

HUMANOID ROBOTS



**Massachusetts
Institute of
Technology**

Marcelo Anjos
presented





Practical in Humanoid Robotics

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University National of Asuncion

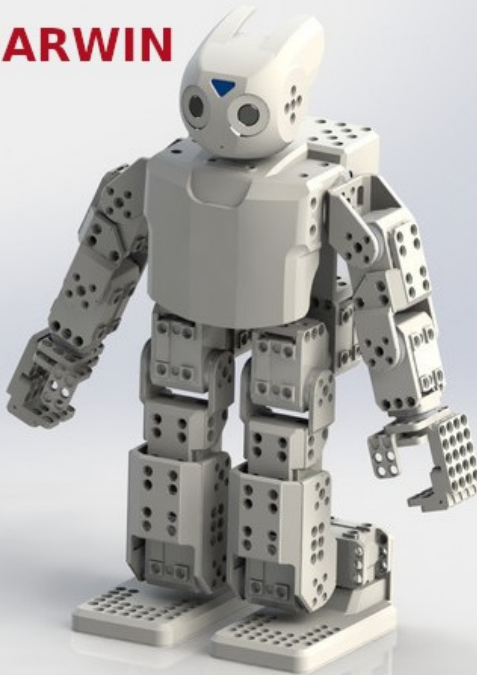


About Me

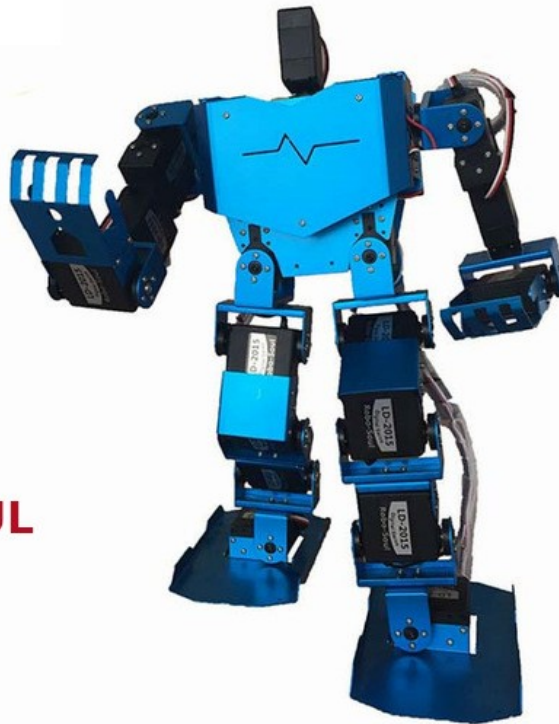
- Maker for hobby
 - Electronic Engineer
 - Software and Computer Engineer
 - Finishing my PHD in Computer Sciences

Motivation

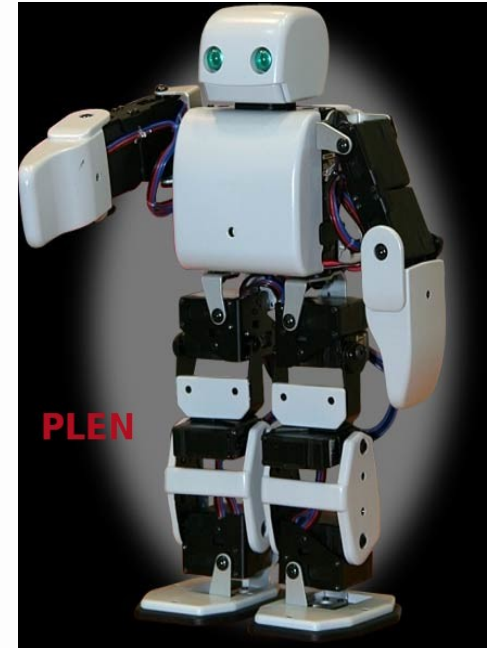
DARWIN



SOUL



PLEN





Humanoid Robot

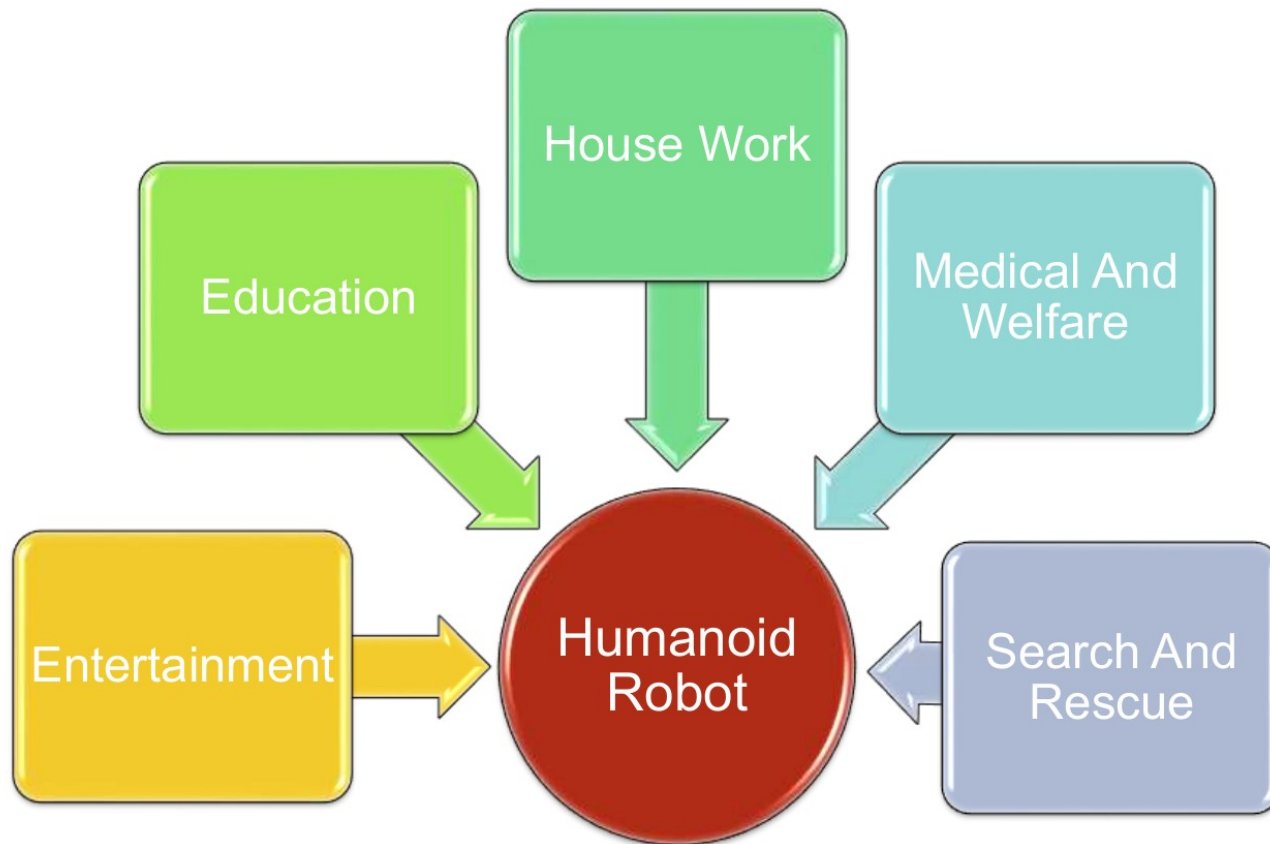
- Humanoid ?.

But it is also a robot made to resemble a human both in appearance and behavior





Humanoid Robot Applications



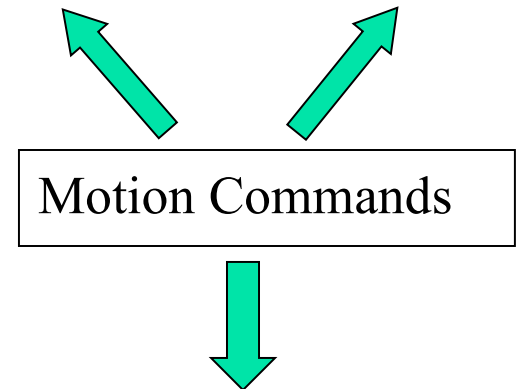


Why do we need a motion specification?

- Difficulties for researchers in robotics:
 - Industrial copyright
 - Programs are not re-usable in different robot families, even different versions of same robot families
 - Have to choose OS based on the drivers provided
 - Not easy to share a robot remotely with other collaborators in different locations

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

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are needed to see this picture.



Windows? Linux? Mac OS?
Embedded OS?



Project goals OpenSource OpenHardware

- Whatever: (cross-model)
 - Provide a network-enabled interface for independent of the controller libraries
 - Access to other robots & simulators.
- Whoever: (cross-platform)
 - User interface must be cross-platform: support Linux, Mac OS X and Windows.
- Wherever: (cross-network)
 - Good quality of service across the Internet.

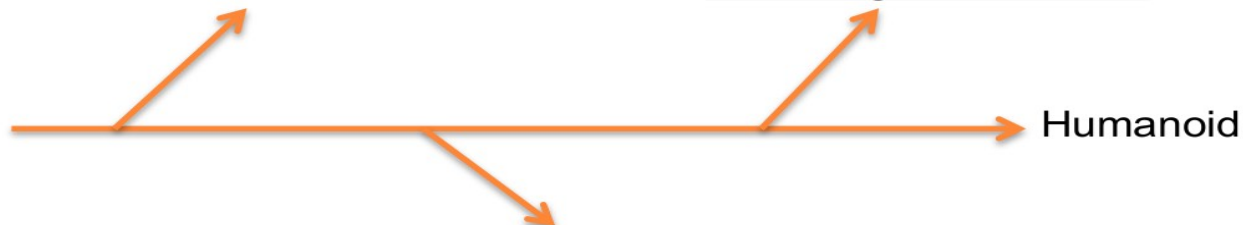


Basic Components of Humanoid

Sensors

- Proprioceptive sensors
- Exteroceptive sensors
- Proximity sensors
- Tactile sensors
- Vision sensors
- Sound sensors

