

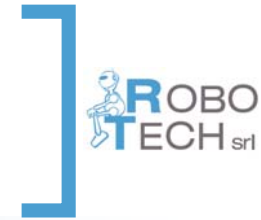
Corso di Percezione Robotica A.A. 2007/2008
Modulo D: Applicazioni ed Esercitazioni
Lezione D.I

**Esercitazione con un robot umanoide
programmabile per edutainment**

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[RoboTech srl]



- RoboTech srl is an academic spin-off company of Scuola Superiore Sant'Anna founded in 2004 by an associate Professor of Biomedical Robotics and a research assistant of the ARTS Lab

- RoboTech mission:

- Long-term vision: **service and personal robotics**
- Short-term target: **edutainment robotics**

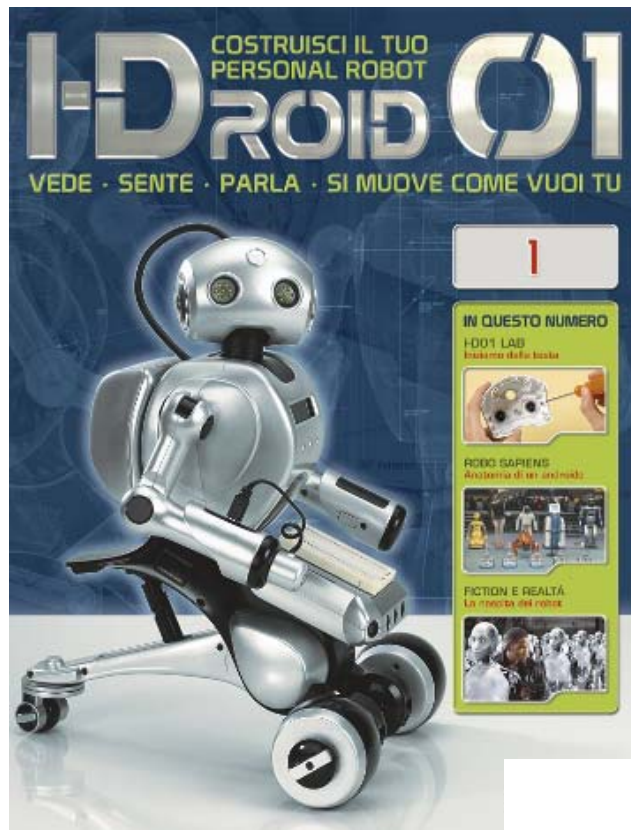
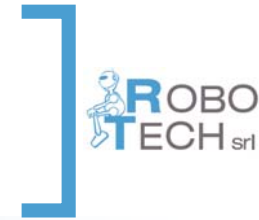


RoboTech Expertise



- Design and development of
 - robotic systems for entertainment and education
 - electronic modules
 - firmware and software
 - systems for acquisition and processing of sensory data
 - ICT facilities based on main existing standards

I-Droid 01 Humanoid Robot



I-Droid 01 is distributed worldwide as a collection in newspaper kiosks by De Agostini, Italian publisher with branches in 30 countries





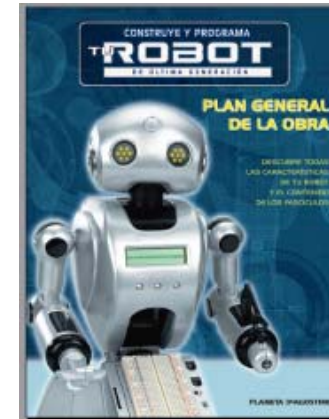
Italy (2 launching, Aug. 2005/Aug. 2006)



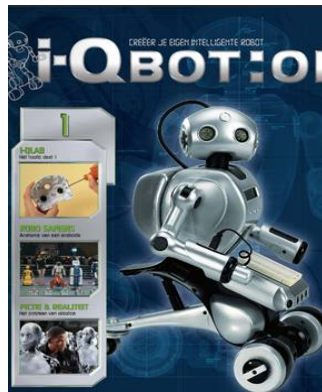
Poland (Mar. 2006)



Japan (Mar. 2006)



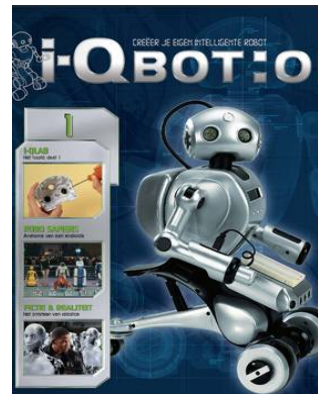
Spain (Sep. 2006)



Netherlands (Jan. 2007)

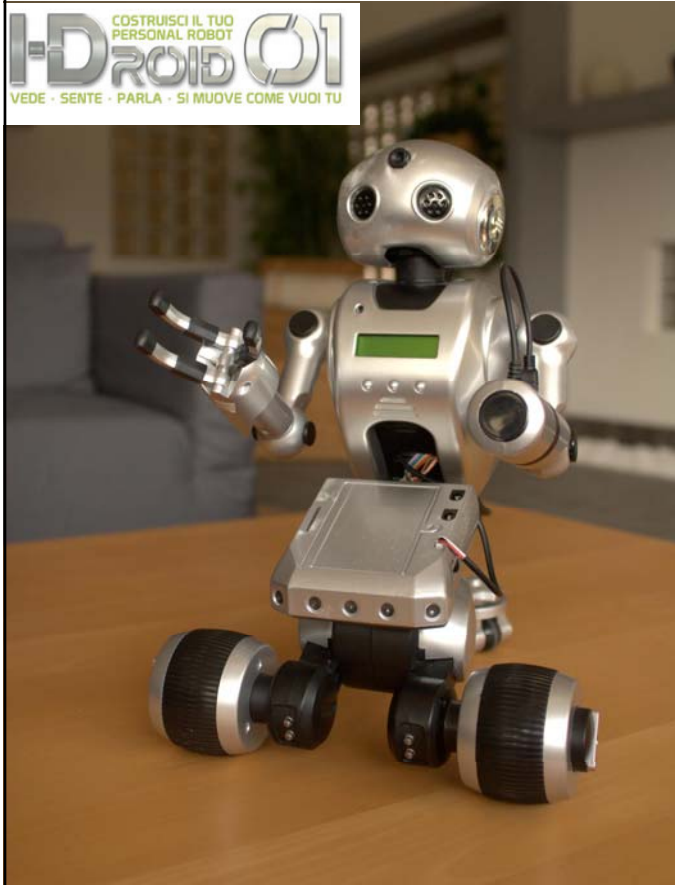
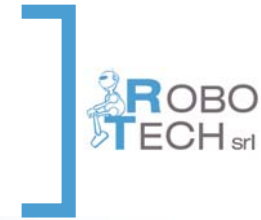


Portugal (Mar. 2007)



Belgium (Jan. 2008)

I-Droid 01 Humanoid Robot



- 8 Dof:
 - base 2
 - trunk 1
 - arms 2
 - head 2
 - hand 1
- 7 Encoders
- 4 Microphones
- 1 CMOS camera
- 1 Touch sensor
- 3 US sensors
- 2 IR sensors
- 1 Temperature sensor
- 24 Led
- 1 Universal remote controller

