

Esercitazione con un robot umanoide programmabile per edutainment

Giancarlo Teti

RoboTech srl – www.RoboTechsrl.com

g.teti@robotechsrl.com



[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:

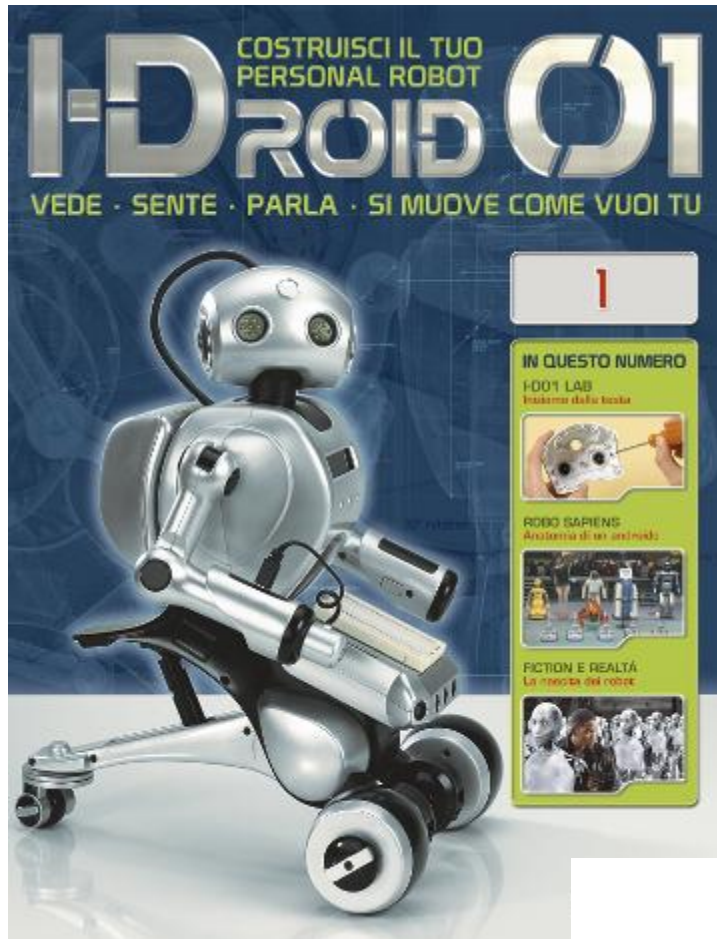
- Long-term vision: **service and personal robotics**
- Short-term target: **edutainment robotics**



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

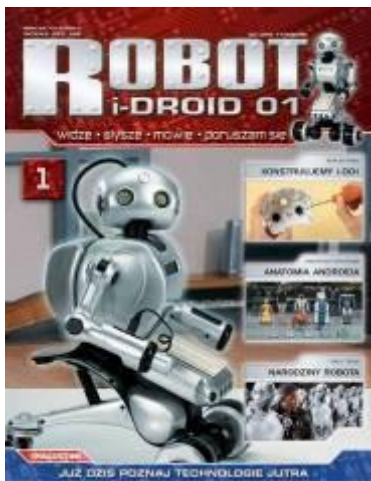
I-Droid 01 Humanoid Robot



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



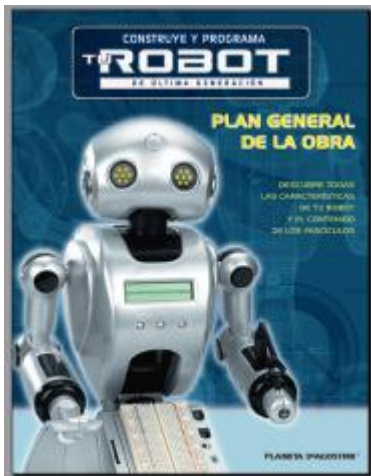
Italy (2 launching, Aug. 2005/Aug. 2006)



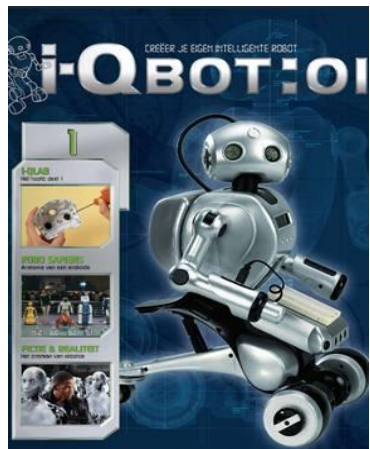
Poland (Mar. 2006)



