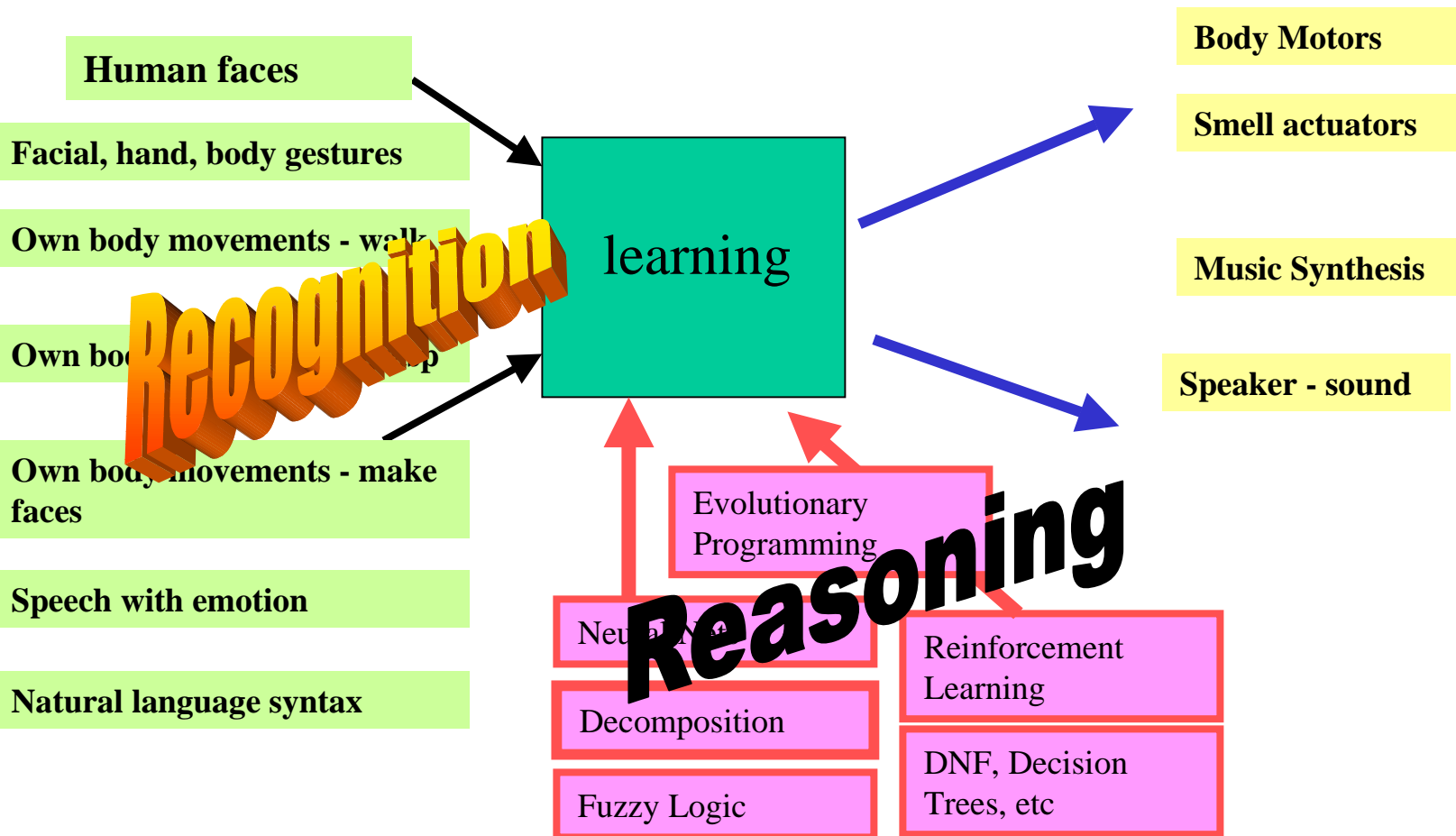
What we have?

1. Lower body (motors too weak)
2. Torso (no hands)
3. Head (no cameras yet)
4. Image Processing, Obstacle avoiding, navigation and planning from PSUBOT (not yet connected)
5. Speech analysis and synthesis software (from OGI)
6. Planning and obstacle avoiding software (separately developed)
7. Natural language conversation with text-to-speech
8. Machine Learning software (Grygiel, Files, Mishchenko)
9. Close collaboration with three top world researchers in robotics