**RED, GREEN
AND YELLOW
EYES LED (3+3)**

CYAN EARS LED

**UP/DOWN
MECHANISM**

**1 PASSIVE REAR
WHEEL**

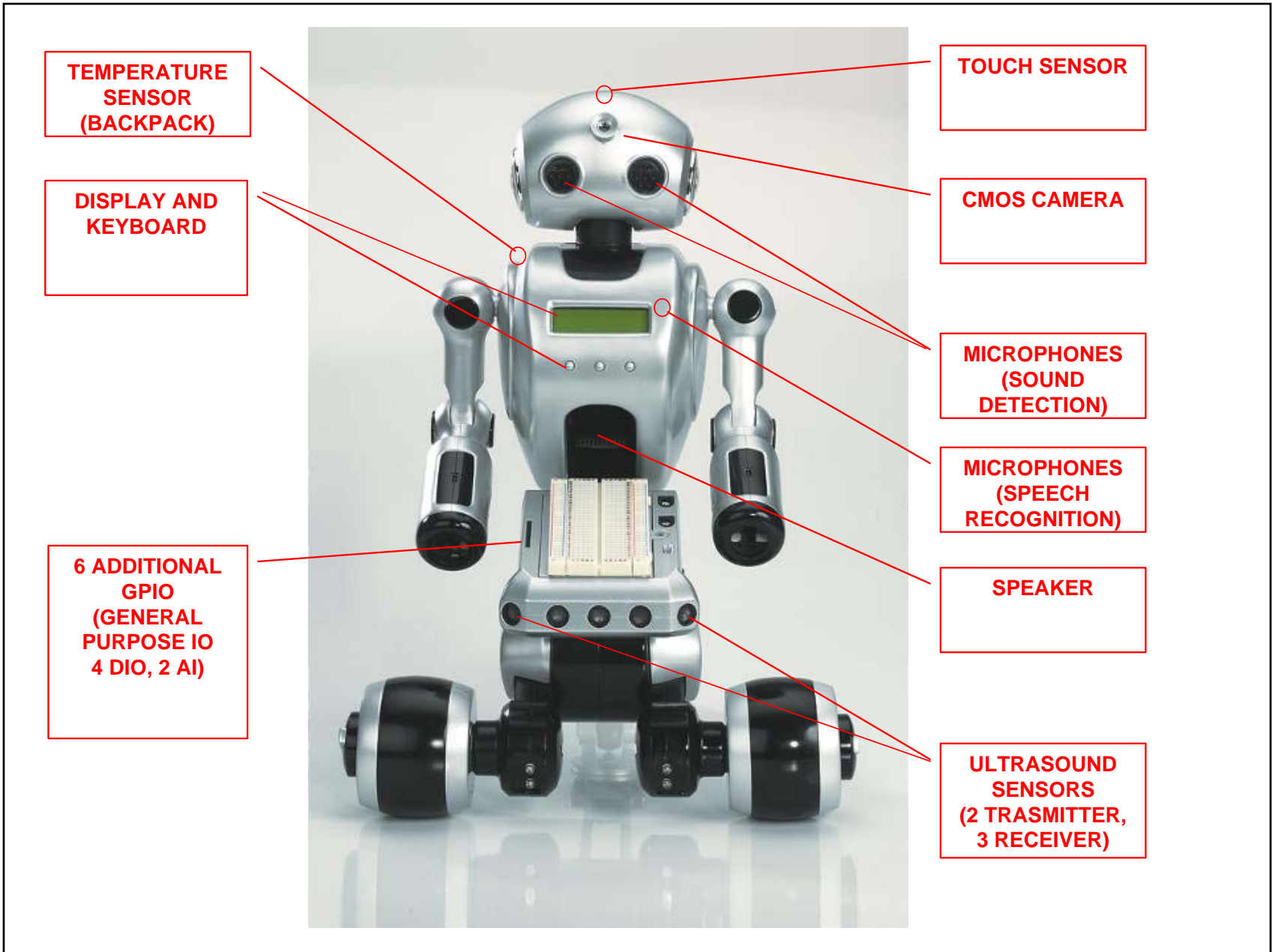
**2 DOF HEAD
WITH
ENCODERS**

**1 DOF ARMS
WITH
ENCODERS**

**PASSIVE ELBOW
JOINT**

**2 ACTIVE
FRONTAL
WHEELS WITH
ENCODERS**





84 speaker independent commands

1 speaker dependent biometric password

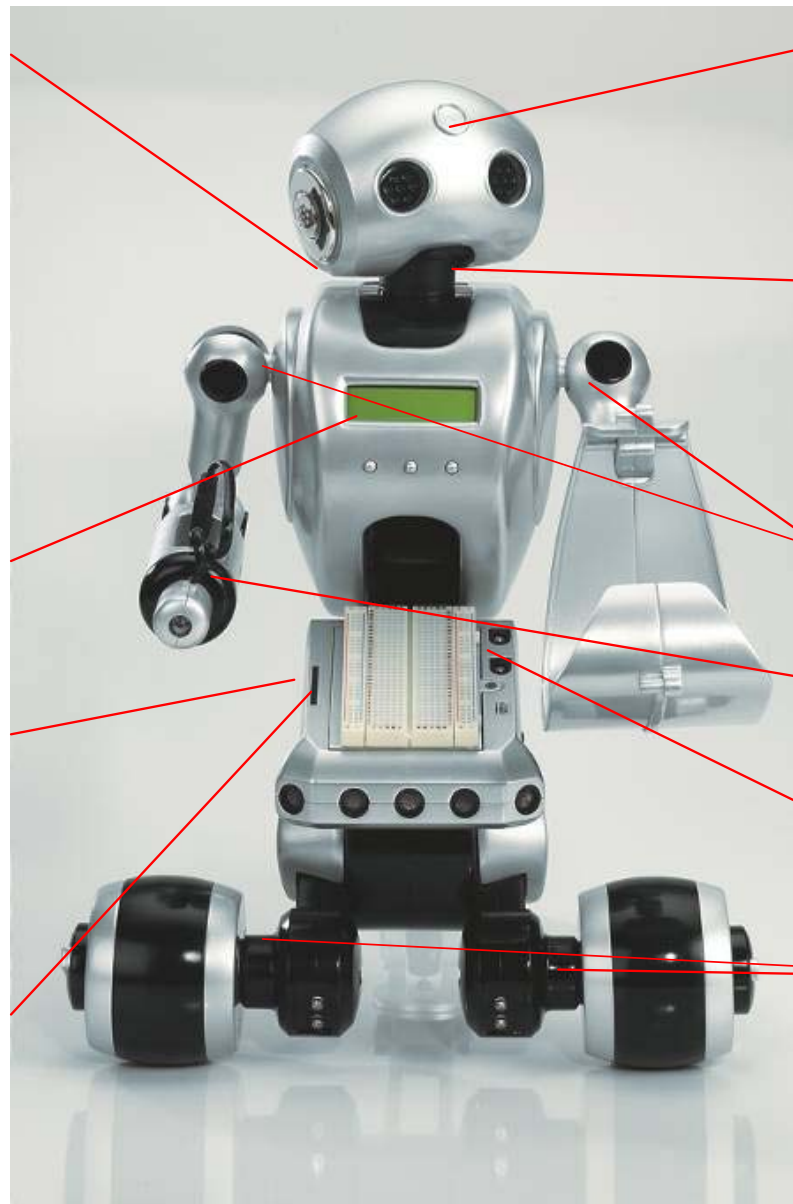
220 preloaded phrases and sounds

10 recordable messages 16 secs each

**Display LCD:
2 rows, 16 columns**

**Batteries:
8 AAA, 1.5V each
4.5V electronics
7.5V motors
4 hours autonomy**

**ADDITIONAL INPUT:
4 Digital Input
0,3V
2 Analog Input
0-3V**



**CMOS Camera sensors:
RGB, 0,3 Mega Pixel;
max resolution 640x480.
standard resolution
160x120.**

**HEAD TILT MOVEMENT:
5 positions
HEAD PAN MOVEMENT:
13 position**

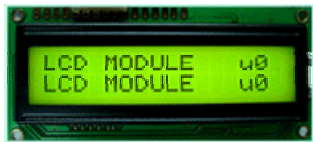
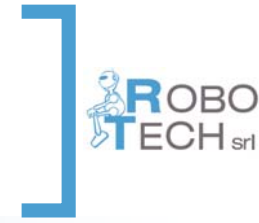
ARMS: 16 positions

HAND: 2 positions

HIP: 2 positions

**BASE:
Max speed:
- 20 cm/s with PID
- 30 cm/s without PID**

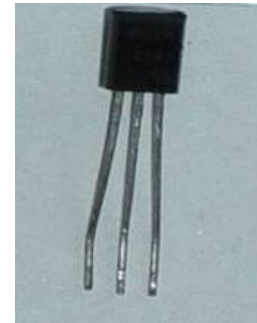
I-Droid 01 sensors, motors and components



