HUMANOID ROBOTS

Massachusetts Institute of Technology

Marcelo Anjos

presented

Practical in Humanoid Robotics

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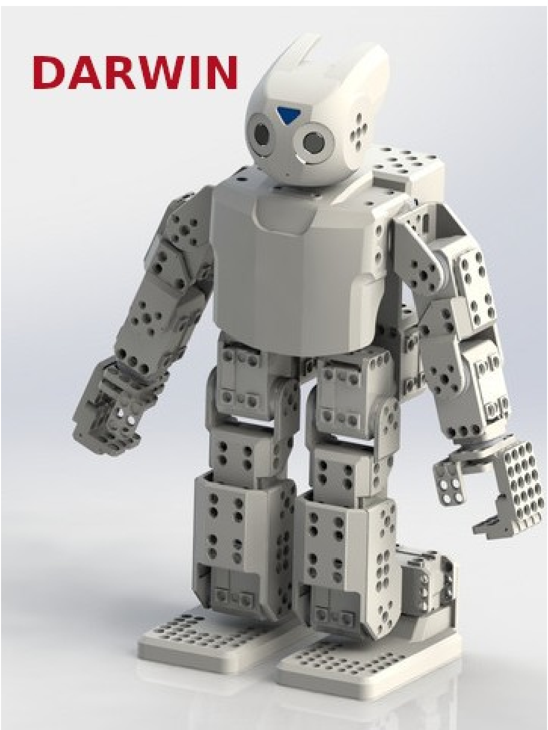
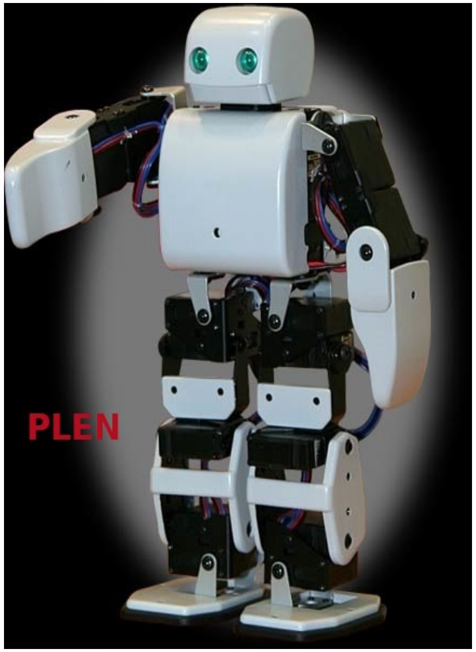
University National of Asuncion

About Me

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

Motivation





Humanoid Robot

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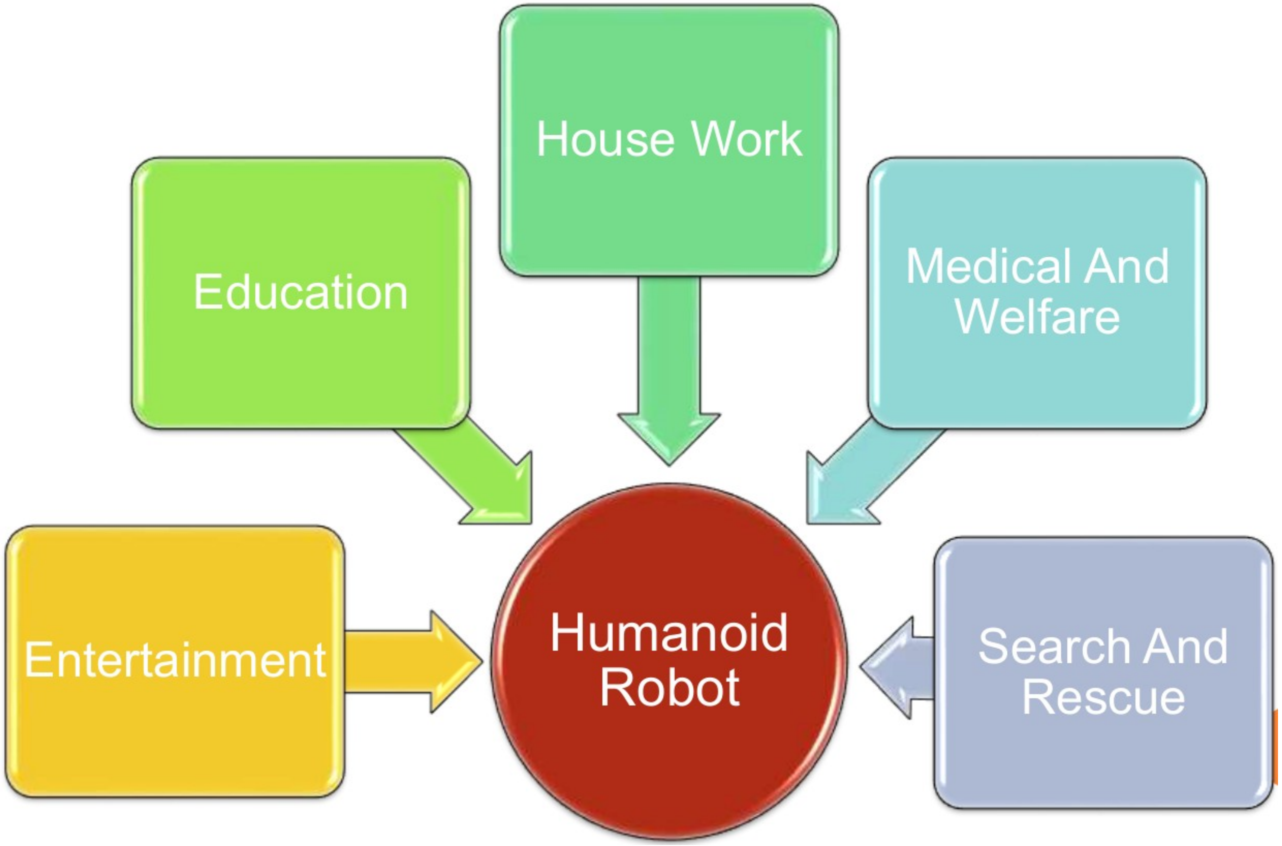
Humanoid refers to any being whose body structure resembles that of a human: head, torso, legs,arms, hands.

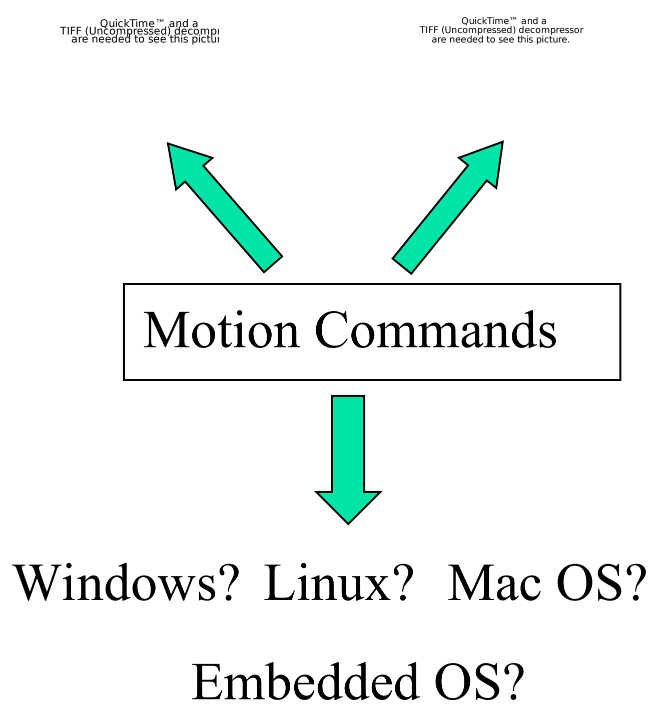
But it is also a robot made to resemble a human both in appearance and behavior

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



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Project goals OpenSource OpenHardware

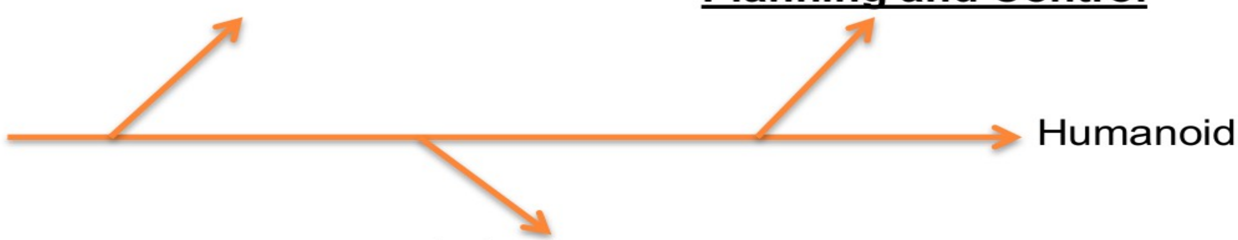
- Whatever: (cross-model)
  - Provide a network-enabled interface for independent of the controller libraries
  - Access to other robots & simulators.
- Whoever: (cross-platform)
  - User interface must be cross-platform: support Linux, Mac OS X and Windows.
- Wherever: (cross-network)
  - Good quality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

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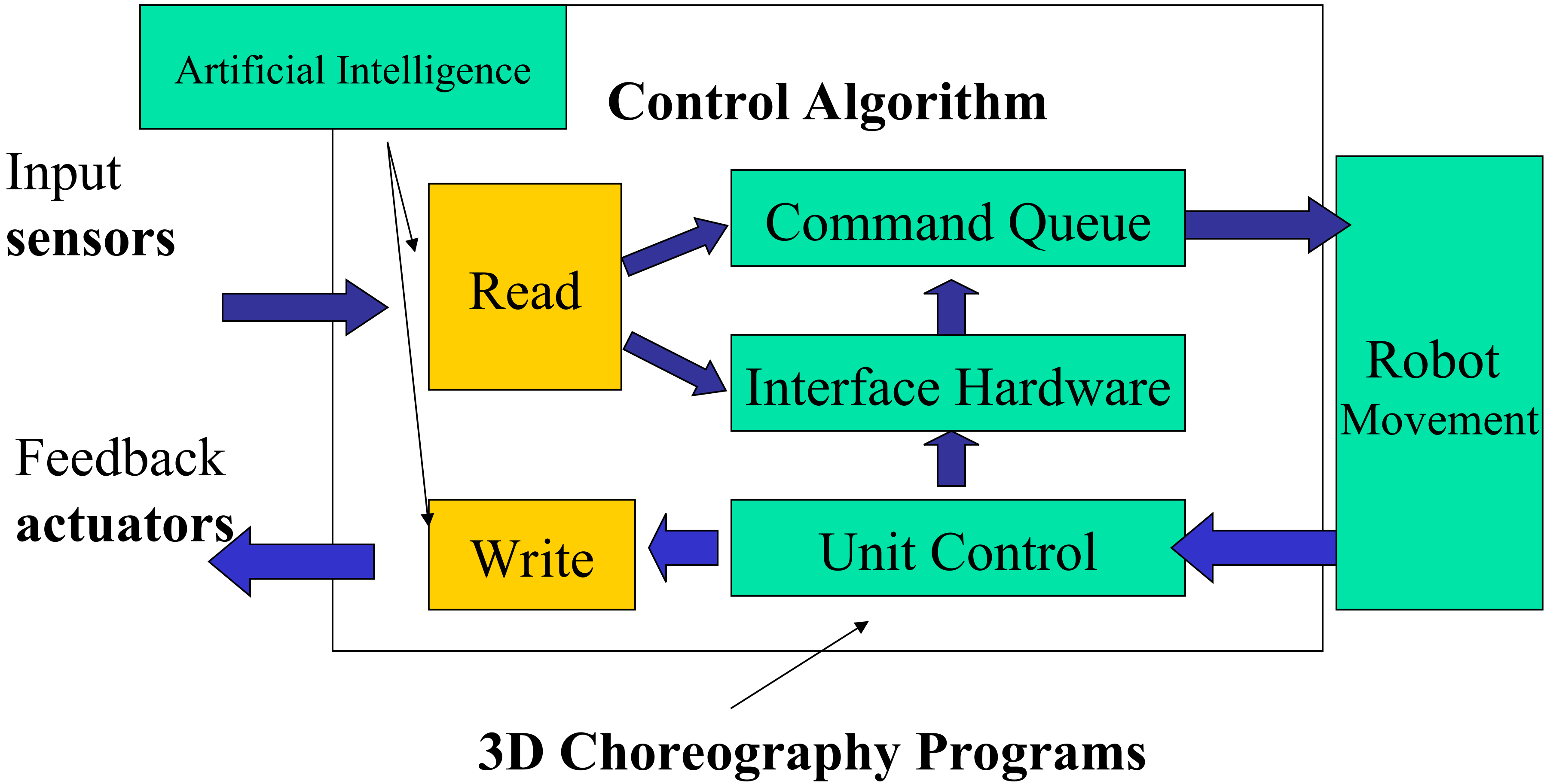
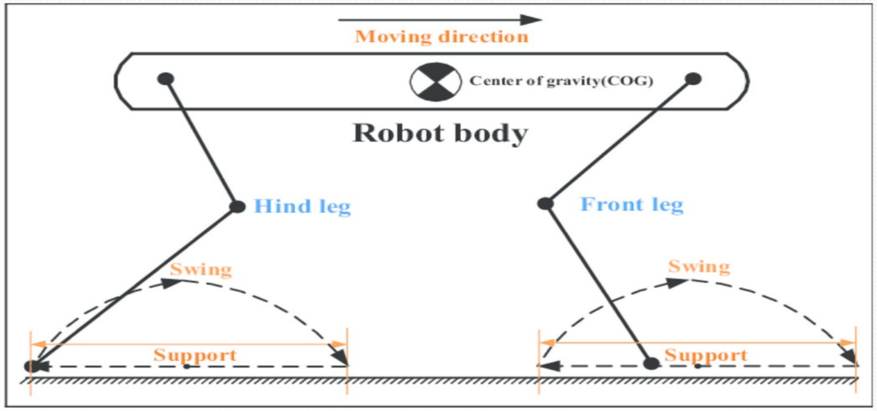
Architecture