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**



**TEMPERATURE
SENSOR
(BACKPACK)**

**DISPLAY AND
KEYBOARD**

**6 ADDITIONAL
GPIO
(GENERAL
PURPOSE IO
4 DIO, 2 AI)**

TOUCH SENSOR

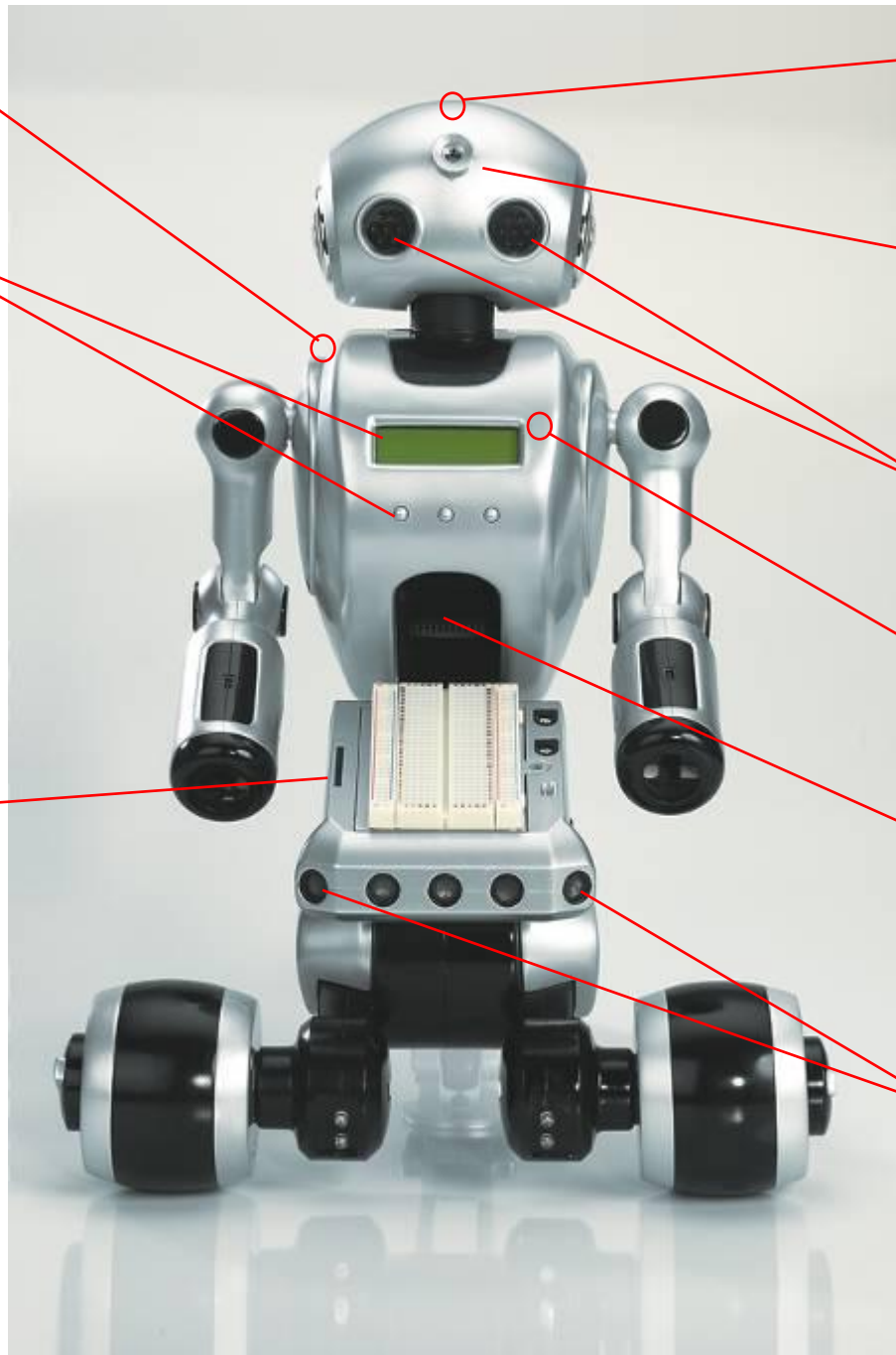
CMOS CAMERA

**MICROPHONES
(SOUND
DETECTION)**

**MICROPHONES
(SPEECH
RECOGNITION)**

SPEAKER

**ULTRASOUND
SENSORS
(2 TRASMITTER,
3 RECEIVER)**



**84 speaker
independent
commands**