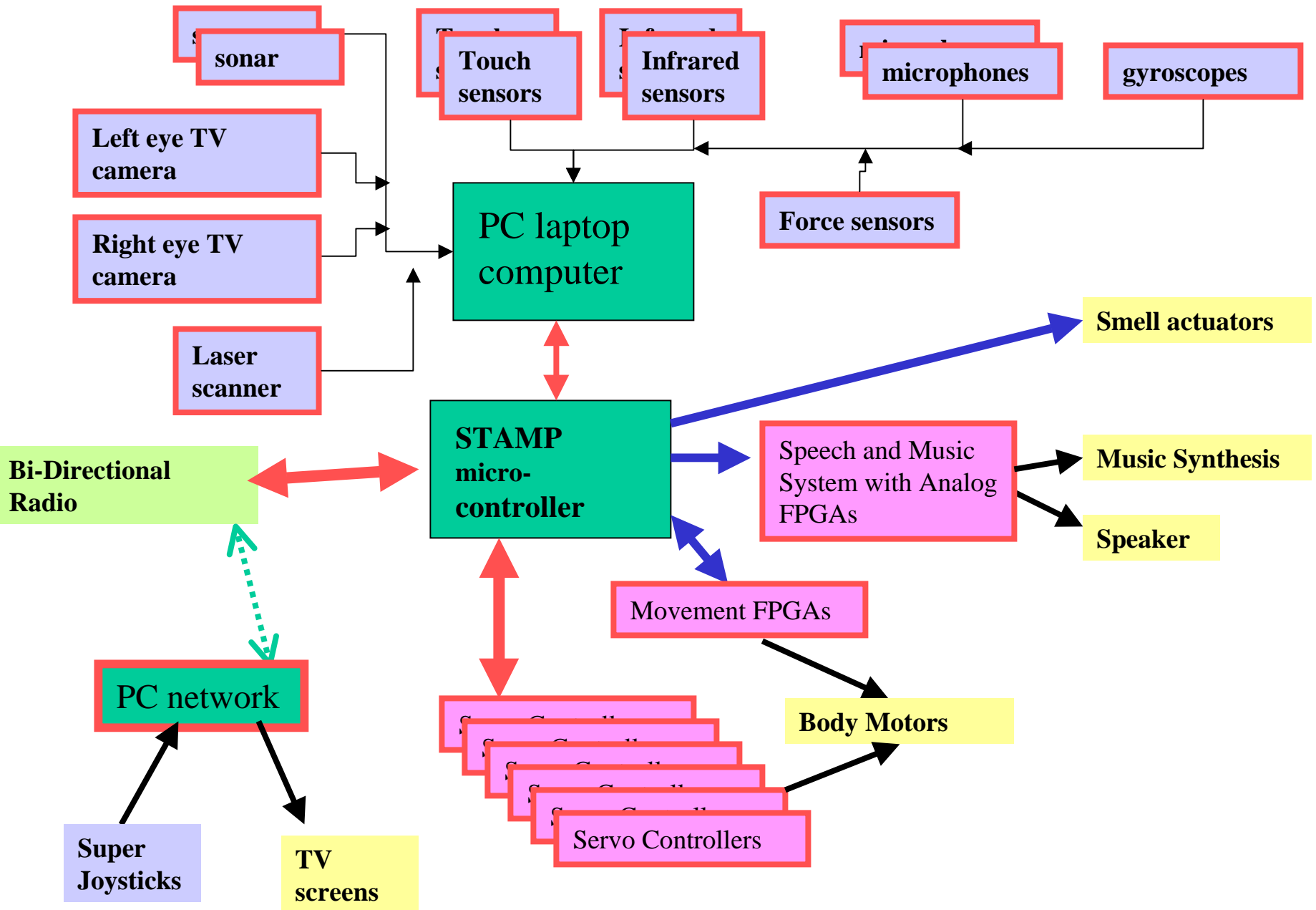


Humanoid Robotics Project

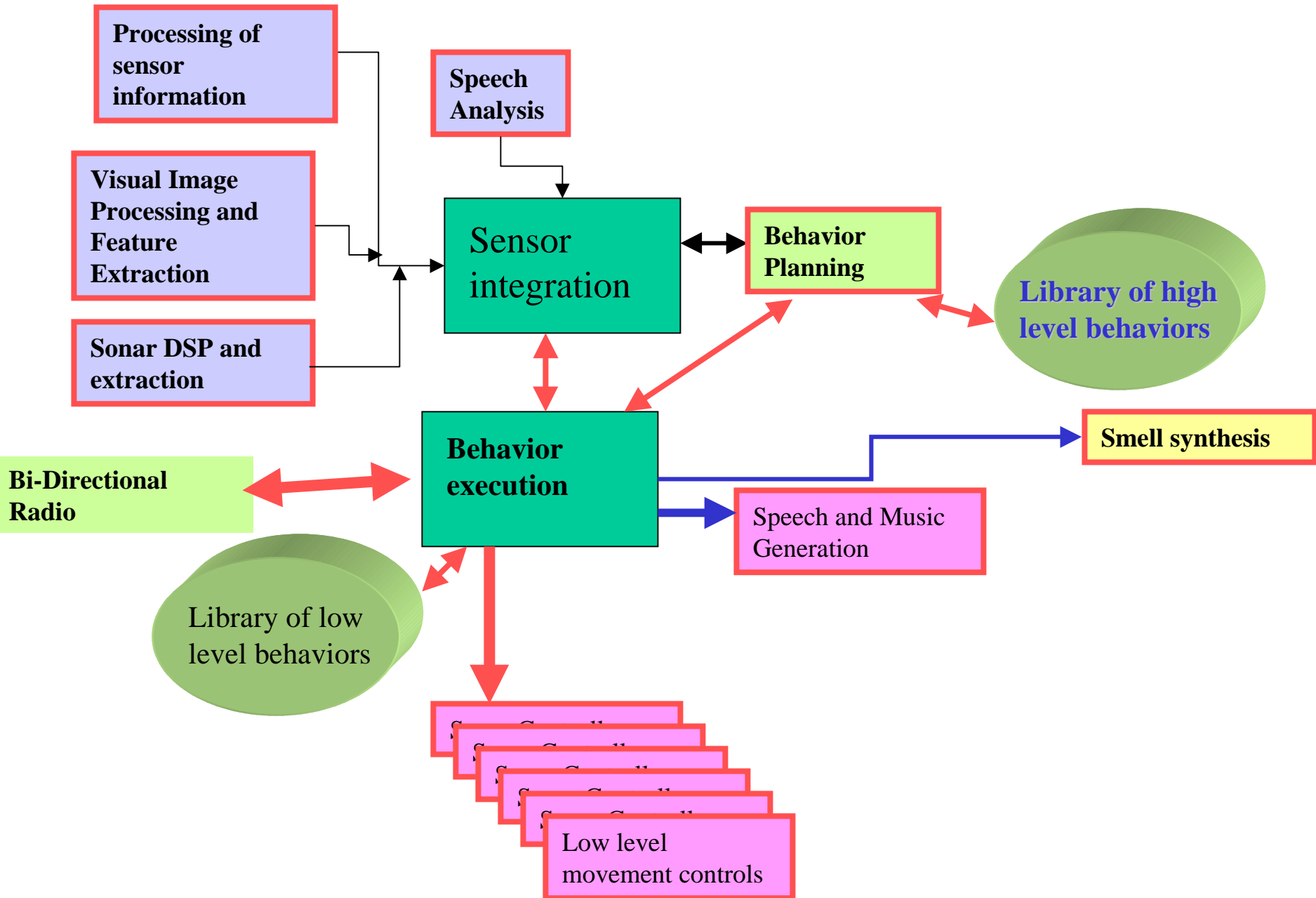
Learning in Humanoid Robotics, as exemplified by Centaur



Hardware Architecture of PSU's Hexapod Centaur



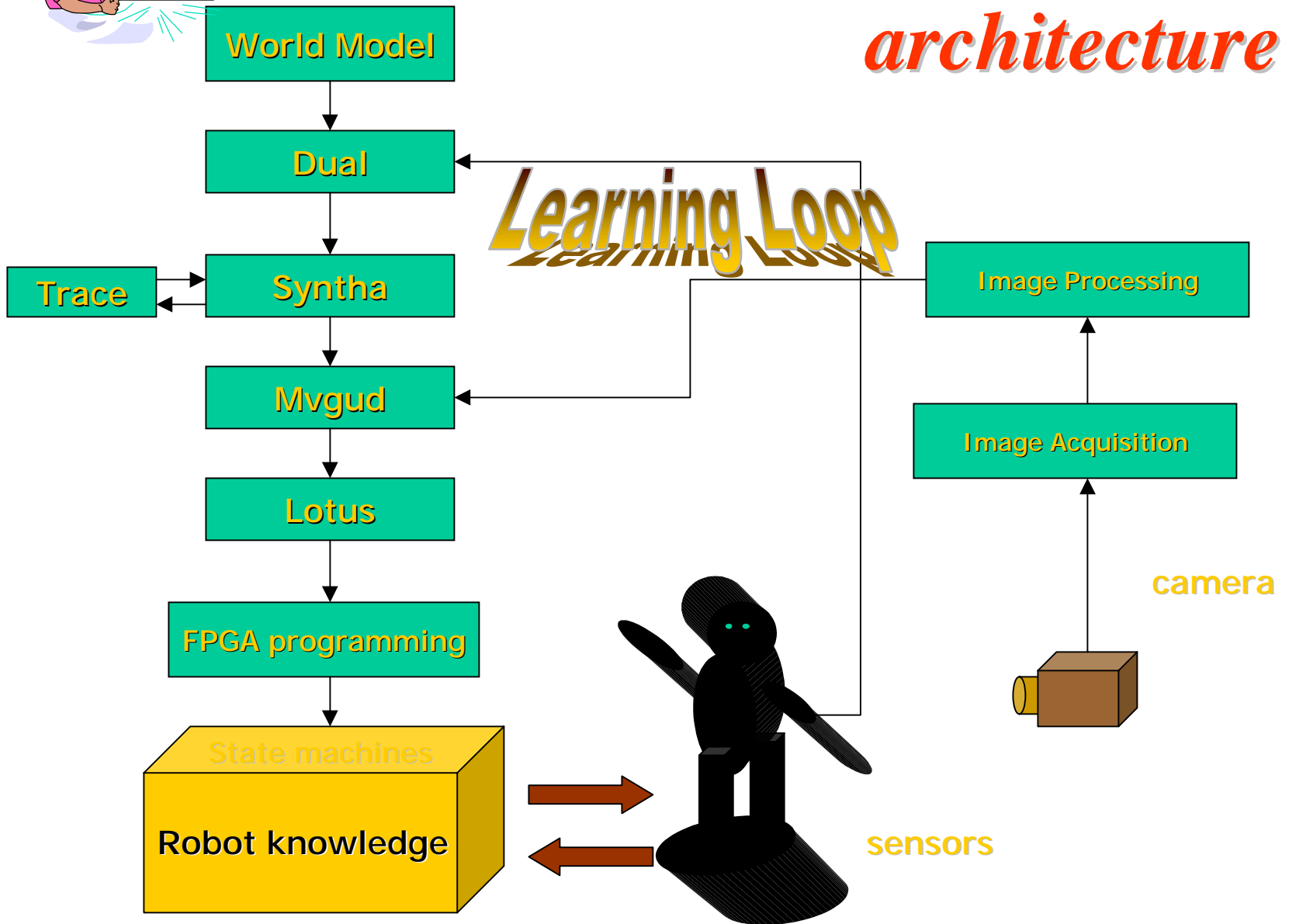
Software Architecture of PSU's Hexapod Centaur



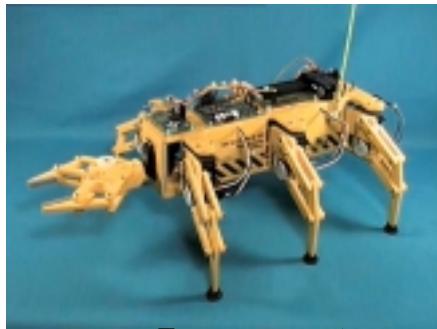
Faster!!