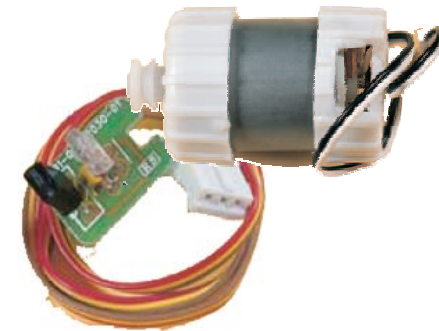
LCD:GDM1602H by Xiamen Ocular Ltd



CMOS Sensor:
SP 2030x by Sino-Pro Ltd



LM35 by National



Motors and Encoders



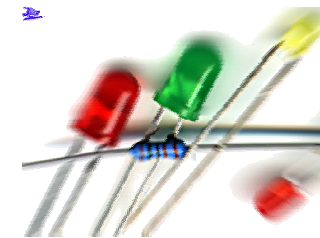
IR Receiver:
VISHAY TSOP32238

IR Transmitter
VISHAY TSAL7600

Picture



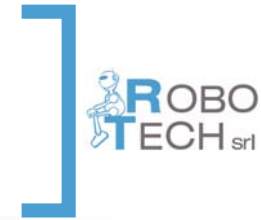
US Sensors: CUR10G1A-40 &
CUT10G1A-40 by ChinaSound



LED

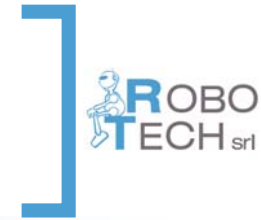
I-Droid01 Humanoid Robot

Technical Specifications



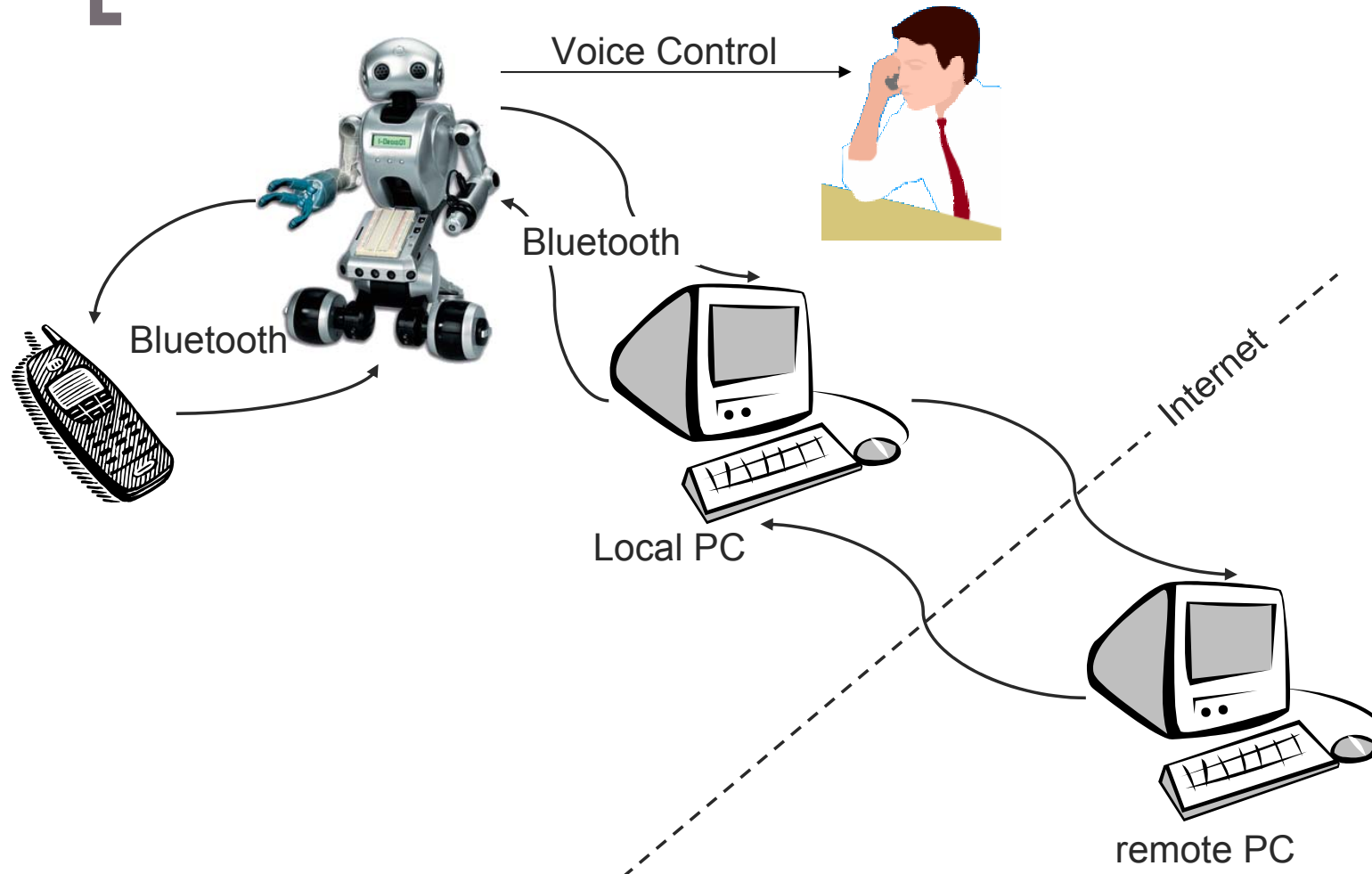
- Weight: 2 Kg
- Dof: 8 actuated, 4 not actuated
 - 2 actuated wheels, max speed 30 cm/s
 - 1 actuated hip joint for stand up/sit down movement
 - 2 dof pan/tilt head: 13 pan positions, 5 tilt position
 - 2 dof left and right arm: shoulder actuated, 16 positions
 - 1 dof hand
- Vocal recognition:
 - 84 "speaker independent" commands
 - 1 "speaker dependent" biometric password
- Speech Synthesis: 220 pre loaded phrases and sounds
- Records up to 10 messages, 16 seconds each
- CMOS Camera sensors: RGB max resolution 640x480
- Bluetooth 2.0 module
- 1 RS-232
- 1 USB ("device")
- 1 Analogic output (B&V module): PWM, low-pass 8KHz
- 2 Analogic inputs (Arms module)
- 4 Digital input/output (Arms module)
- Ultrasound sensors: 2 emitters, 3 receivers
- 1 temperature sensor
- 2 IR sensors: operative range 20-60cm
- 1 LCD, 2 rows, 16 columns
- Batteries: 8 AA, 4 hours autonomy (typical)

I-Droid 01 Humanoid Robot

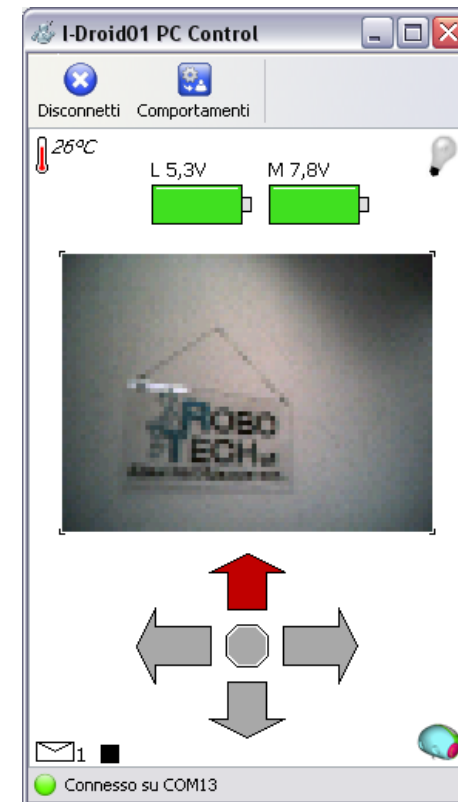


- Speech recognition and synthesis capabilities (Voice control)
- Image processing and visual recognition capabilities
- Detection of sound direction
- Obstacle avoidance (US sensors) capability
- Emotion and mood expression
- Behavior based and Neural Network based software control system
- Remote control by mobile phone and PC via Bluetooth
- Reprogrammable
- “Breadboard” for user custom circuits development