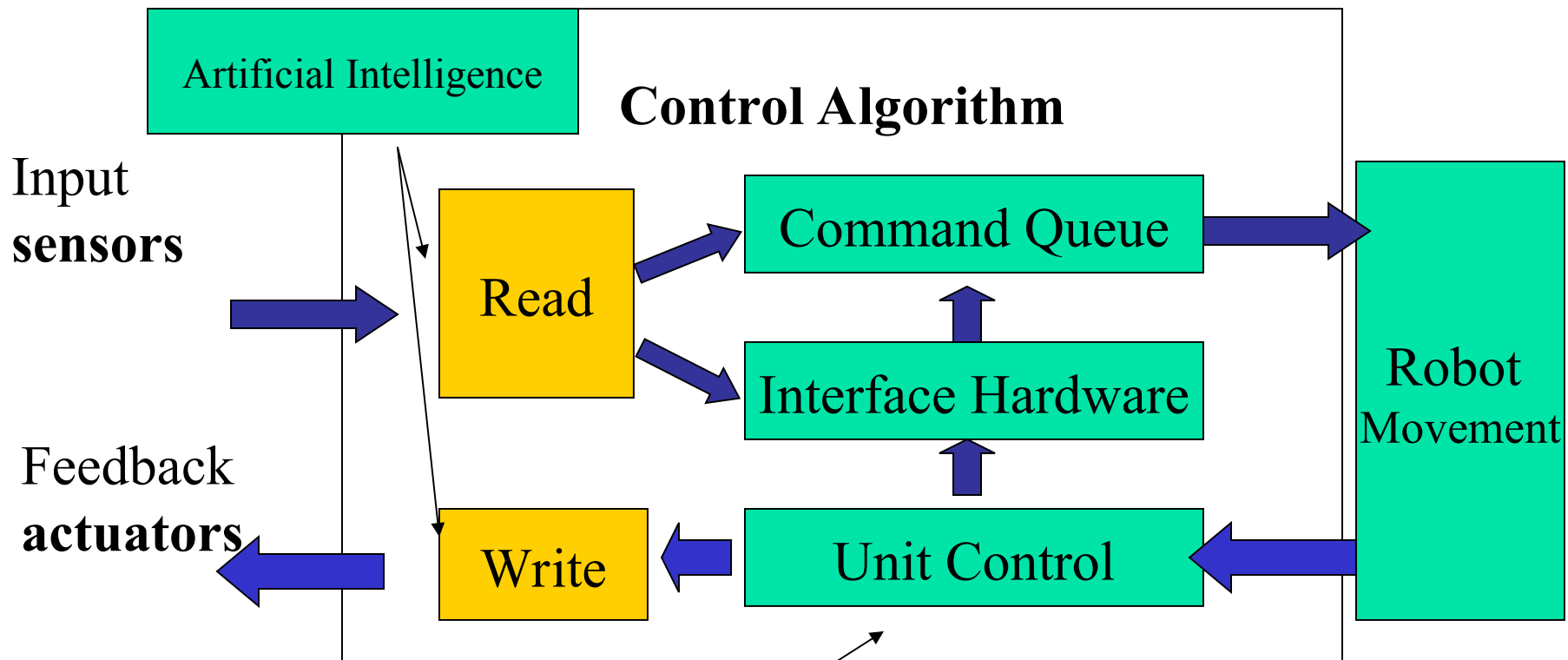
Planning and Control



Actuators

- Hydraulic and electric actuators
 - ☐ DC motor
 - ☐ Stepper motor
 - ☐ A Servo motor
- Piezoelectric actuators
- Ultrasonic actuators
- Pneumatic actuators

Architecture

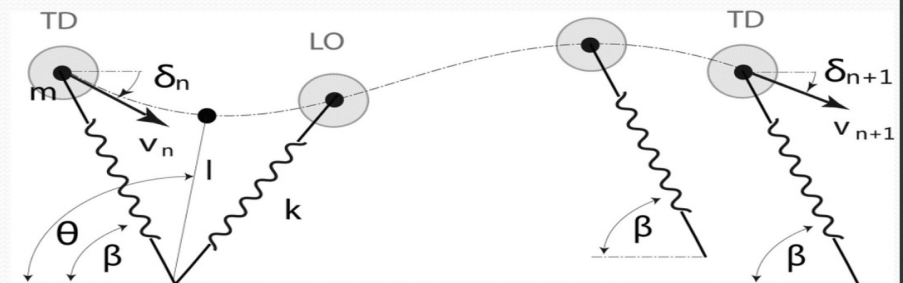
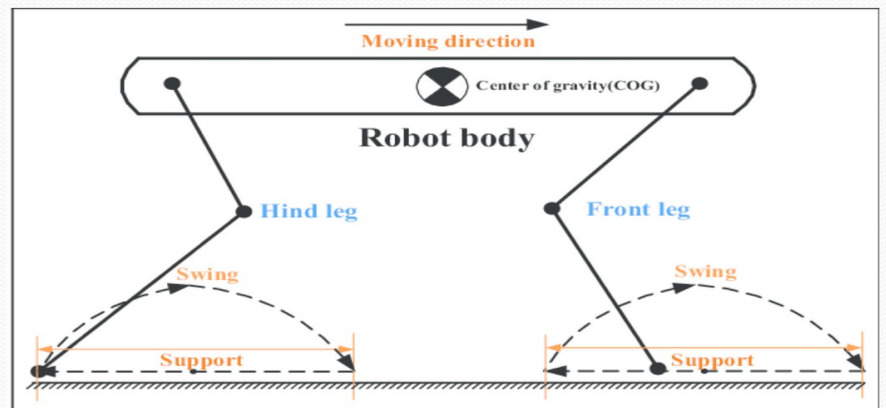


3D Choreography Programs

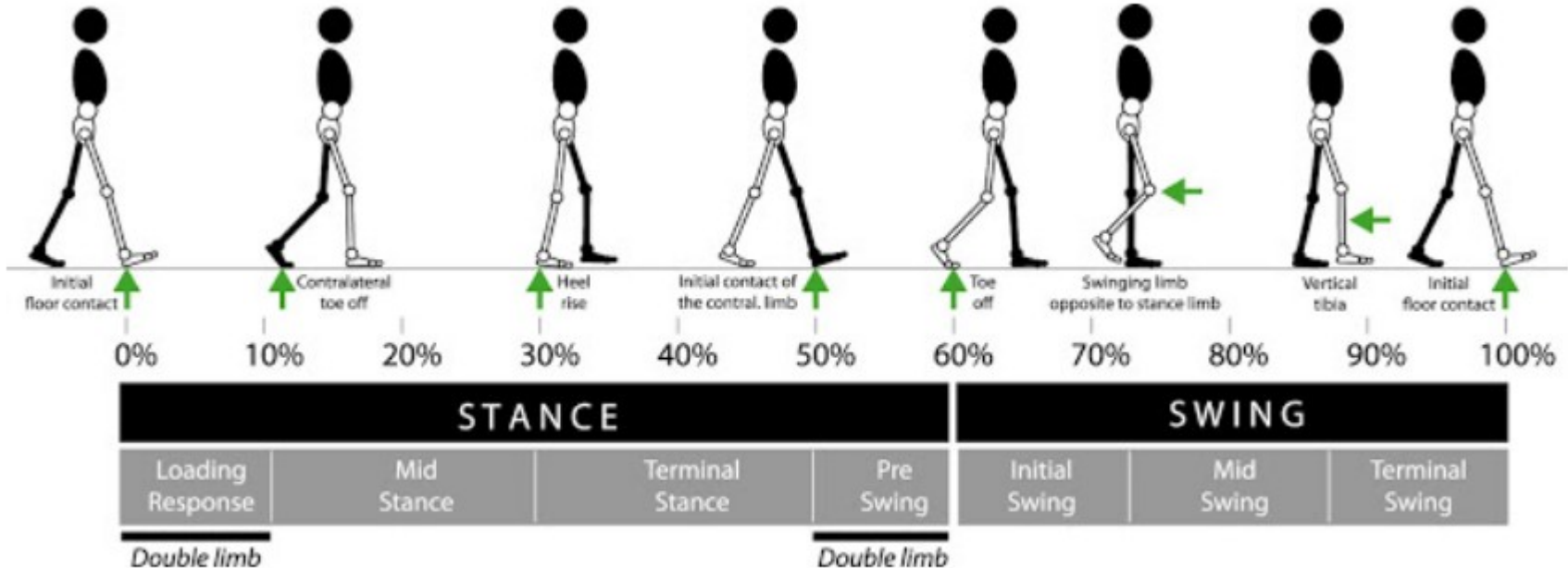
Locomotion – Walking Video

LEGGED LOCOMOTION

- Legged locomotion is much easier to accomplish (and much safer to develop and test) on smaller humanoids.
- The SDR-4X was recently developed by Sony as a domestic robot capable of handling uneven surfaces and stairs on the fly.
- Honda's P3 humanoid.
- Honda now has another smaller and lighter android known as P3.

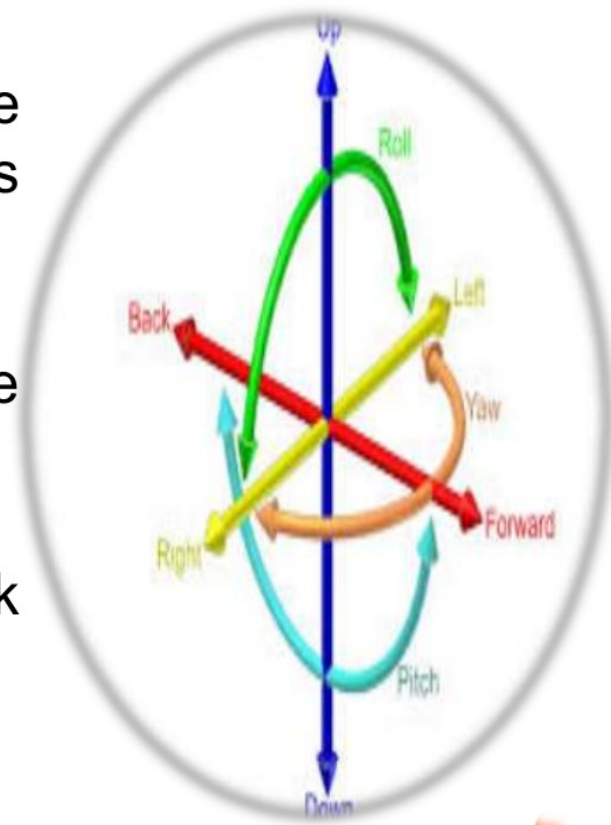


Locomotion



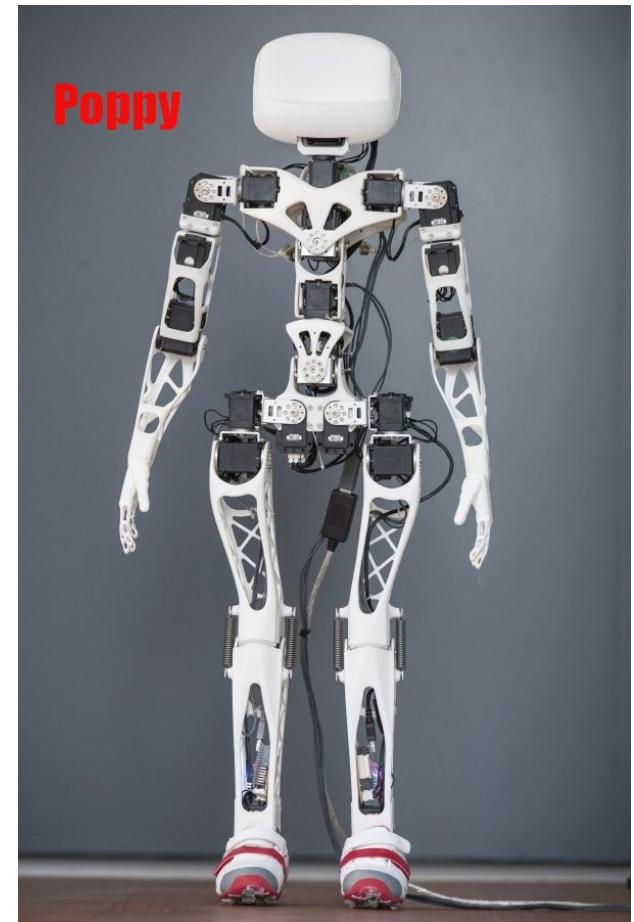
Degree of Freedom (DOF)

- The degrees of freedom is the number of independent parameters that define its configuration.
- The term is widely used to define the motion capabilities of robots.
- Consider a robot arm built to work like a human arm.



Prices for Human Sizes Robots

- Poppy Child Kit
 - +- 9.000 u\$\$
- Big Size Servo Motor
- $20 \times 2.000 \text{ U}\$\$ = 40.000 \text{ u}\$\$.$



Parts - Kits and Prices.