Human teacher

MUVAL architecture

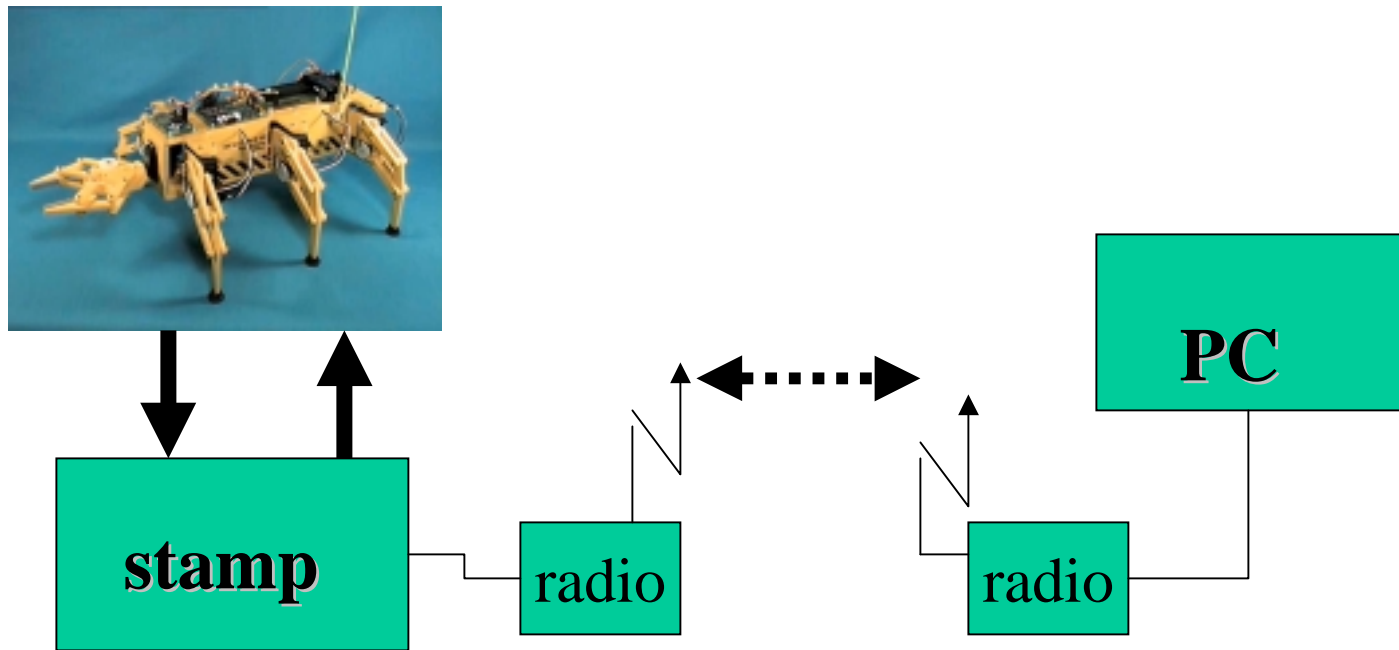


Hexapod I control - phase one

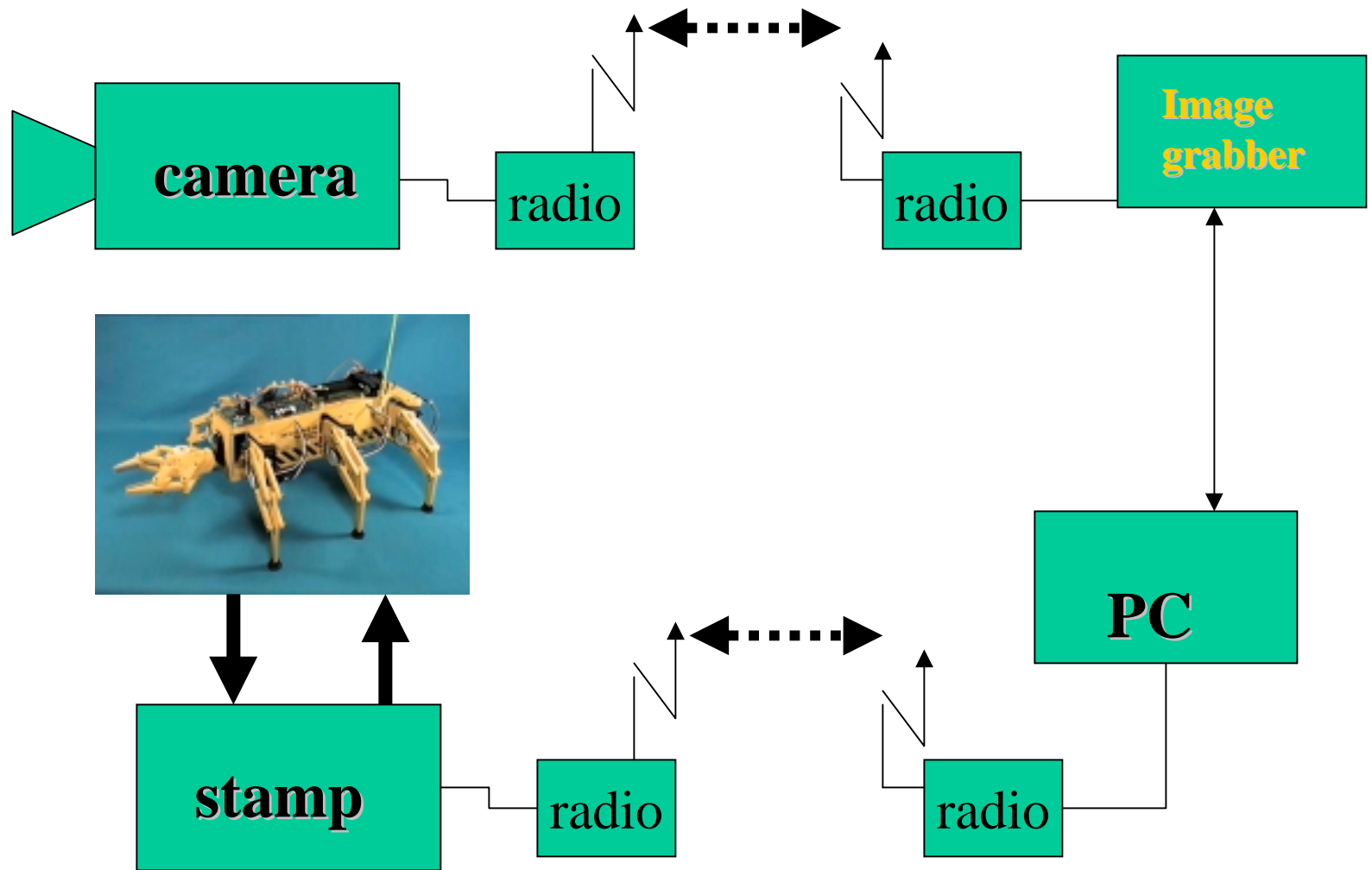


stamp

Hexapod I control - phase two



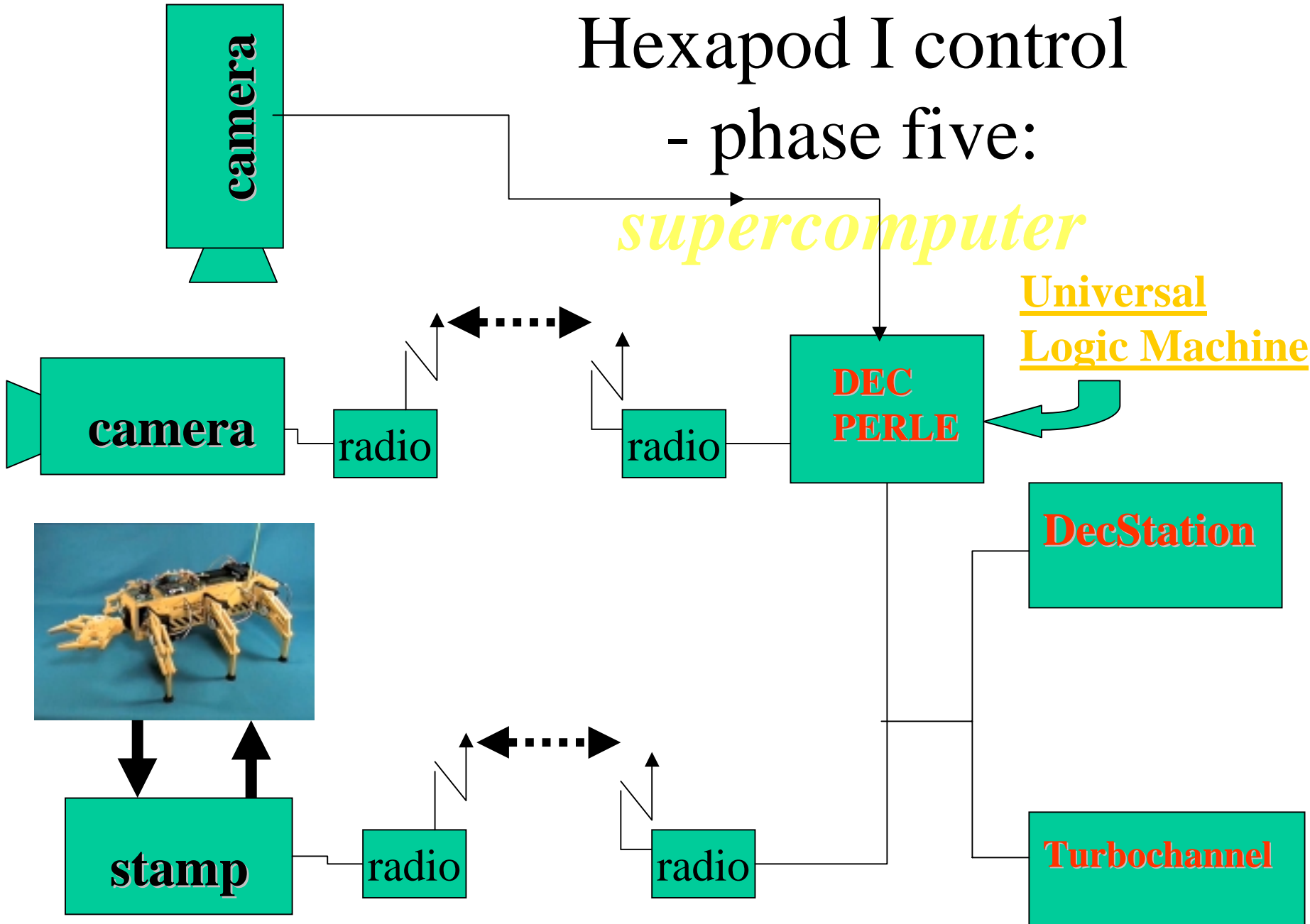
Hexapod I control - phase three



Hexapod I control - phase five:

supercomputer

Universal
Logic Machine



Future work...