I-Droid01 User Interfaces



I- Droid 01 Interfaces: GUIs for PC and Mobile Phone

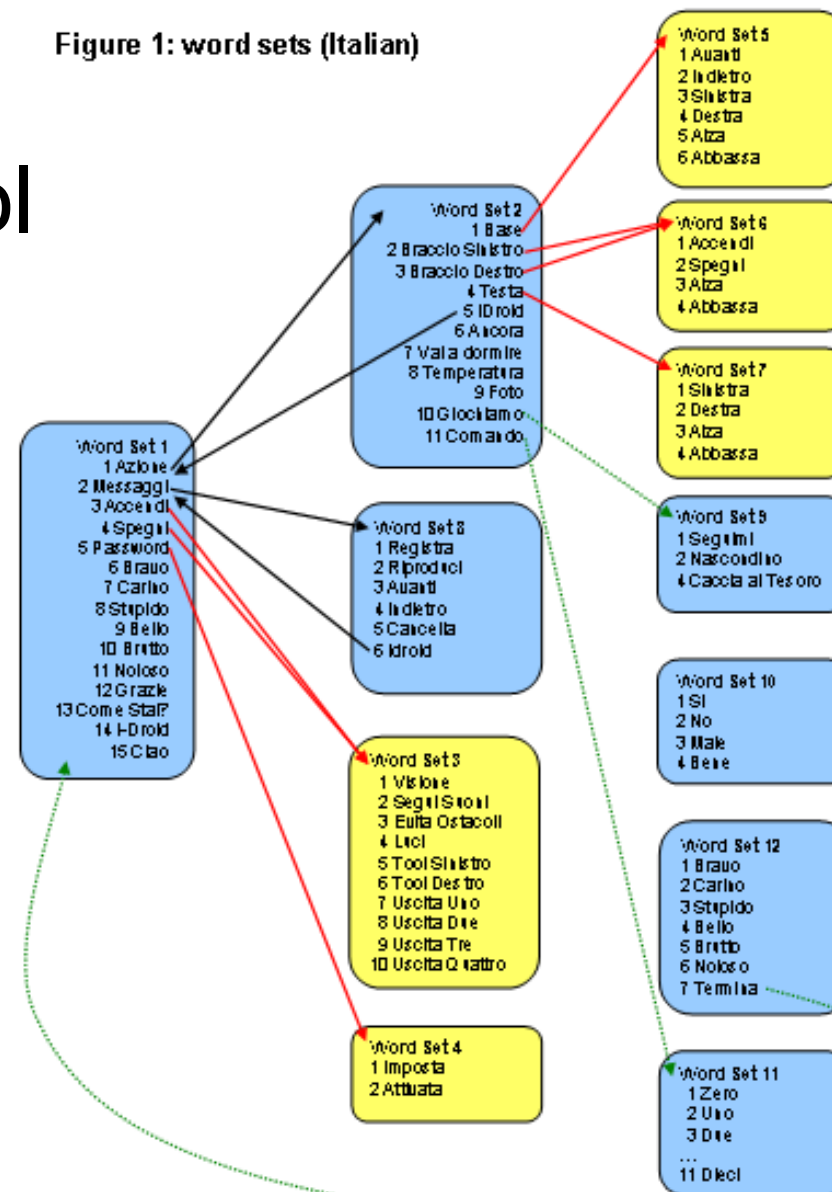


Based on Java
Technology

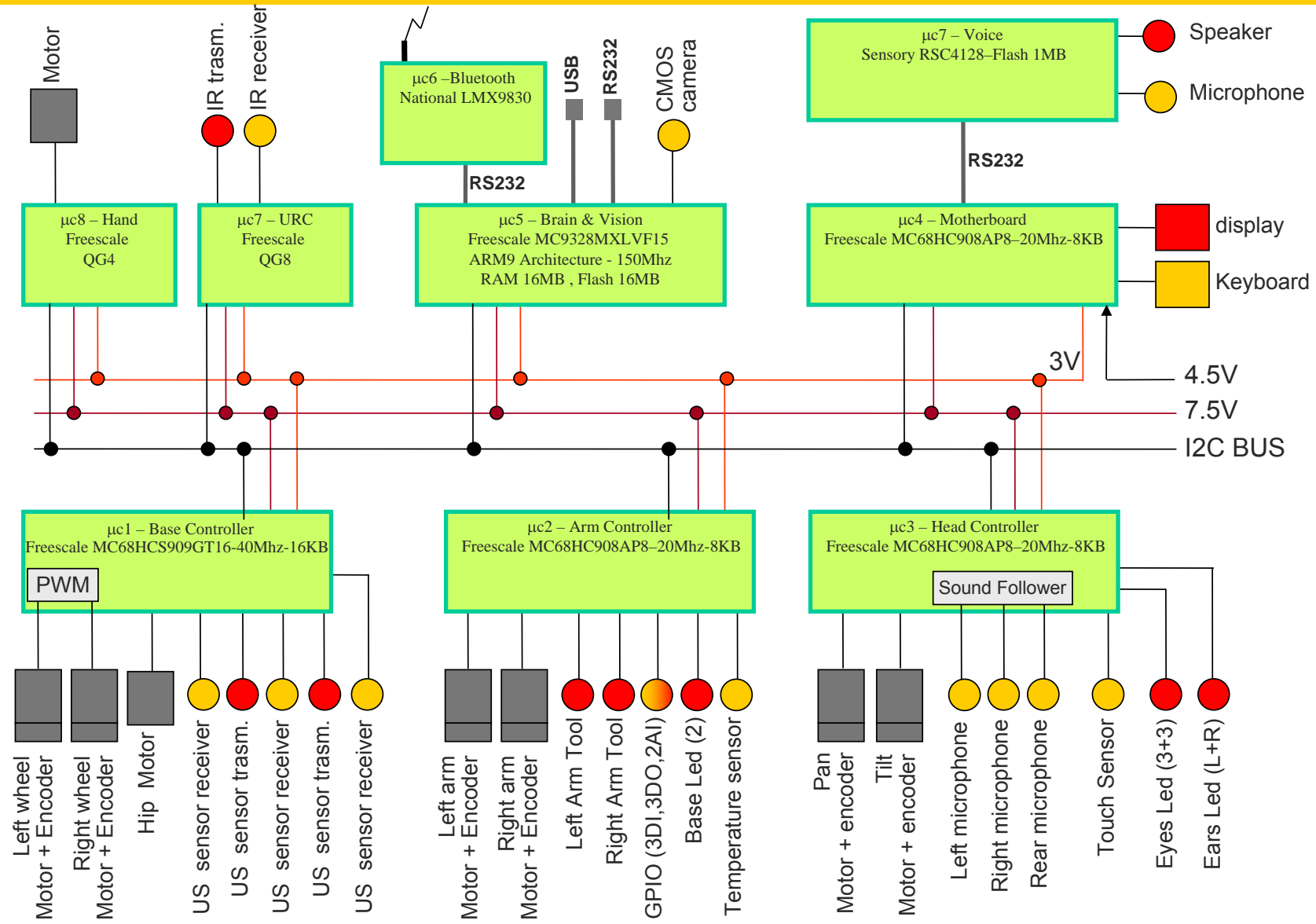
Voice Control

- 11 wordsets
- 84 different commands
- Languages:
 - Italian
 - Japanese
 - Polish
 - Dutch
 - Spanish
 - Portuguese

