

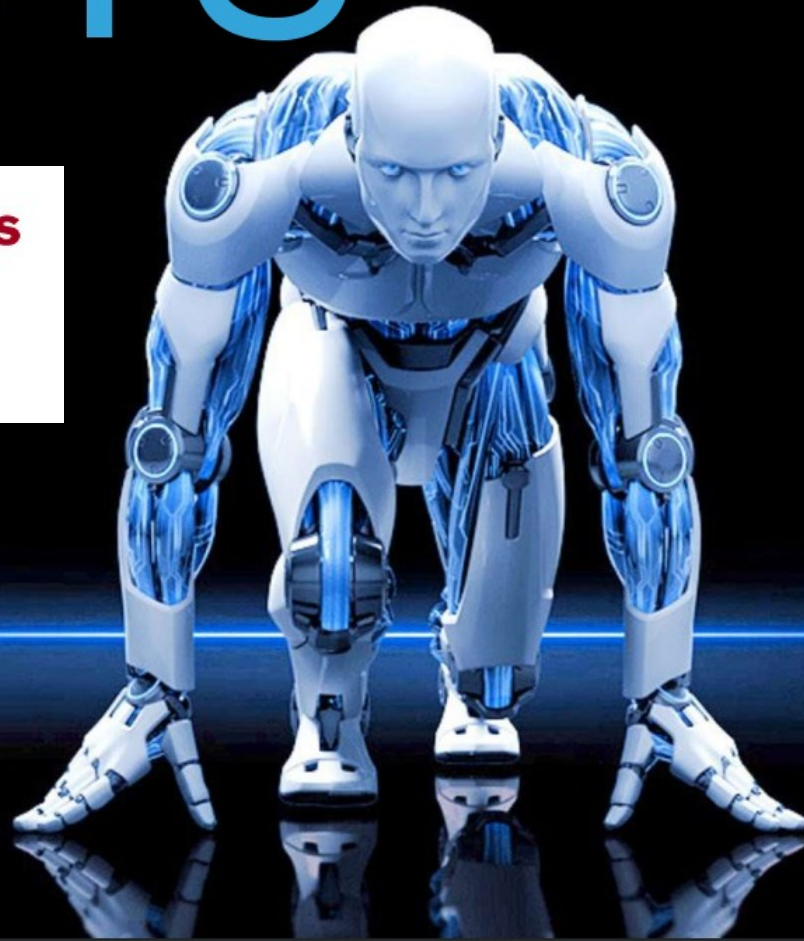
HUMANOID ROBOTS



**Massachusetts
Institute of
Technology**

Marcelo Anjos

presented





Practical in Humanoid Robotics

Marcelo dos Anjos

University National of Asuncion

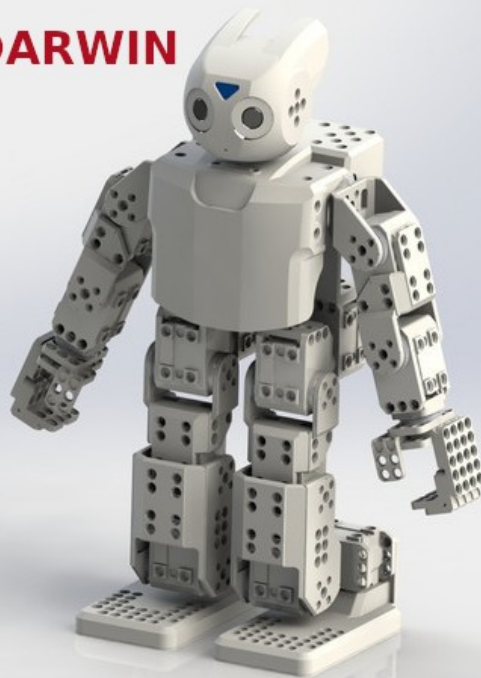


About Me

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

Motivation

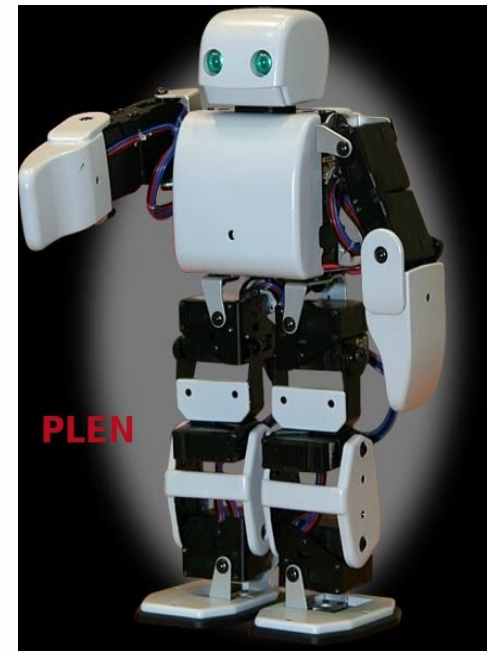
DARWIN



SOUL



PLEN





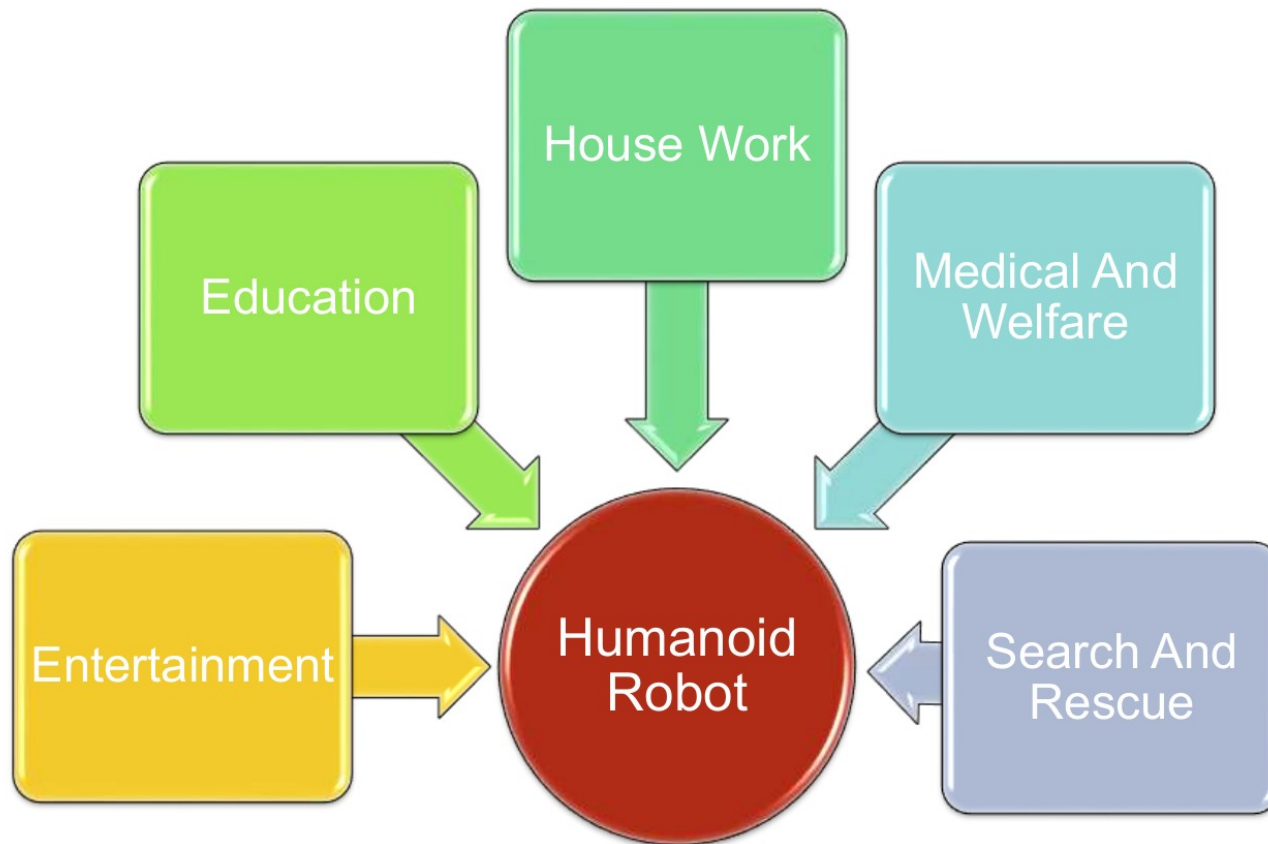
Humanoid Robot

- Humanoid 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

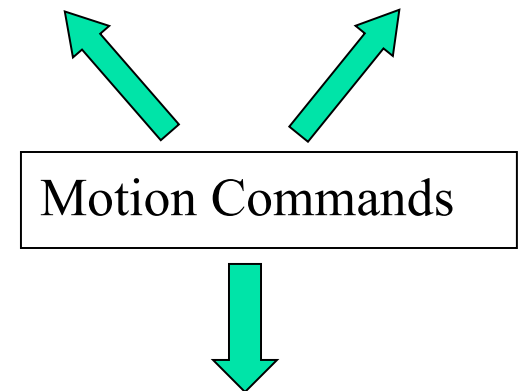


Why do we need a motion specification?

- 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

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

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TIFF (Uncompressed) decompressor
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.