- Light weight!
- Robot Puppet Theatre
- Humanoid robot in human theatre - “Faithful Robot” by Stanislaw Lem



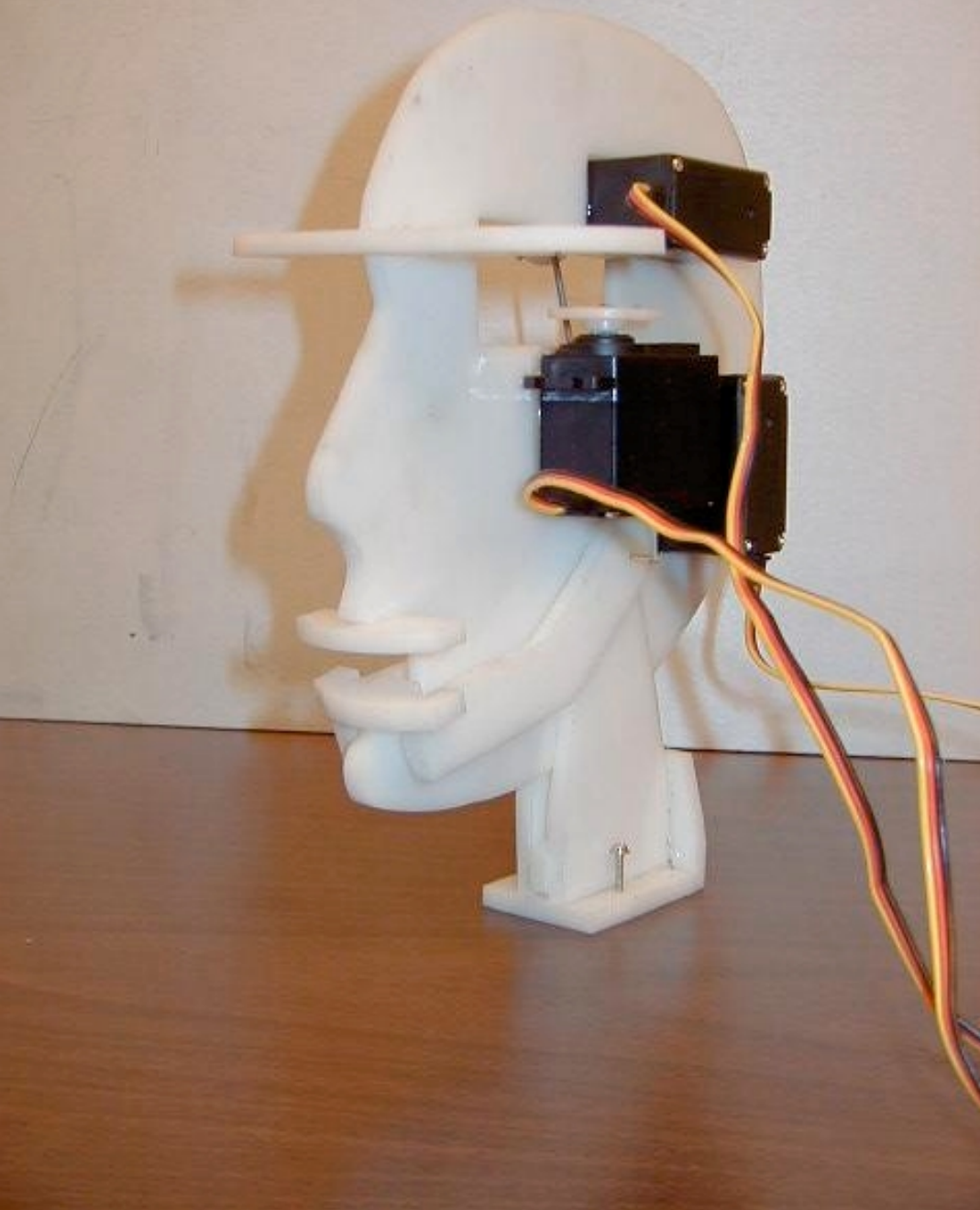
You can help...

- Robotics and Automation IEEE Society - the only student chapter in Oregon
- Go recruit to high schools
- Help to build one of our robots
- Perform in our theatre as radio-operator
- Classes in robotics and projects
- M.S. and Ph.D. theses
- Capstone Projects

Building a head



Clone your head in 8 easy steps



- 1. Cut the skull from playwood or plastic
- 2. Glue in the servos
- 3. Connect servos to interface
- 4. Program for your head movements (use ready C++ interface or Basic interface)
- 5. Make a latex mask of your face
- 6. Put the mask on the skull
- 7. Record your voice
- 8. Synchronize

Who will be cloned first?



- Dr. Hall
- Dr. Lendaris
- Dr. Greenwood
- Dr. Mishchenko
- Mrs. Jady Bates
- Dr. Perkowski