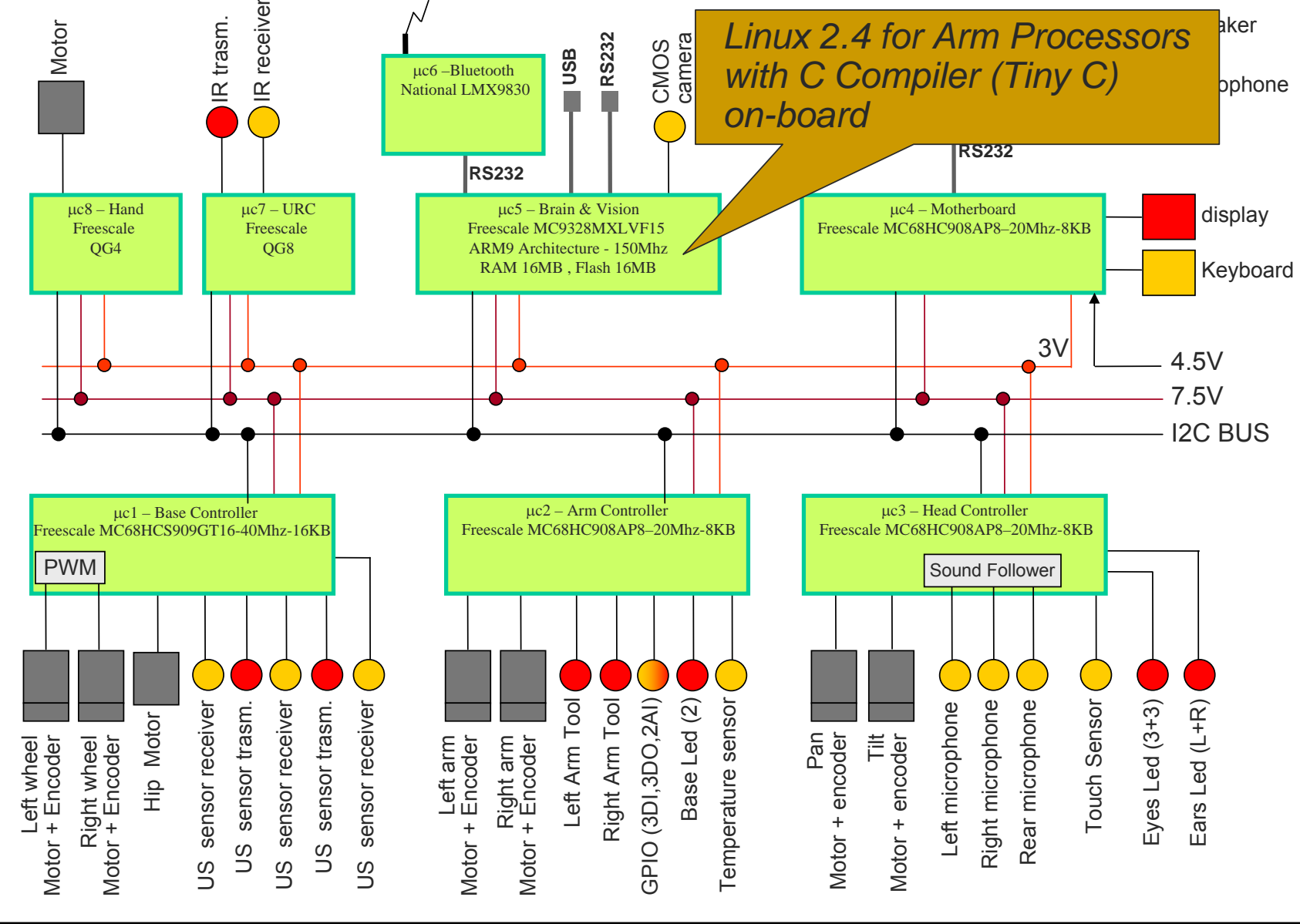
Figure 1: word sets (Italian)



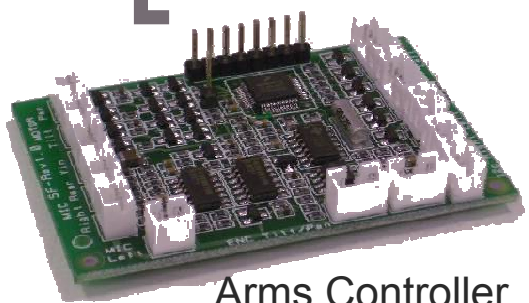
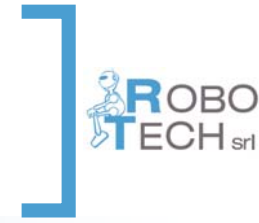
I-DROID 01 HARDWARE ARCHITECTURE



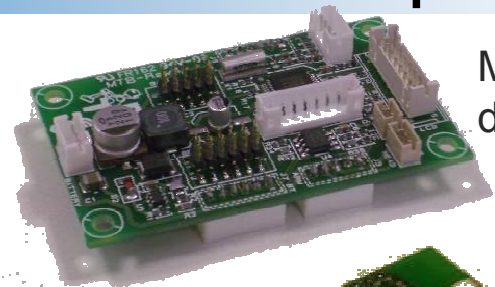
I-DROID 01 HARDWARE ARCHITECTURE



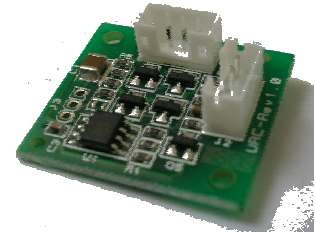
Design and development of I-Droid01 electronic components



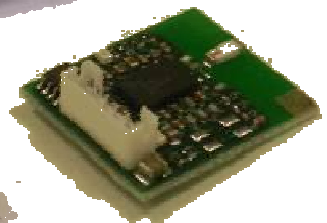
Arms Controller Base Controller



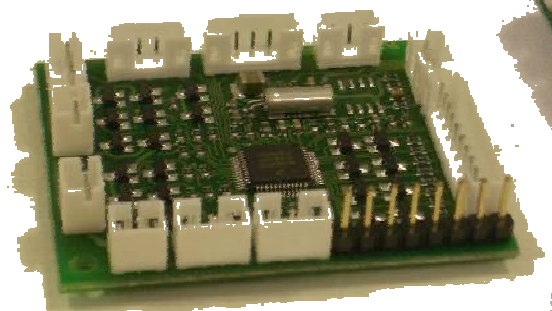
Motherboard and display controller



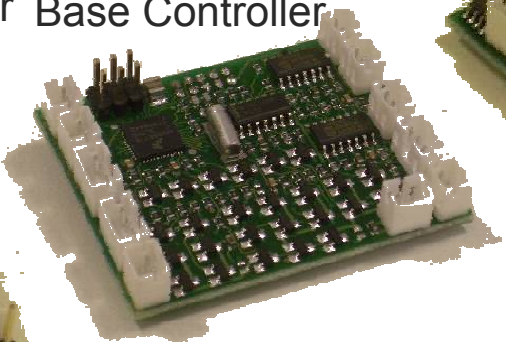
URC Module



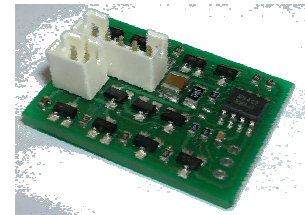
Bluetooth Module



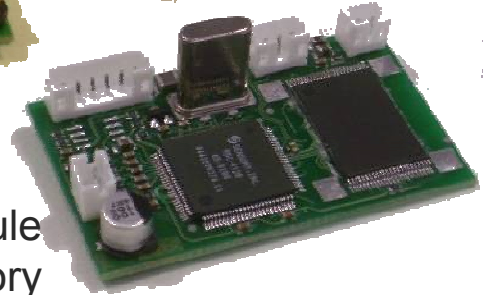
Head Controller



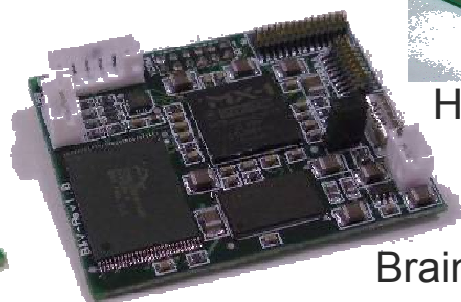
Voice recognition module based on Sensory Technologies