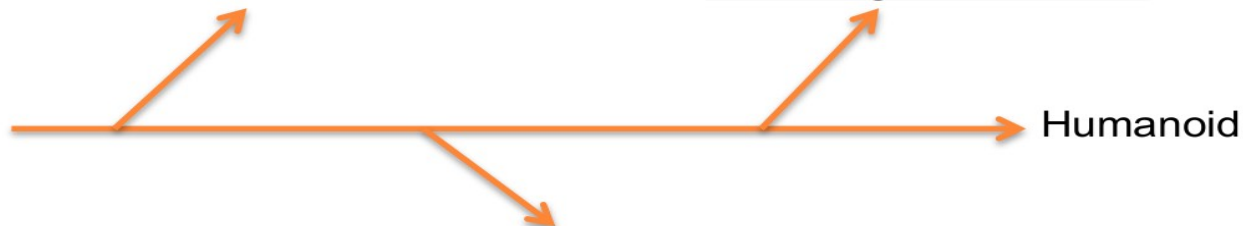


Basic Components of Humanoid

Sensors

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

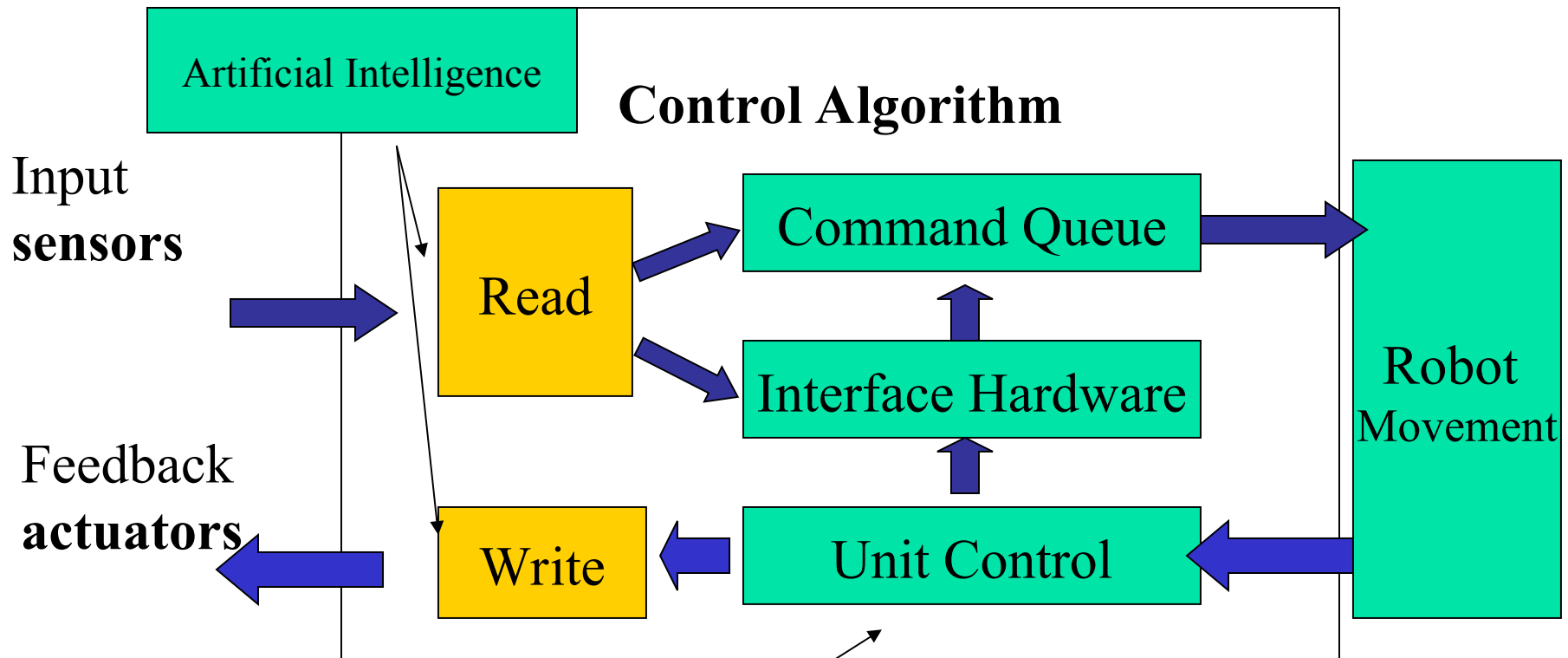
Planning and Control



Actuators

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

Architecture

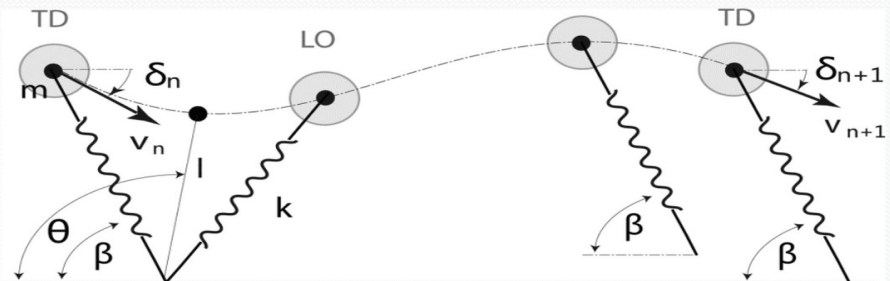
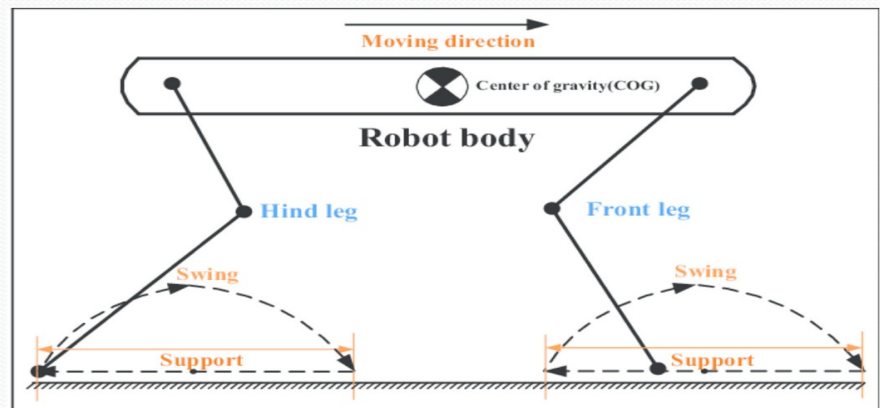


3D Choreography Programs

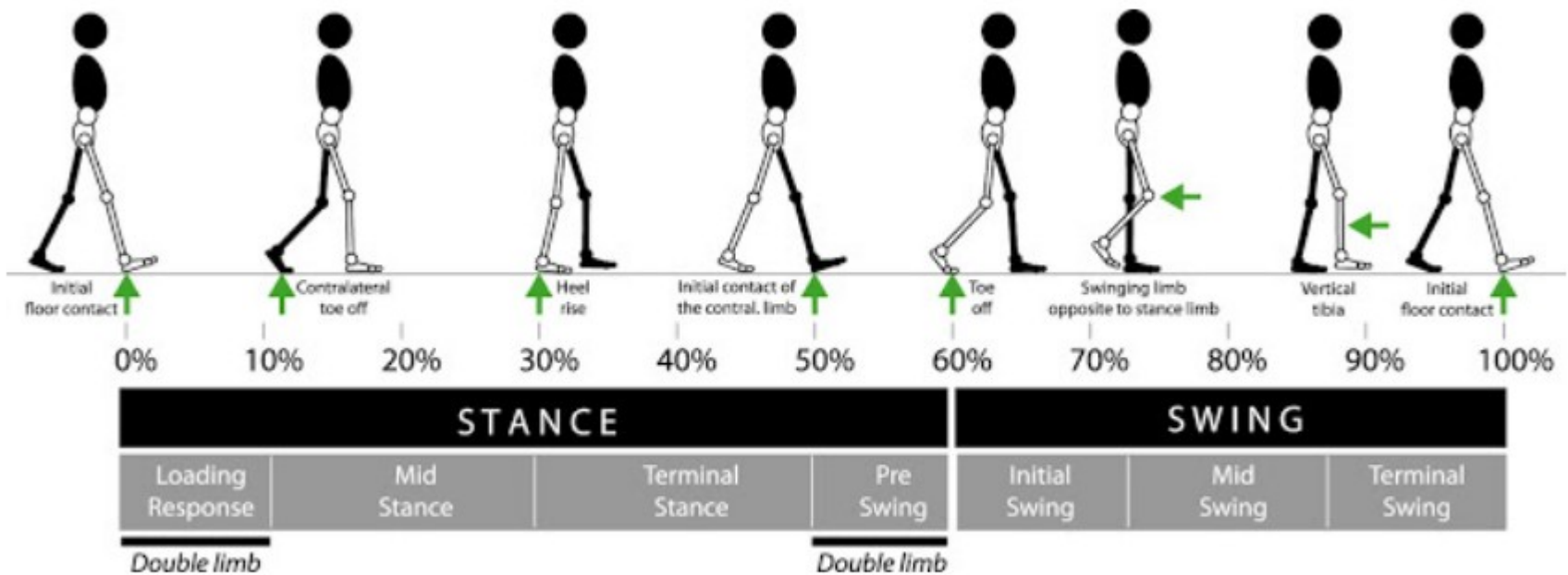
Locomotion – Walking Video

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.

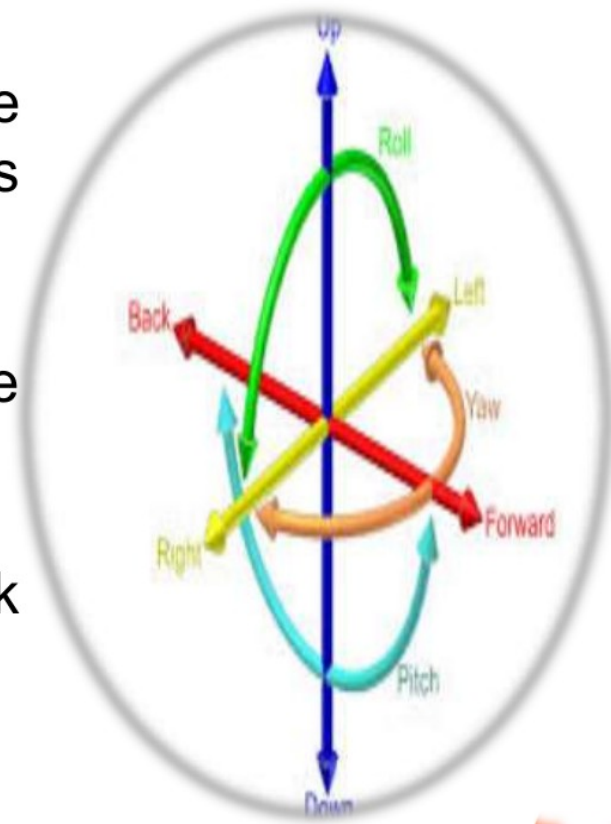


Locomotion



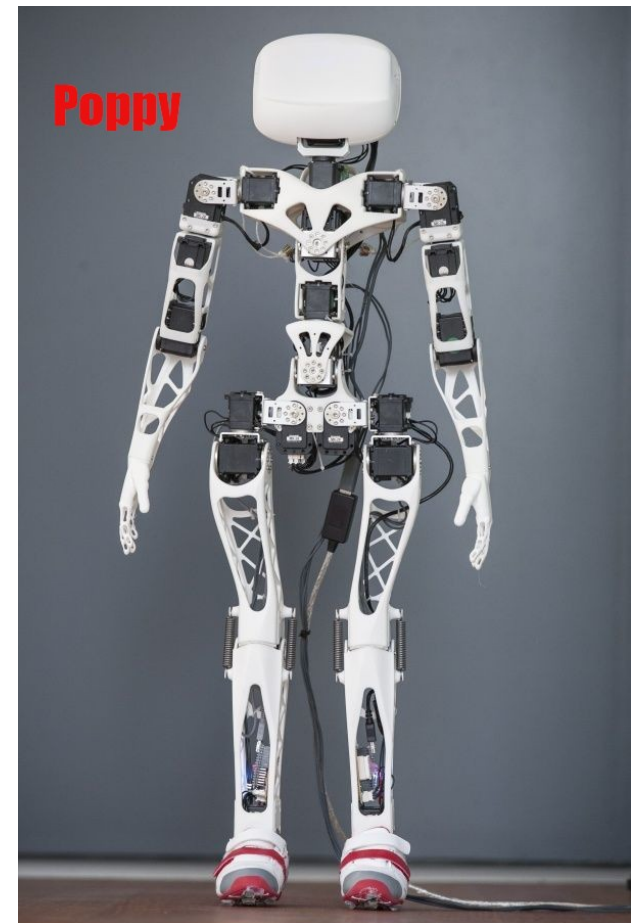
Degree of Freedom (DOF)

- 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 x 2.000 U\$\$ = 40.000 u\$\$.