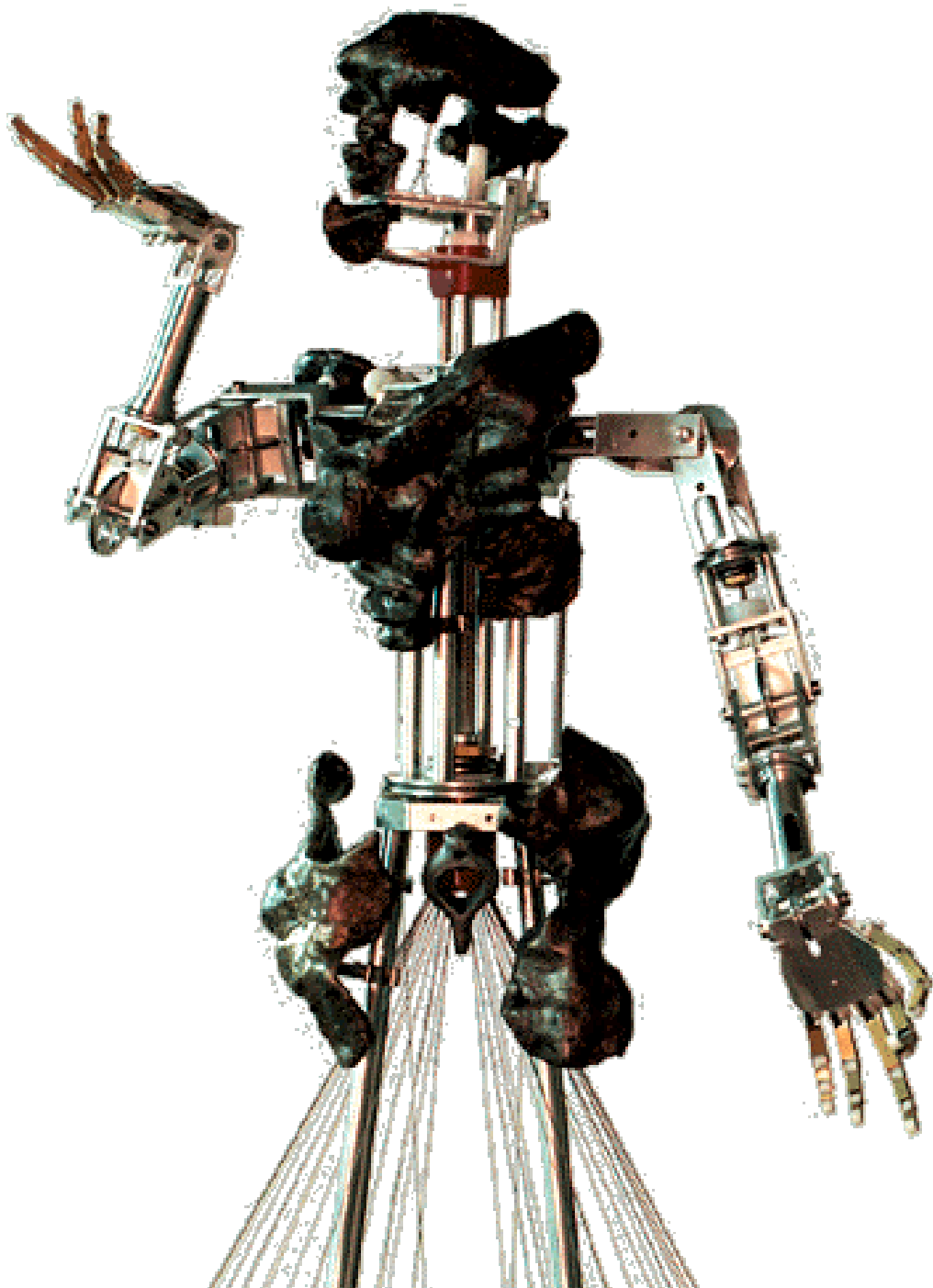


**How to
animate
limbs?**



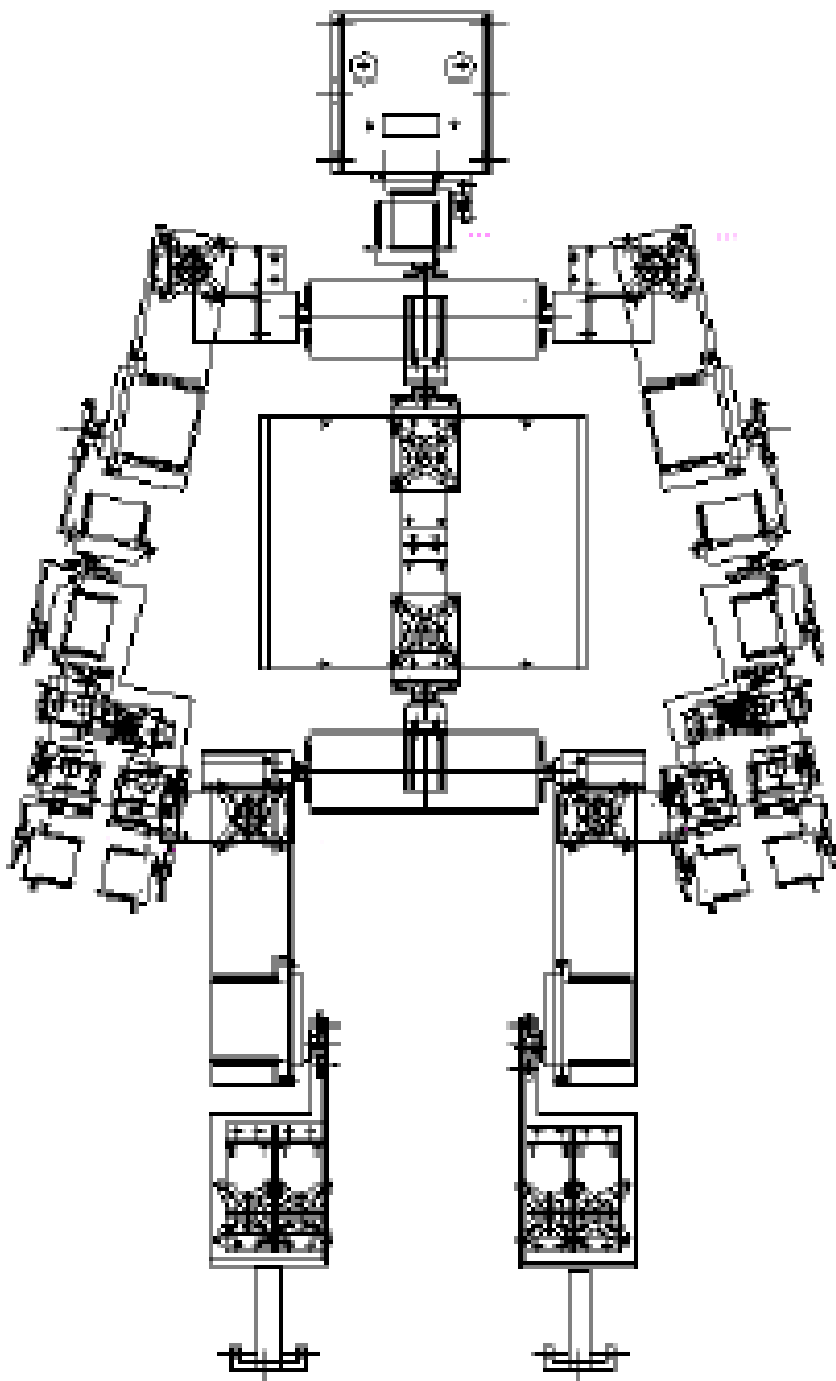
Goboy

- In 1992, Garvey initiated a form of humorous, non-violent guerrilla warfare against the so-called artworld, playground of the paranoid, narcissistic and vacuous rich.
- He unleashed his robot panhandler Goboy on places of institutional power such as museums, symphony halls, opera houses and shopping malls, and videotaped the astonishing results.
- These records of the notorious unannounced (and most-times unwelcome) visits of Omnicircus robots have become legendary comic critiques of our trivia-besotten times.

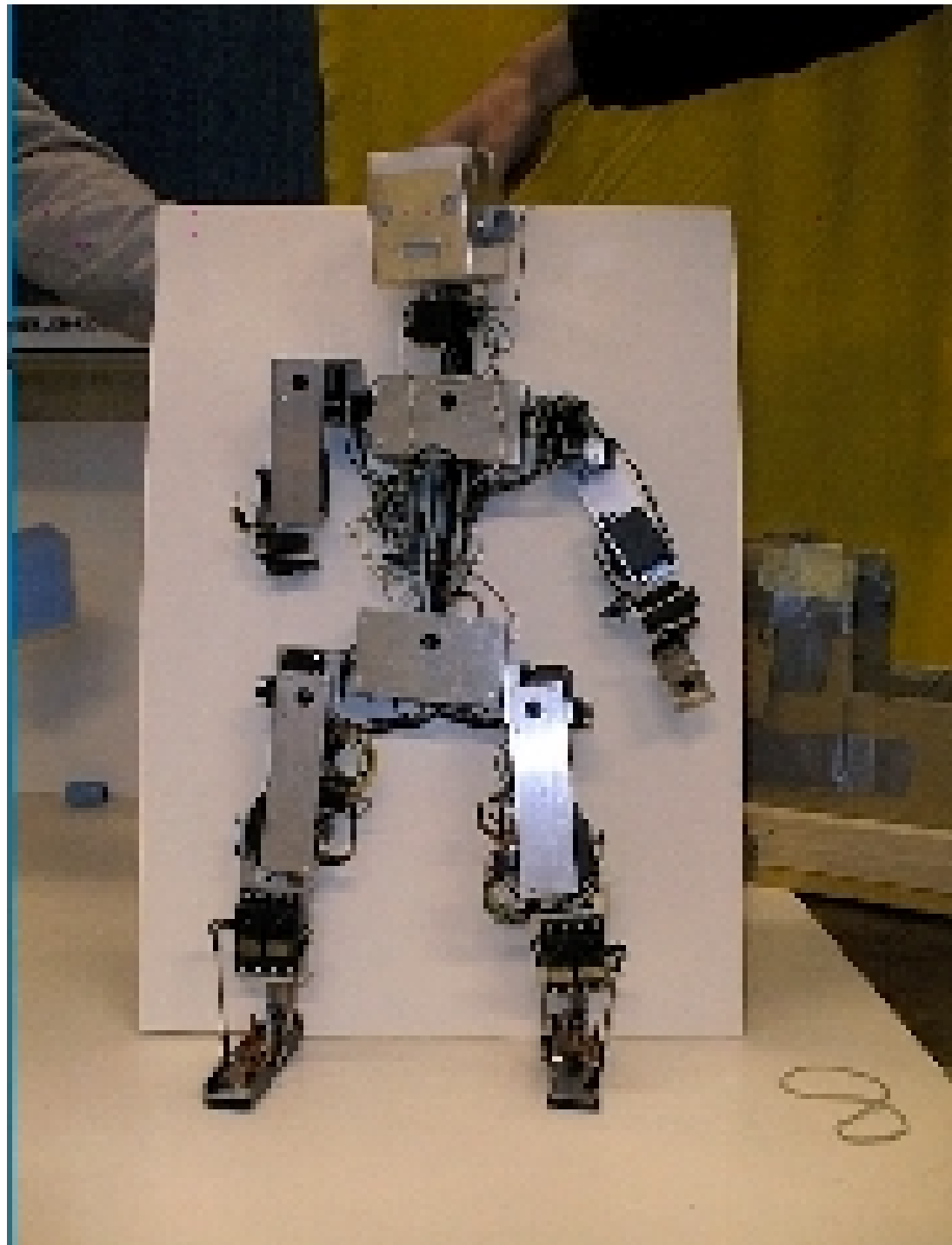
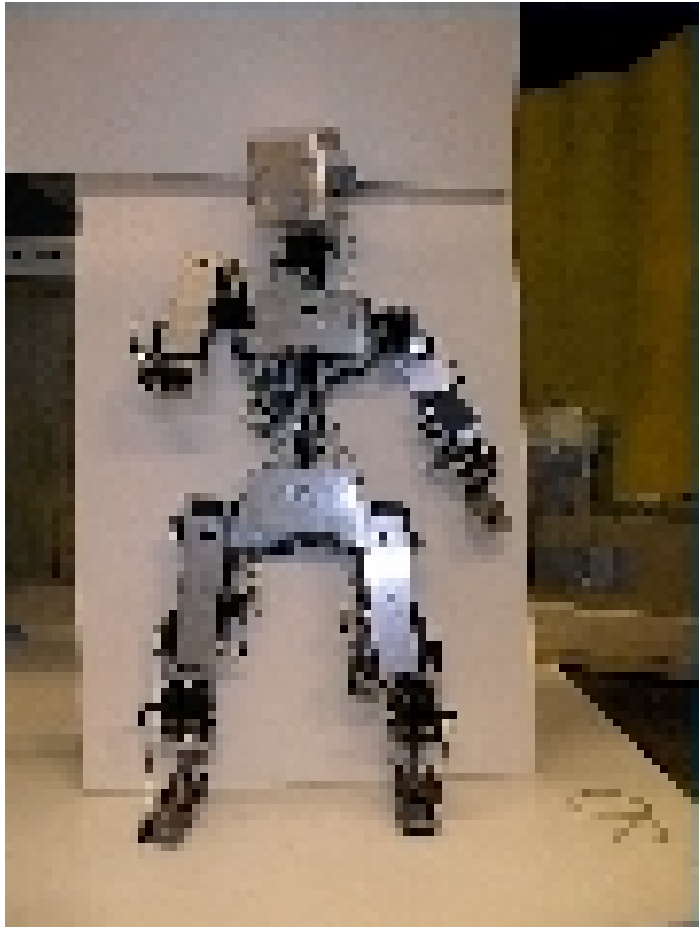


- This is *Slave Zero*, a half-scale **robotic actor** with 21 servo actuators & 42 degrees of freedom.
- Designed and built by Carl Pisaturo in 1997-8, shown here with sculpted body panels by Frank Garvey.
- She and a mate are blurring the boundaries between sculpture, dance and theater while extending the language of each.