**1 speaker dependent
biometric password**

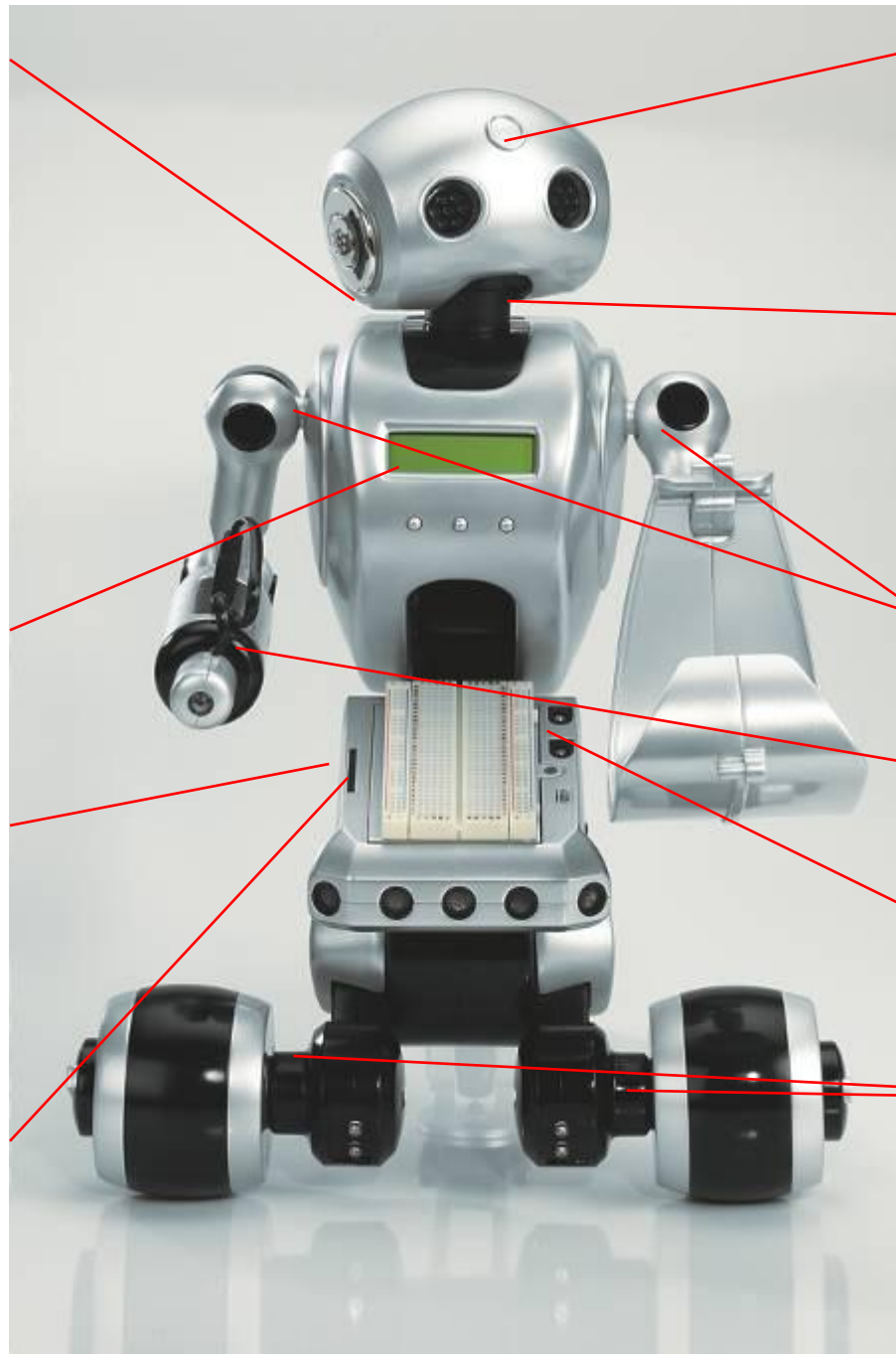
**220 preloaded
phrases and sounds**

**10 recordable
messages 16 secs
each**

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

**Batteries:
8 AAA, 1.5V each
4.5V electornics
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**

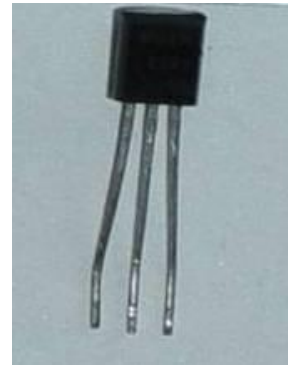
I-Droid 01 sensors, motors and components