Parts - Kits and Prices.



SOUL

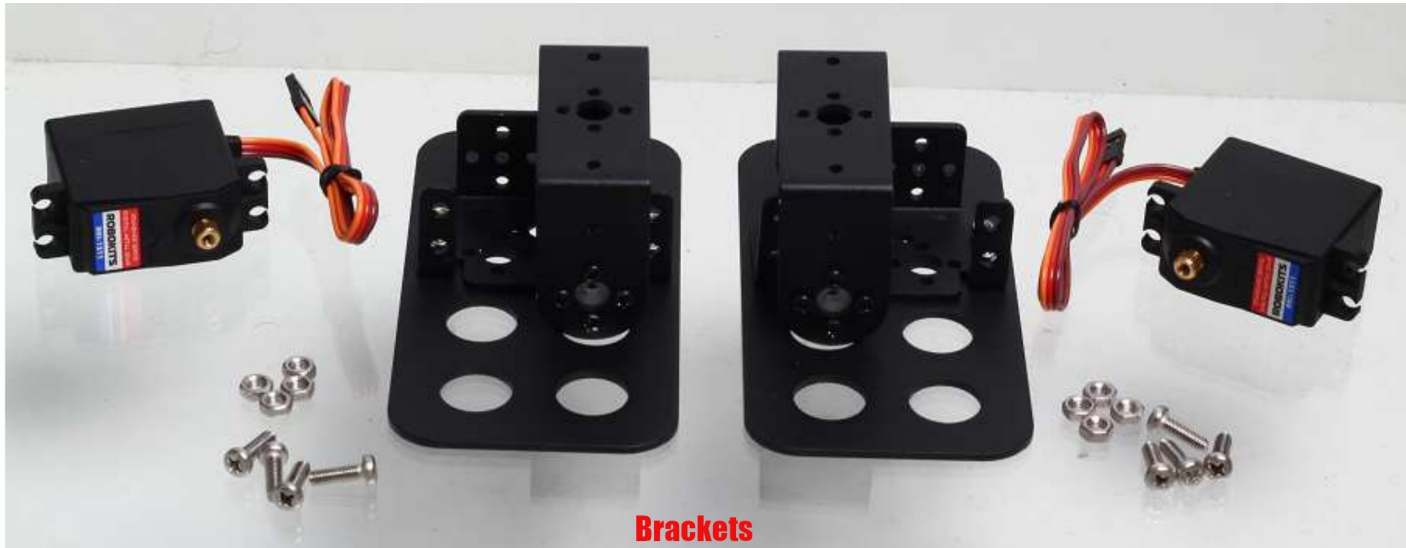


DARWIN



Plen2

Parts



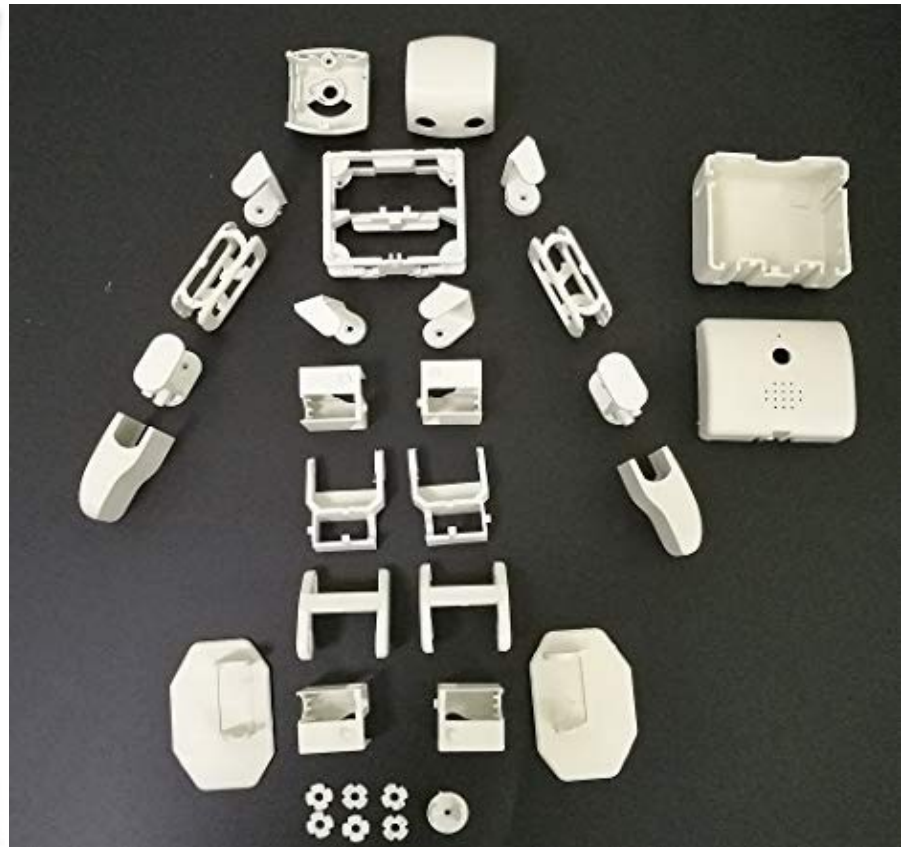
Parts

Aluminum

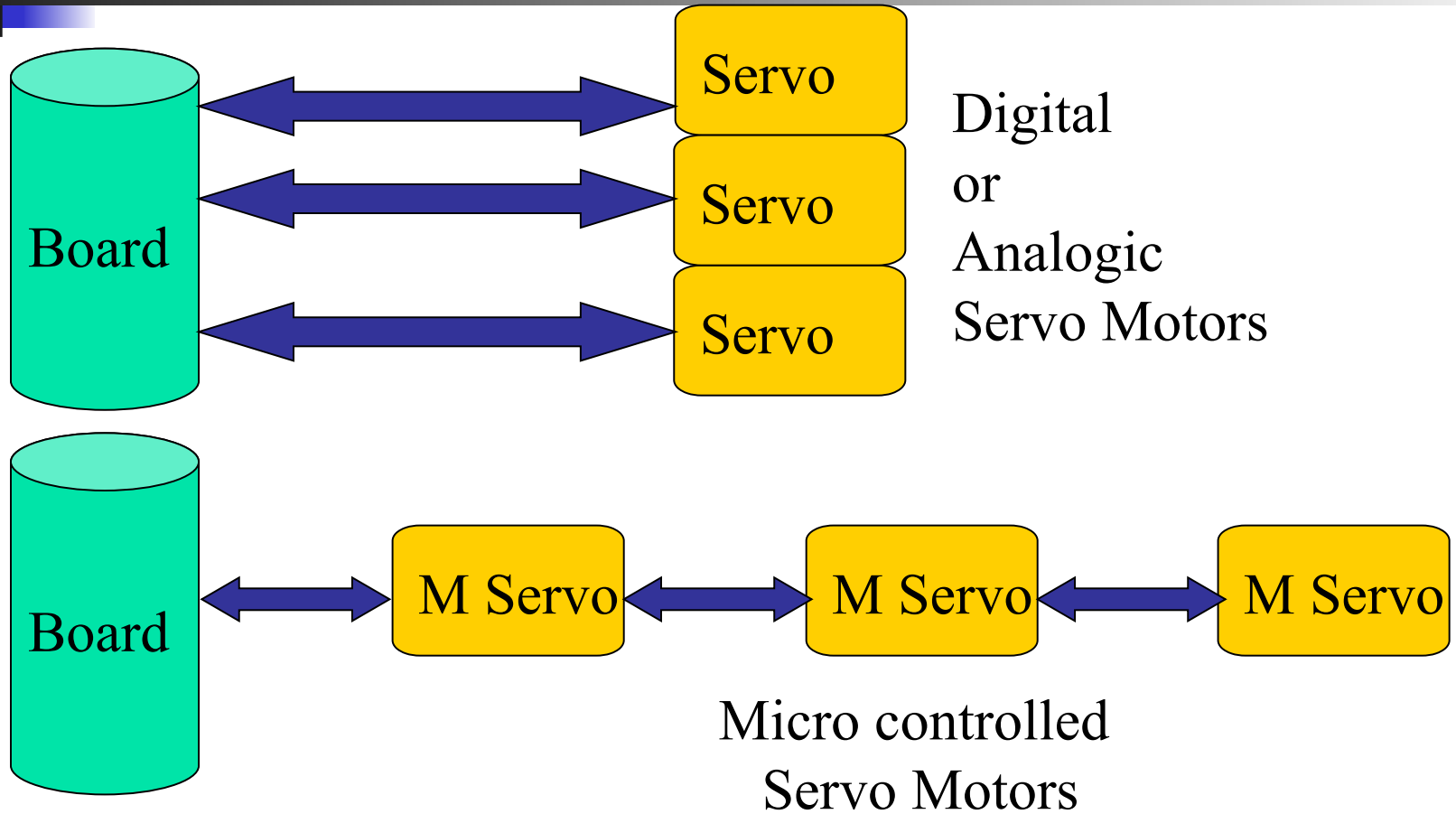


www.nuttyengineer.com

Parts



Servo Motor



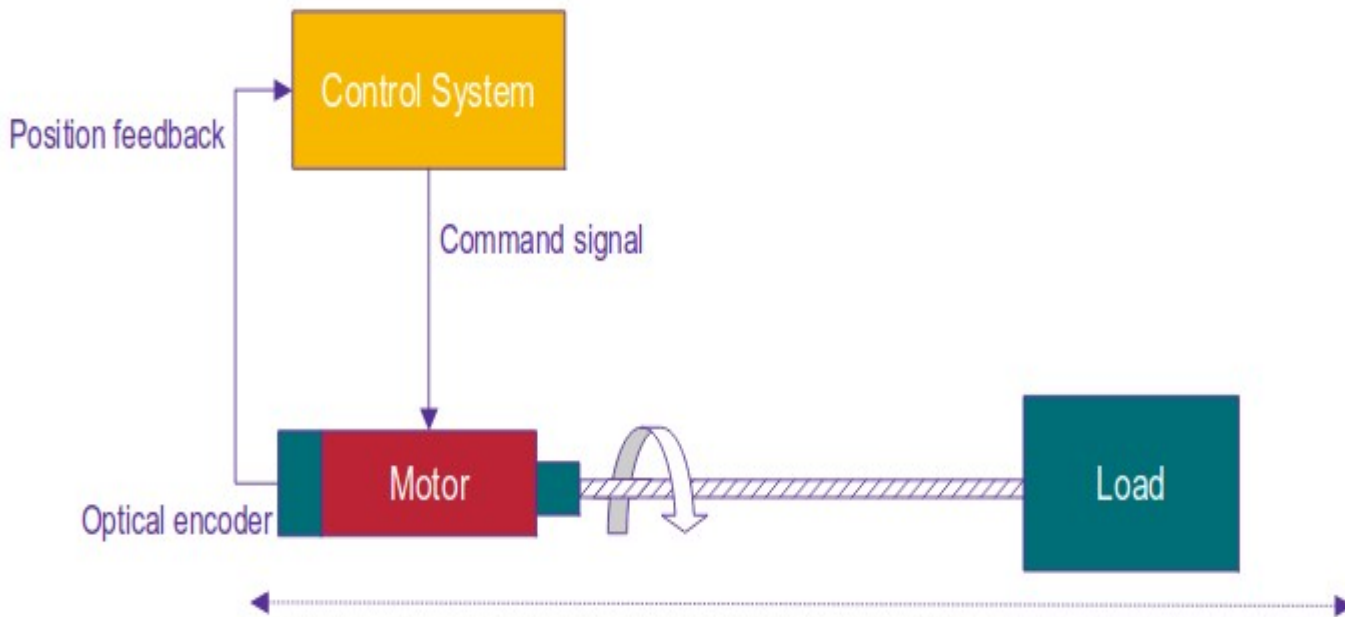


Micro controlled Servo Motor with PID

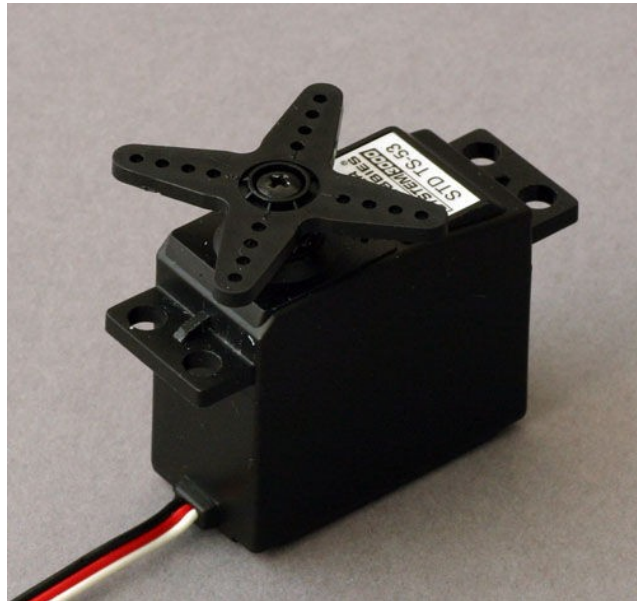
- PID is the most commonly used servo control algorithm:
 - Proportional
 - Integral
 - Derivative

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

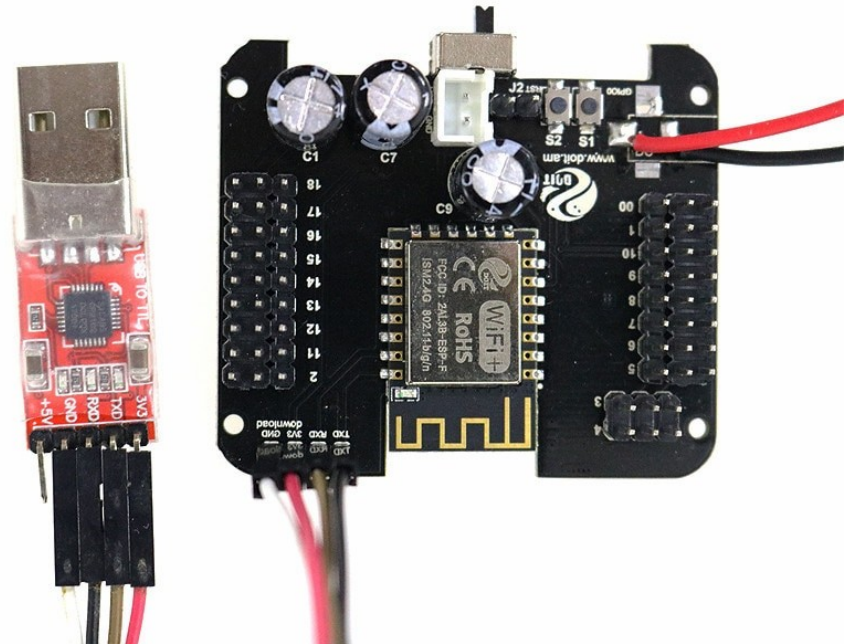
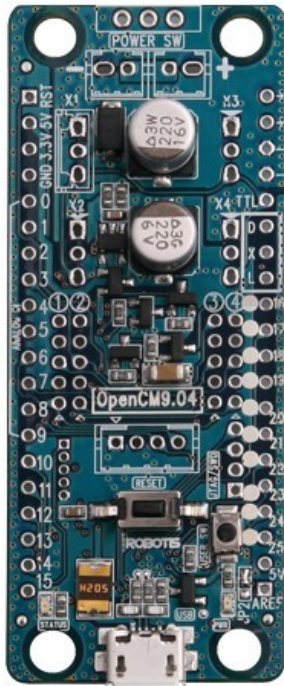
Micro controlled Servo Motor with PID



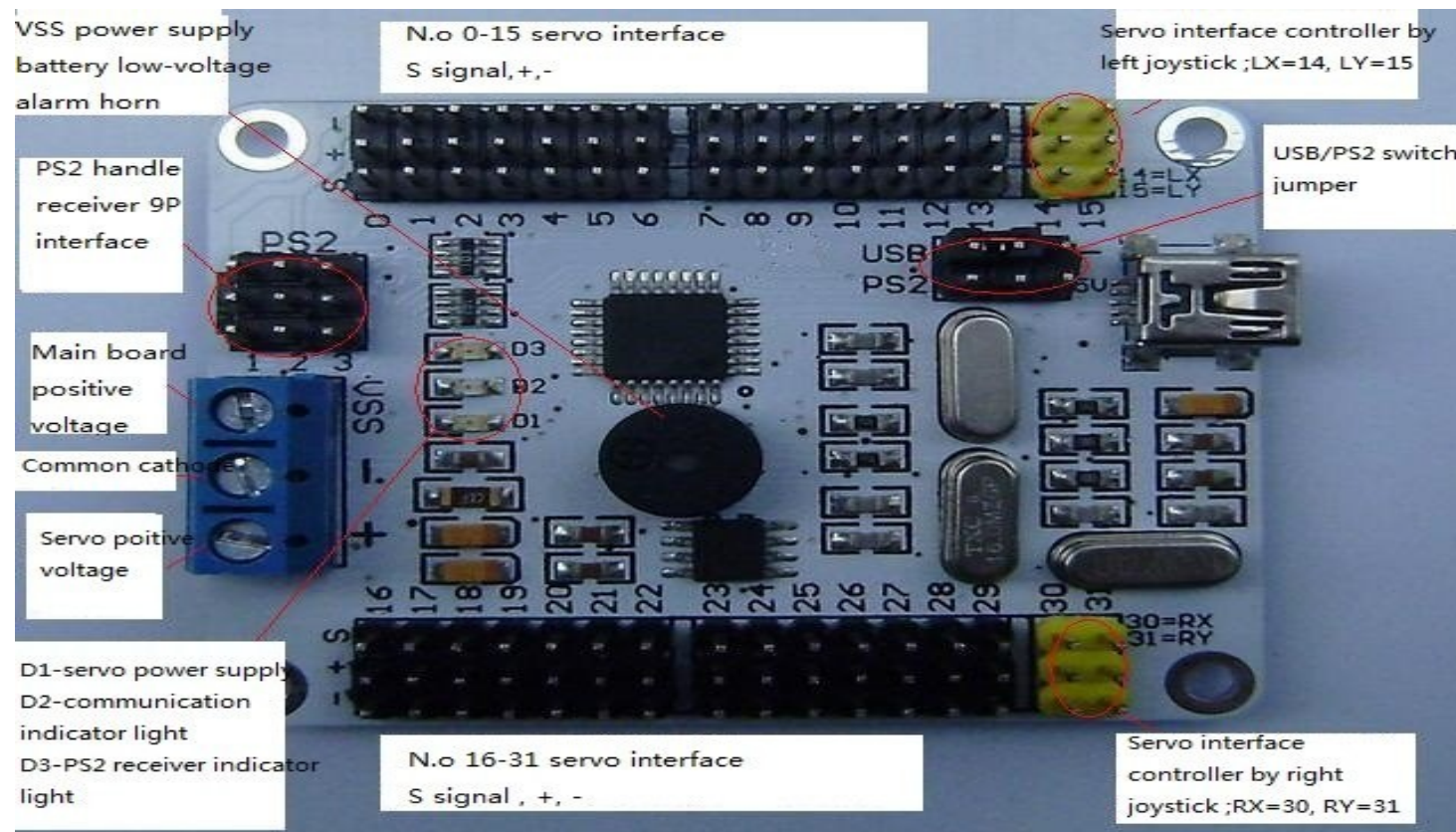
Servo Motor – Video and Practical



Main Board Control



Main Board Control - Practical



3D Choreography - Practical

The screenshot shows the R-Motion software interface for controlling a Darwin-MINI robot. The central 3D view displays the robot with 16 numbered joints (1-16) for motion editing. The interface includes a timeline at the top, a 'Robot Pose' table on the left, and a 'Joint Group' panel on the right. The status bar at the bottom shows connection details and timestamps.

Robot Pose

ID	3D Robot	Real Robot
1	0	? ?
2	0	? ?
3	-9	? ?
4	9	? ?
5	0	? ?
6	0	? ?
7	-32	? ?
8	32	? ?
9	-34	? ?
10	34	? ?
11	56	? ?
12	-56	? ?
13	37	? ?
14	-37	? ?
15	-30	? ?
16	30	? ?

Joint Group

- None (Alt+1)
- All (Alt+2)
- (Alt+3)
- (Alt+4)
- (Alt+5)
- (Alt+6)
- (Alt+7)
- (Alt+8)
- (Alt+9)
- (Alt+0)

Positioning | **Differential Positioning**

150.0 Steps | -141.0 Steps

10 | 1 | 0.1

Mirroring

Status Bar:

- Connect (F10) | Sync Mode
- Port: - | Baudrate: -