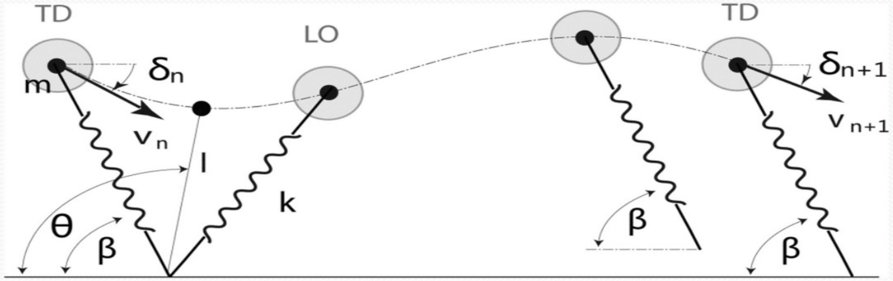


Locomotion – Walking Video

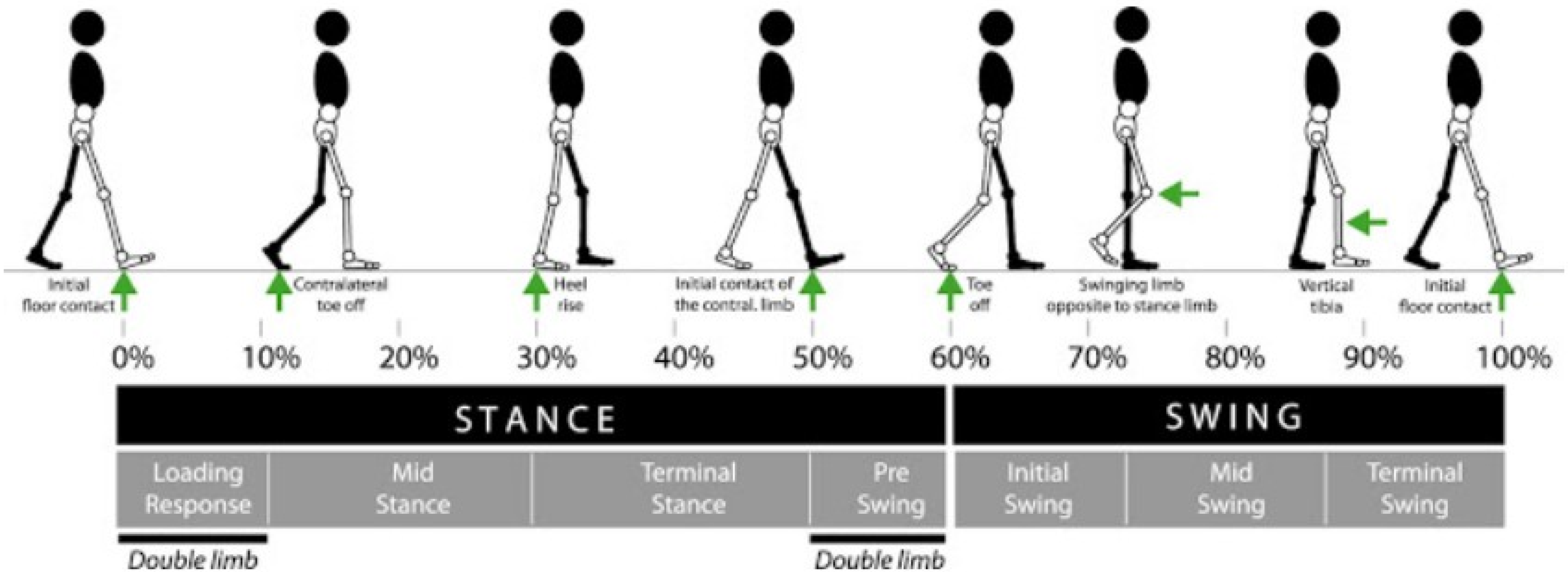
LEGGED LOCOMOTION

- 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



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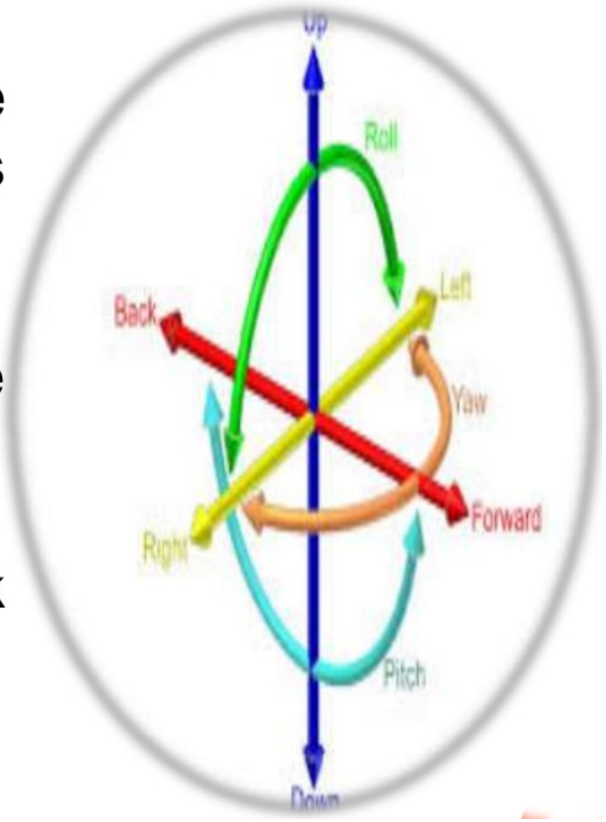
Degree of Freedom (DOF)

- 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.

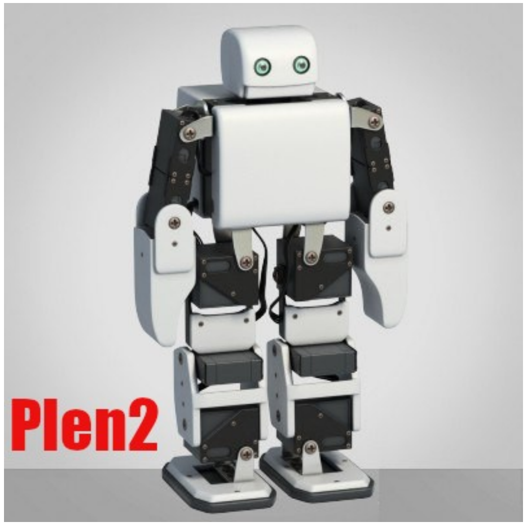


Prices for Human Sizes Robots

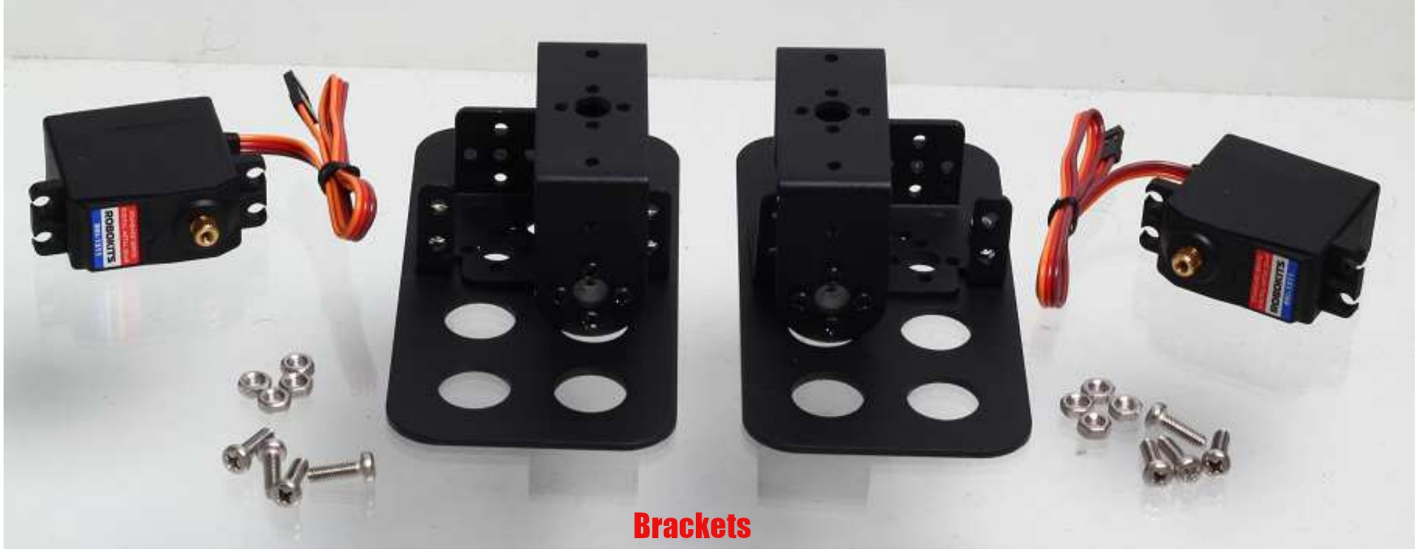
- Poppy Child Kit
  - +- 9.000 u$$

- Big Size Servo Motor
- 20 x 2.000 U$$ = 40.000 u$$.

Parts - Kits and Prices.