SOUL

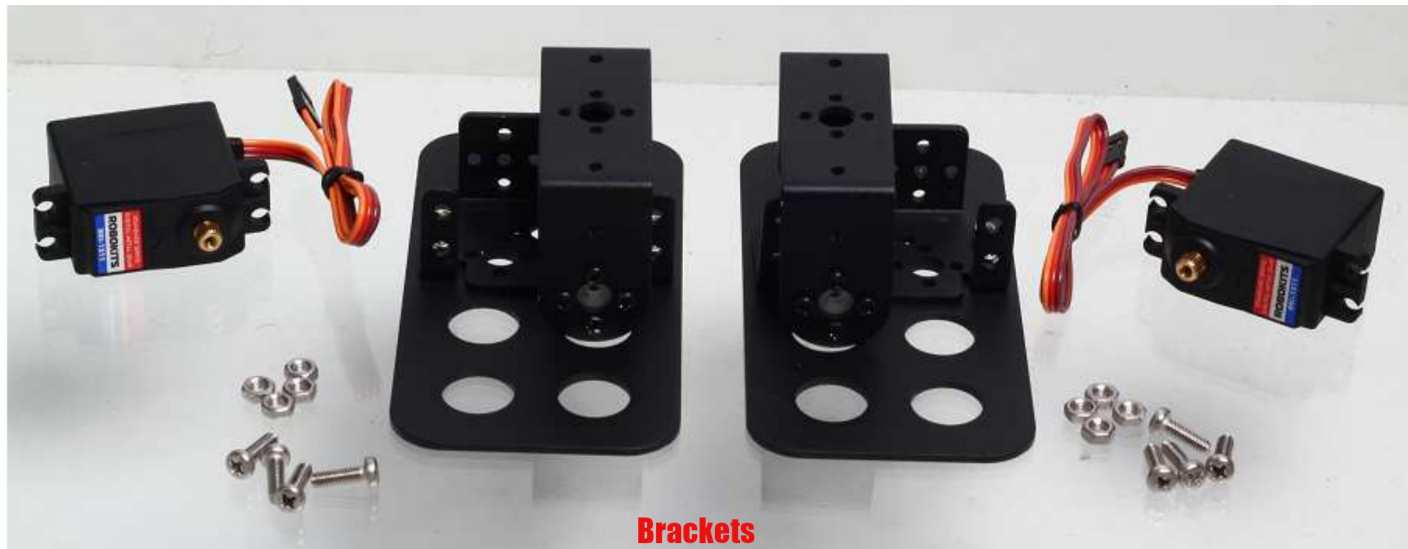


DARWIN



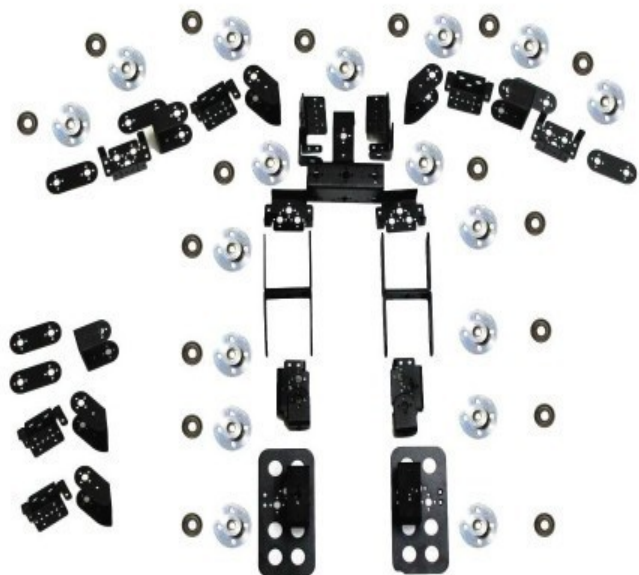
Plen2

Parts

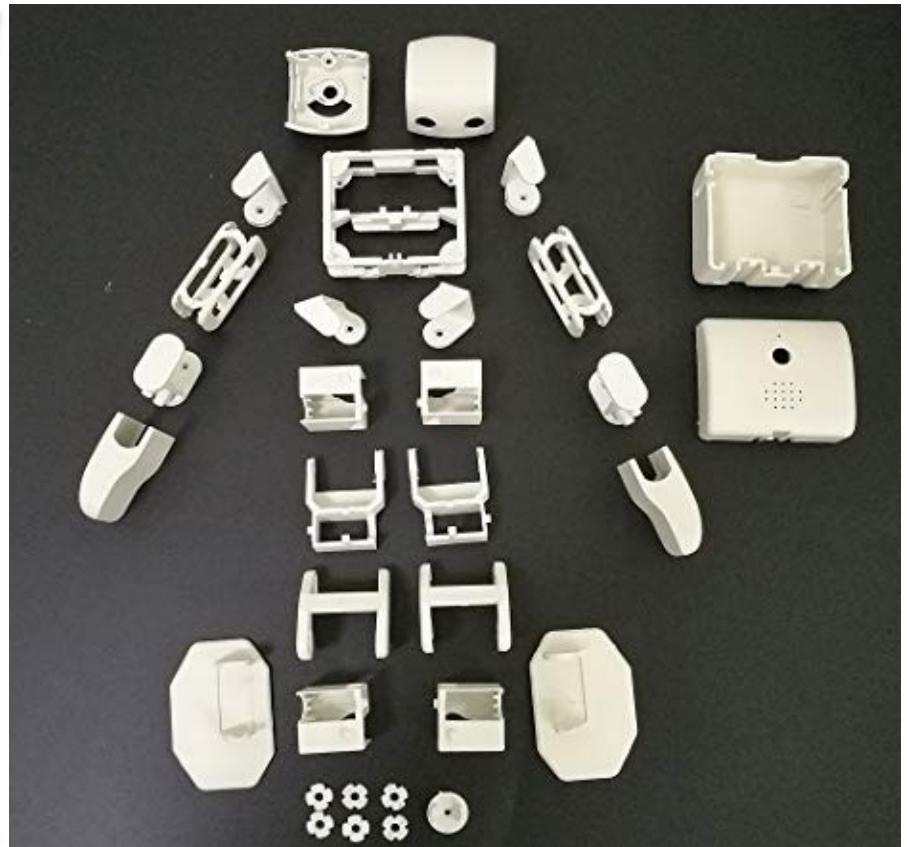


Parts

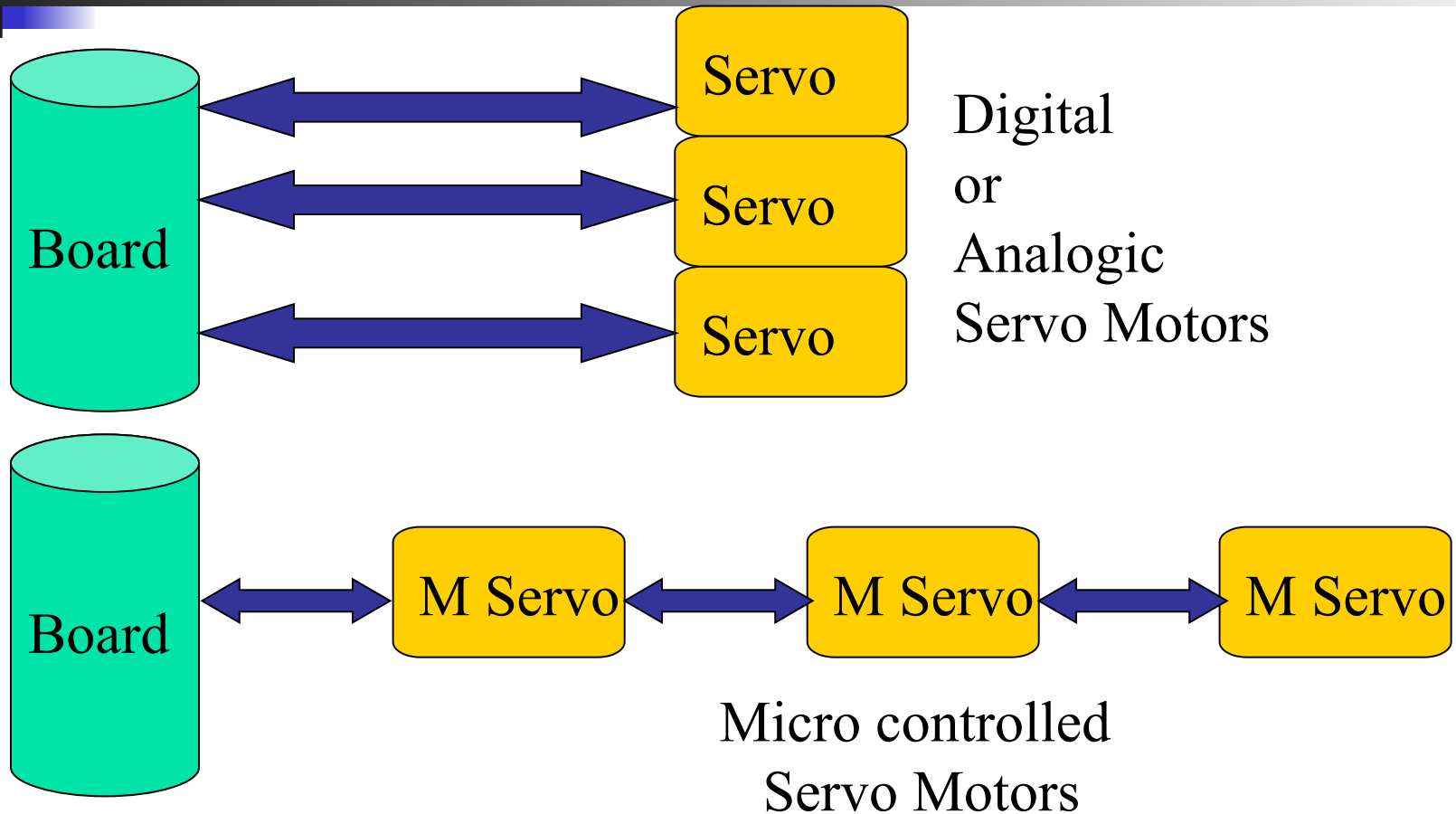
Aluminum



Parts



Servo Motor

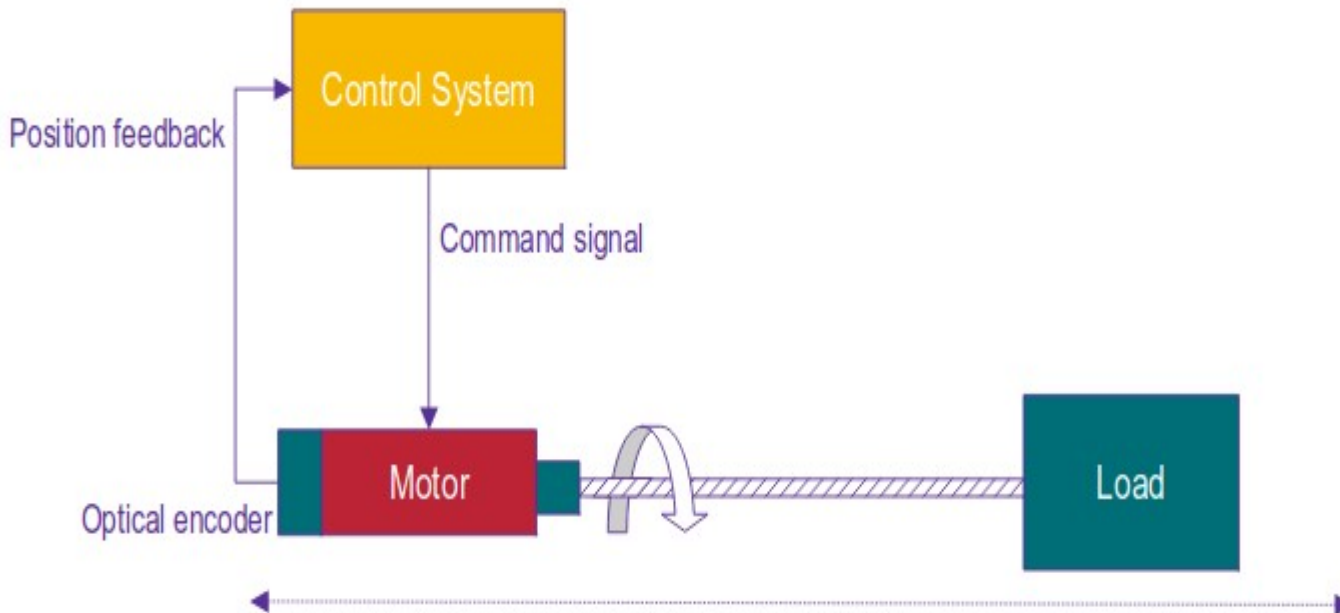




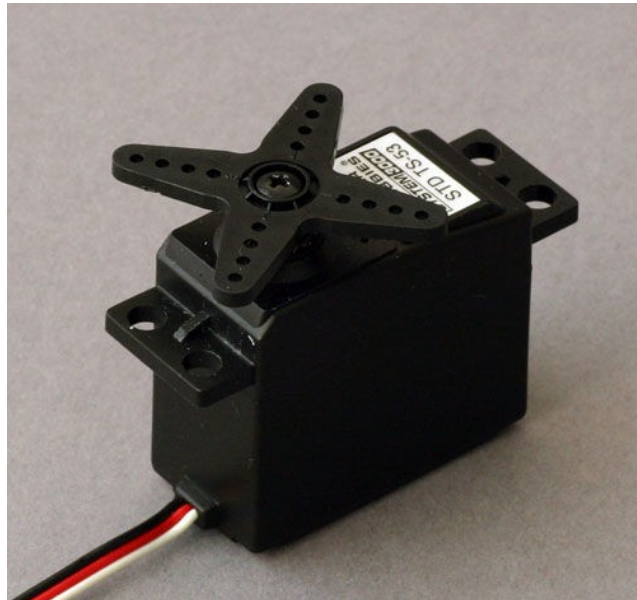
Micro controlled Servo Motor with PID

- PID is the most commonly used servo control algorithm:
 - Proportional
 - Integral
 - Derivative
- PID systems can be understood by way of analogous physical models.

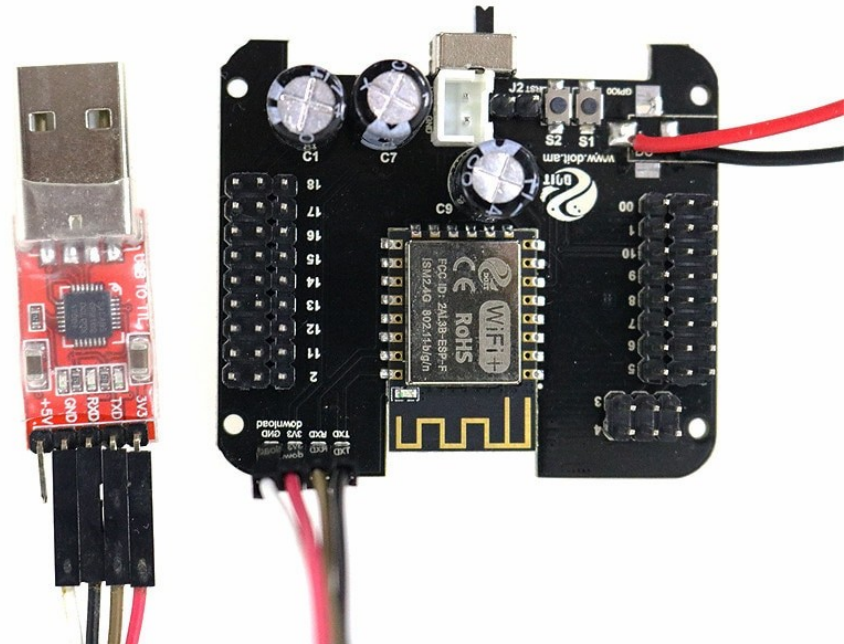
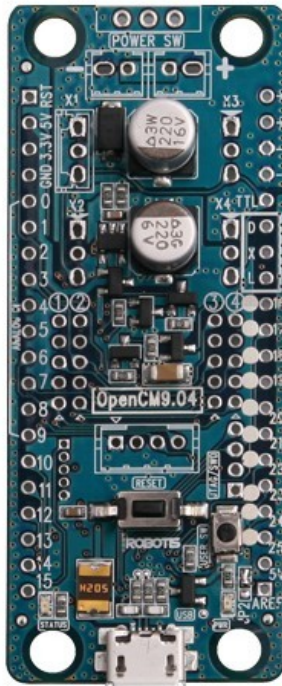
Micro controlled Servo Motor with PID