Prototype of future walking robot



We take ideas from Honda,
Elvis and several other robots

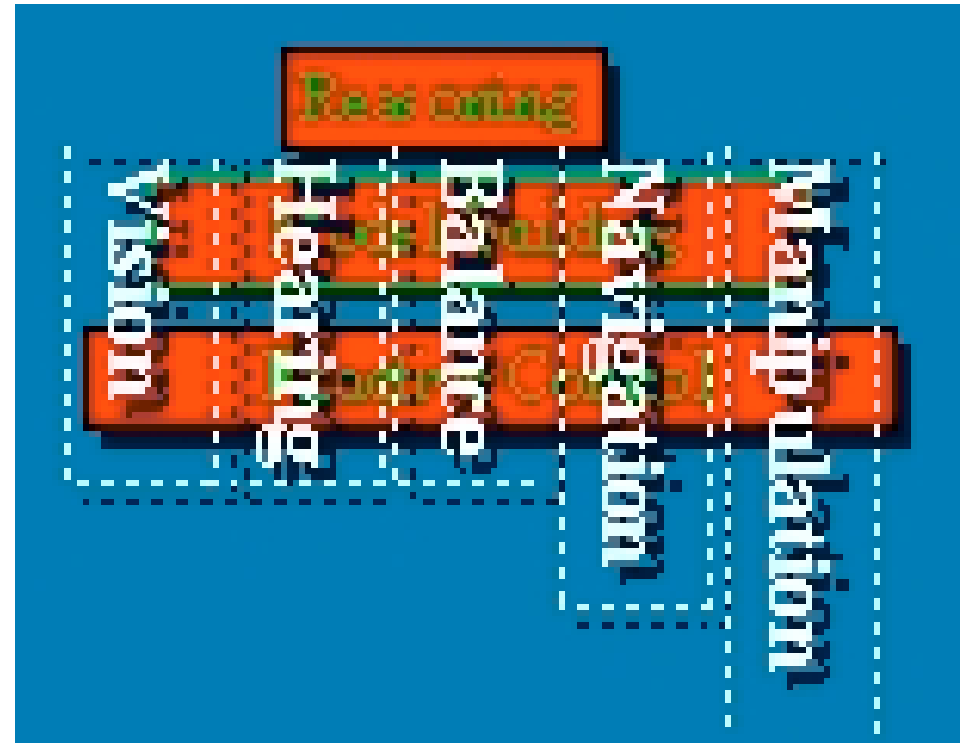


Specifics

- **Inexpensive techniques**
 - PC + micro-controllers + FPGA/FPAA boards for Lattice Corporation
 - R/C servos
 - Serial communication
 - Standard Intel Cameras
 - 3-D mouse for balance
- **A mixture of Lisp and Visual C++**

Control Architecture

- *Reasoning*
- *Model Building*
- *Reactive Control*



Differs from human

Senses

- **Vision**
- **Hearing**
- **Balance**
- **Pressure sensors**
- **(Cannot smell and taste..:)**

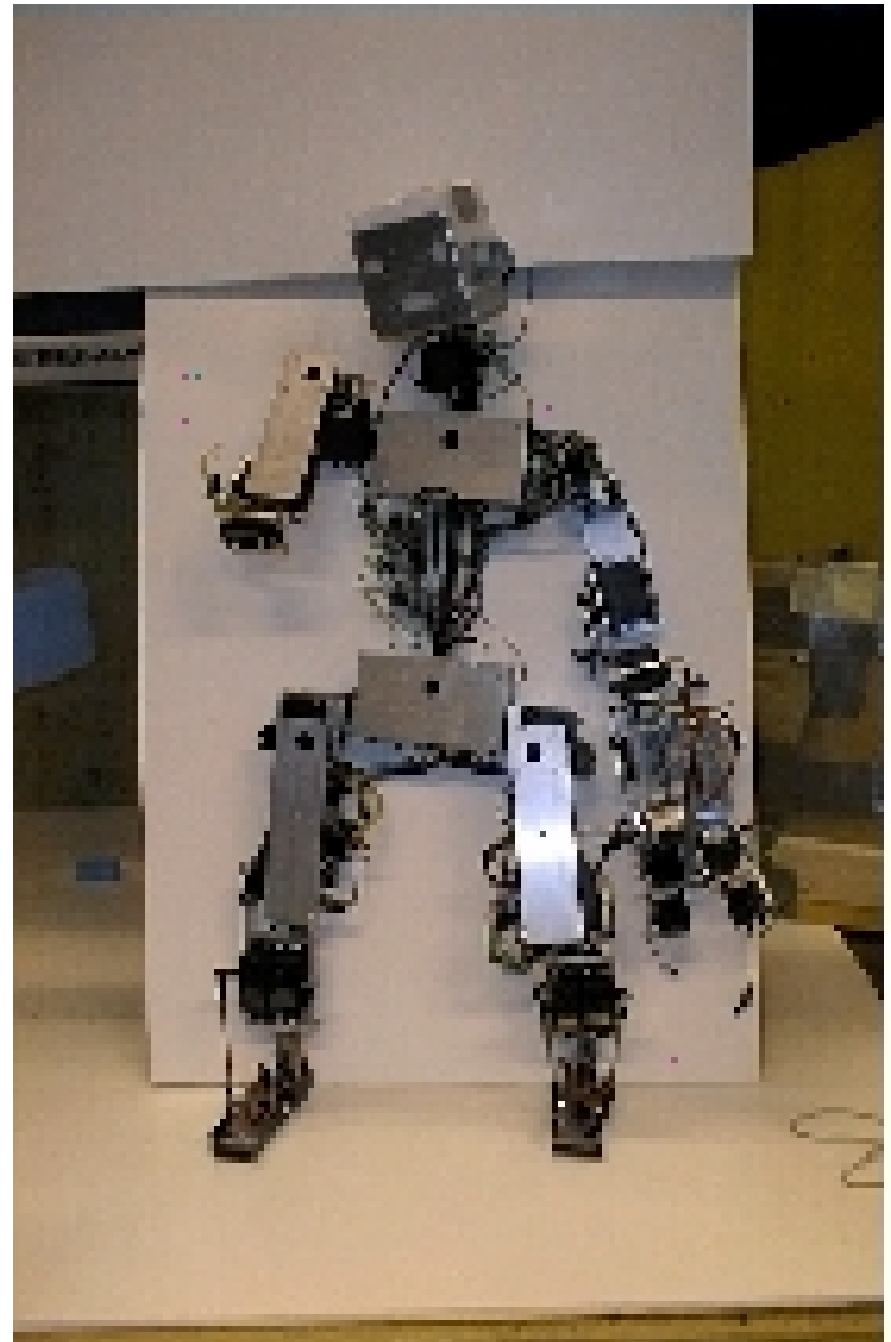
Experiments

- **Balance**
- **Walking**
- **Navigation**
- **Hearing**
- **Vision**
- **Manipulation**
- **Planning**