Hand Module



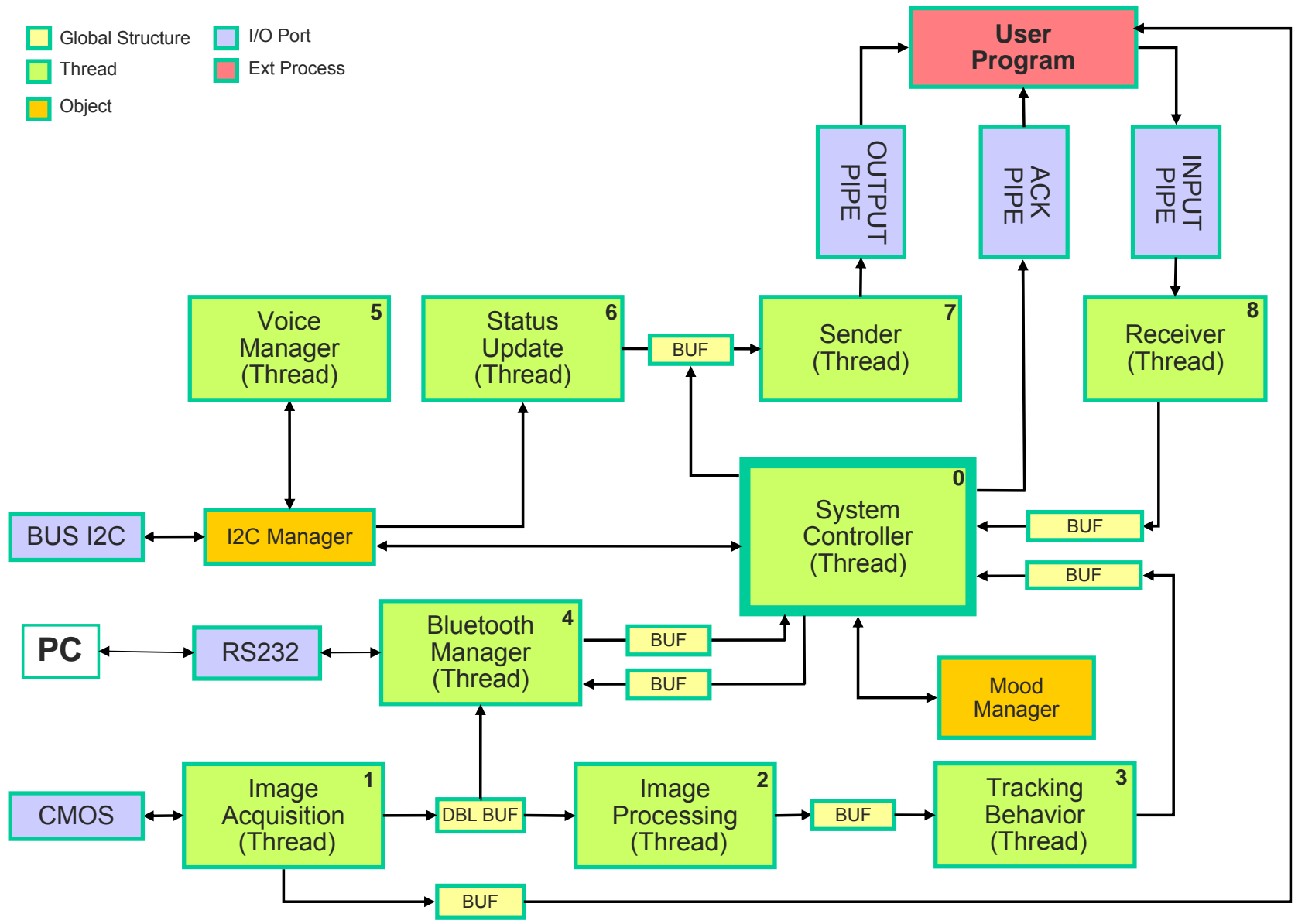
Brain module based on ARM-9 processor with Linux Embedded



Software Architecture

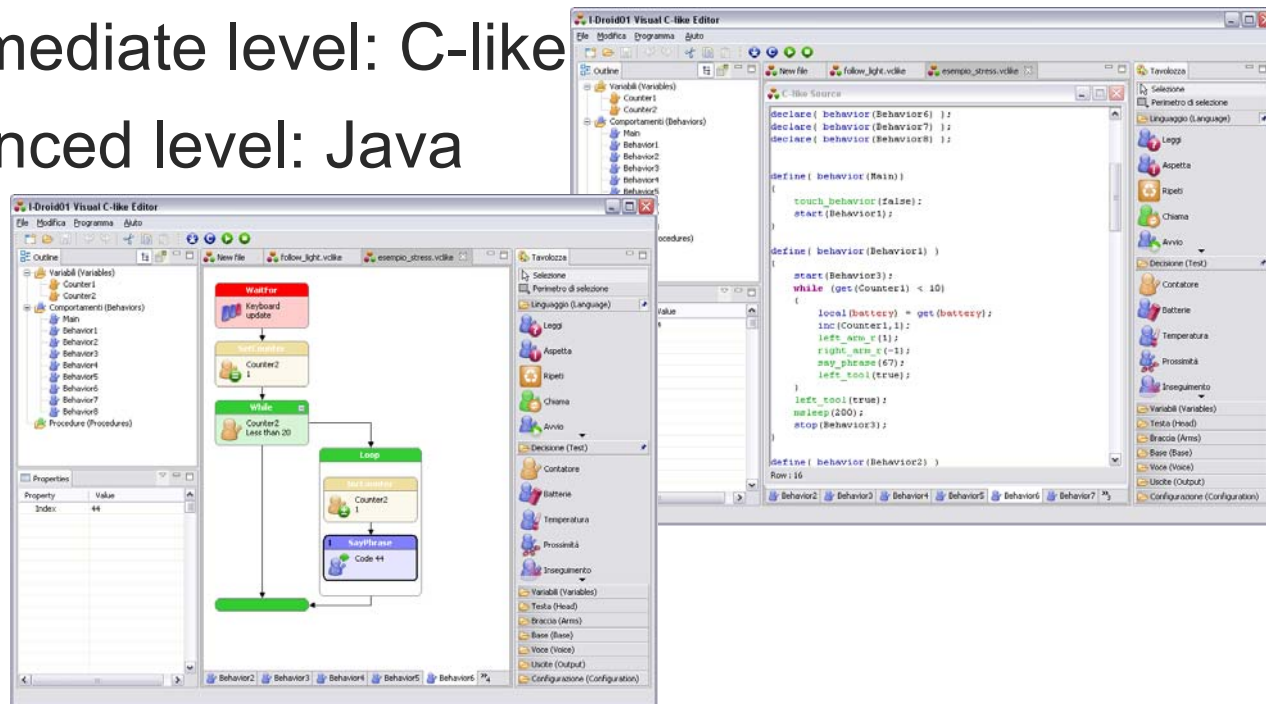
- Operative System:
 - Linux 2.4 for Arm Processors with C Compiler (Tyni C) on-board
- Two Main Process:
 - *System Controller* for running robot behaviours
 - *User Process* for running user programs
- Multi Treads Architecture
 - A process run for each behaviour and for the main robot functionalities
 - 9 threads run concurrently
 - Robot status is implemented as global structure shared between threads