LCD:GDM1602H by
Xiamen Ocular Ltd



CMOS Sensor:
SP 2030x by Sino-Pro Ltd



LM35 by National



Motors and
Encoders



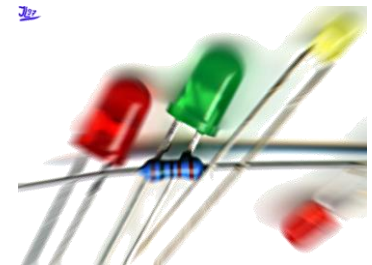
IR Transmitter
VISHAY TSAL7600

IR Receiver:
VISHAY TSOP32238

Picture



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



LED

I-Droid01 Humanoid Robot

Technical Specifications

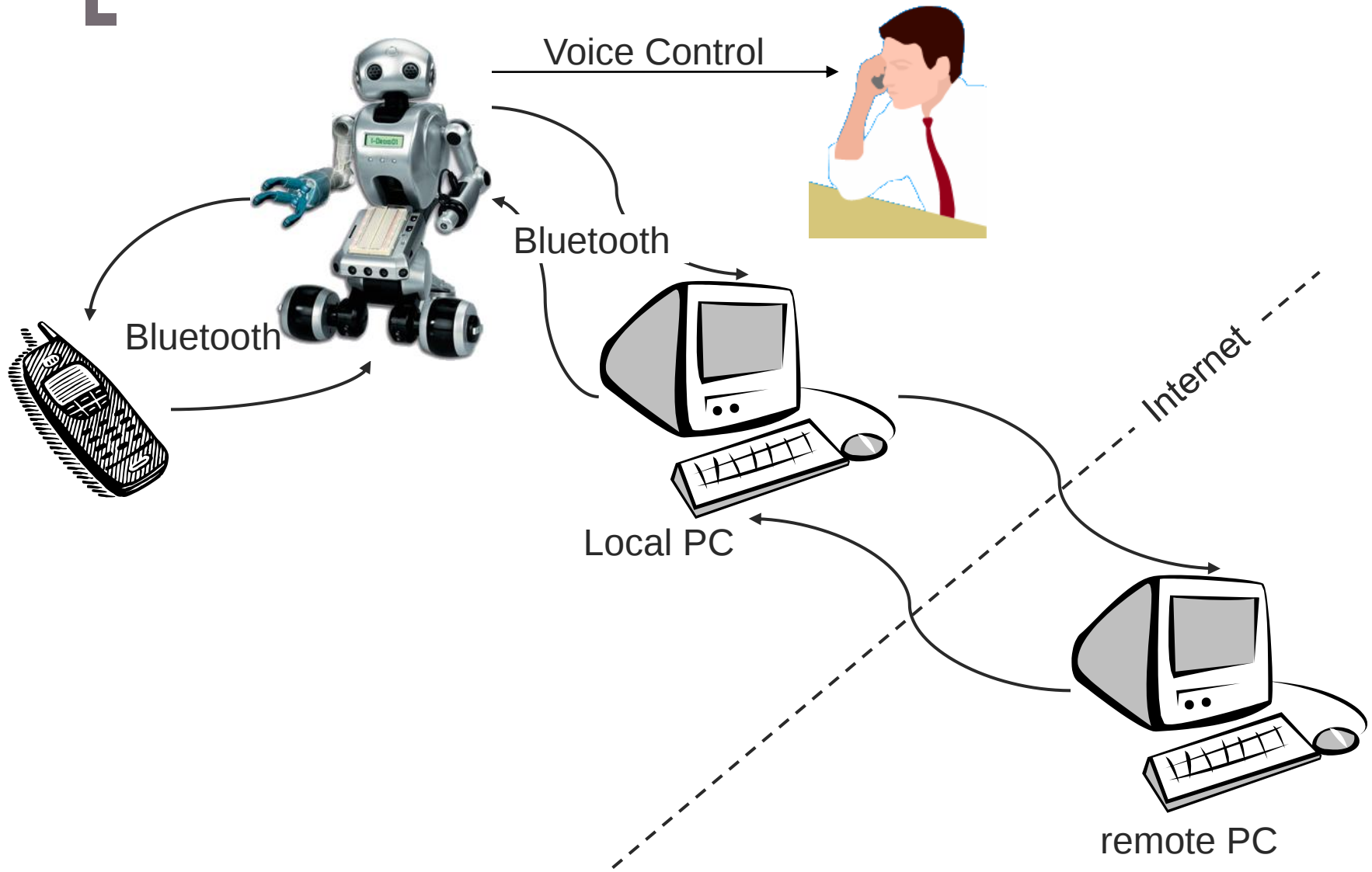
- Weight: 2 Kg
- Dof: 8 actuated, 4 not actuated
 - 2 actuated wheels, max speed 30 cm/s
 - 1 actuated hip joint for stand up/sit down movement
 - 2 dof pan/tilt head: 13 pan positions, 5 tilt position
 - 2 dof left and right arm: shoulder actuated, 16 positions
 - 1 dof hand
- Vocal recognition:
 - 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