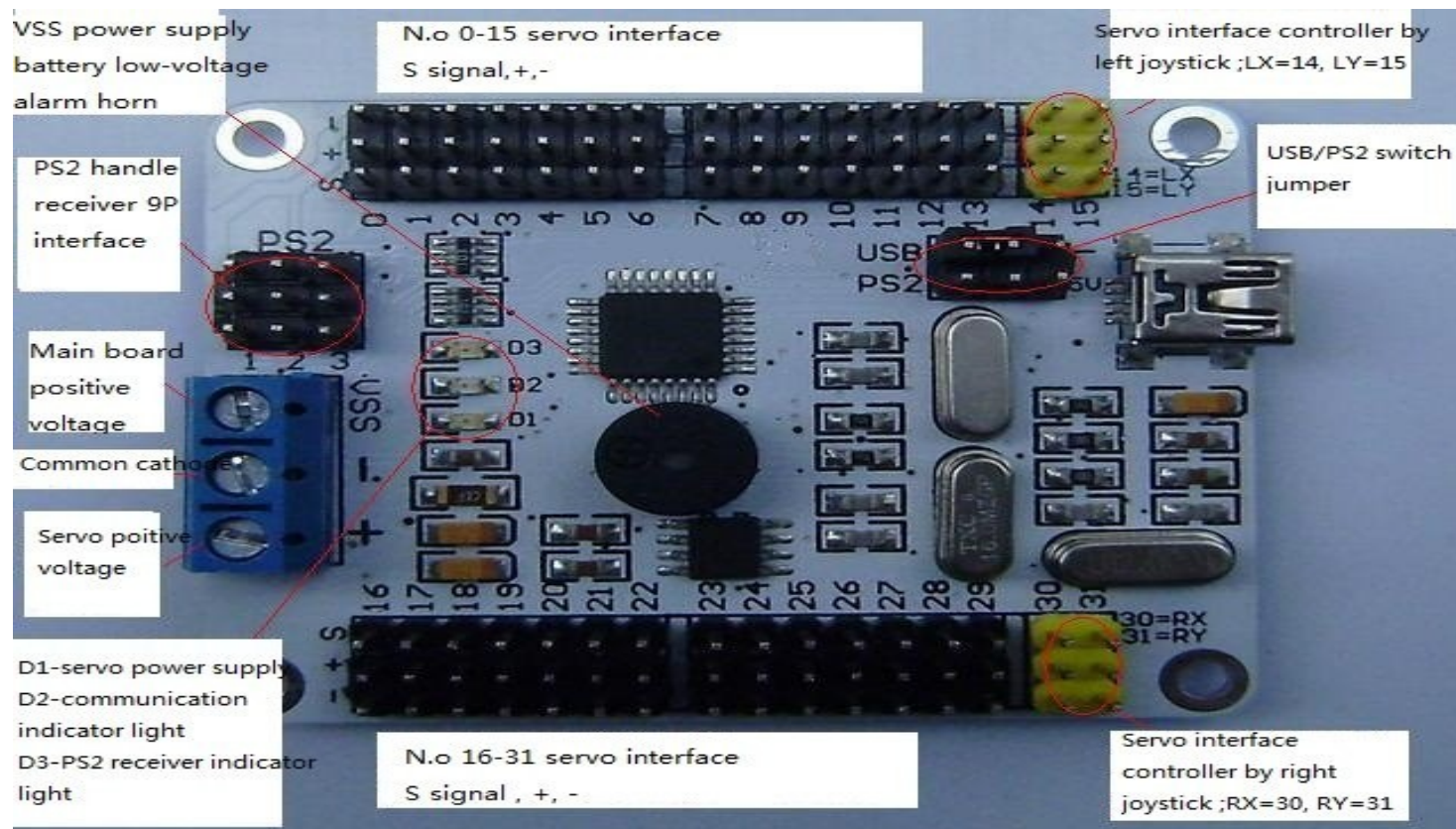
Servo Motor – Video and Practical



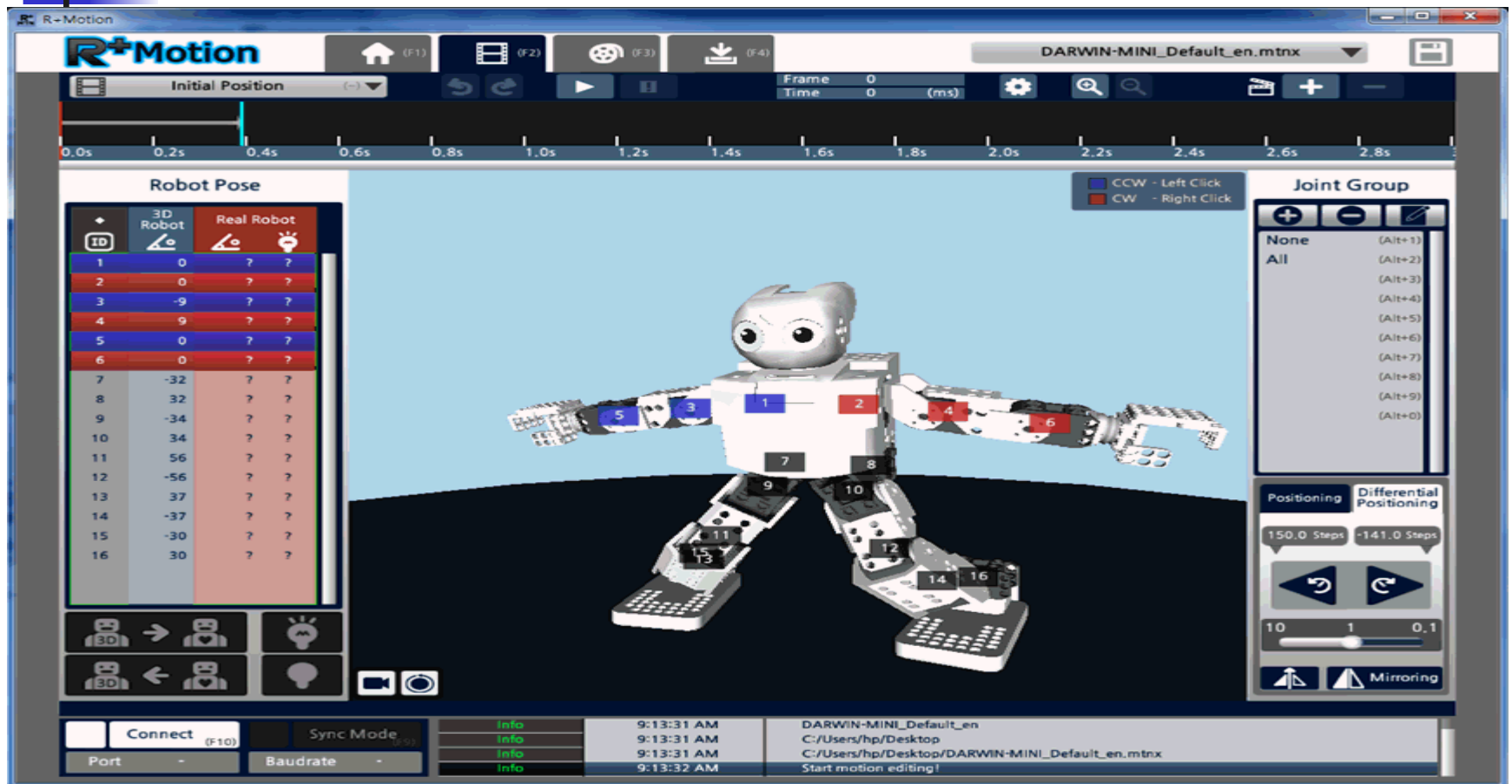
Main Board Control



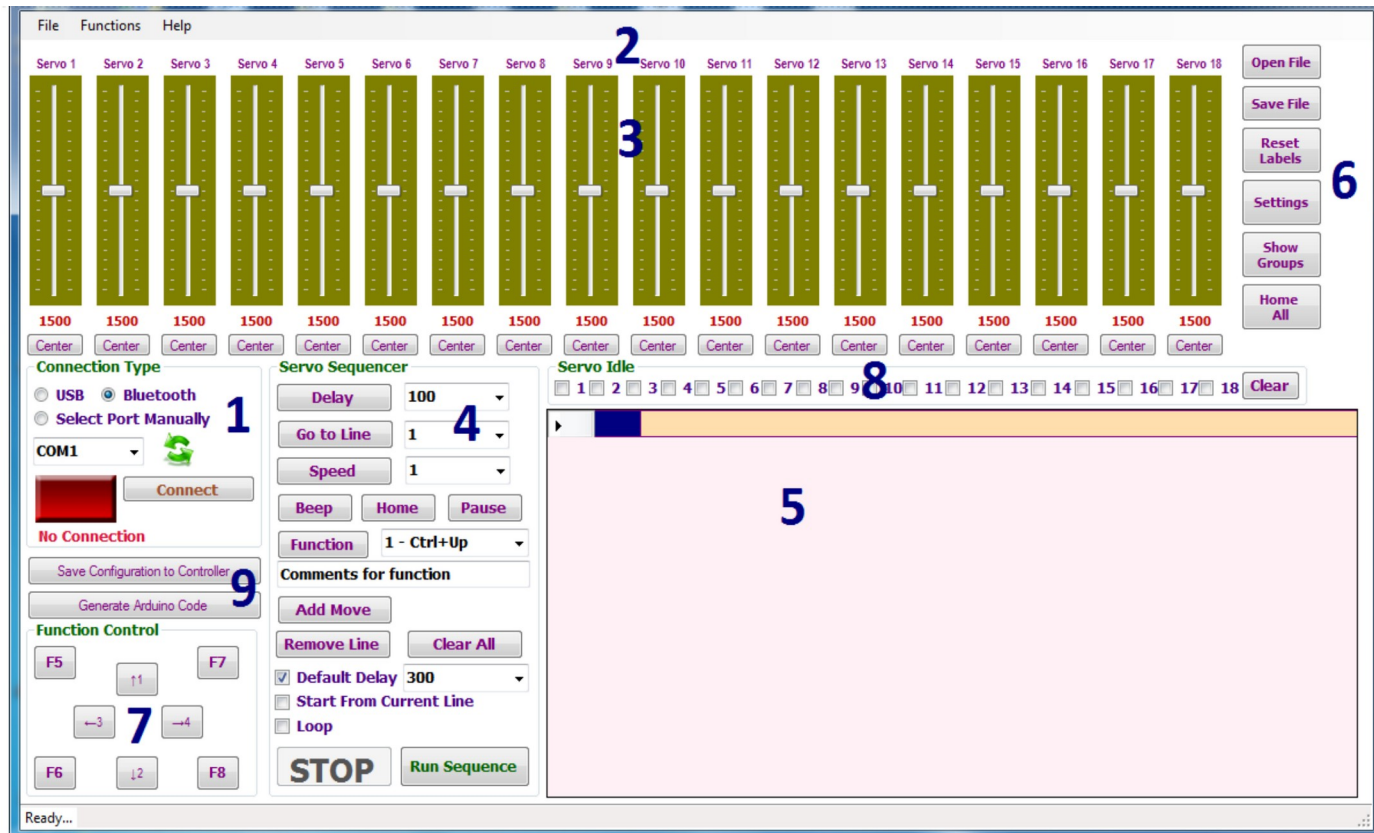
Main Board Control - Practical



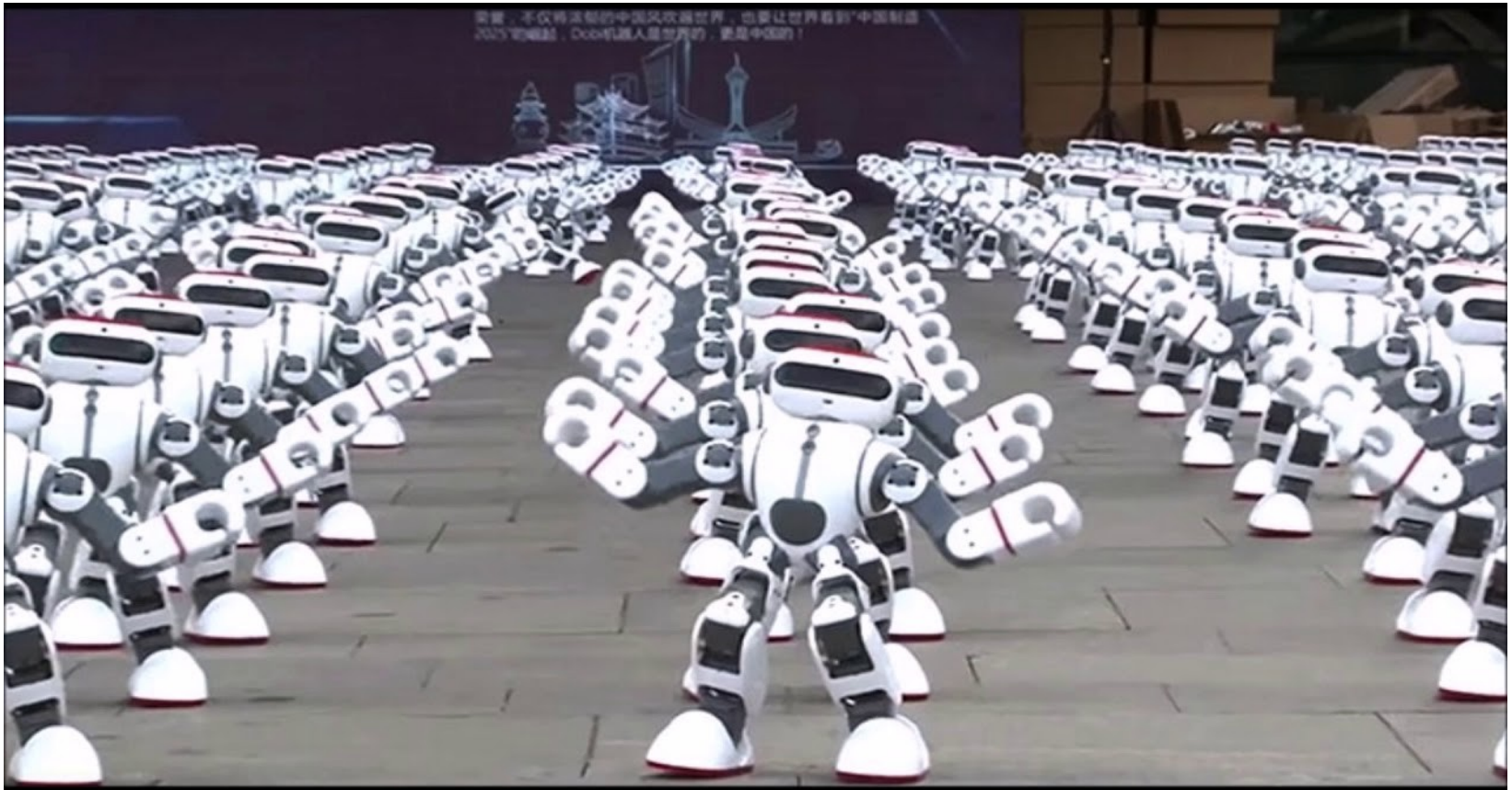
3D Choreography - Practical



Sequencer – Practical



Dancing – Video and Practical





Artificial Intelligence

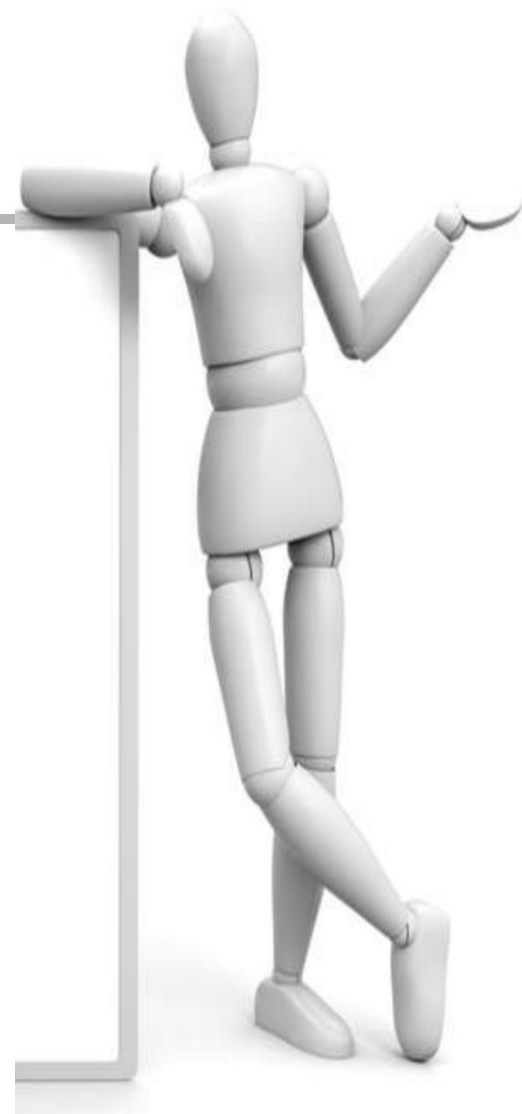