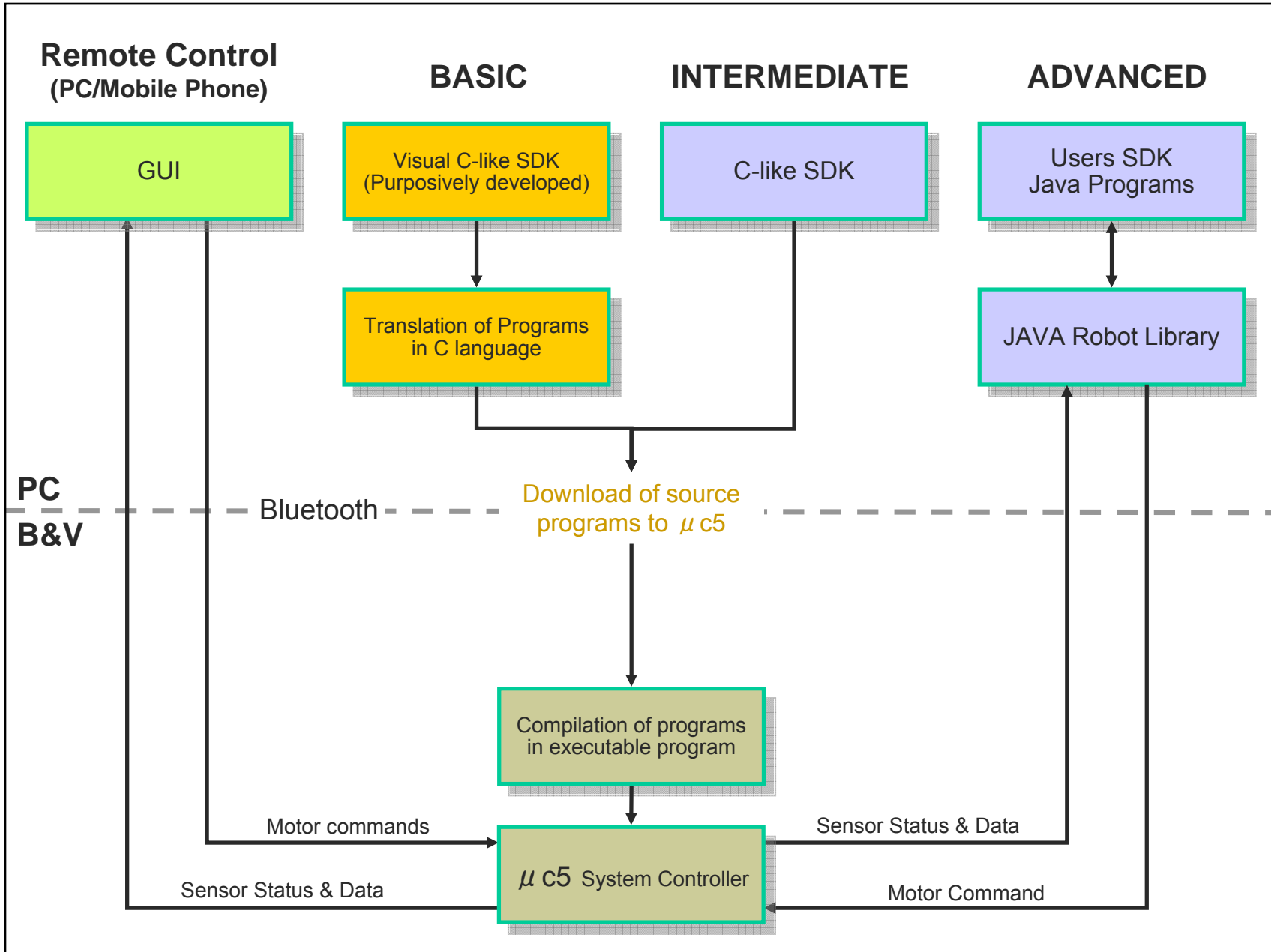
I-DROID01 SOFTWARE ARCHITECTURE



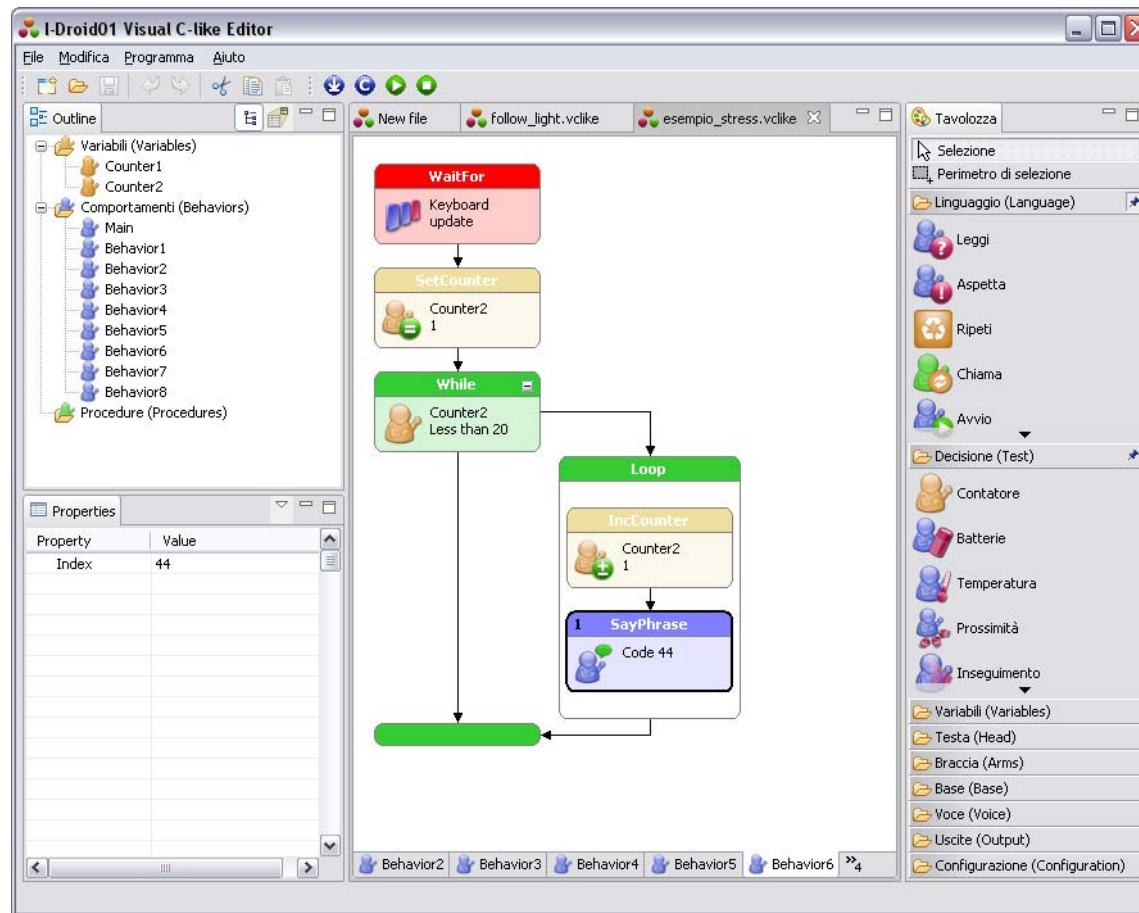
I-Droid 01 Programming

- Three different programming modalities:
 - Basic level: graphical/icons (Visual C-like)
 - Intermediate level: C-like
 - Advanced level: Java