- 9:13:31 AM | 9:13:31 AM | 9:13:31 AM | 9:13:32 AM
- DARWIN-MINI_Default_en | C:/Users/hp/Desktop | C:/Users/hp/Desktop/DARWIN-MINI_Default_en.mtrnx | Start motion editing!

Sequencer – Practical

The screenshot shows the Servo Sequencer software interface. It features a menu bar with 'File', 'Functions', and 'Help'. Below the menu bar is a row of 18 servo sliders, each labeled 'Servo 1' through 'Servo 18'. Each slider has a 'Center' button below it. To the right of the sliders is a vertical stack of buttons: 'Open File', 'Save File', 'Reset Labels', 'Settings', 'Show Groups', and 'Home All'. Below the sliders is a 'Servo Idle' section with checkboxes for servos 1 through 18 and a 'Clear' button. The main interface is divided into several sections: 'Connection Type' (with radio buttons for 'USB', 'Bluetooth', and 'Select Port Manual'), 'Servo Sequencer' (with fields for 'Delay', 'Go to Line', and 'Speed'), 'Function' (with a dropdown menu), 'Comments for function', 'Function Control' (with function key buttons), and 'Run Sequence' (with 'STOP' and 'Run Sequence' buttons). A large pink area on the right side of the interface is labeled '5'. The status bar at the bottom left shows 'Ready...'. Numbered callouts (1-9) point to various UI elements: 1 points to the 'Bluetooth' radio button; 2 points to the 'Servo 9' slider; 3 points to the 'Servo 9' 'Center' button; 4 points to the 'Go to Line' field; 5 points to the large pink area; 6 points to the 'Settings' button; 7 points to the 'Function Control' section; 8 points to the 'Servo Idle' checkboxes; and 9 points to the 'Save Configuration to Controller' button.