- Borrowing characteristics from human intelligence, and applying them as algorithm a computer friendly way.





Recognition Technology

1. Recognition of moving objects
2. Posture/gesture recognition
3. Environment recognition
4. Sound recognition
5. Face recognition.

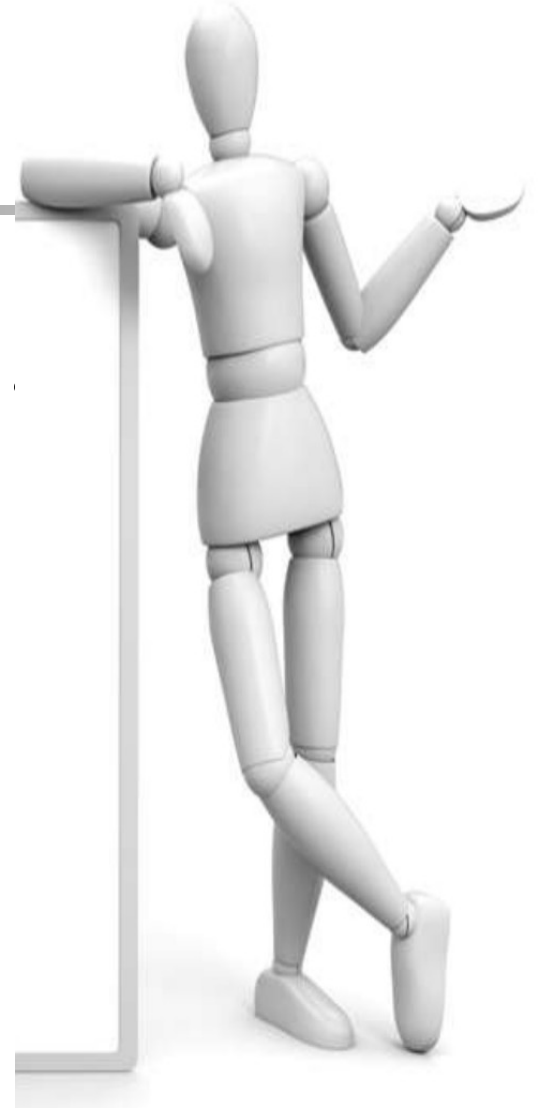




Sound Recognition

Many Robots can distinguish between voices and other sounds.