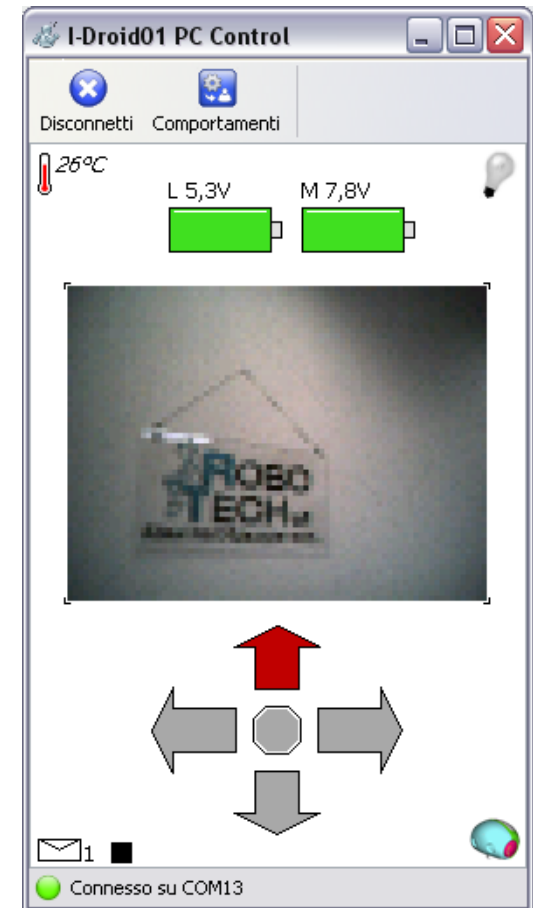


- Speech recognition and synthesis capabilities (Voice control)
- Image processing and visual recognition capabilities
- Detection of sound direction
- Obstacle avoidance (US sensors) capability
- Emotion and mood expression
- Behavior based and Neural Network based software control system
- Remote control 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