Dancing – Video and Practical





Artificial Intelligence

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

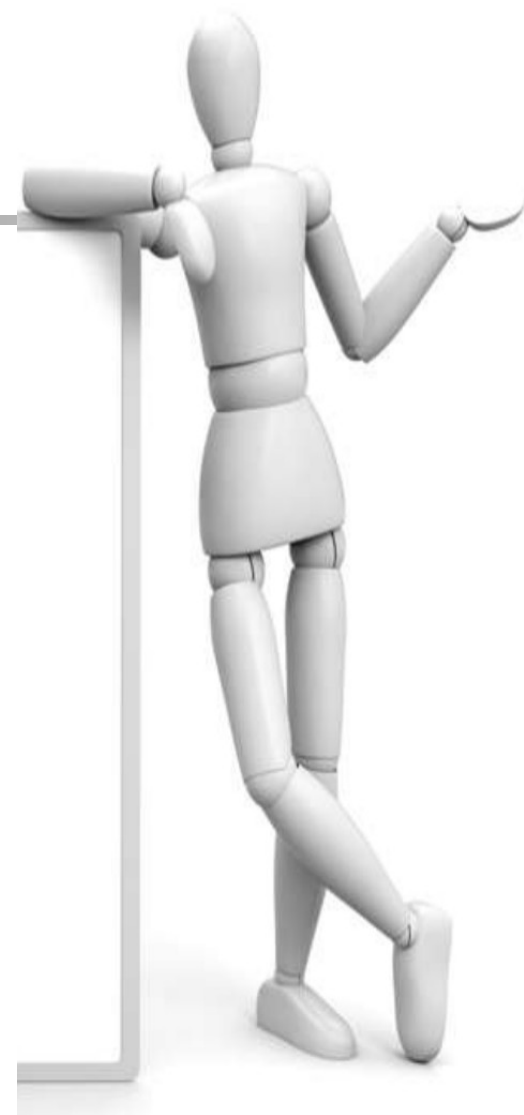
Borrowing characteristics from human intelligence, and applying them as algorithm in a computer friendly way.





Recognition Technology

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

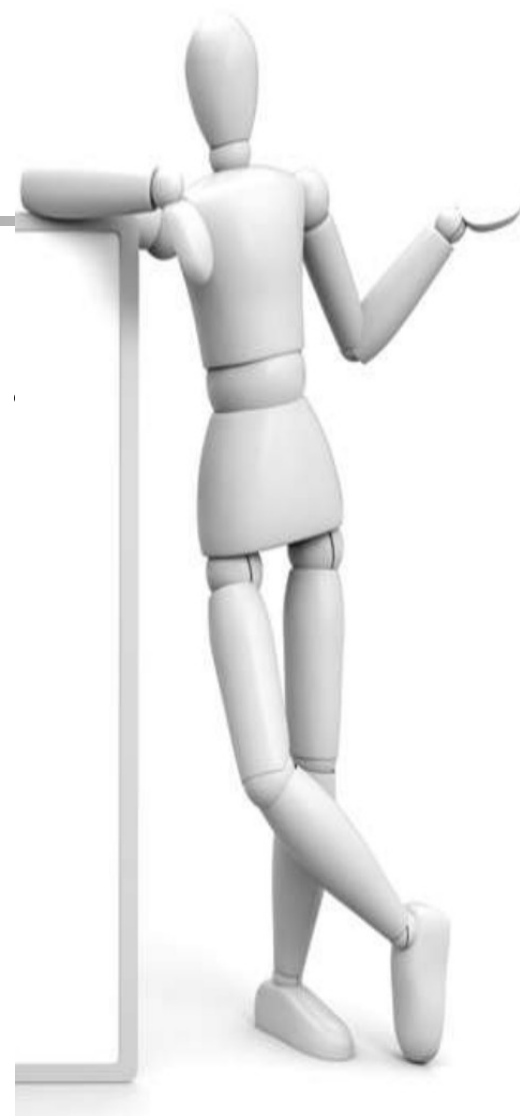




Sound Recognition

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.