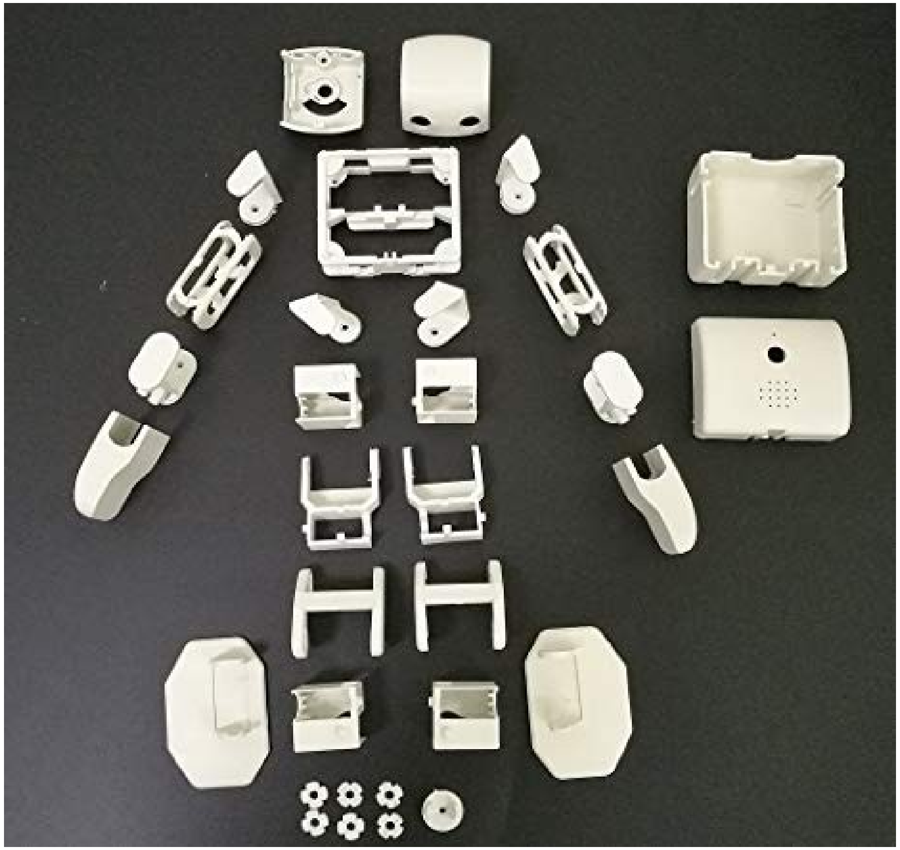


Parts



Parts

Parts



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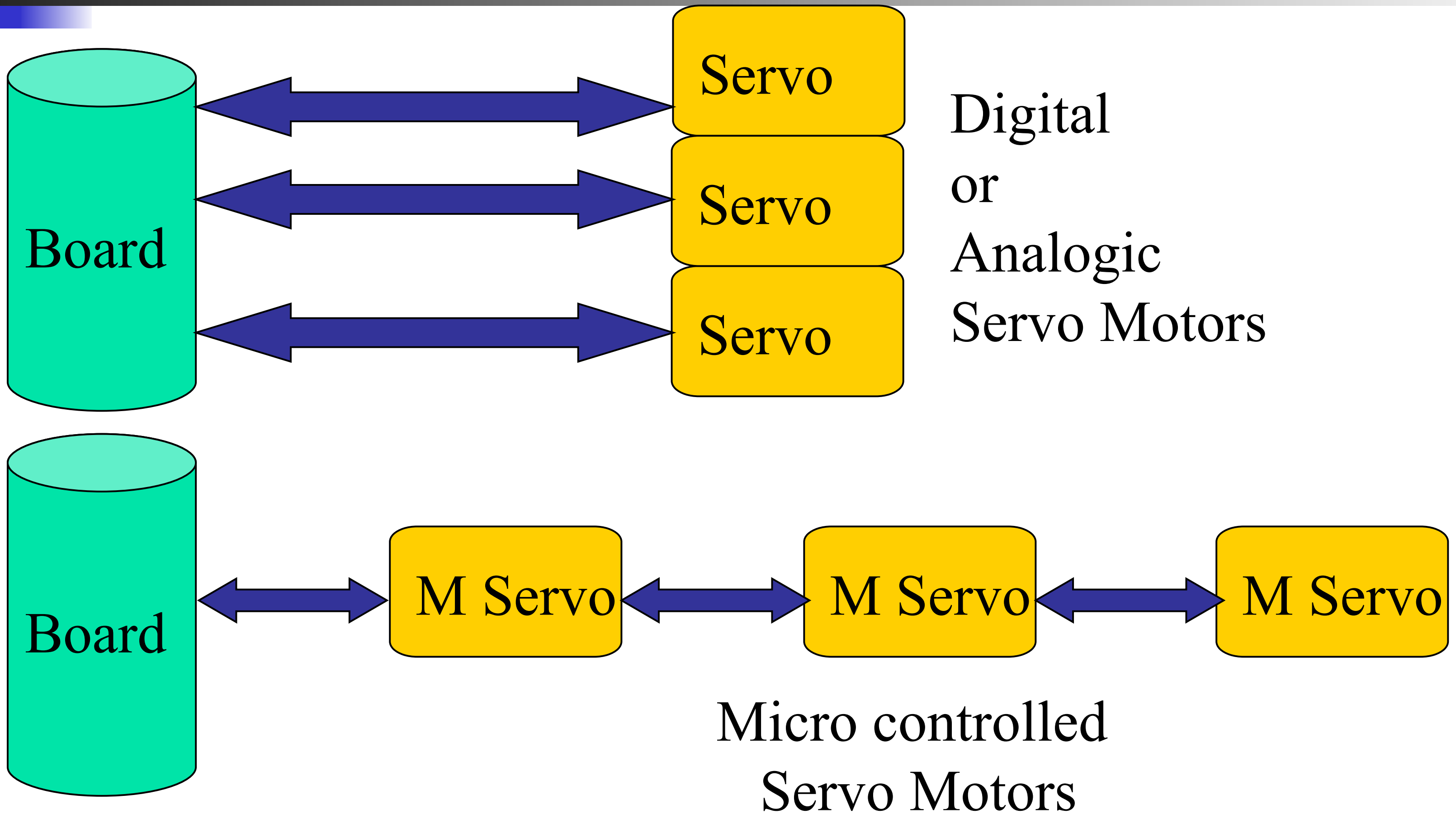
Servo Motor

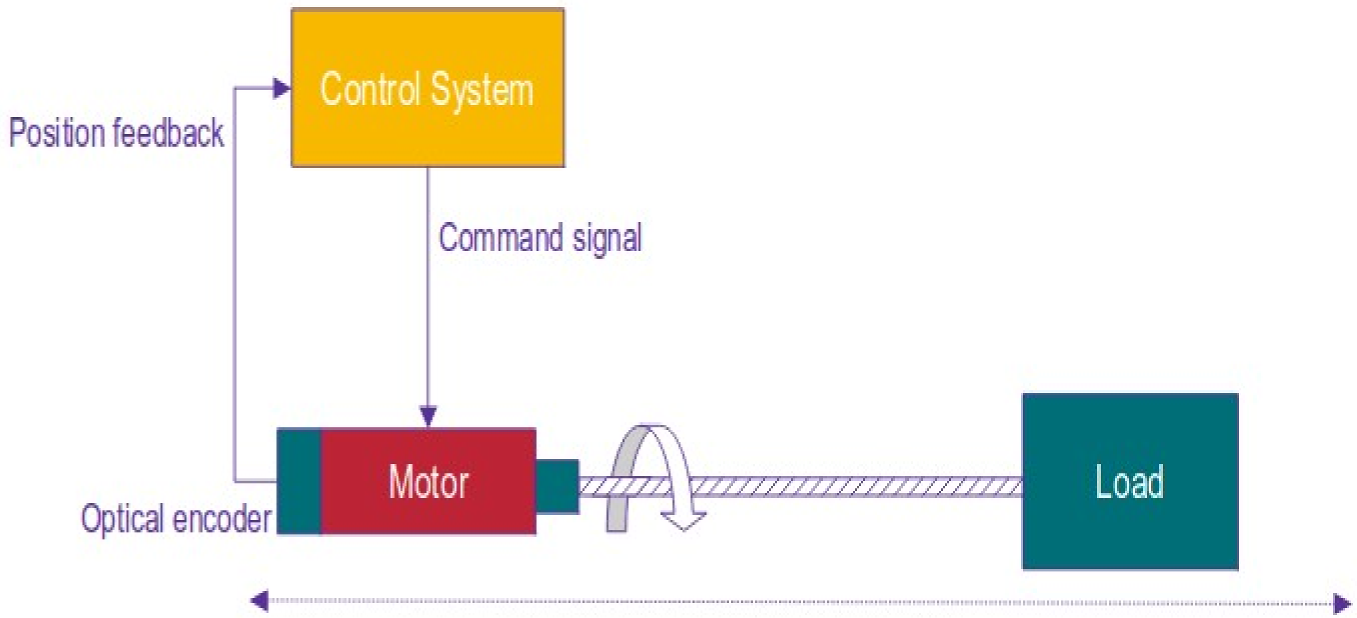

Board
Servo
Servo
Servo
Digital
or
Analogic
Servo Motors
Board
M Servo
M Servo
M Servo
Micro controlled
Servo Motors

Micro controlled Servo Motor with PID

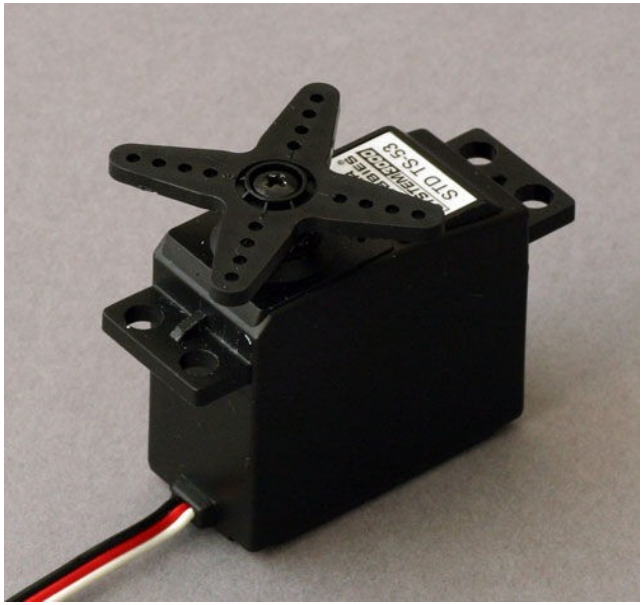
- PID is the most commonly used servo control algorithm:
  - **<u>P</u>**roportional
  - **<u>I</u>**ntegral
  - **<u>D</u>**erivative

- PID systems can be understood by way of analogous physical models.

Micro controlled Servo Motor with PID



Servo Motor – Video and Practical



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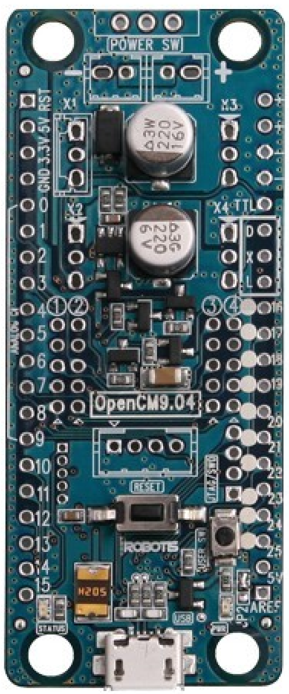
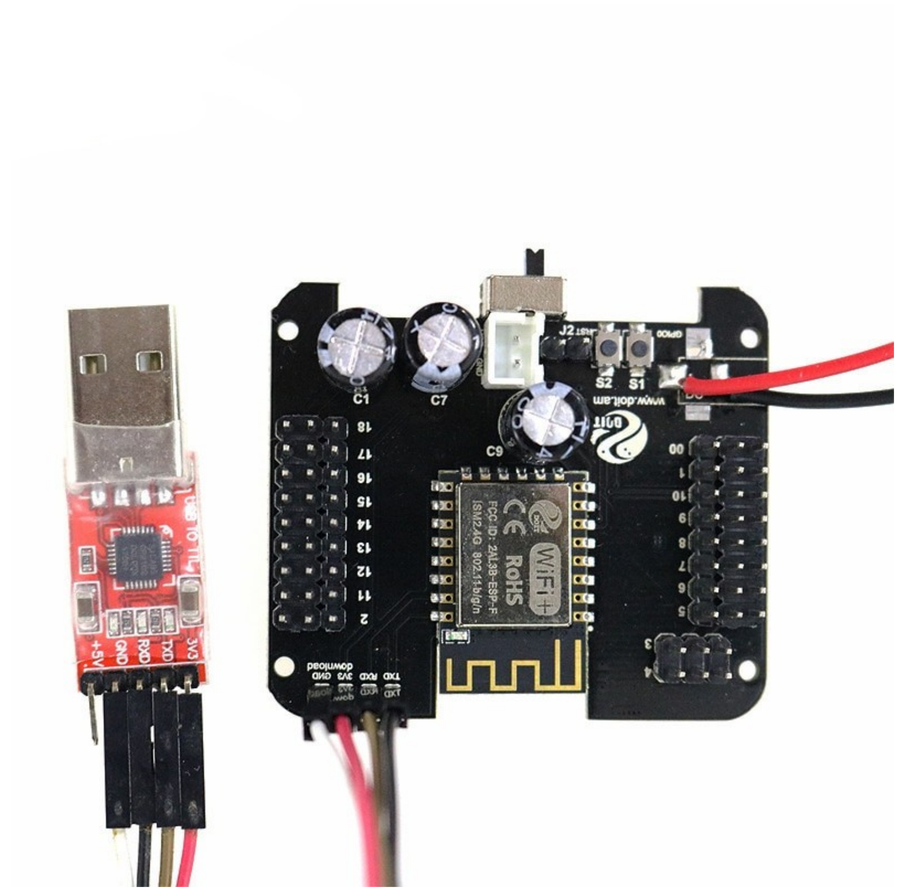
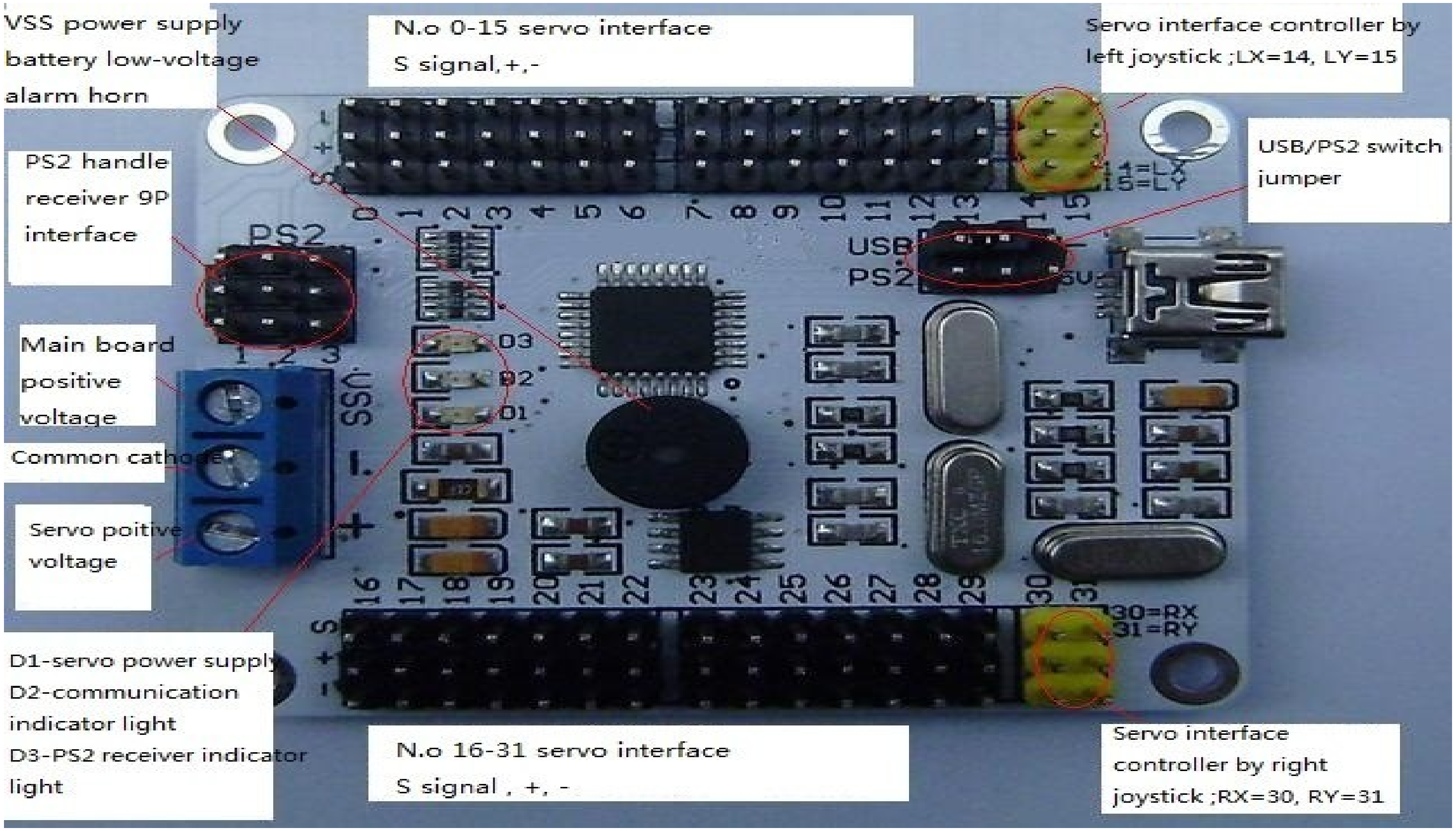
Main Board Control