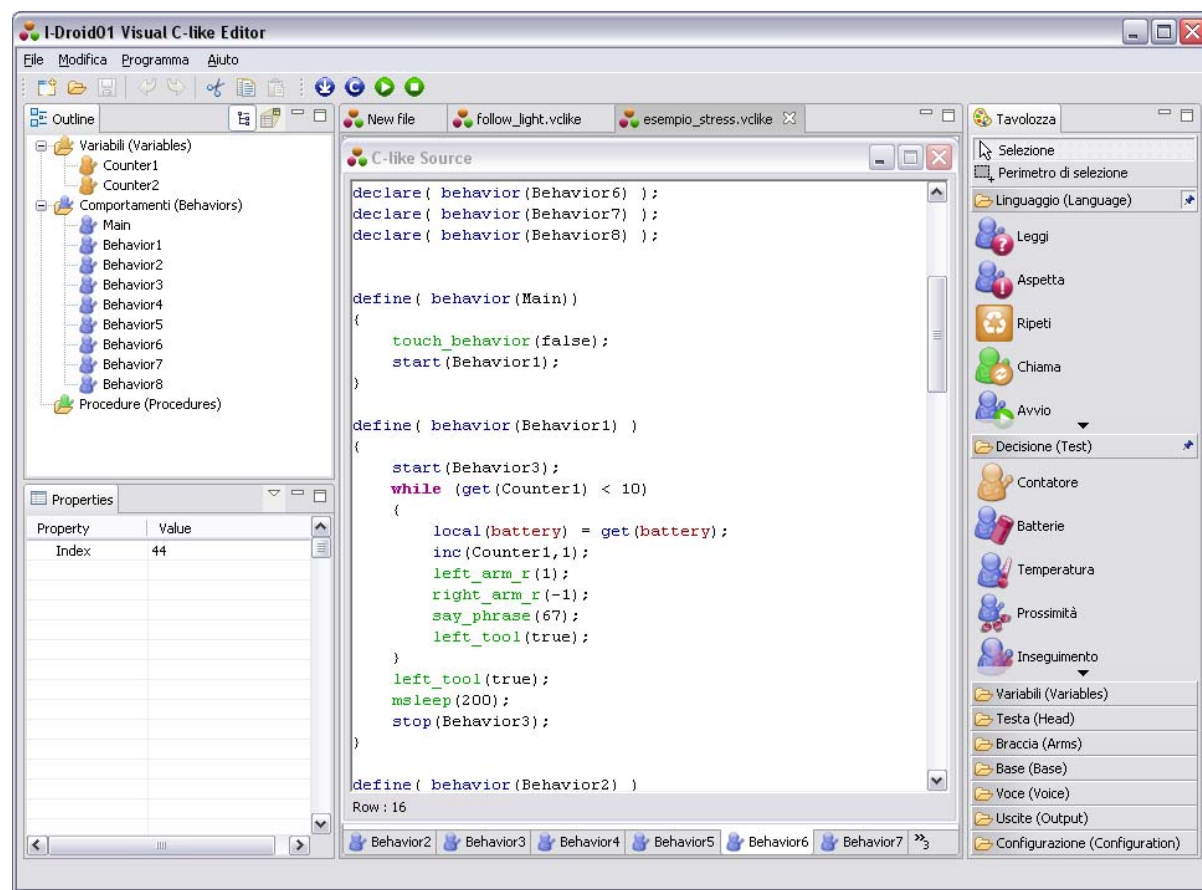


Robot Programming: Visual C-like



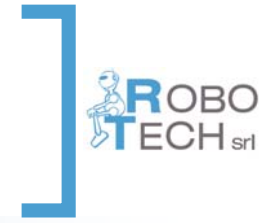
Behaviour based

Robot Programming: C-like

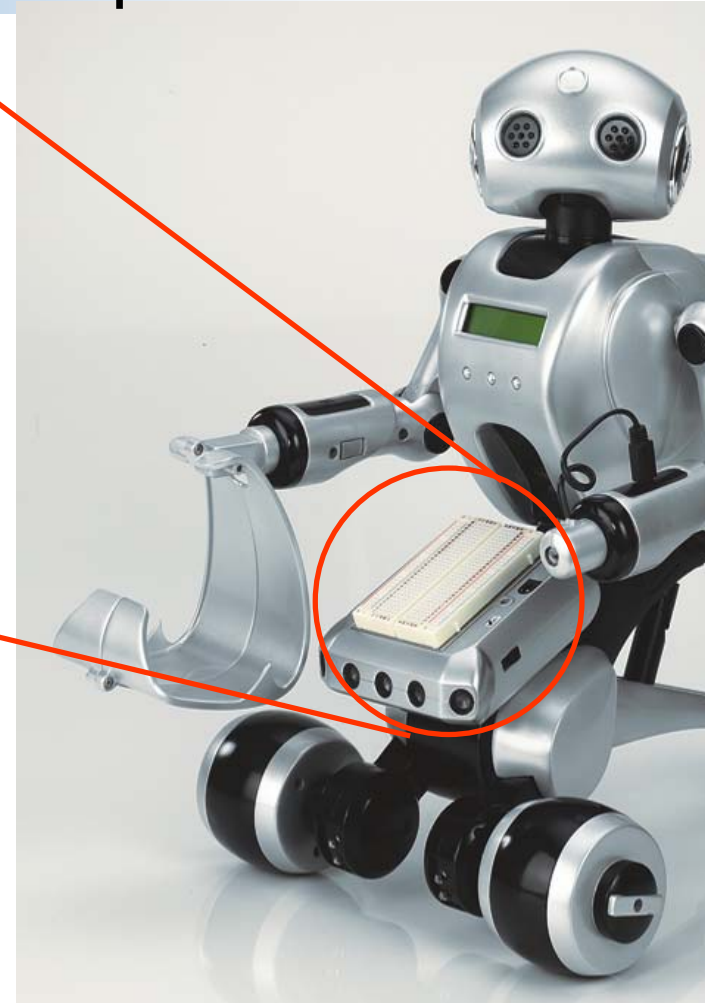
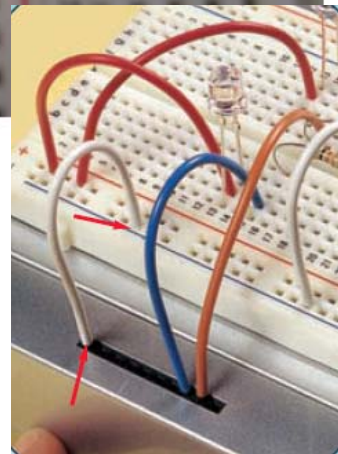
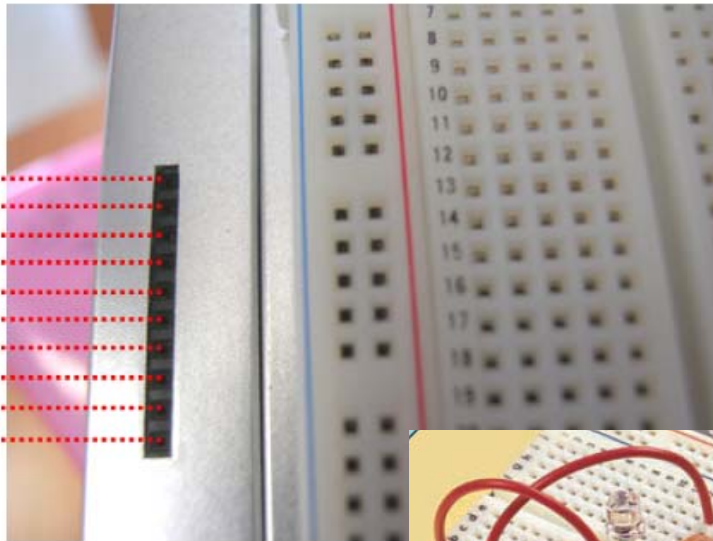


Automatic translation from Visual C-like to C-like language

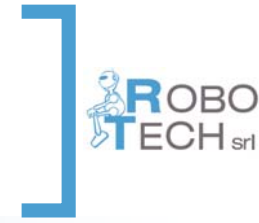
Additional GPIO and breadboard for user custom circuits development



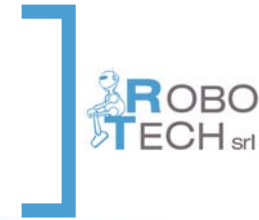
- 1. GND
- 2. I2C-SCL
- 3. I2C-SDA
- 4. Digital I/O 4
- 5. Digital I/O 3
- 6. Digital I/O 2
- 7. Digital I/O 1
- 8. Analog IN 1
- 9. Analog IN 2
- 10. 3V



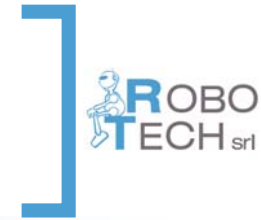
I-Droid 01 games: follow a colored object



I-Droid 01 games: find a colored object



[Contacts



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