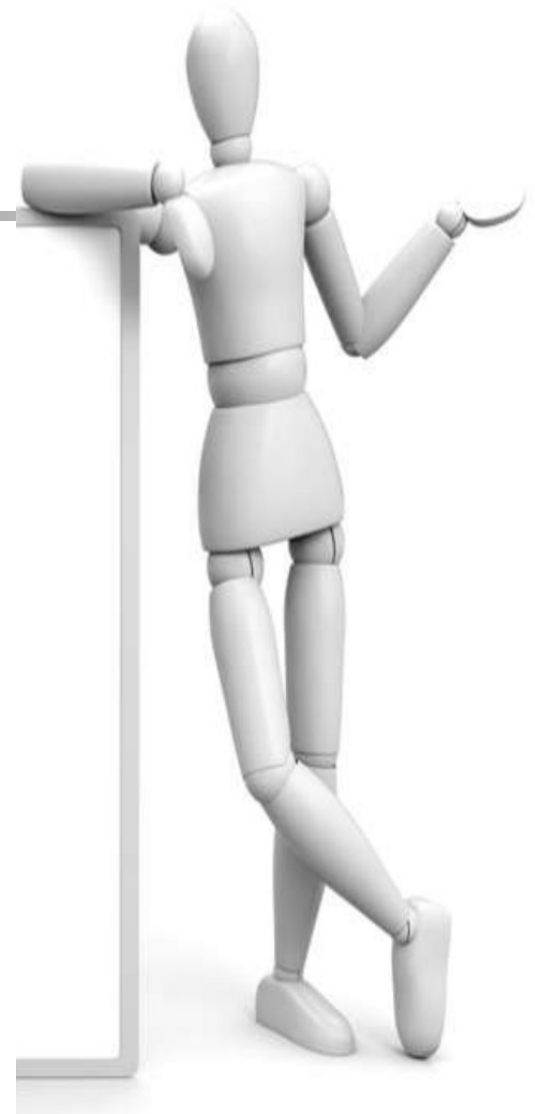




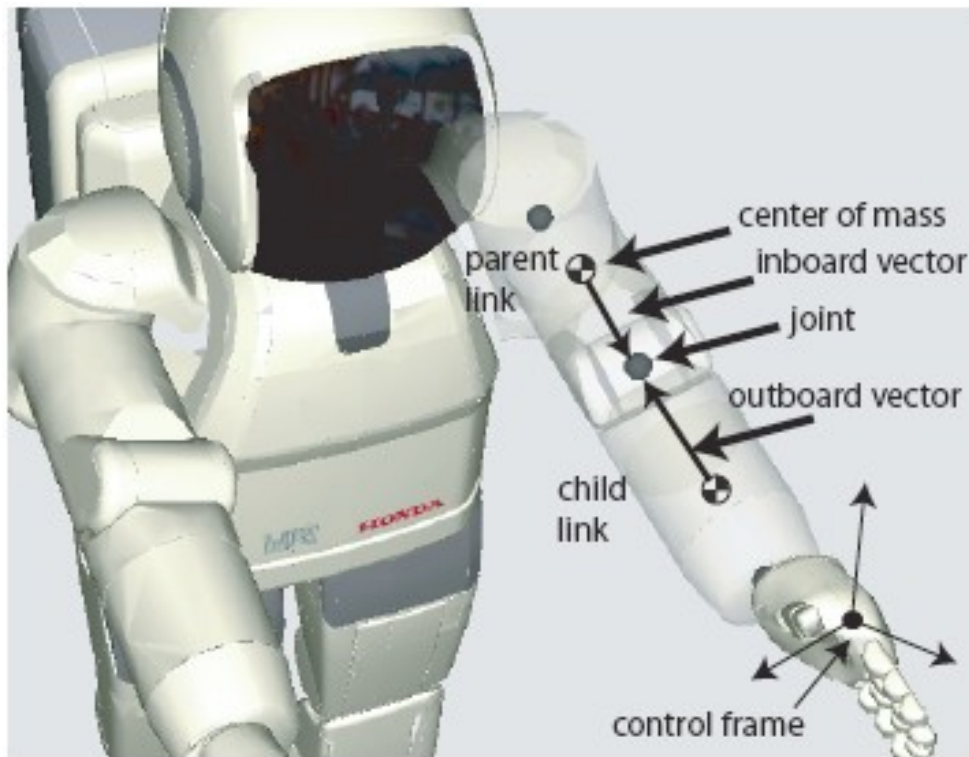
Facial Recognition

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



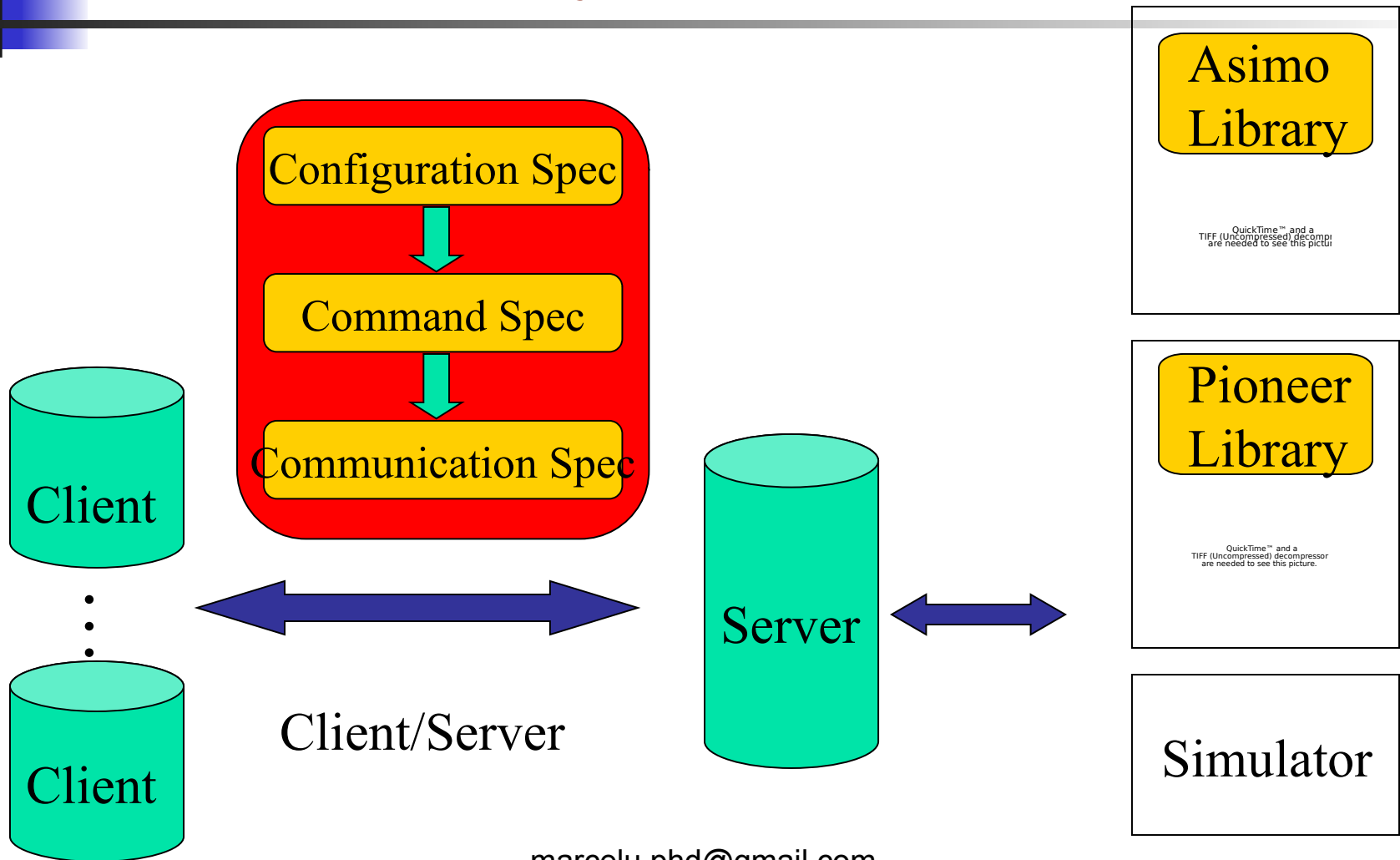
Abstraction

Configuration Spec

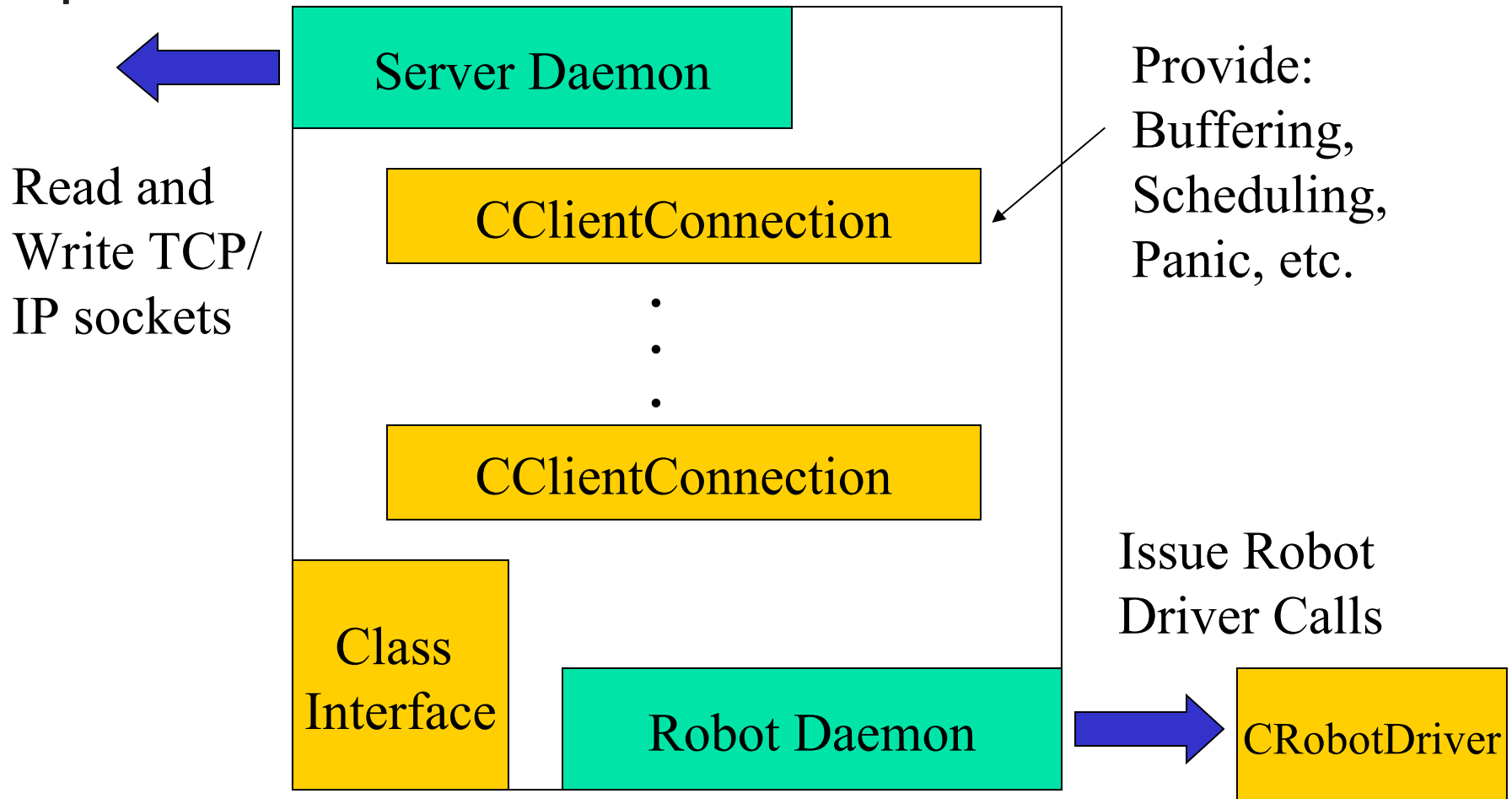
Command Spec

Communication Spec

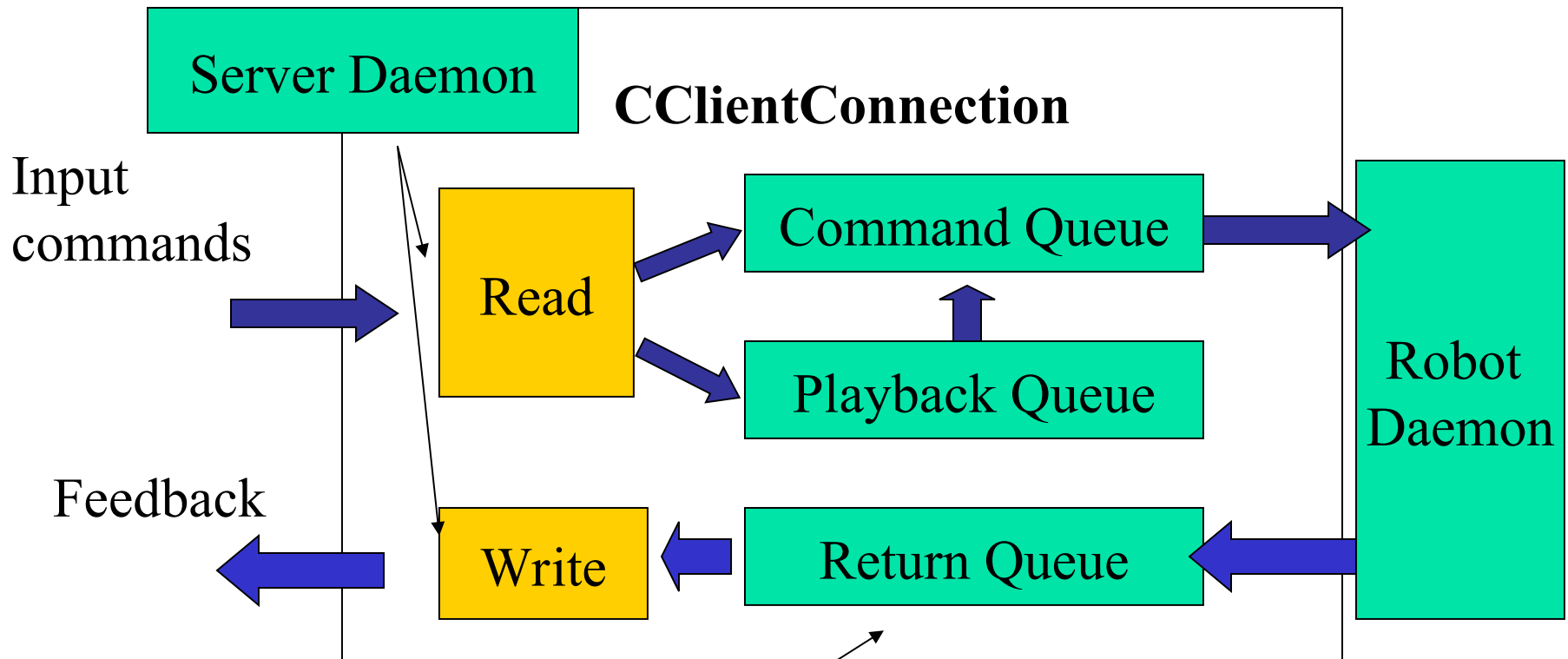
Architecture - System Overview



Architecture - Robotalk Server



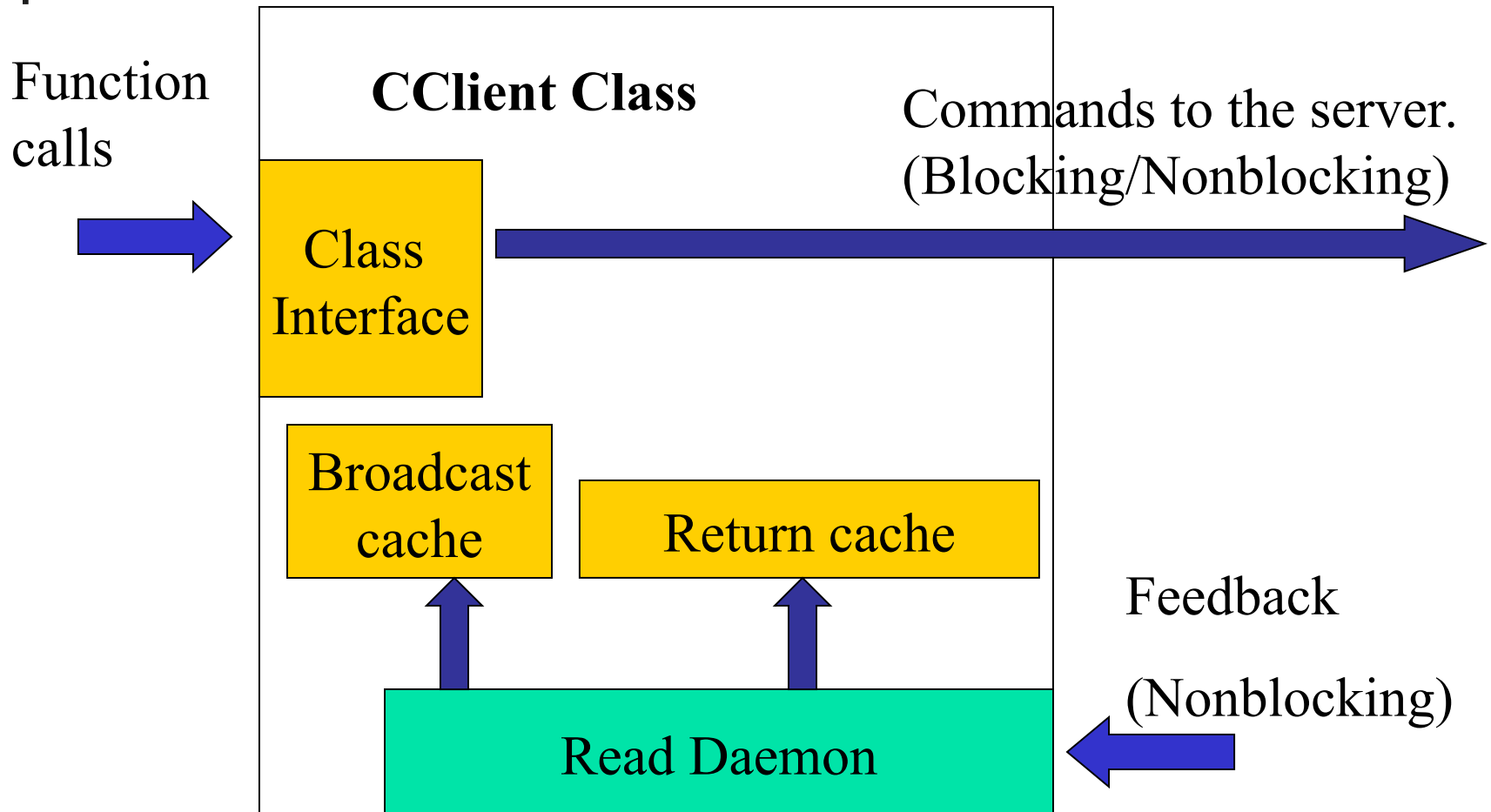
Architecture - CClientConnection



Priority Queues

marcelu.phd@gmail.com

Architecture - CClient





Architecture - Communication Modes