Main Board Control - Practical



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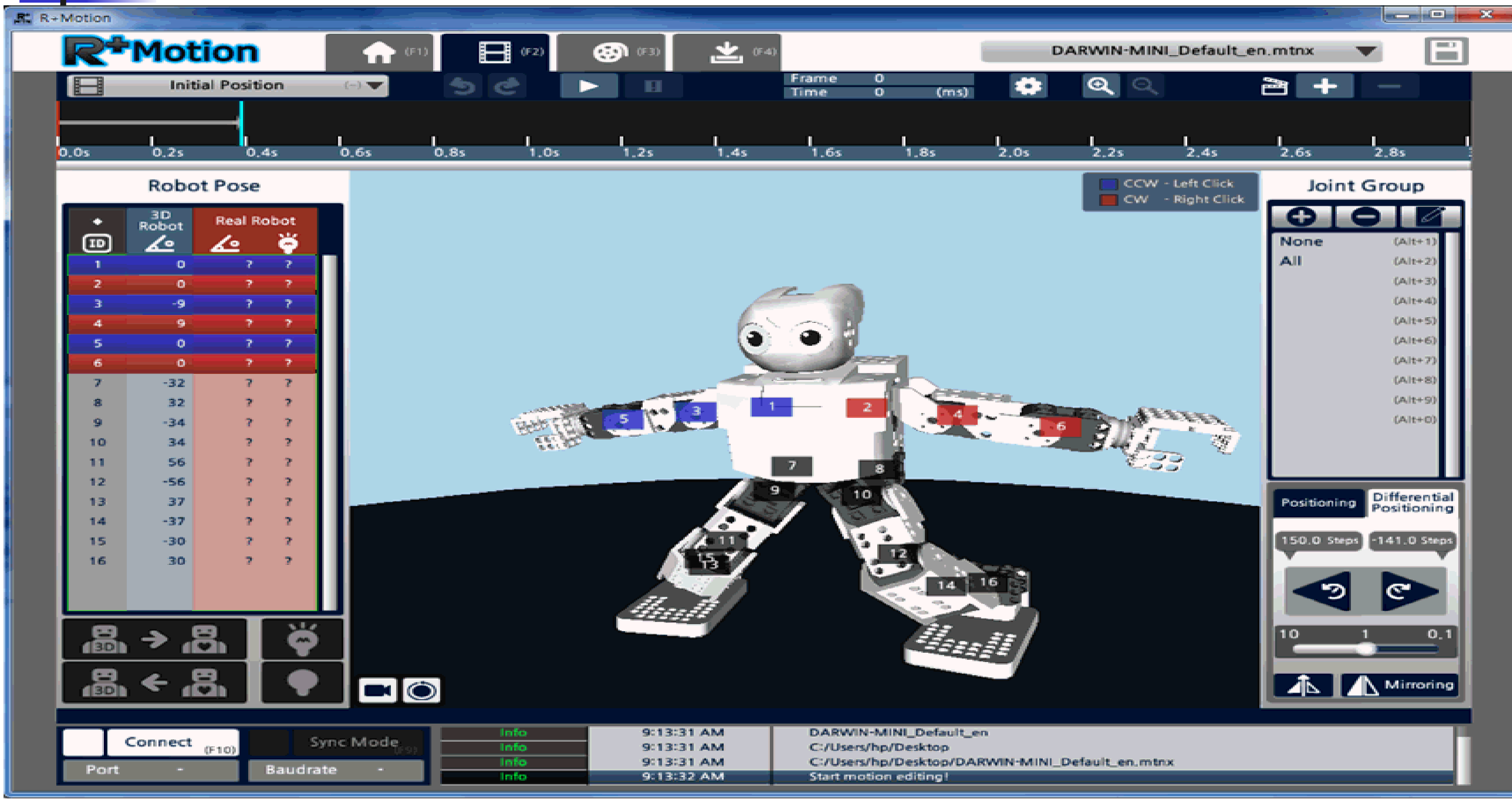
3D Choreography - Practical



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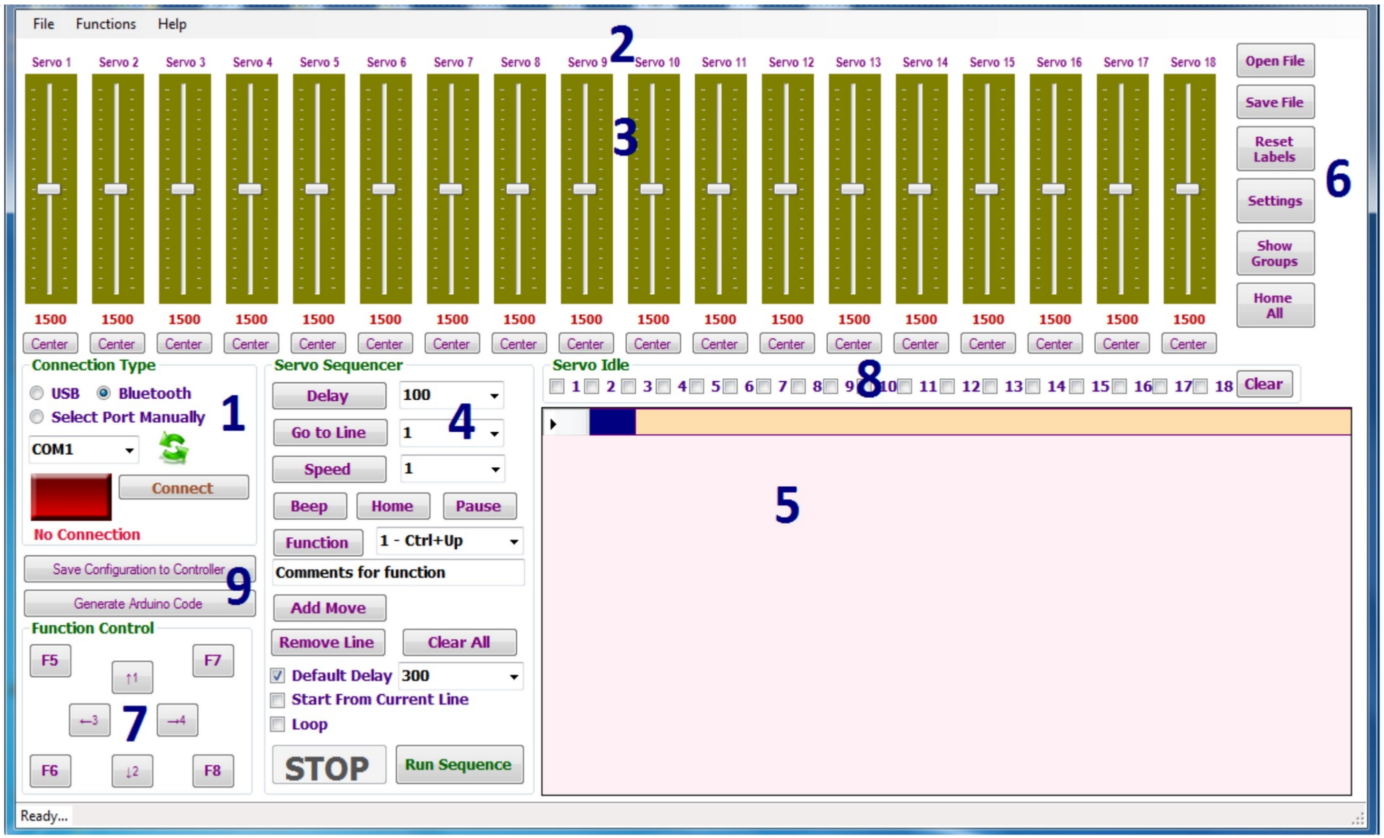
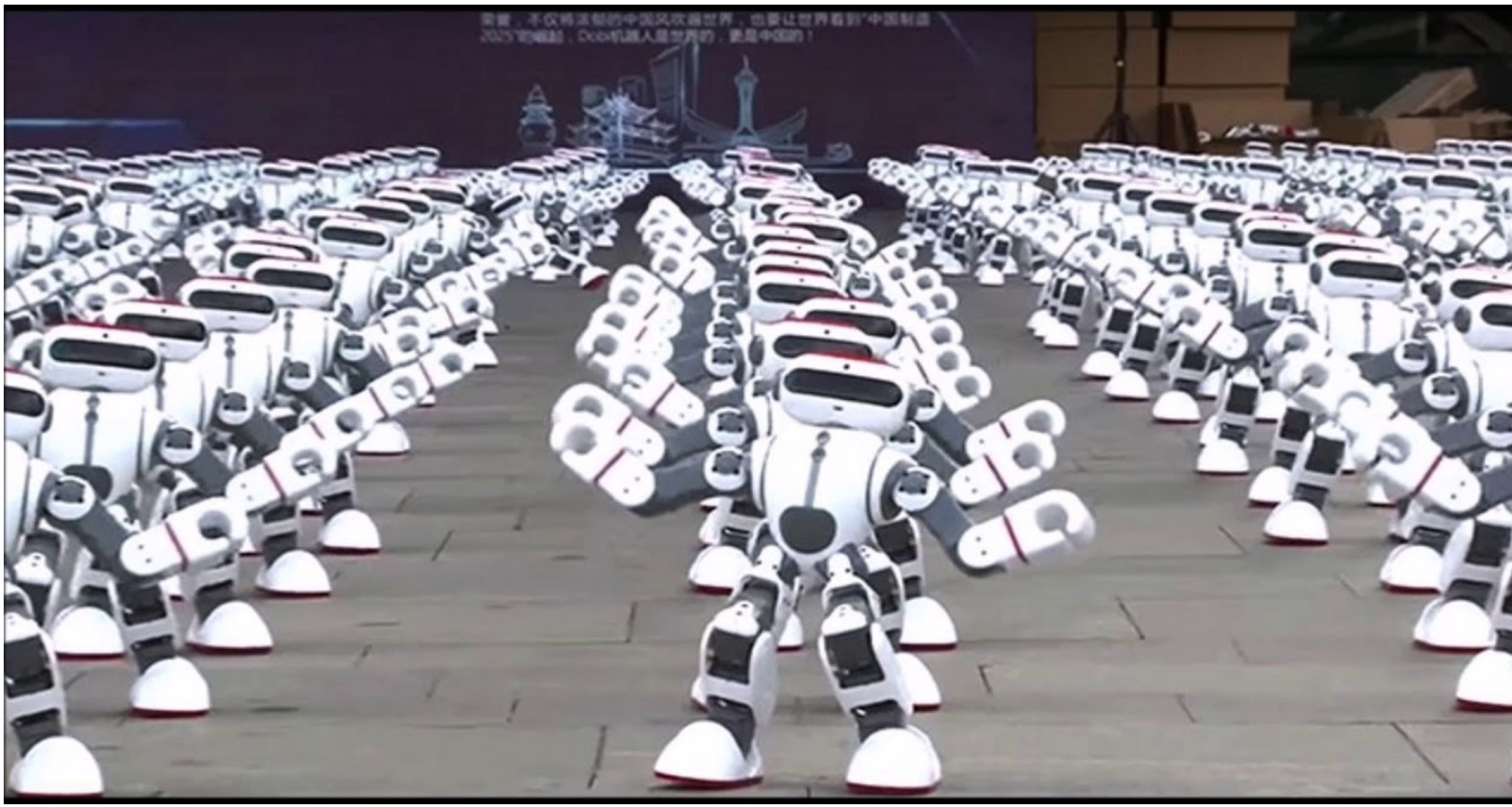
Sequencer – Practical