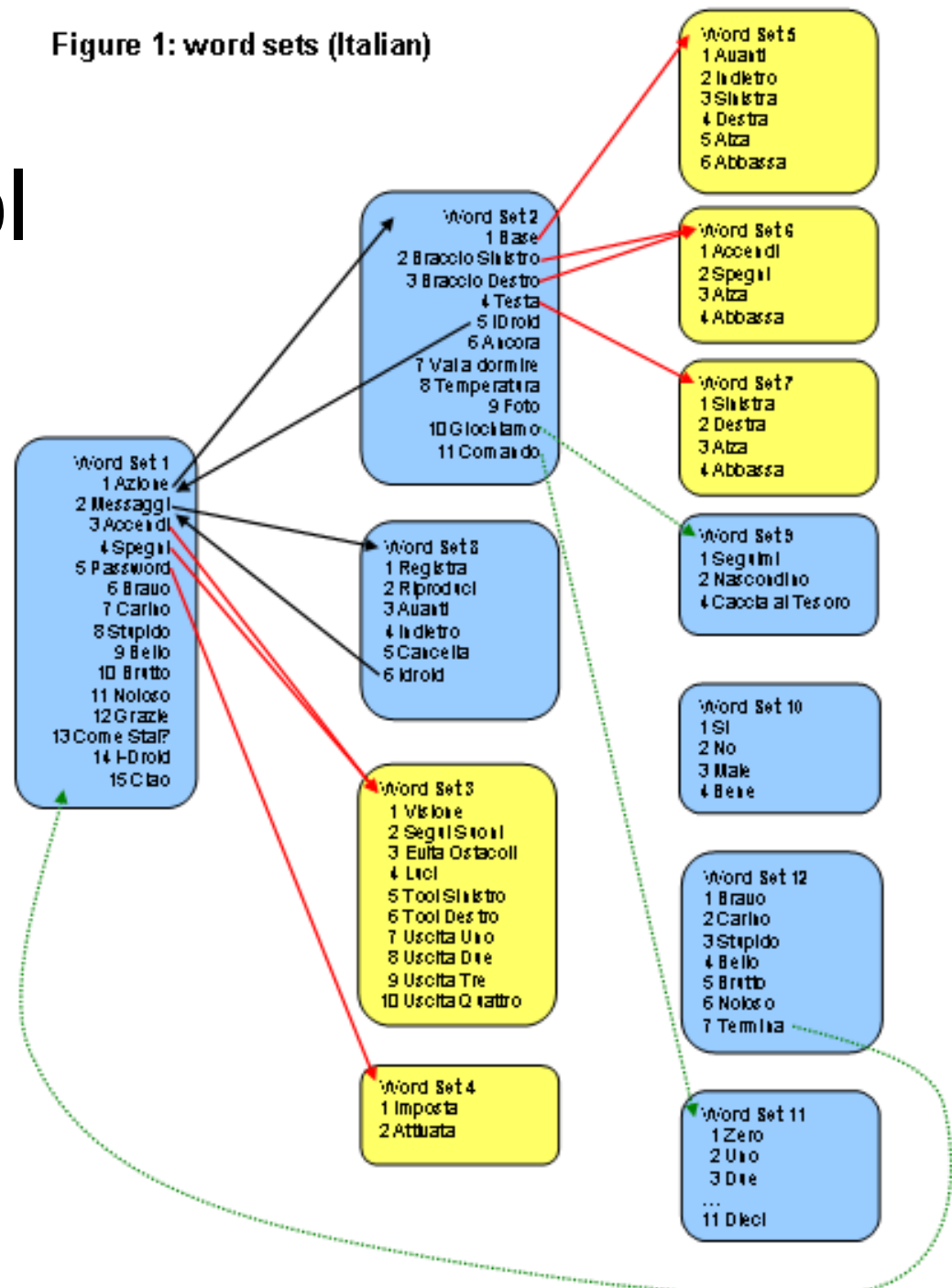


Based on Java
Technology

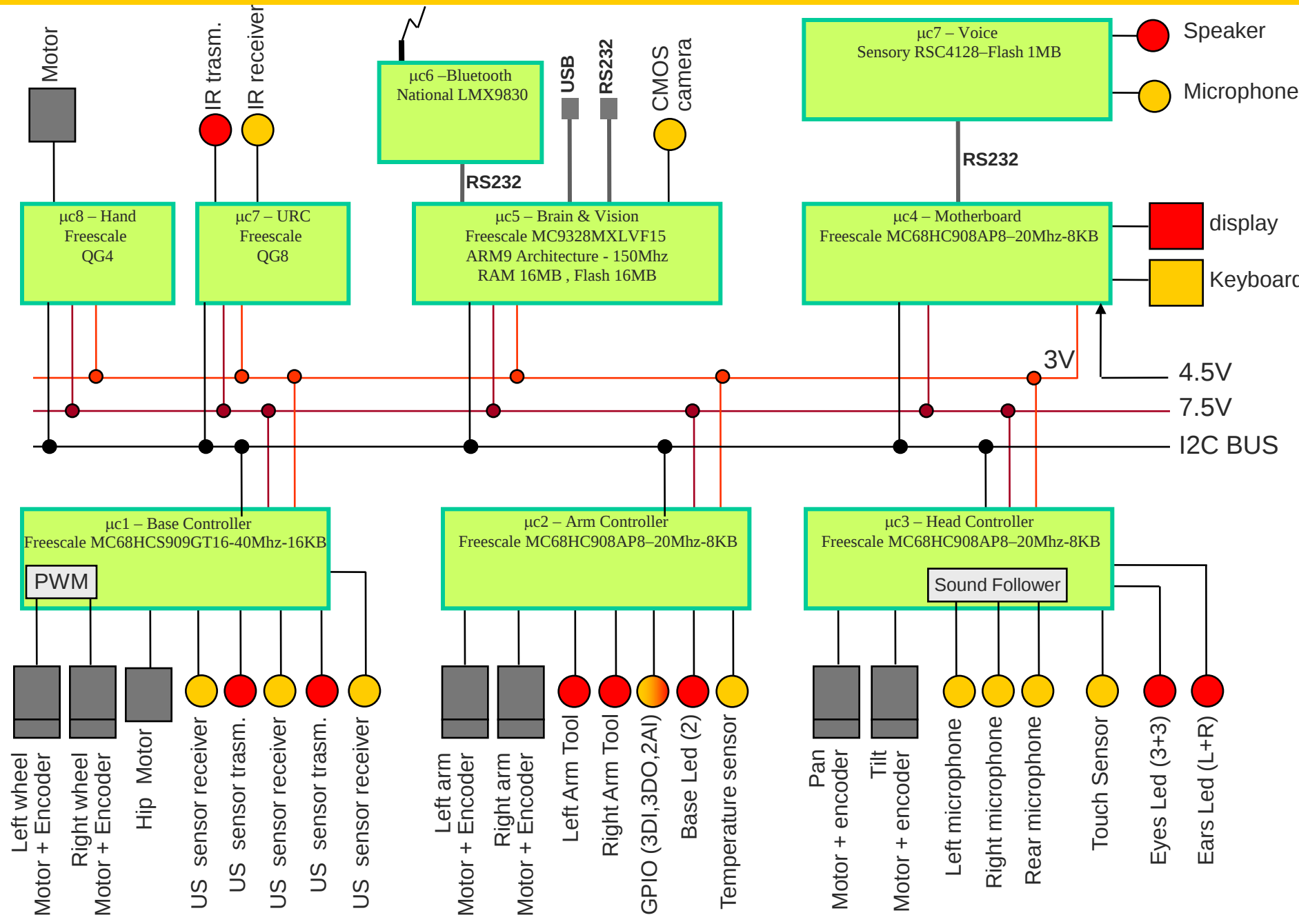
Voice Control