- **Direct mode:**

blocking & instantaneous, for debug purposes

- **Delay mode:**

nonblocking, instantaneous or delay

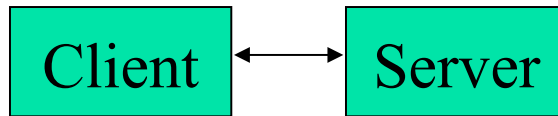
- **Playback mode:**

nonblocking, adaptive caching based on channel quality

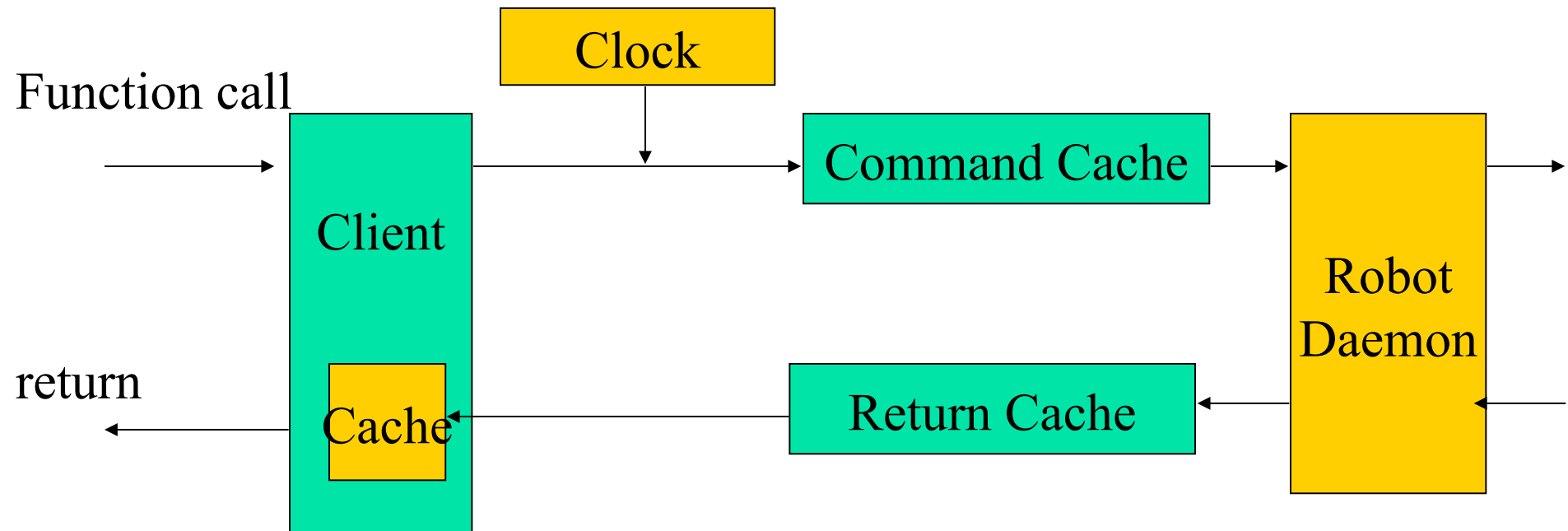
- **Broadcast mode:**

periodic query feedback

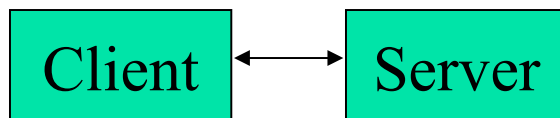
Direct Mode



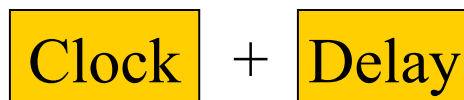
Sync system clock



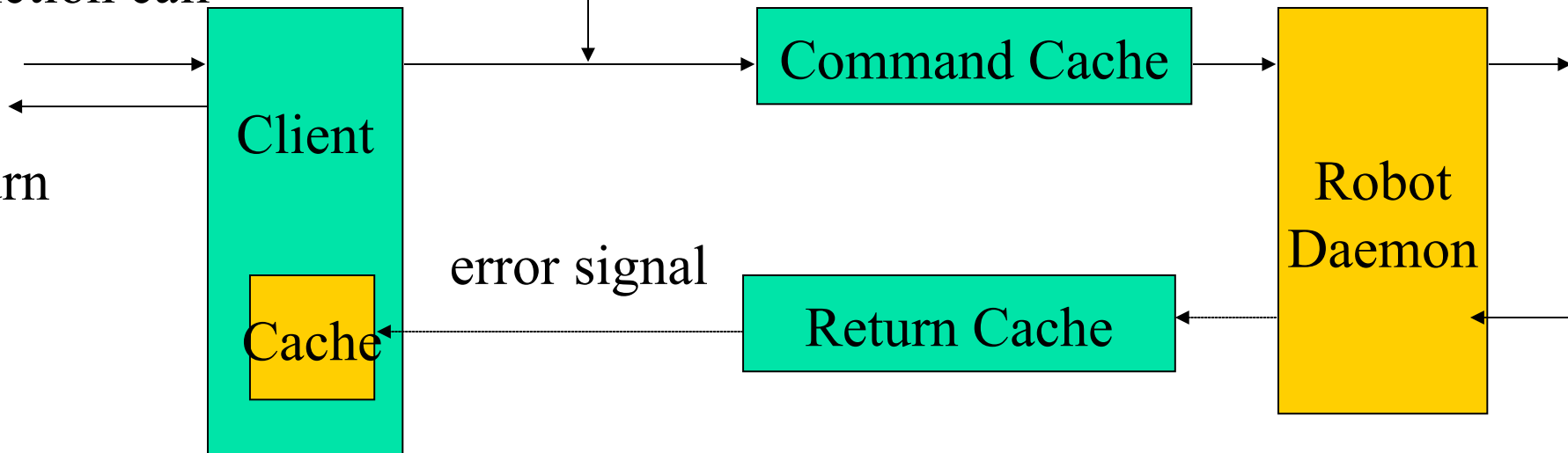
Delay Mode



Sync system clock

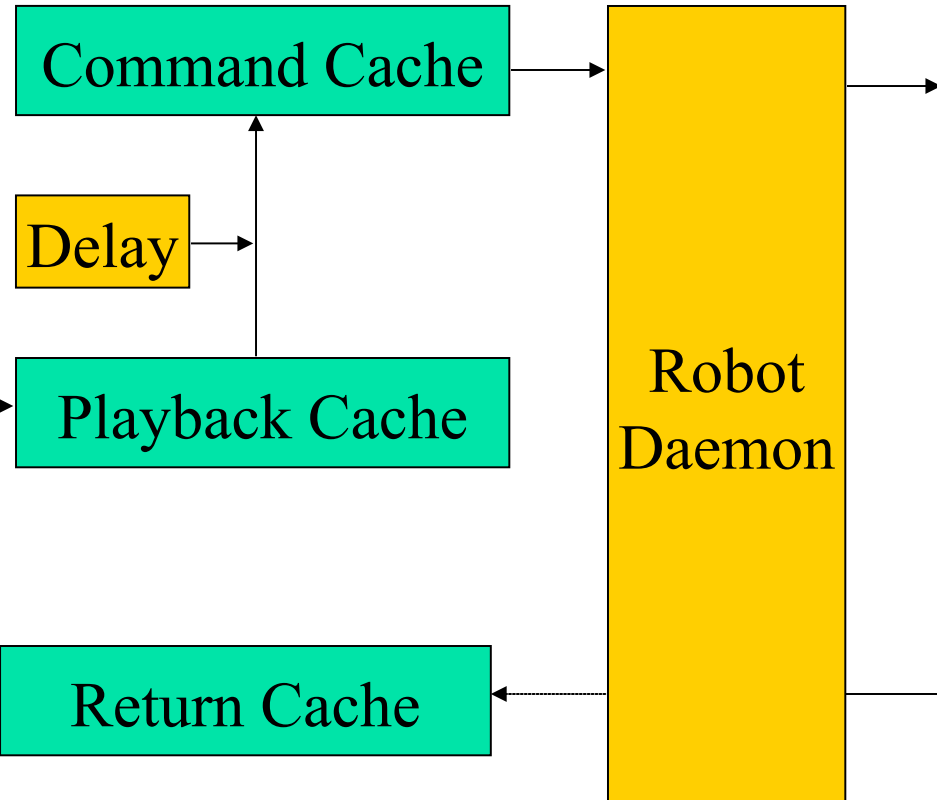
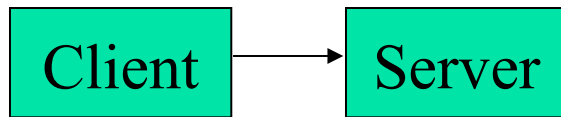