Dancing – Video and Practical



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Artificial Intelligence

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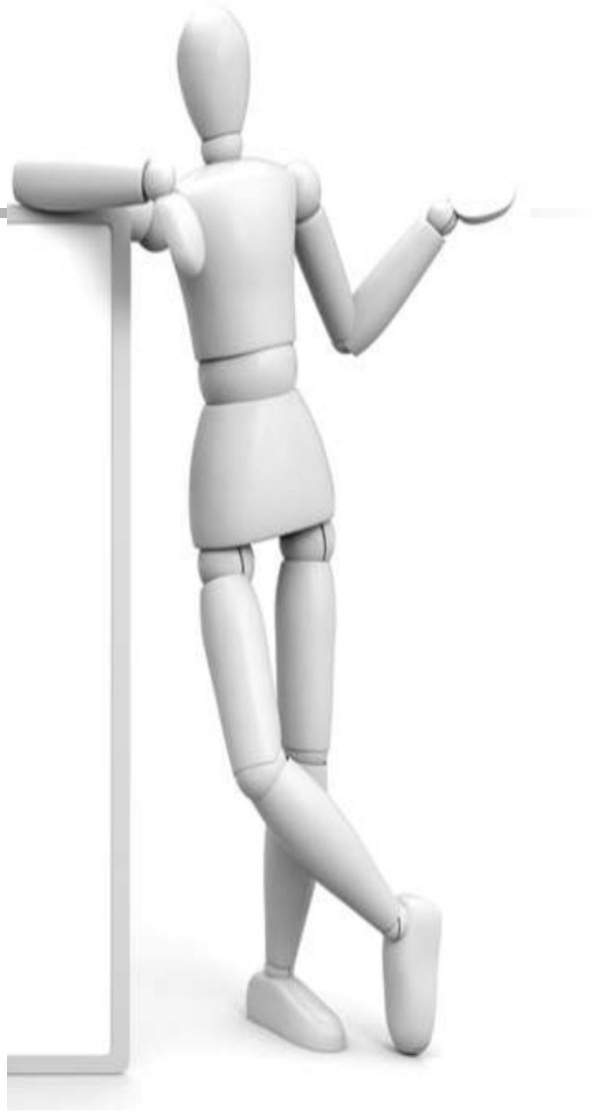
Artificial intelligence (AI) is a branch of science, which deals with helping machines find solutions to complex problem in a more human like fashion.

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

Recognition Technology

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



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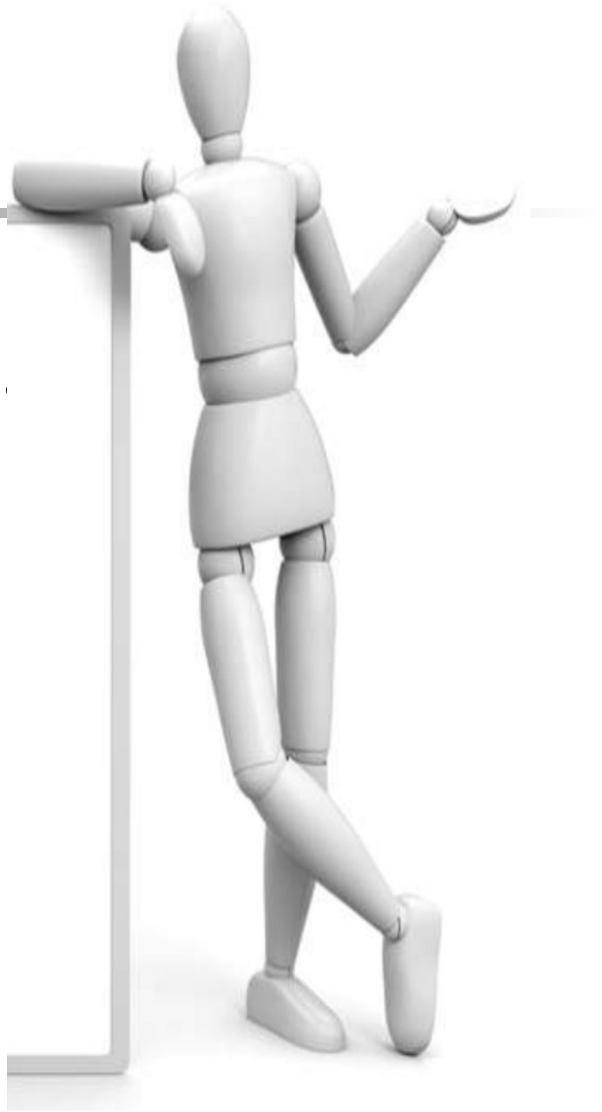
Sound Recognition

Many Robots can distinguish between voices
other sounds.

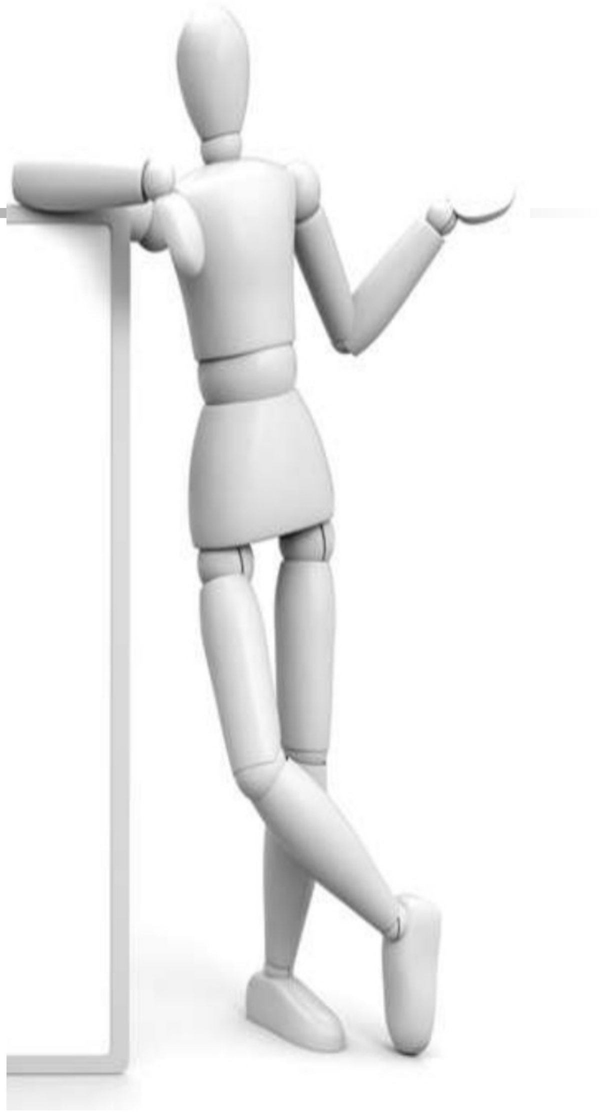
He can respond to his name, face people when being spoken to, and recognize sudden, unusual sounds such as that of a falling object or a collision, and face in that direction.



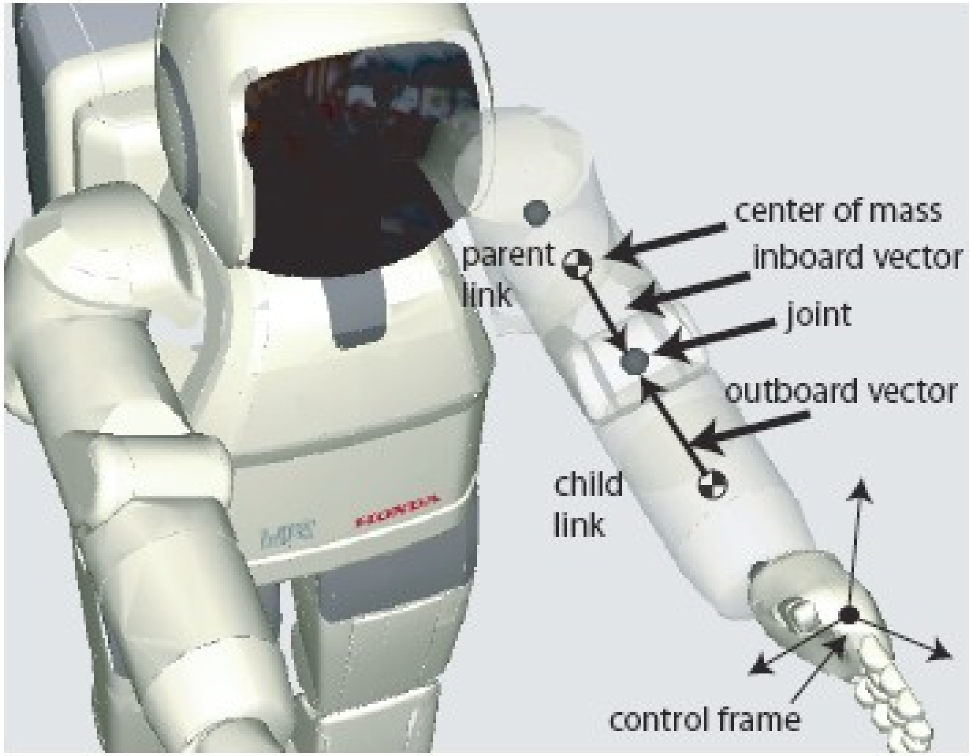
Facial Recognition

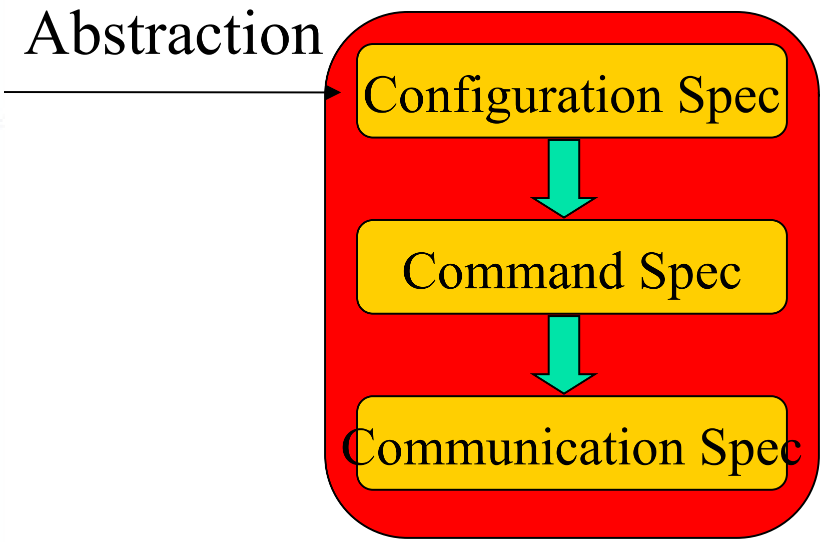
Many Robots has the ability to recognize faces, or the human being is moving.