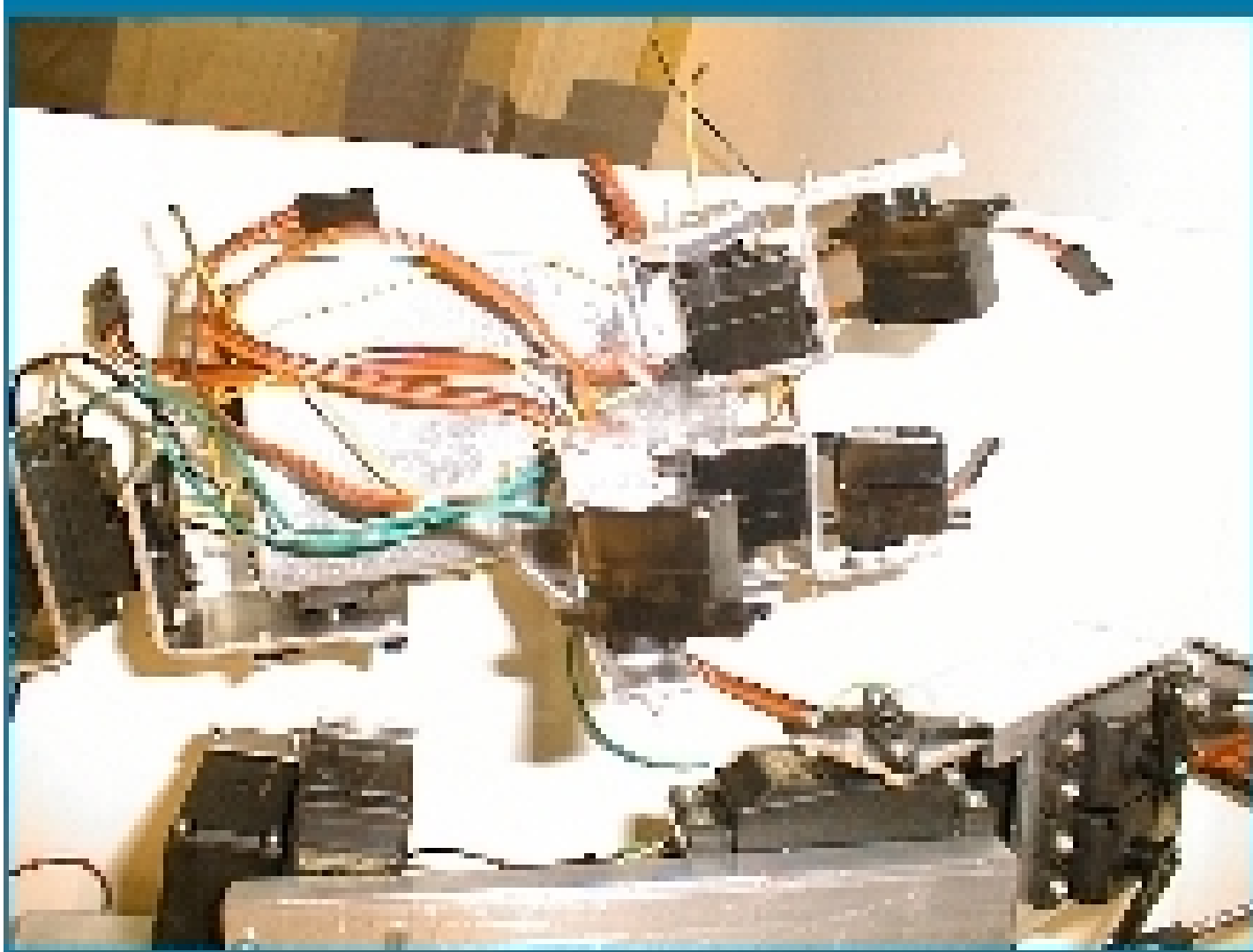
Experimental set-up of Elvis



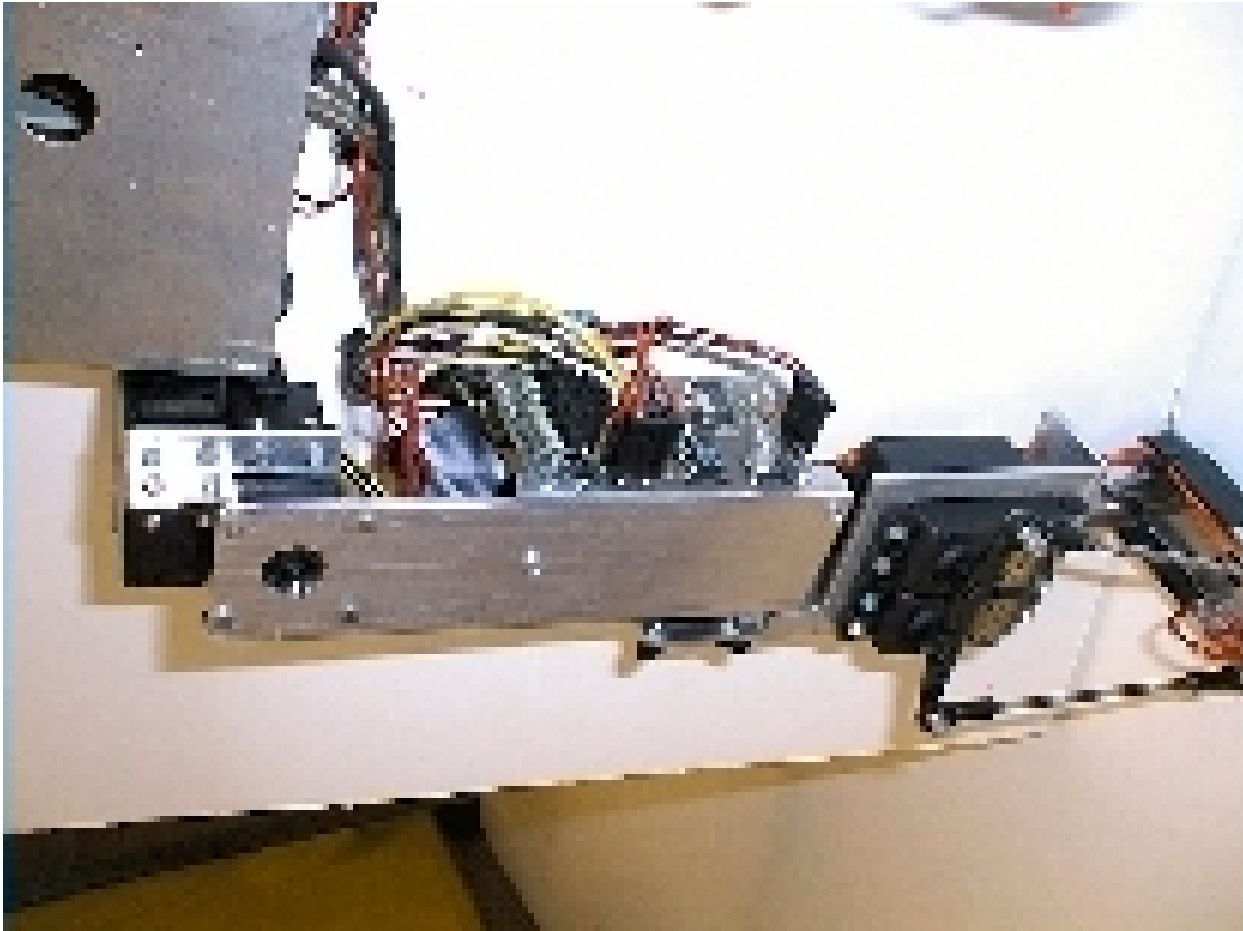
Give me a hand...



Hand..two fingers and a thumb...