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

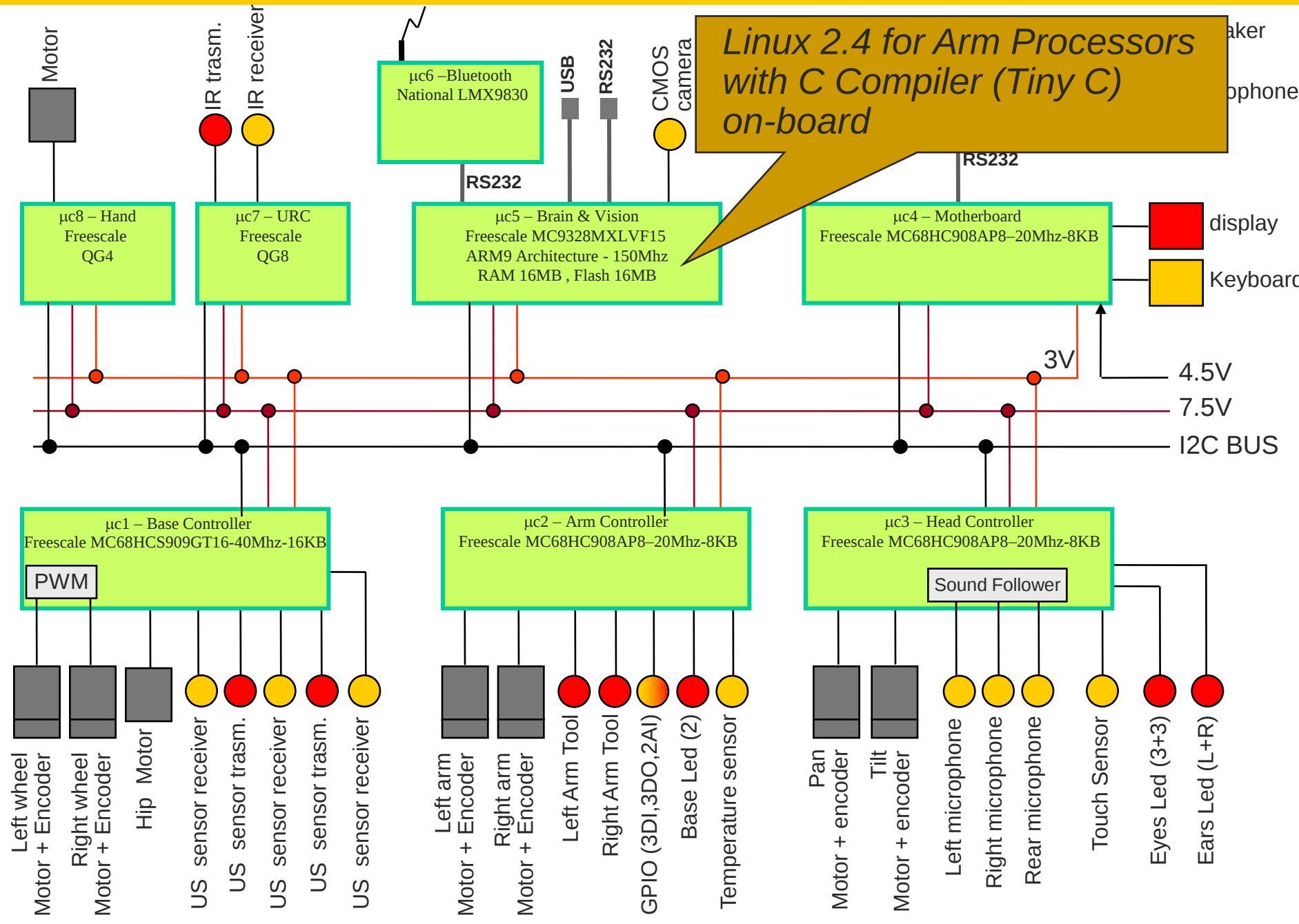
Figure 1: word sets (Italian)