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



Architecture - Specification Standard





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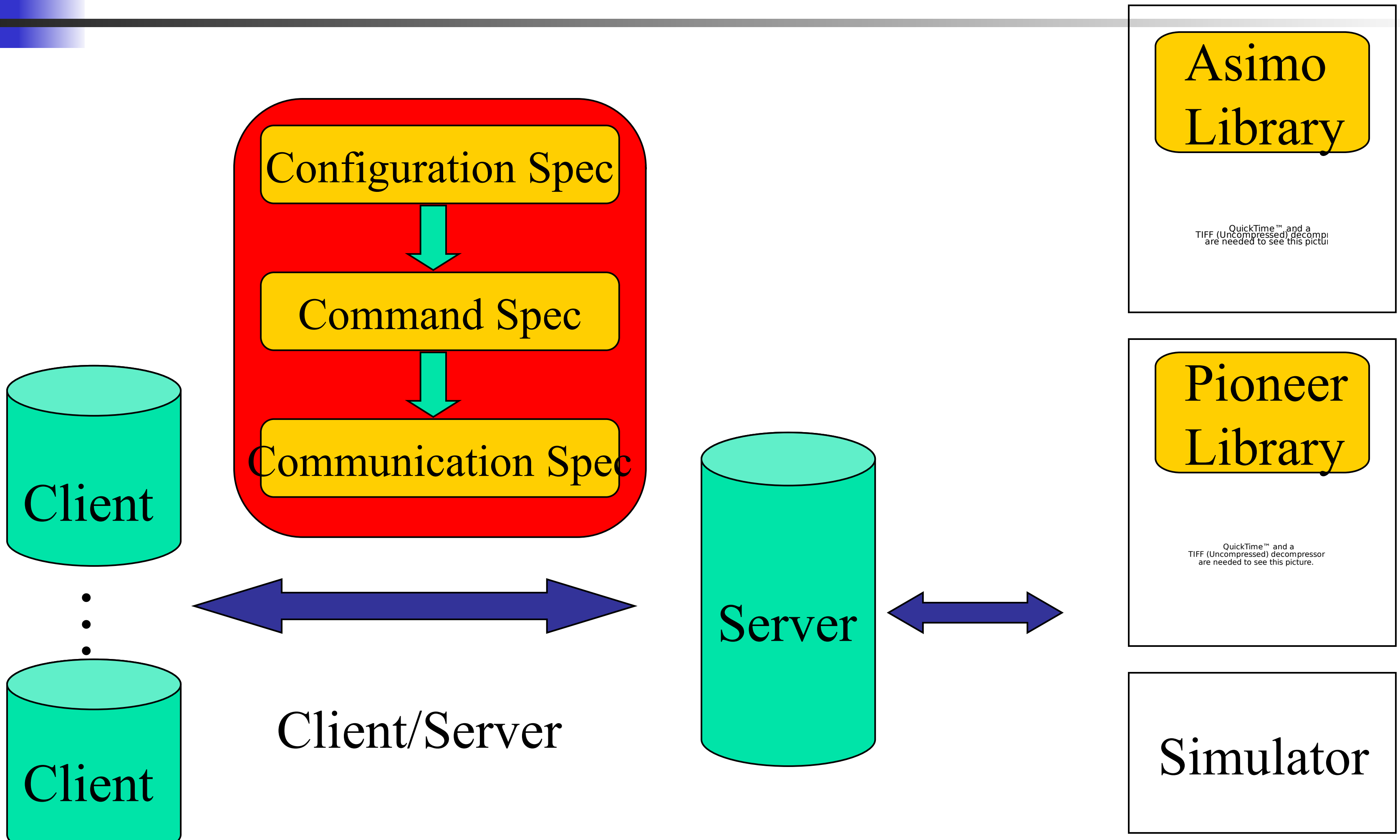
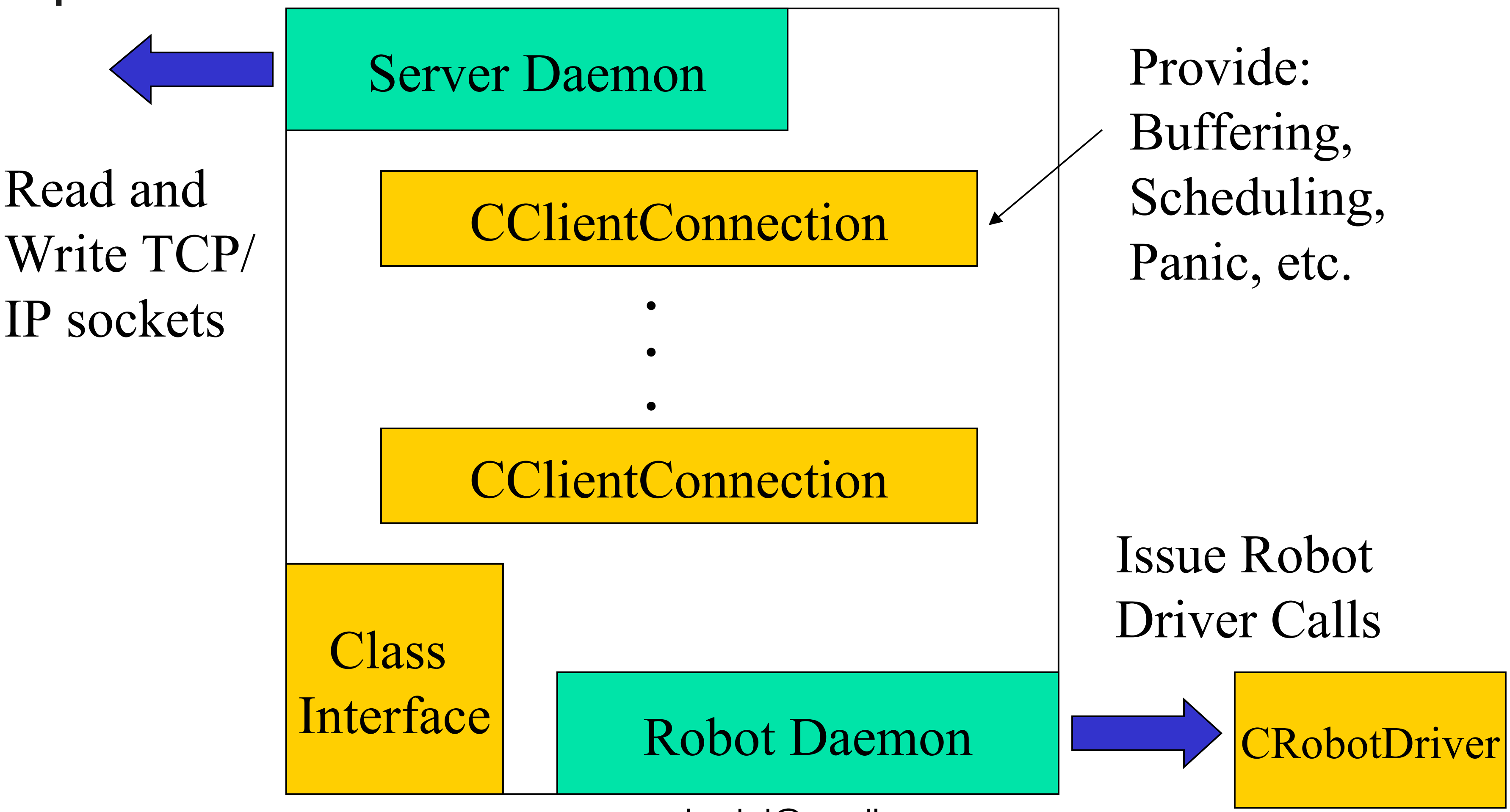
Architecture - System Overview



Architecture - Robotalk Server



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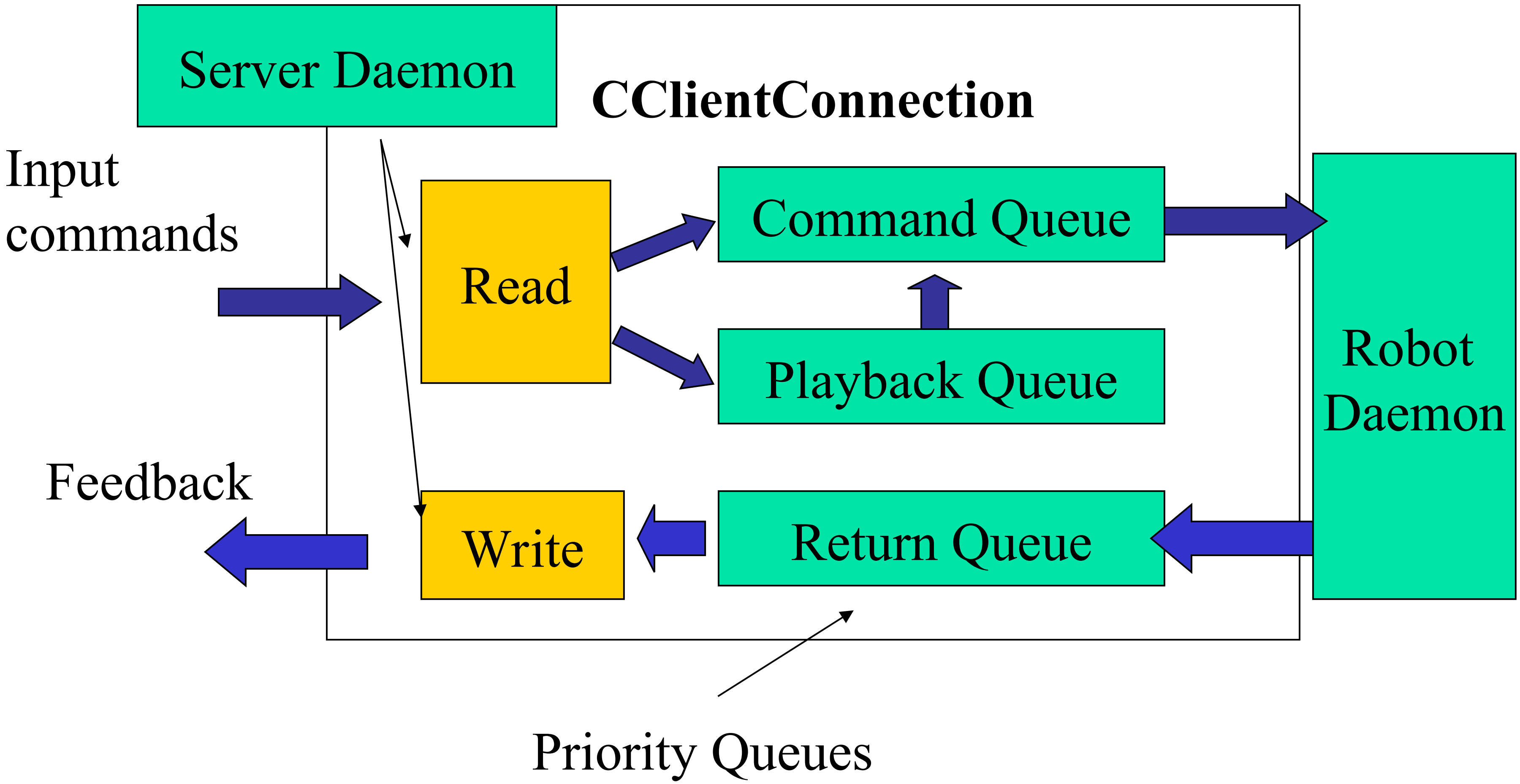
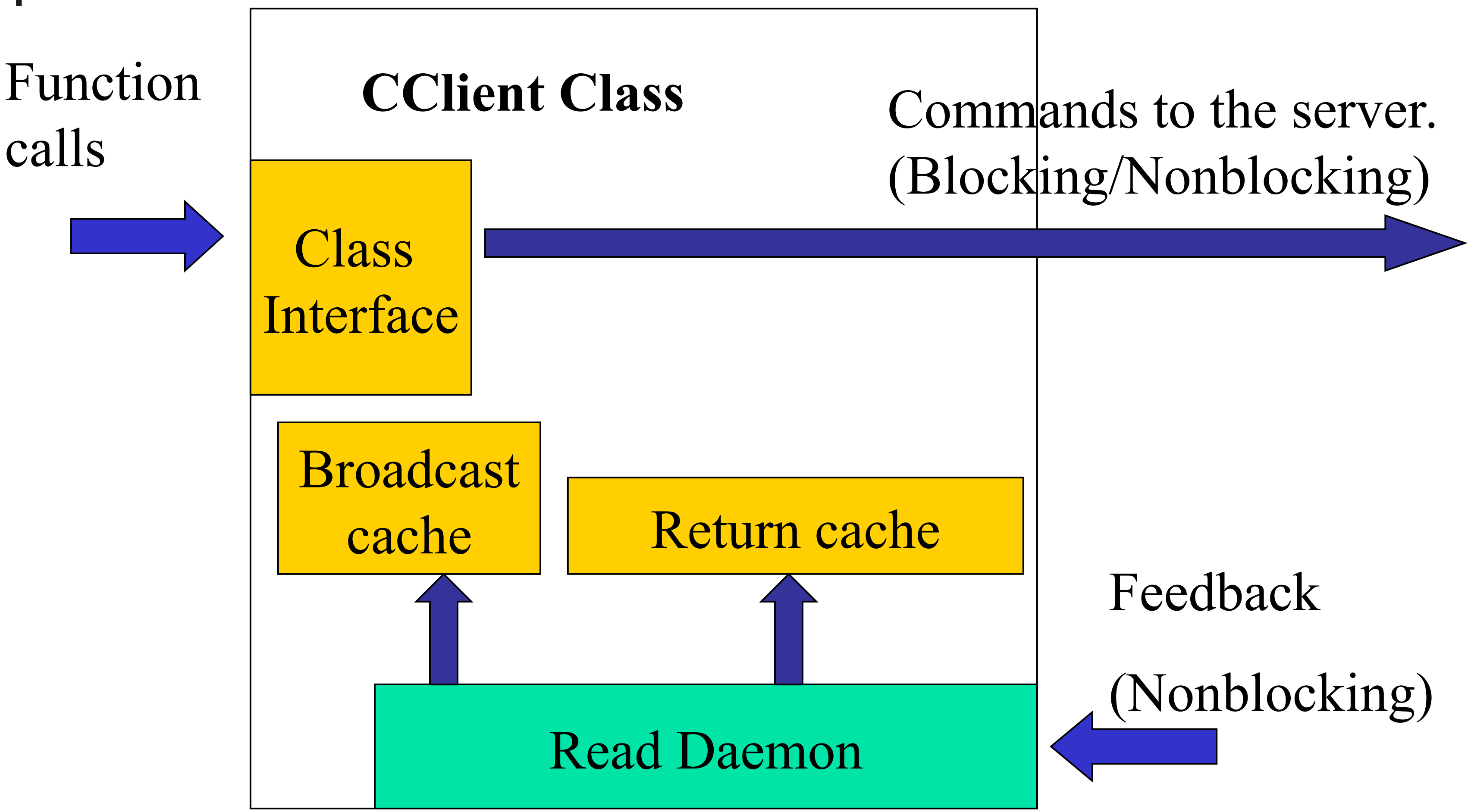
Architecture - CClientConnection