Function call

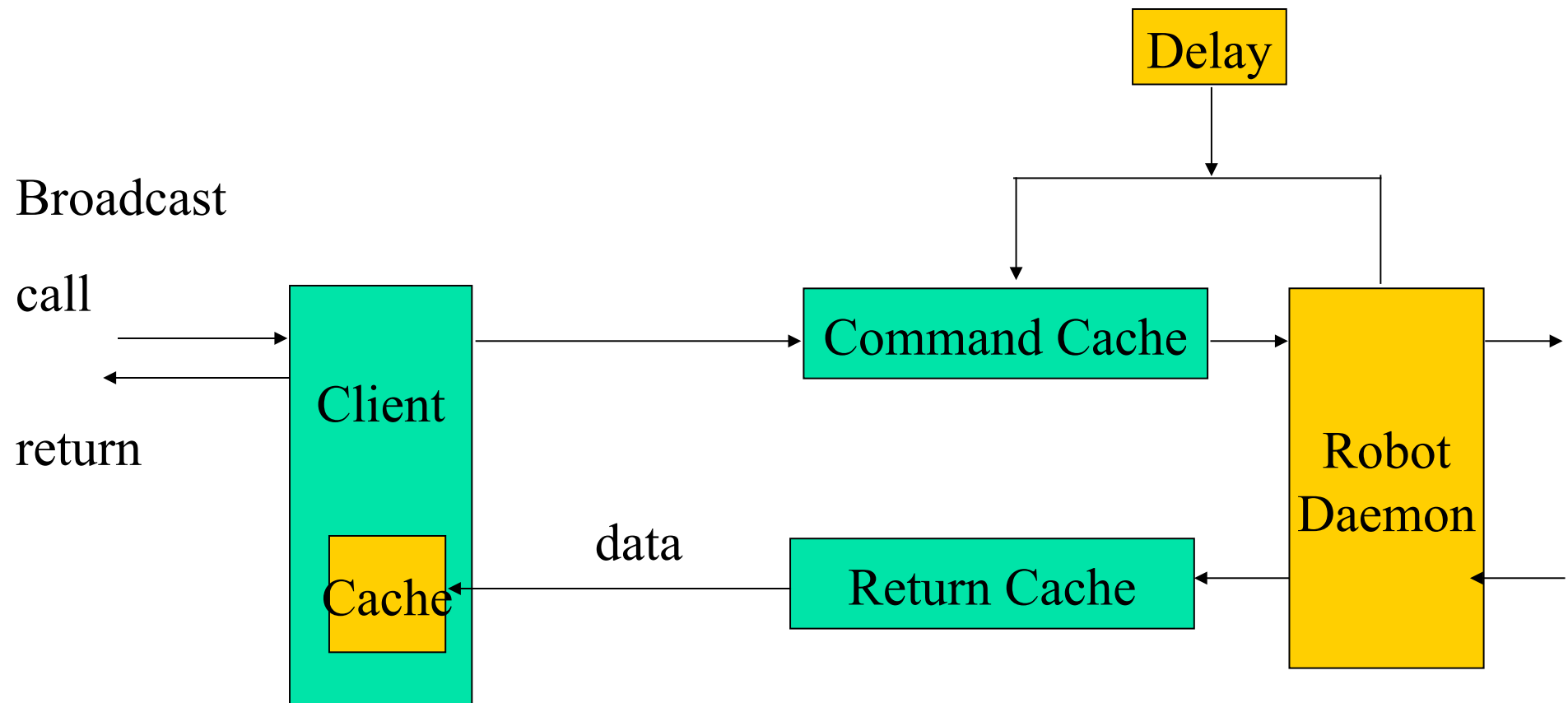


Playback Mode

Length of the sequence



Broadcast Mode

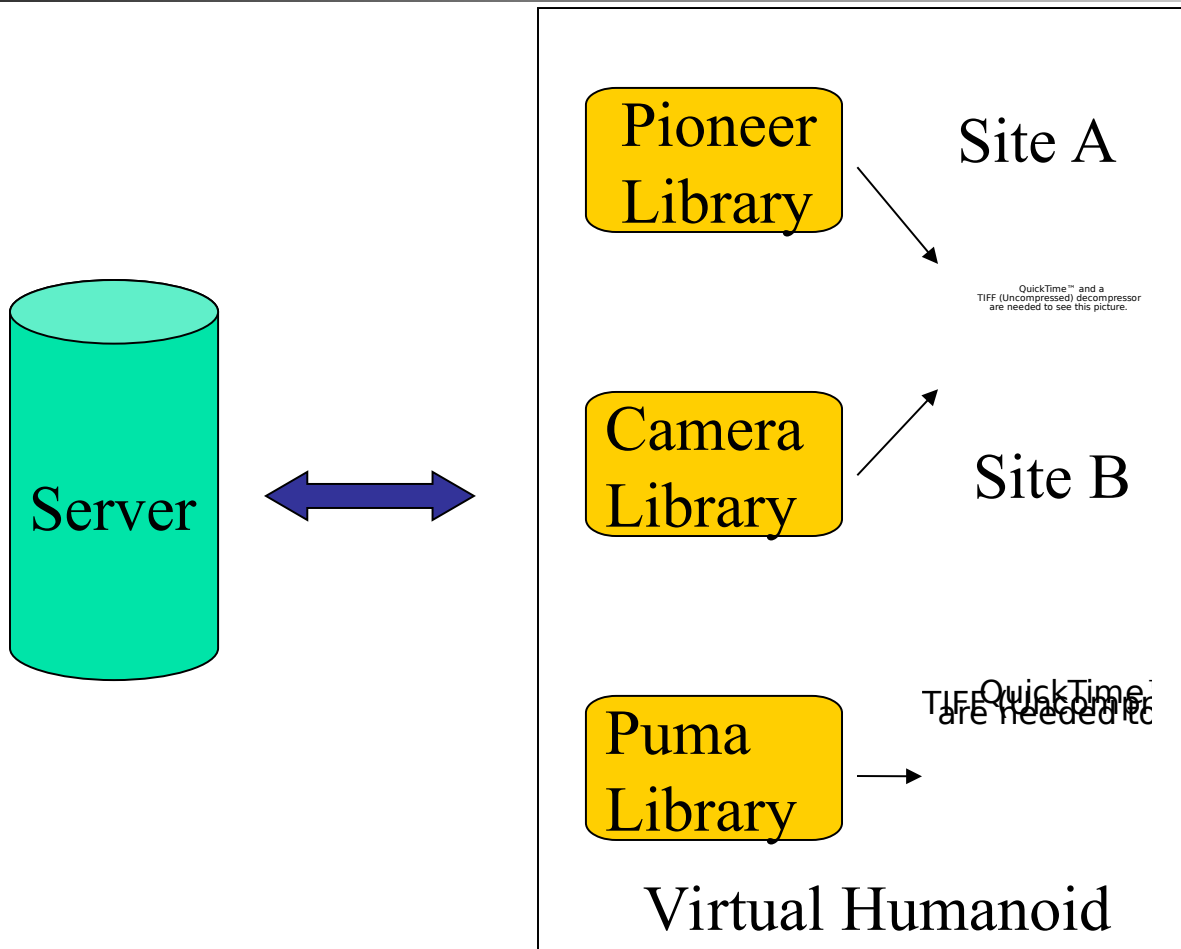




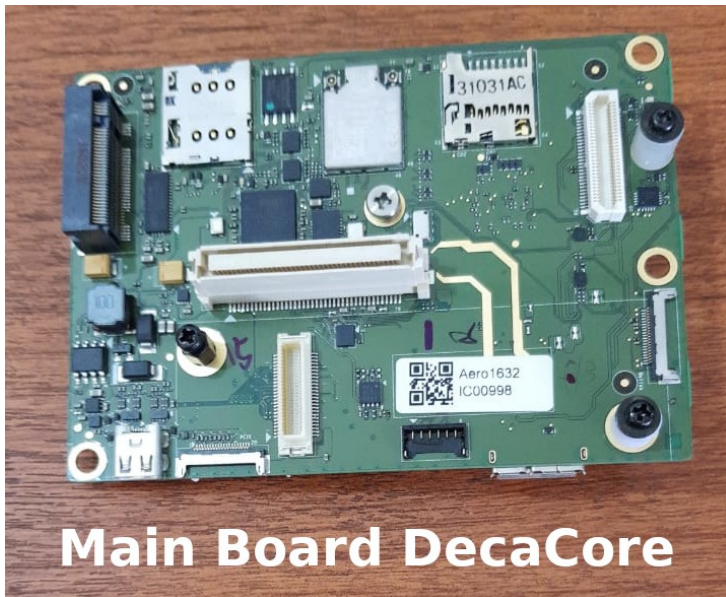
Conclusions

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

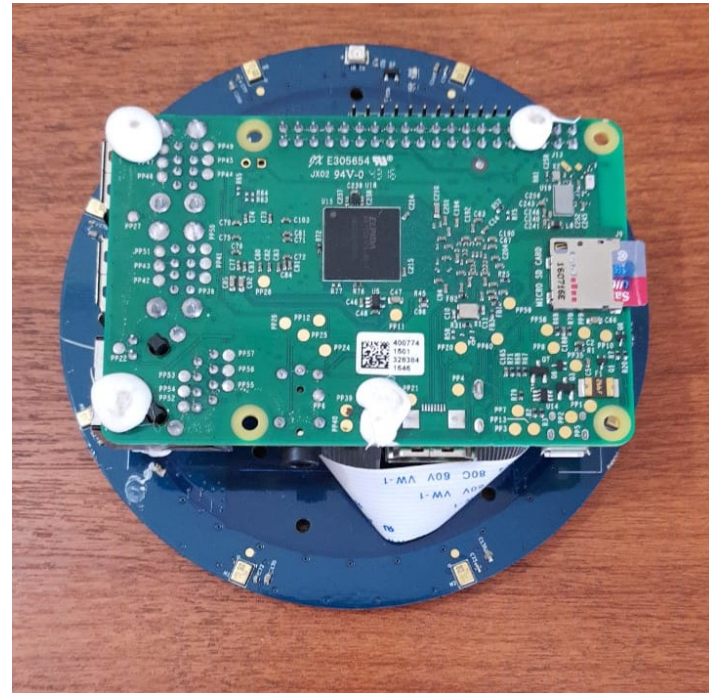
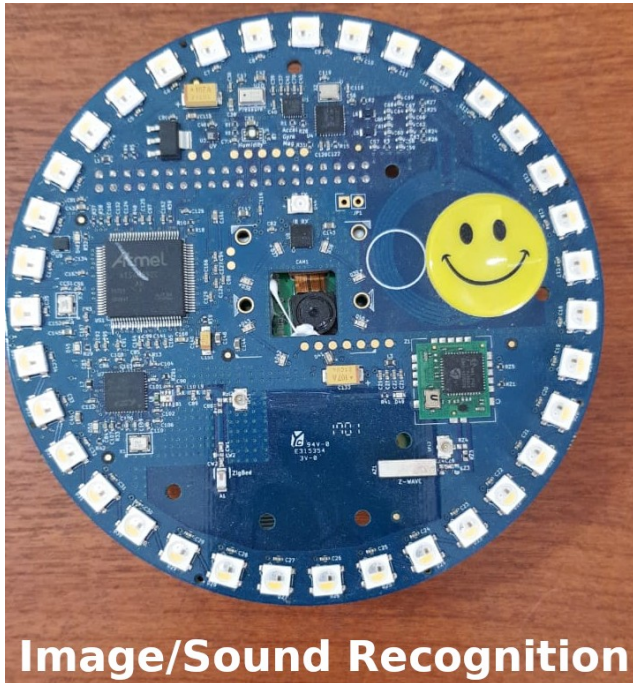
Virtual Humanoid



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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