☞ He can respond to his name, face people when being spoken to, and recognize sudden, unusual sounds such as that of a falling object or a collision, and face in that direction.

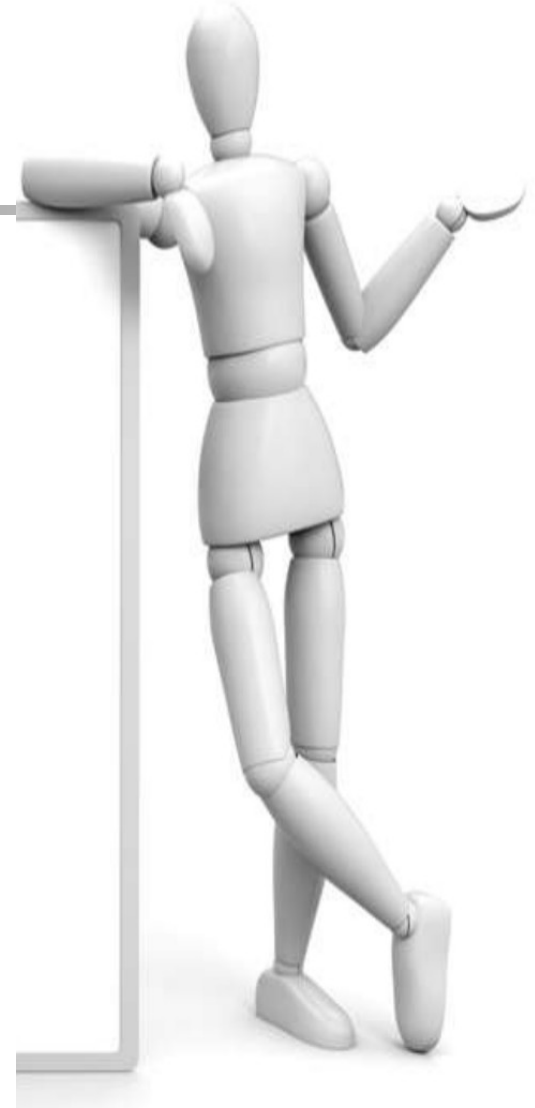




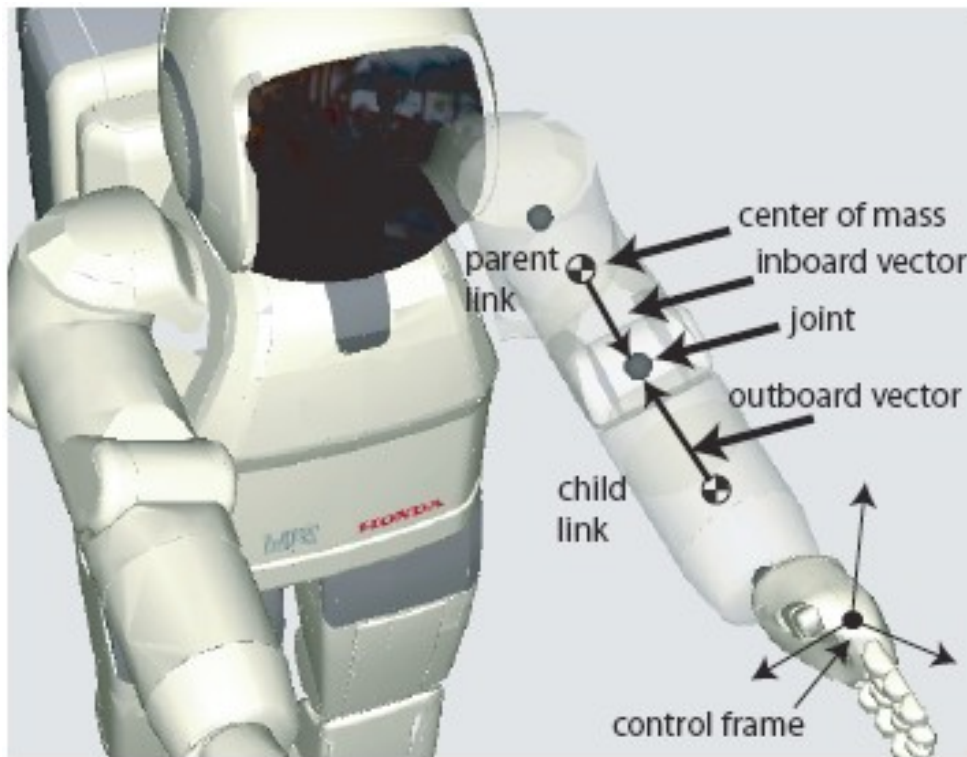
Facial Recognition

Many Robots has the ability to recognize faces, or the human being is moving.

☞ It can individually recognize faces. Once they are registered it can address them by name.