Architecture - CClient



Architecture - Communication Modes

- Direct mode:

blocking & instantaneous, for debug purposes

- Delay mode:

nonblocking, instantaneous or delay

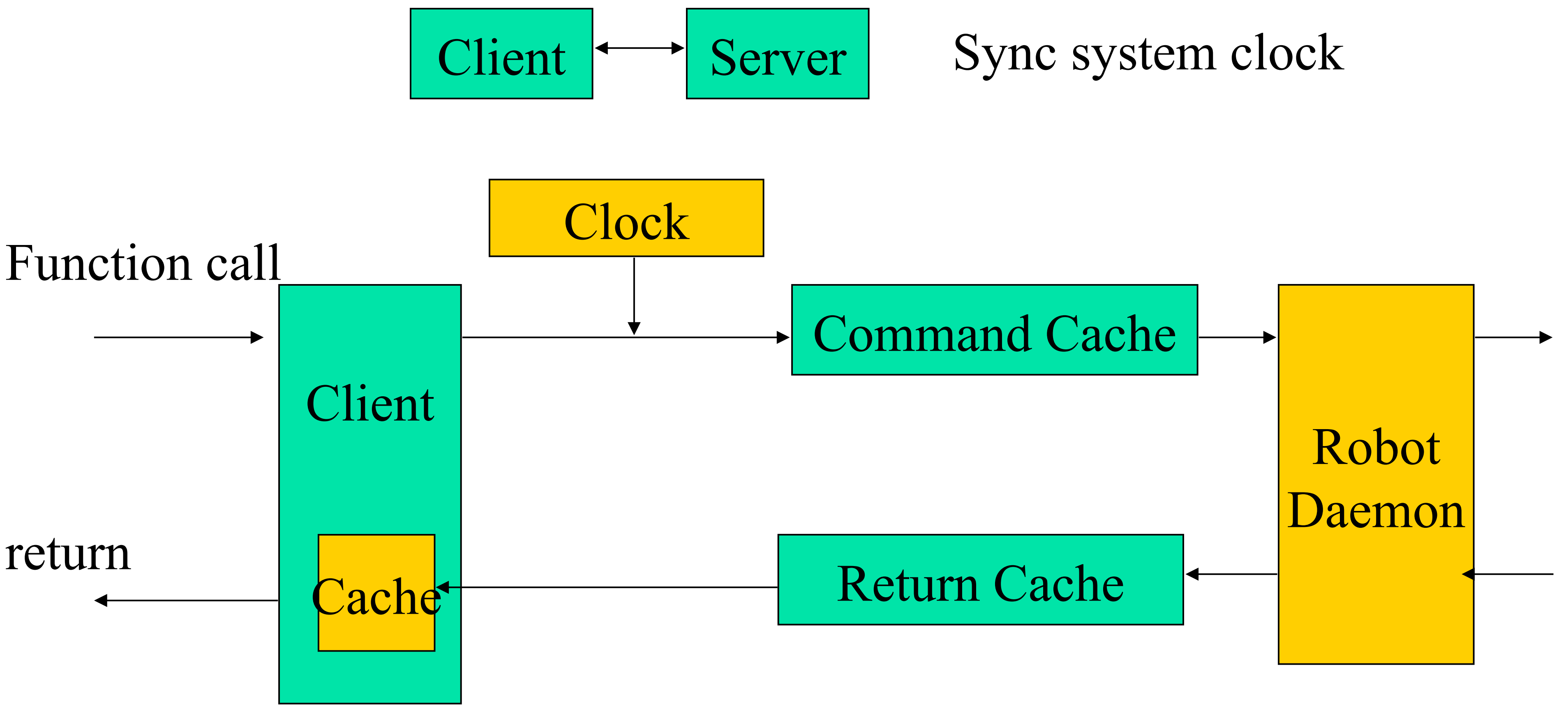
- Playback mode:

nonblocking, adaptive caching based on channel quality

- Broadcast mode:

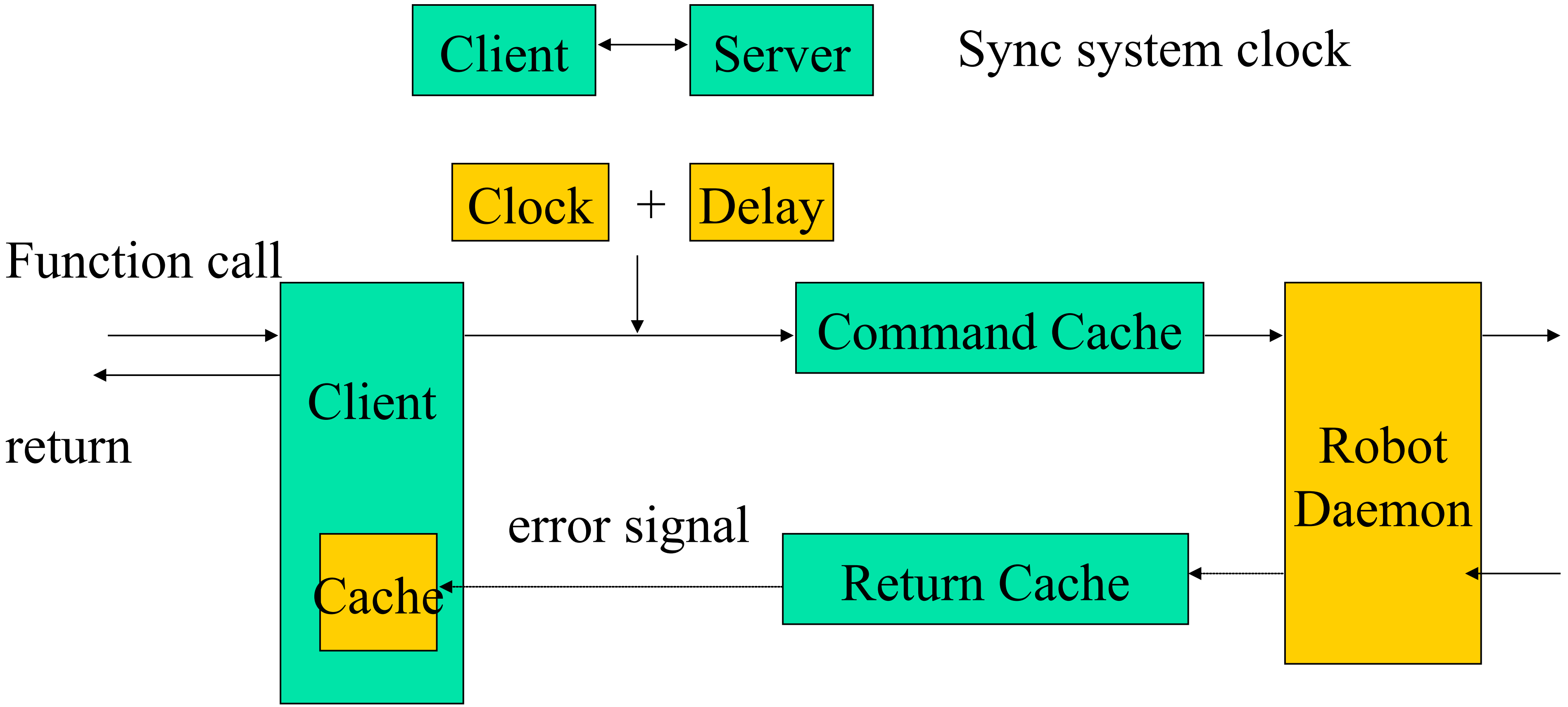
periodic query feedback

Direct Mode

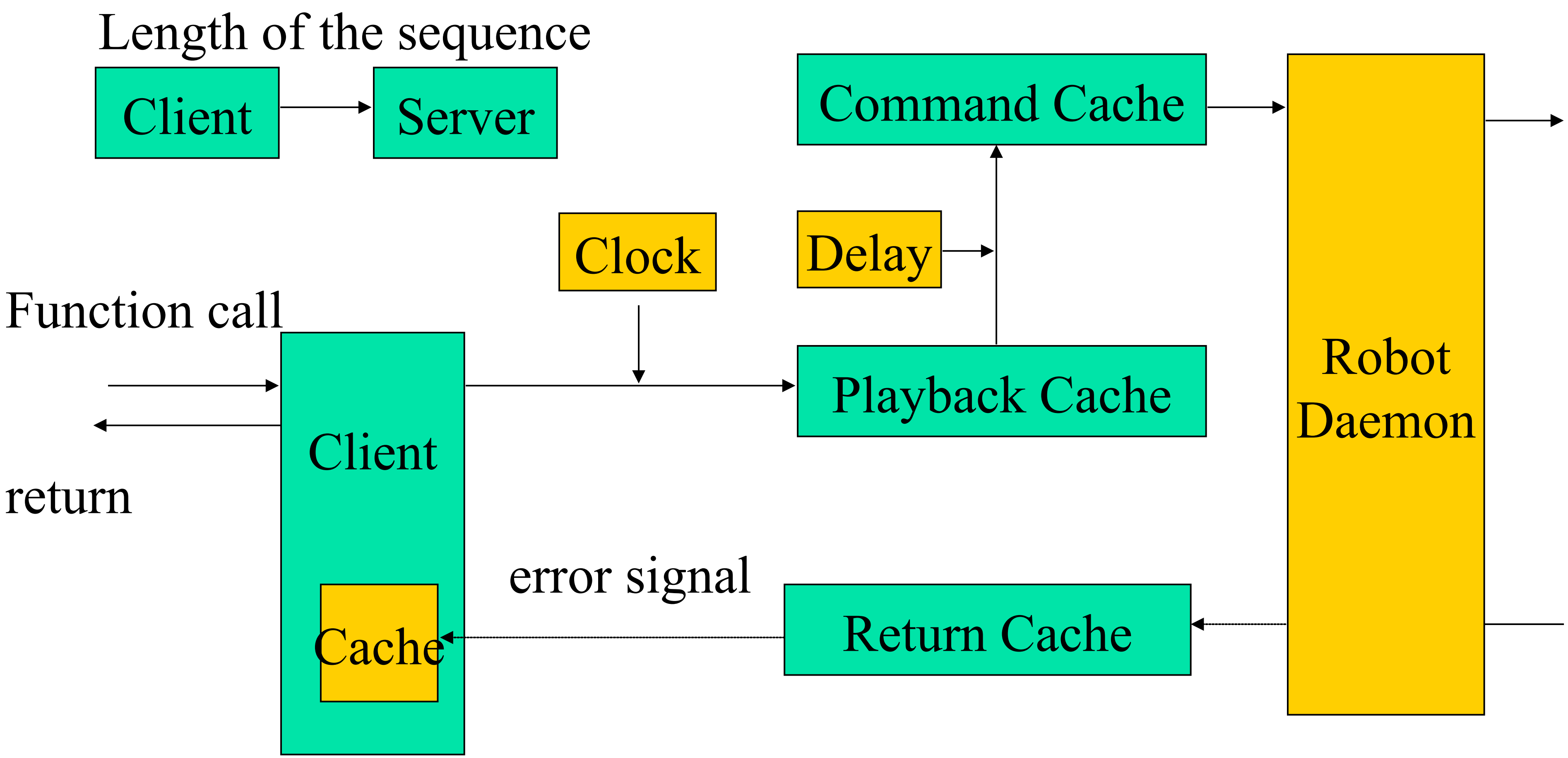


Client
Server
Sync system clock
Clock
Function call
Client
Command Cache
Robot
Daemon
return
Cache
Return Cache