Controller card on leg





Foot

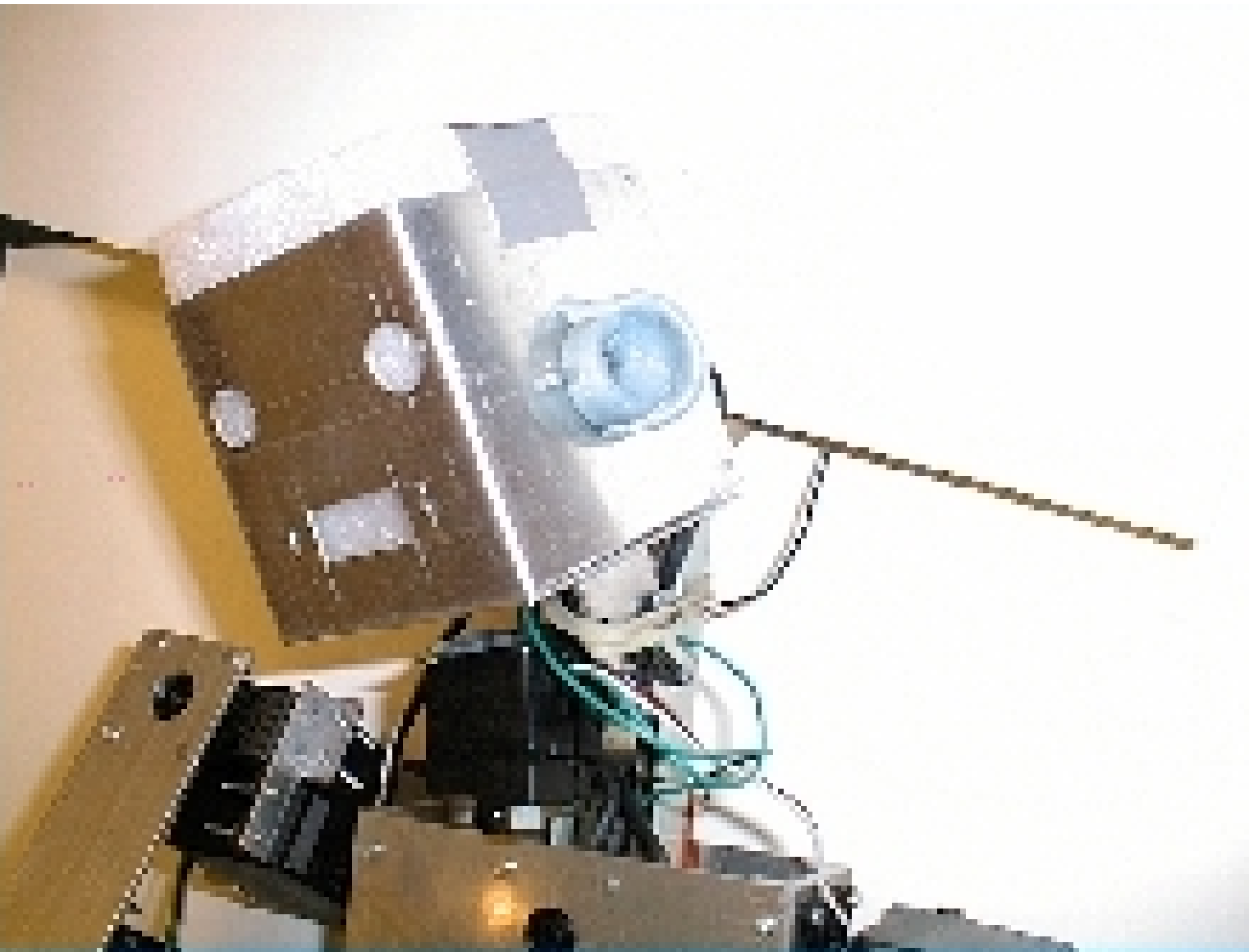
Balance

- **Two Electronic Gyros**
- **(From 3-D mouse)**

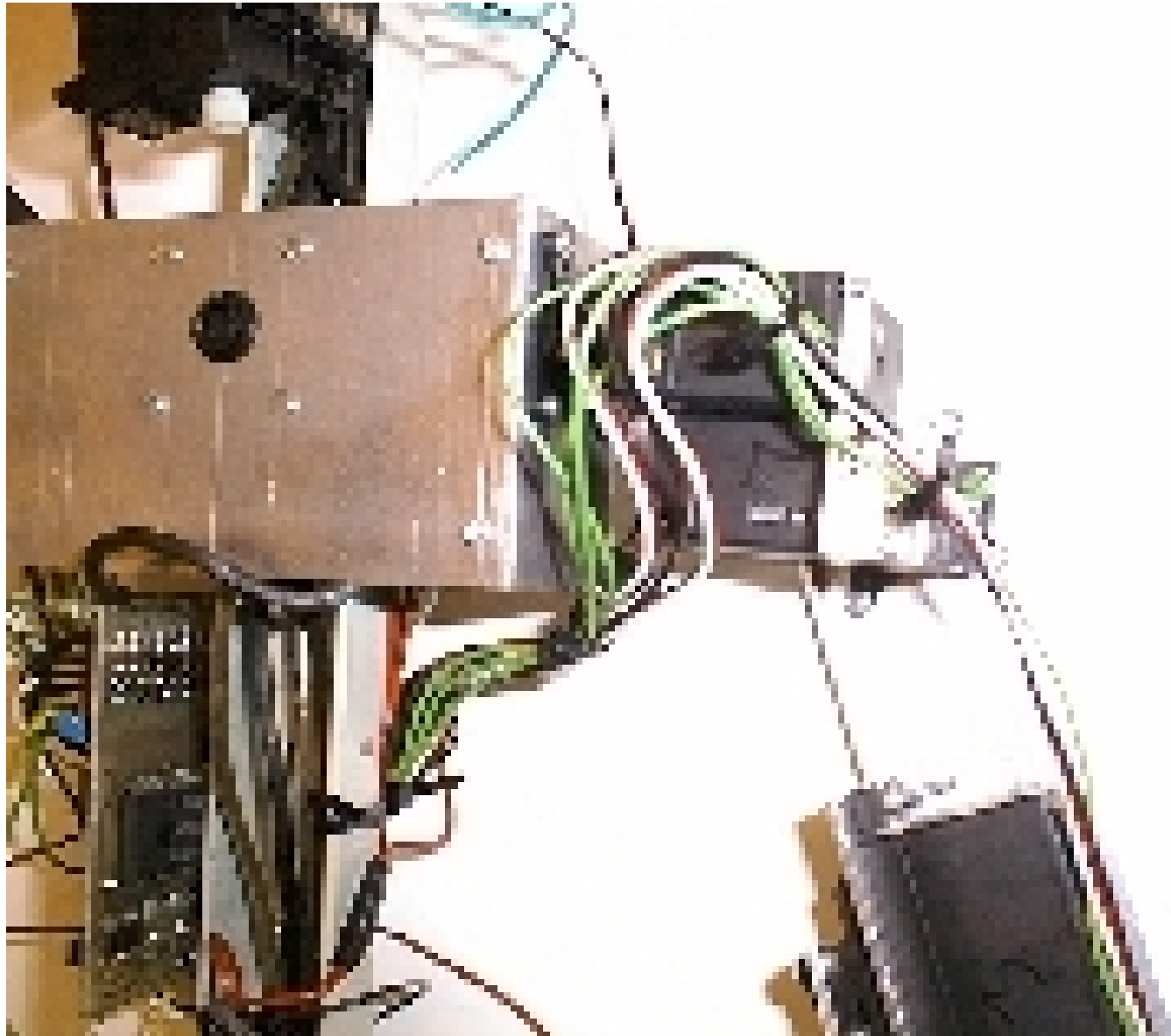
Knee



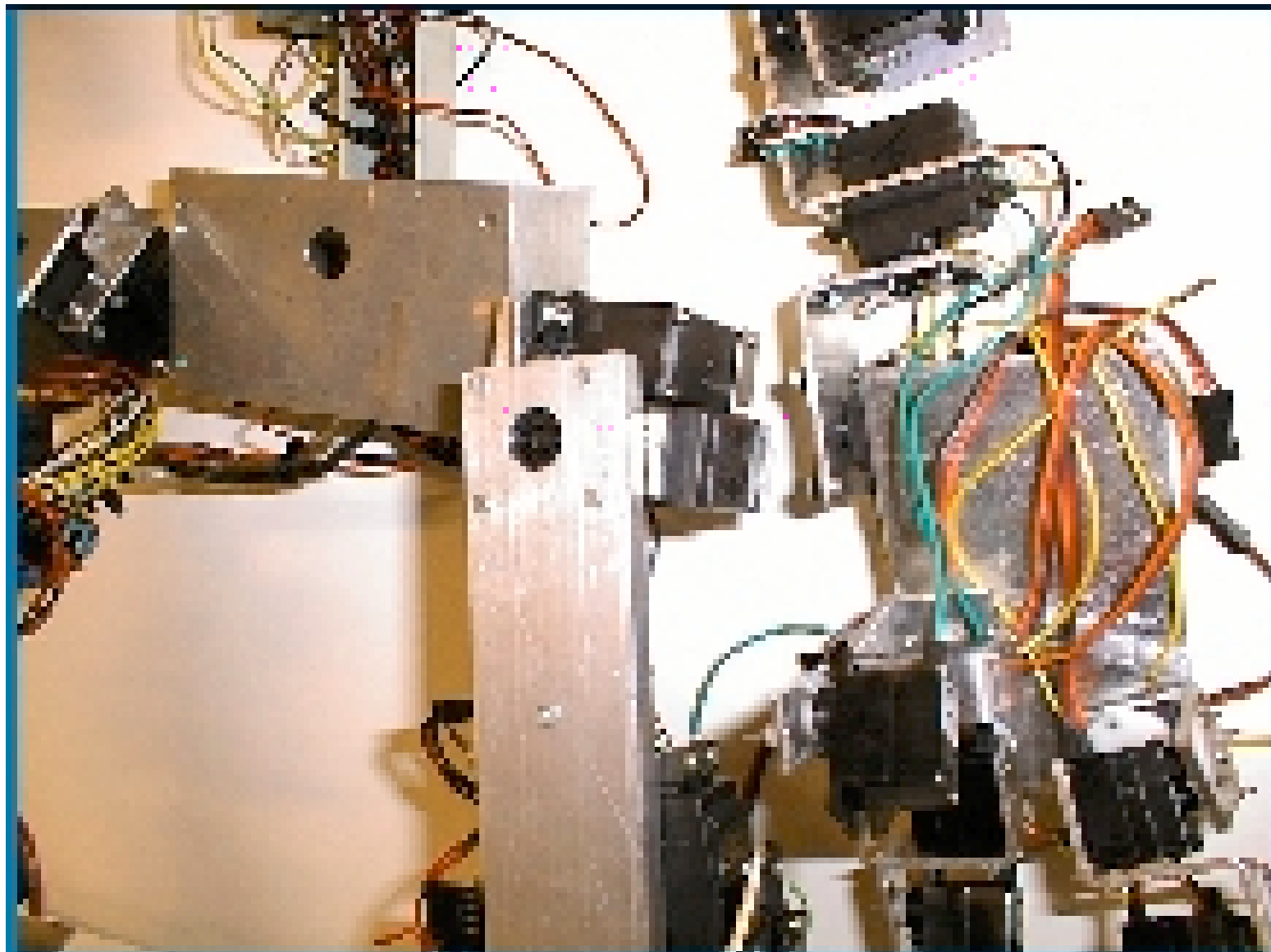
Head and ears:



Shoulder

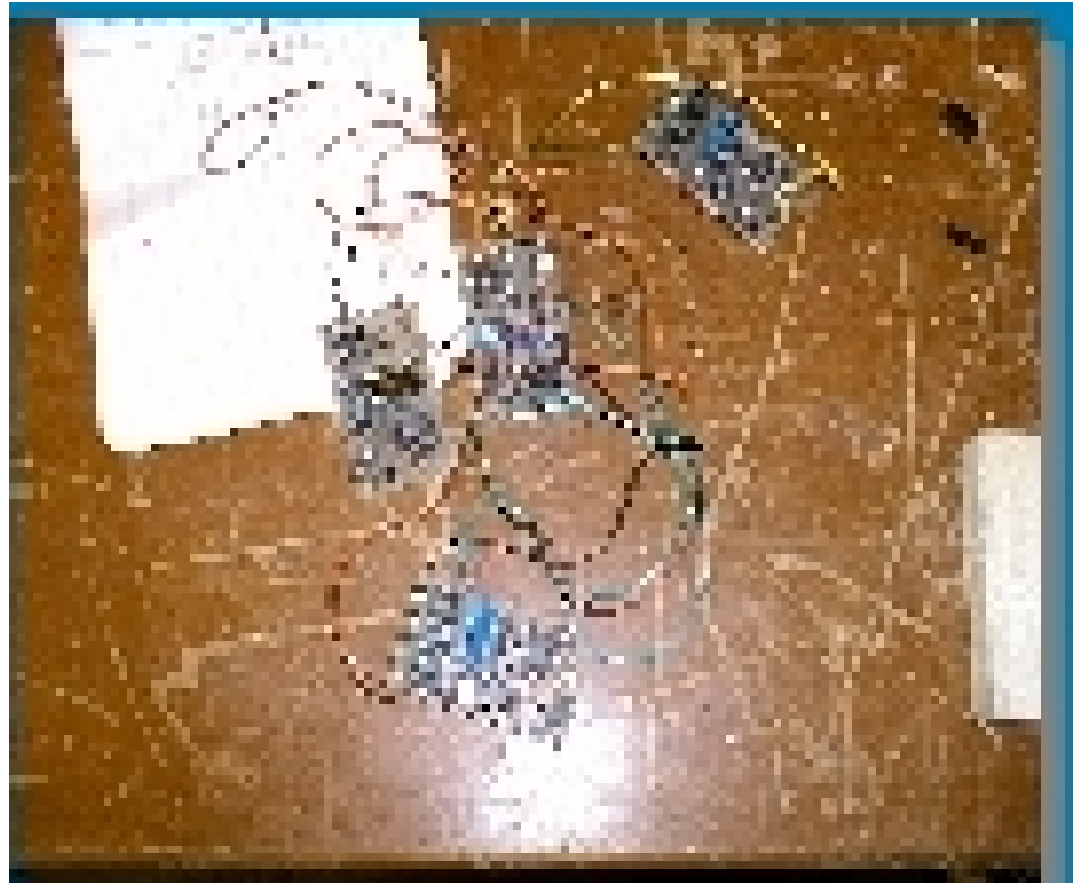


Hip and arm



Controller card

- **Own construction**
- **Controls 8 servos**
- **Read 8 A/D ports**
- **Serial communication**
- **Cascade serial bus**
- **Can close servos down**



Experiments

- **Balance (First experiments performed)**
- **Hearing (Direction of sound)**
- **Vision (3-D Map)**
- **Planning (Path planning)**

Conclusions

- **Building humanoid robots is tough but it can be done in University environment**
- **We plan to accomplish several tasks from very simple to very complicated**
- **High school students, hobbyists, undergraduate and graduate students, visiting specialists and faculty will be working arm-by-arm to accomplish practical goals.**