Architecture - Specification Standard



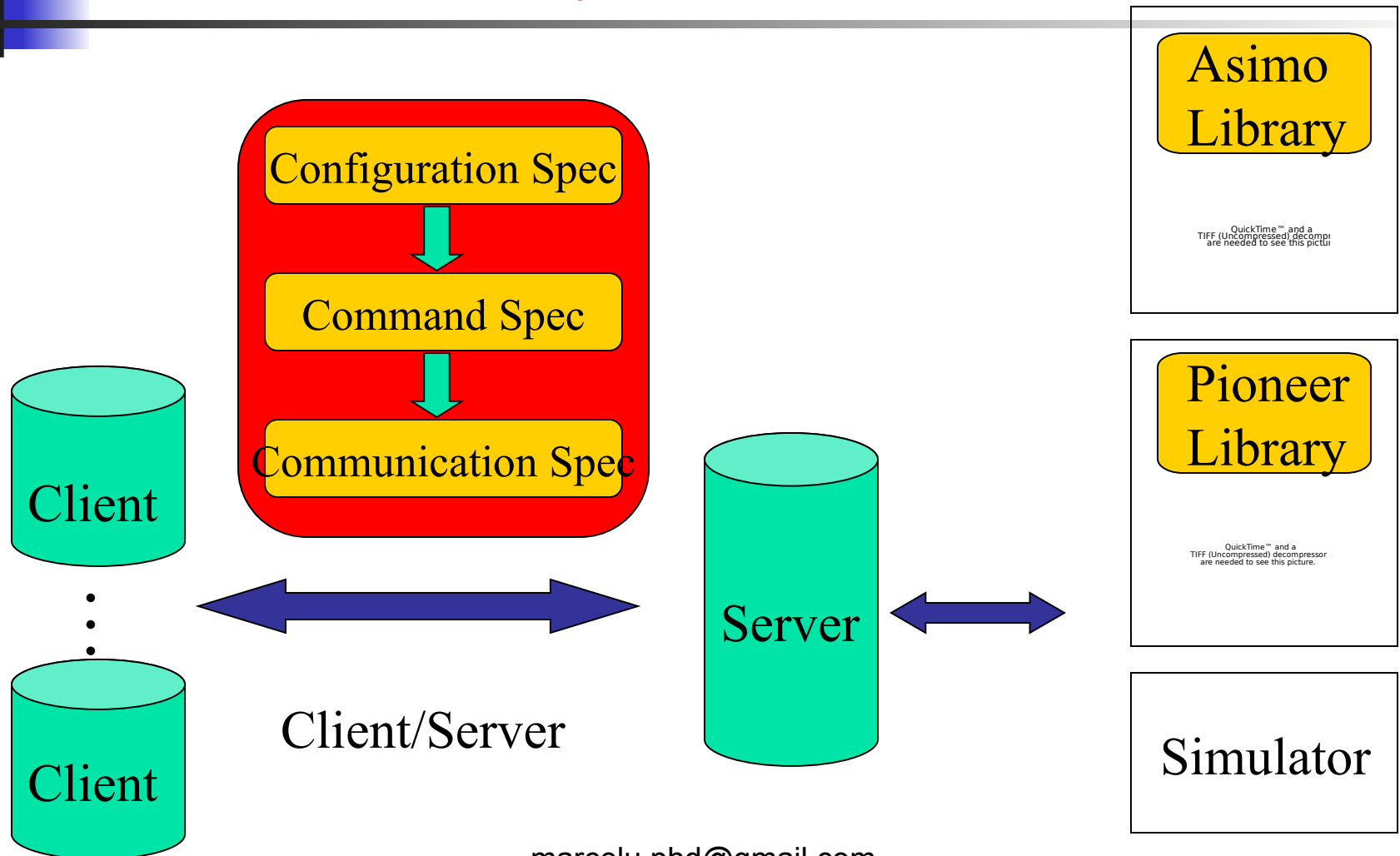
Abstraction

Configuration Spec

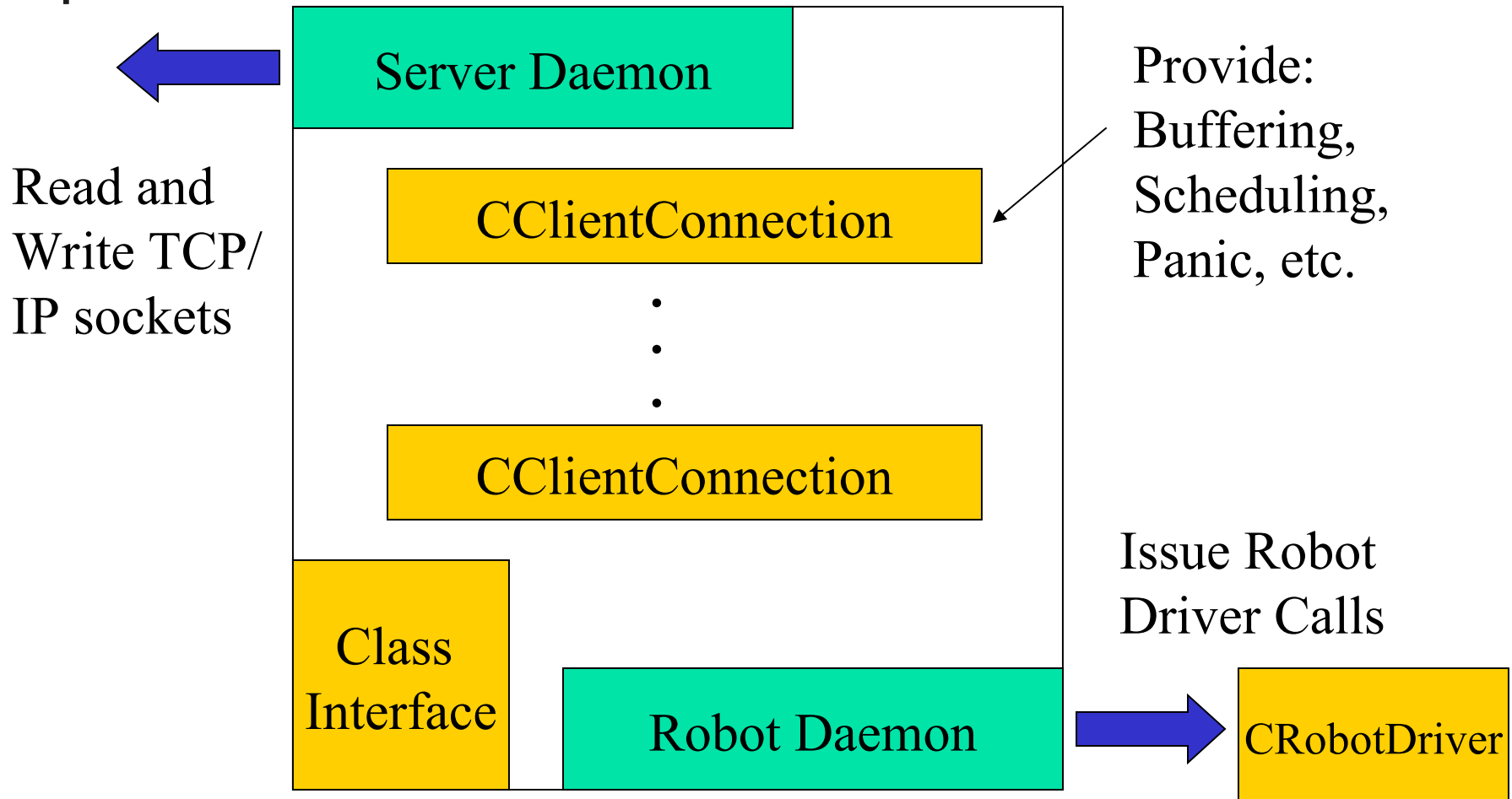
Command Spec

Communication Spec

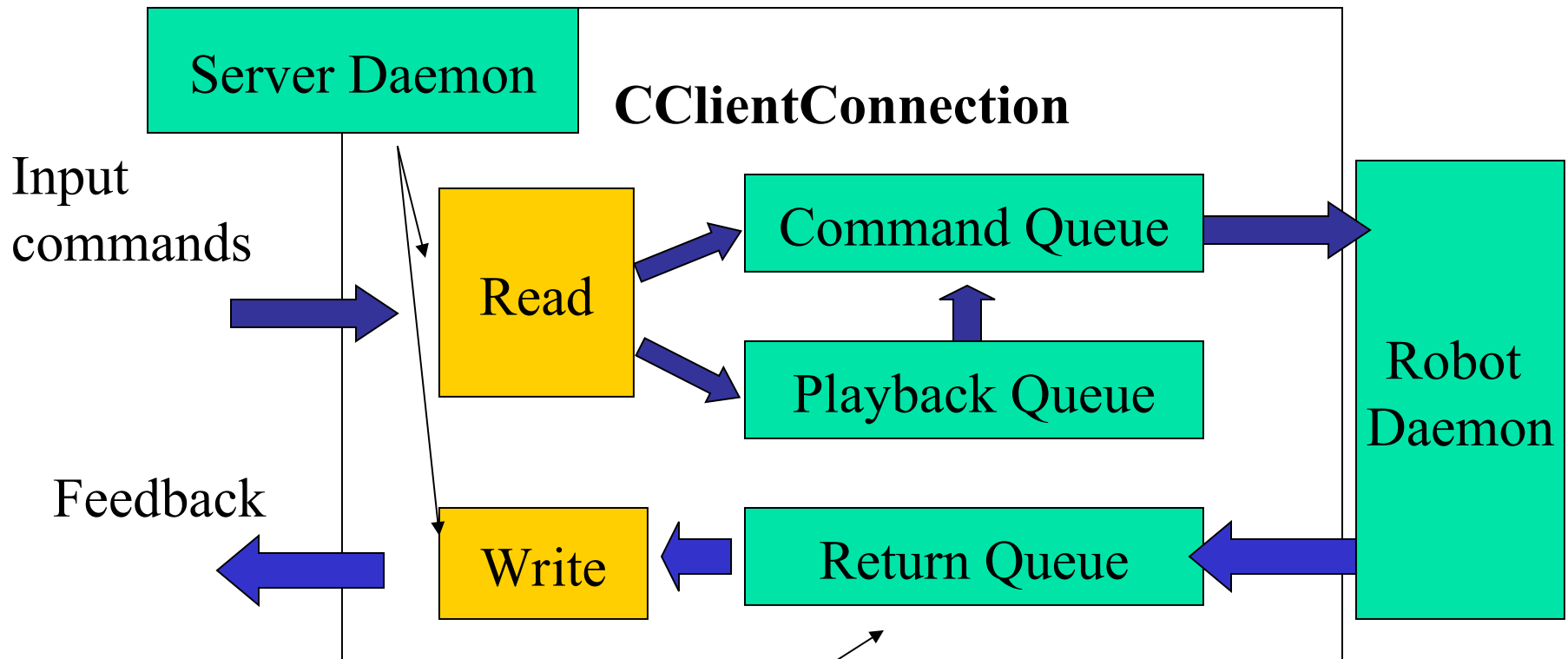
Architecture - System Overview



Architecture - Robotalk Server



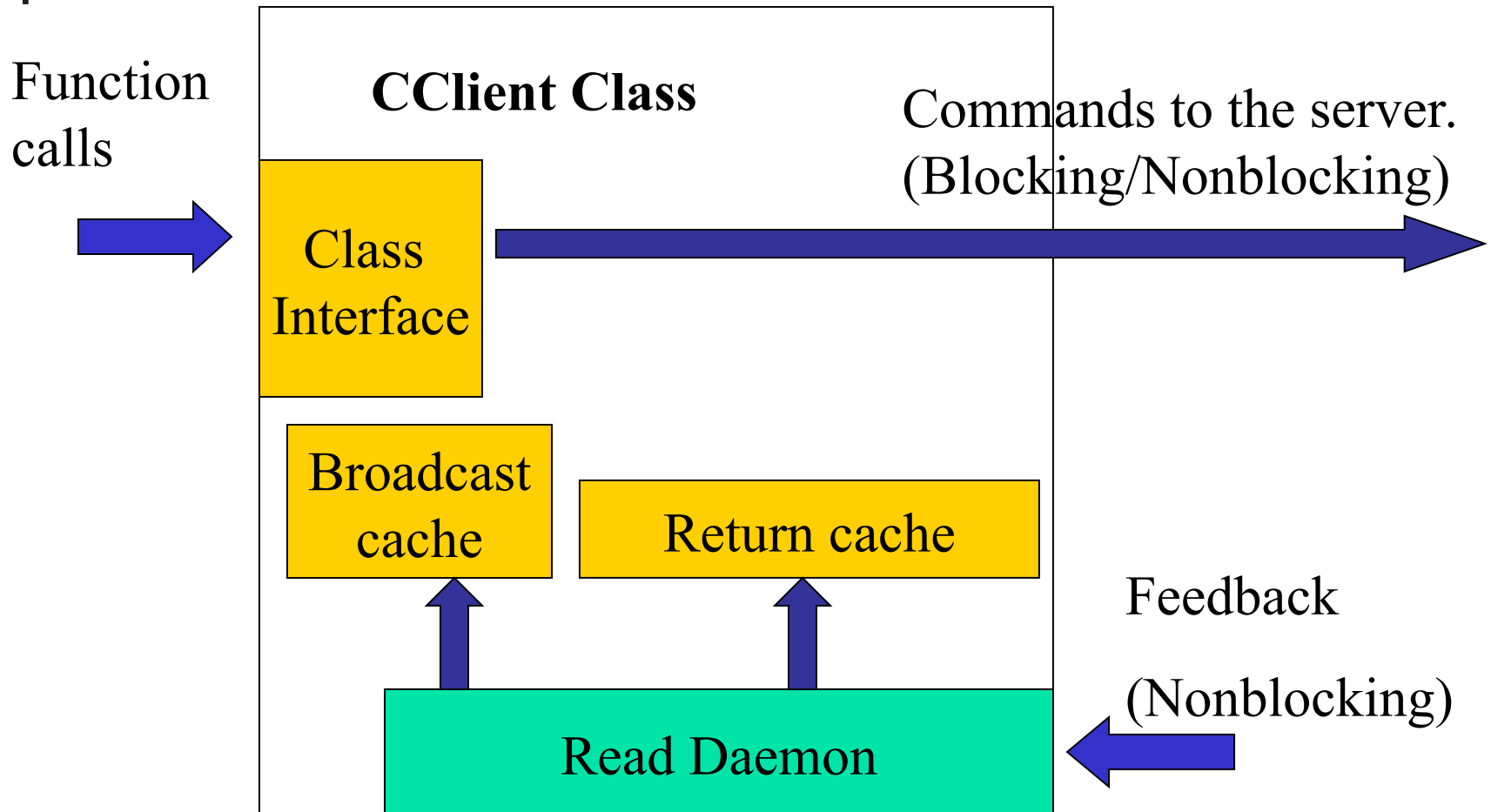
Architecture - CClientConnection



Priority Queues

marcelu.phd@gmail.com

Architecture - CClient





Architecture - Communication Modes

- Direct mode:

blocking & instantaneous, for debug purposes

- Delay mode:

nonblocking, instantaneous or delay

- Playback mode:

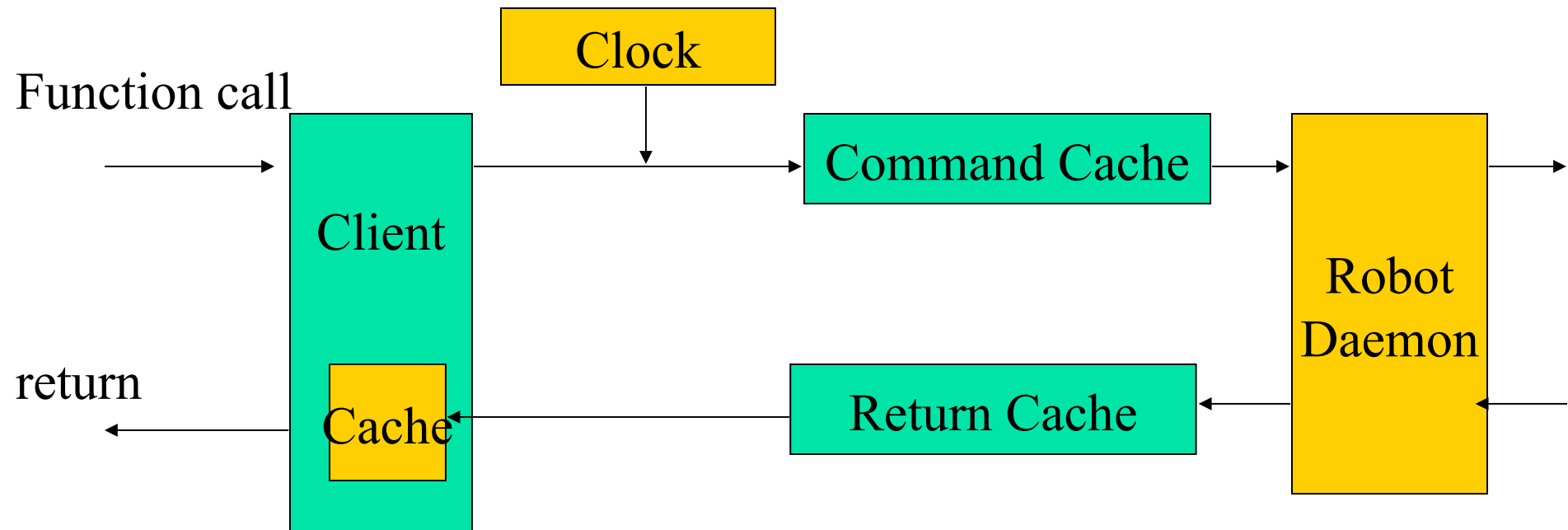
nonblocking, adaptive caching based on channel quality