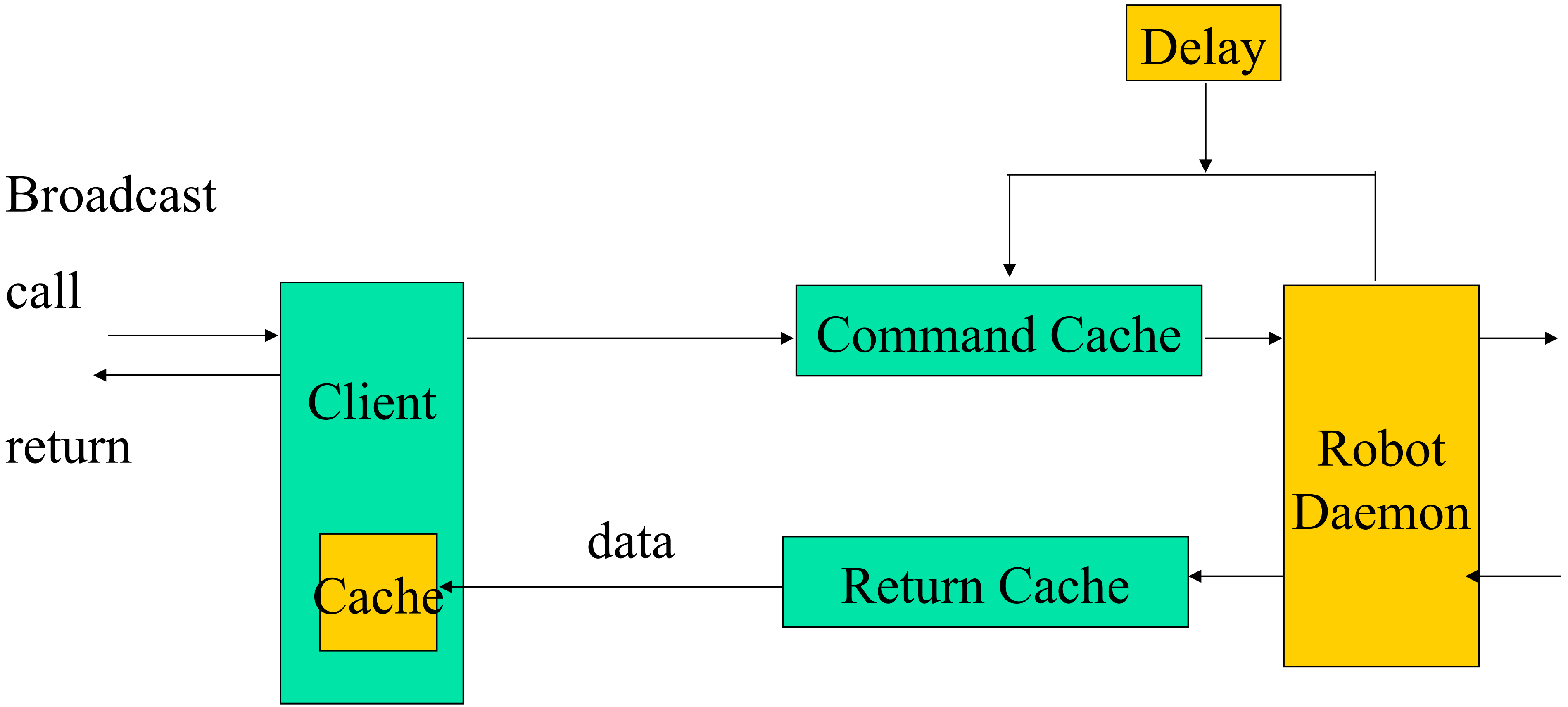
Delay Mode


Client
Server
Sync system clock
Clock
+
Delay
Function call
Command Cache
Client
Robot
Daemon
return
error signal
Return Cache
Cache

Playback Mode



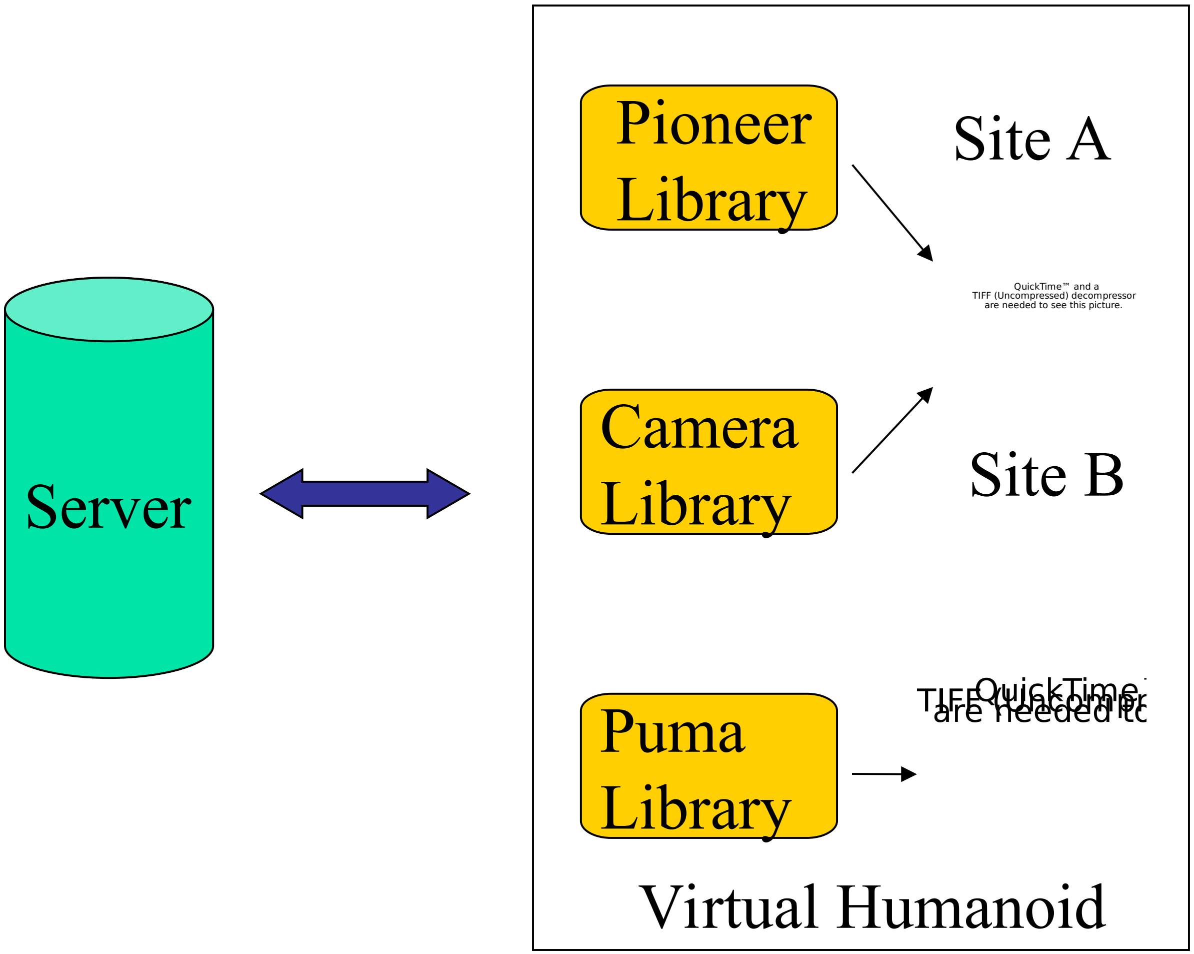
Broadcast Mode



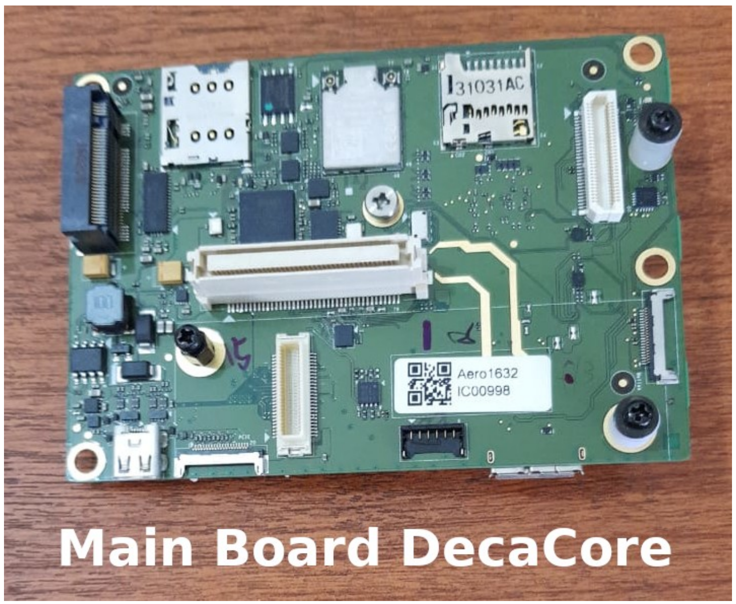
Conclusions

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

Virtual Humanoid



Conclusion



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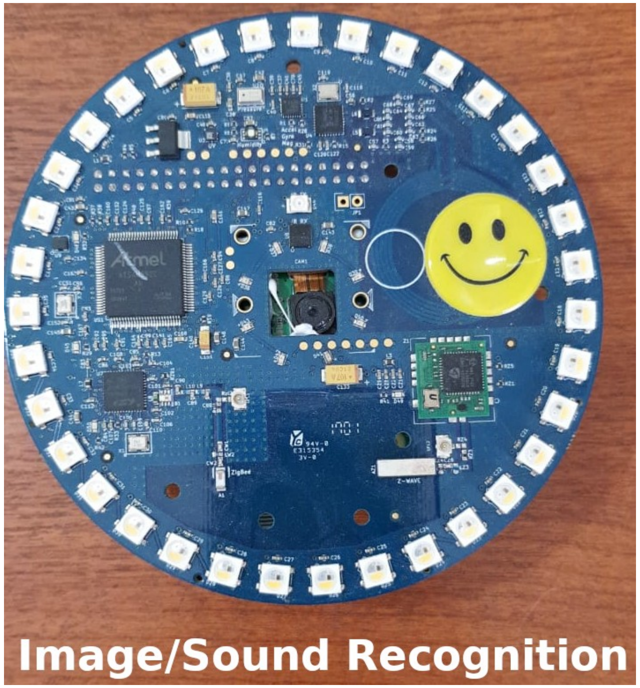
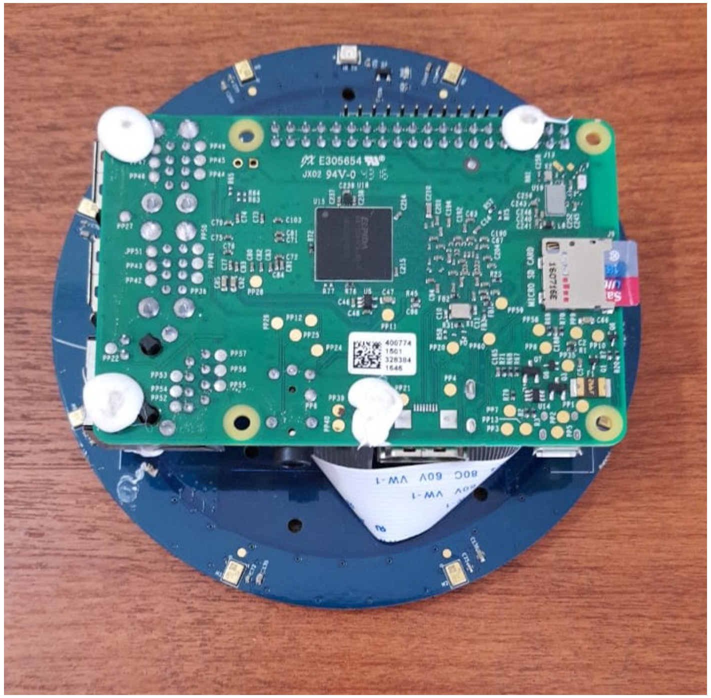
Conclusion





Conclusion

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== http://plen.jp/playground/wiki/about

== www.airspacedefense.org

== All CODES in

https://github.com/splash2018

Thank you!

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