- Broadcast mode:

periodic query feedback



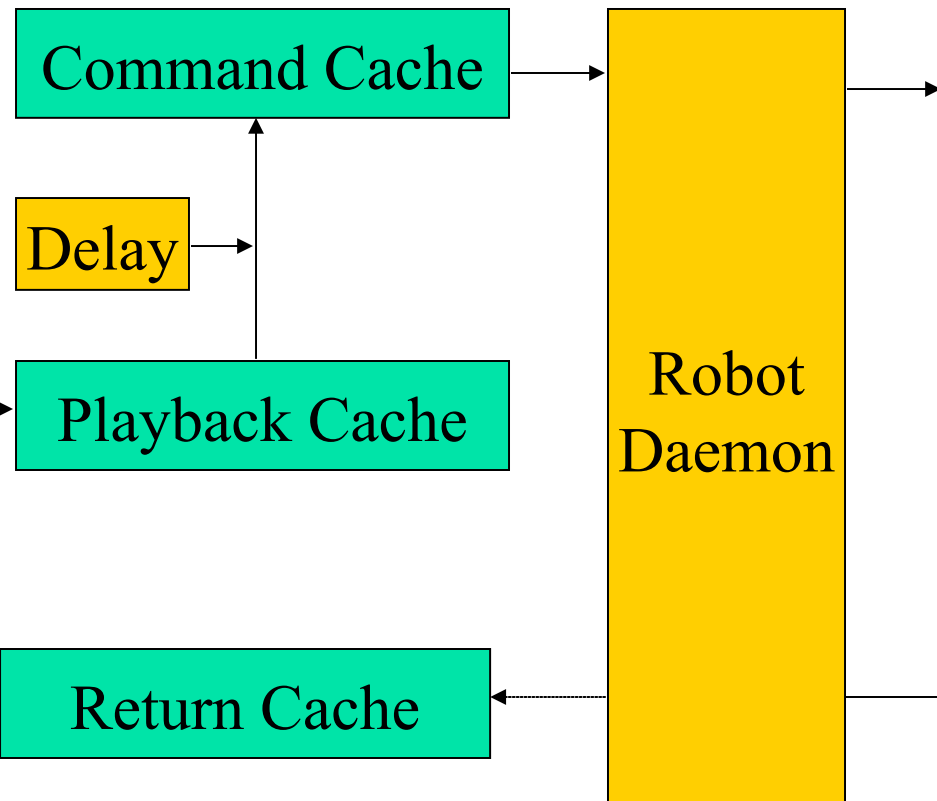
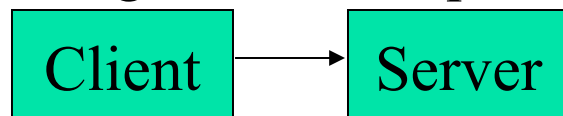
Direct Mode





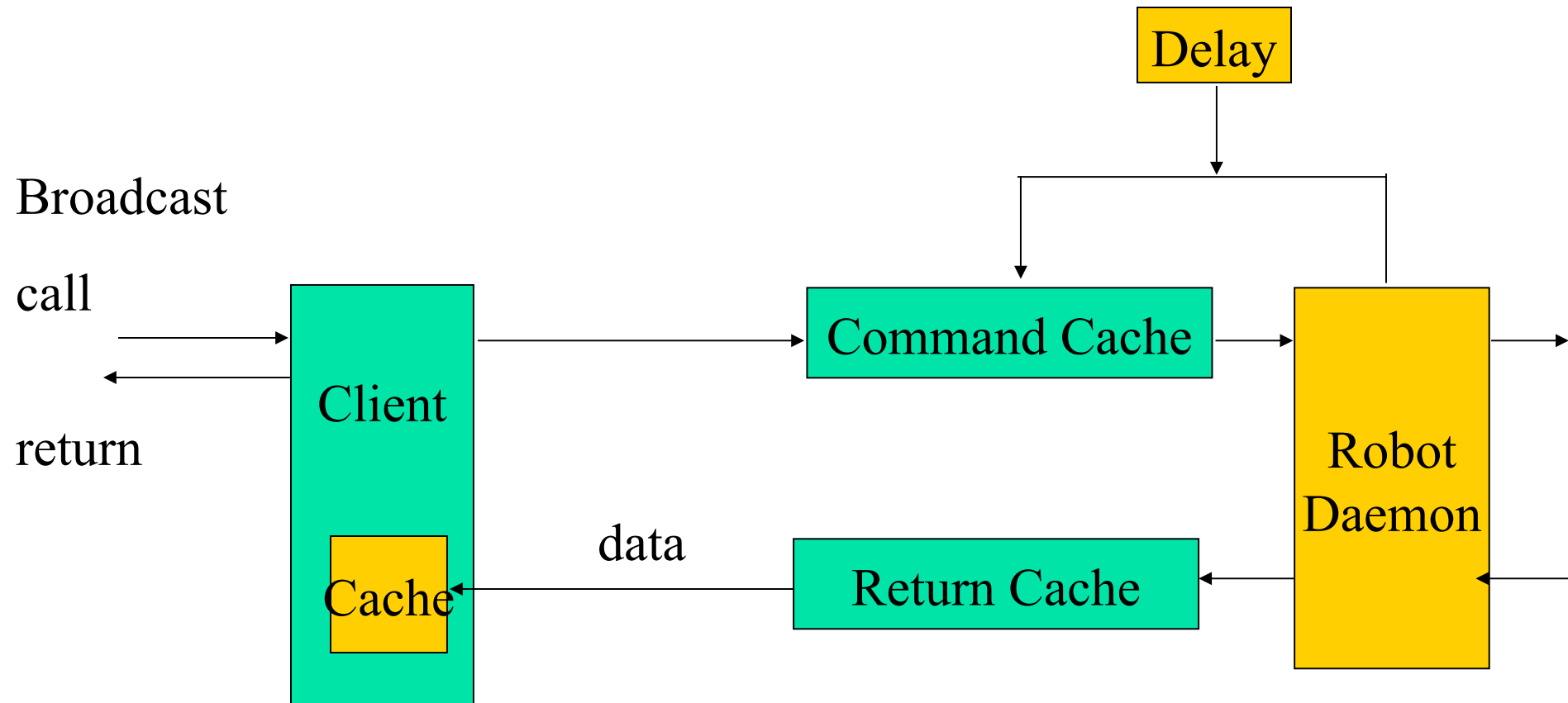
Playback Mode

Length of the sequence





Broadcast Mode

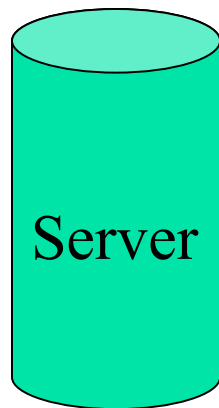




Conclusions

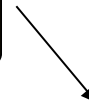
- Motivations
- System Structure
- Four Network Command Modes
- Future Extensions
 - Exclusive control
 - Data channels
 - Controlling multiple humanoid robots
 - Virtual humanoid robots

Virtual Humanoid



Pioneer
Library

Site A



QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Camera
Library

Site B



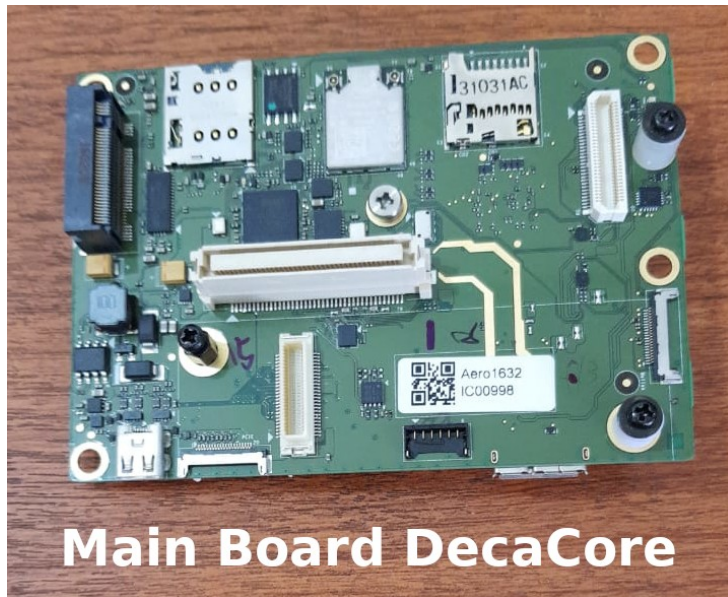
Puma
Library

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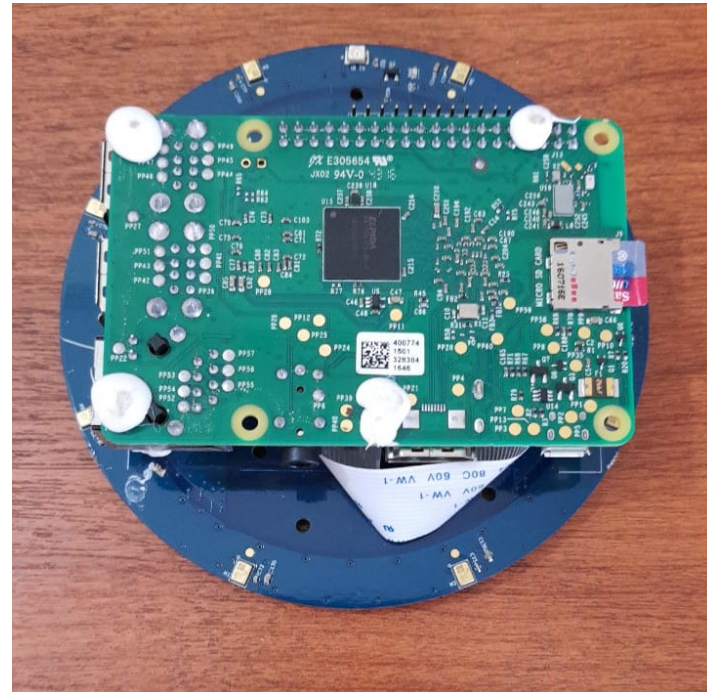
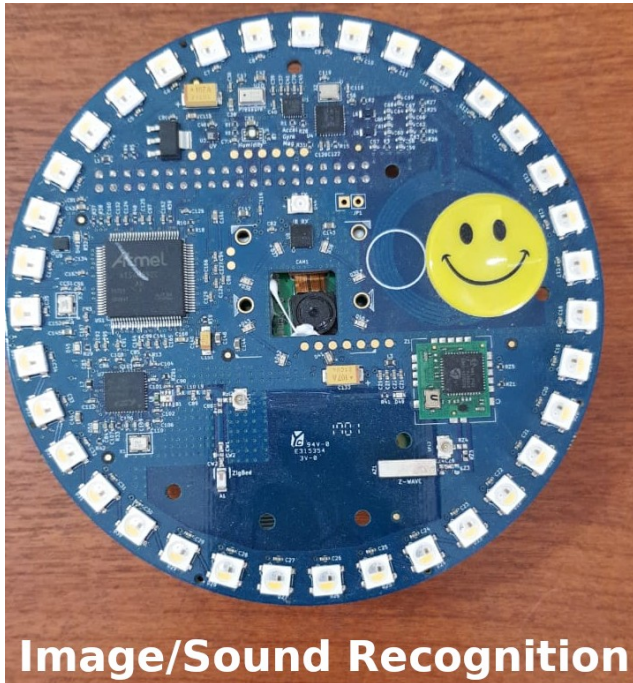


Virtual Humanoid

Conclusion



Conclusion



Conclusion





References

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- == C. Zhou and Q. Meng, “Dynamic balance of a biped robot using fuzzy reinforcement learning agents,” Fuzzy Sets and Systems 134(1) (2003) 169-187.
- == <http://www.davidgeer.com/artificial-intelligence-humanoids-david-geer.pdf>
- == <http://plen.jp/playground/wiki/about>
- == www.airspacedefense.org
- == **All CODES in**
<https://github.com/splash2018>



Thank you!



**THANK
YOU**



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