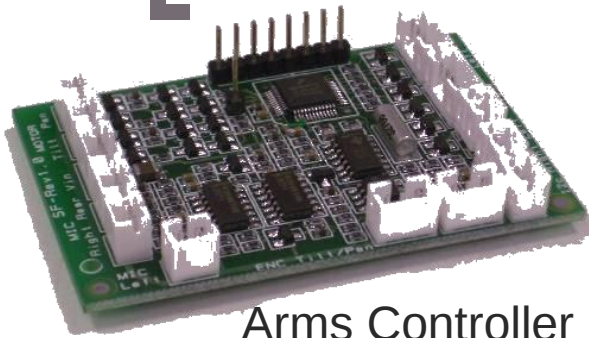
I-DROID 01 HARDWARE ARCHITECTURE



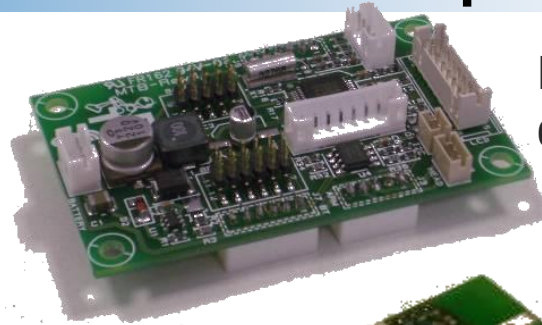
I-DROID 01 HARDWARE ARCHITECTURE



Design and development of I-Droid01 electronic components

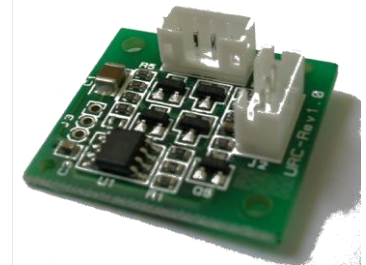


Arms Controller



Base Controller

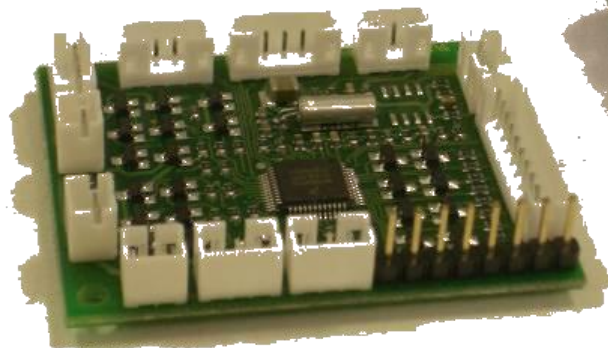
Motherboard and display controller



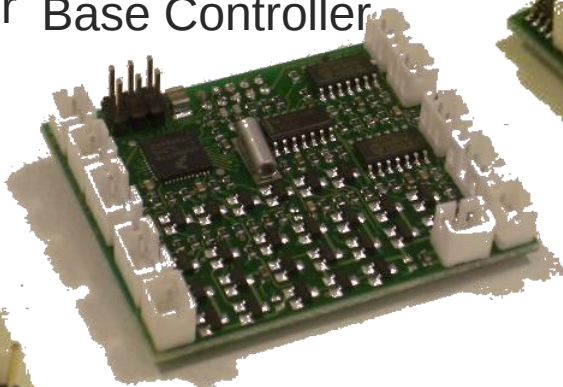
URC Module



Bluetooth Module



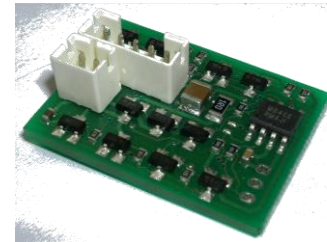
Head Controller



Voice recognition module
based on Sensory
Technologies



Brain module
based on ARM-9 processor
with Linux Embedded

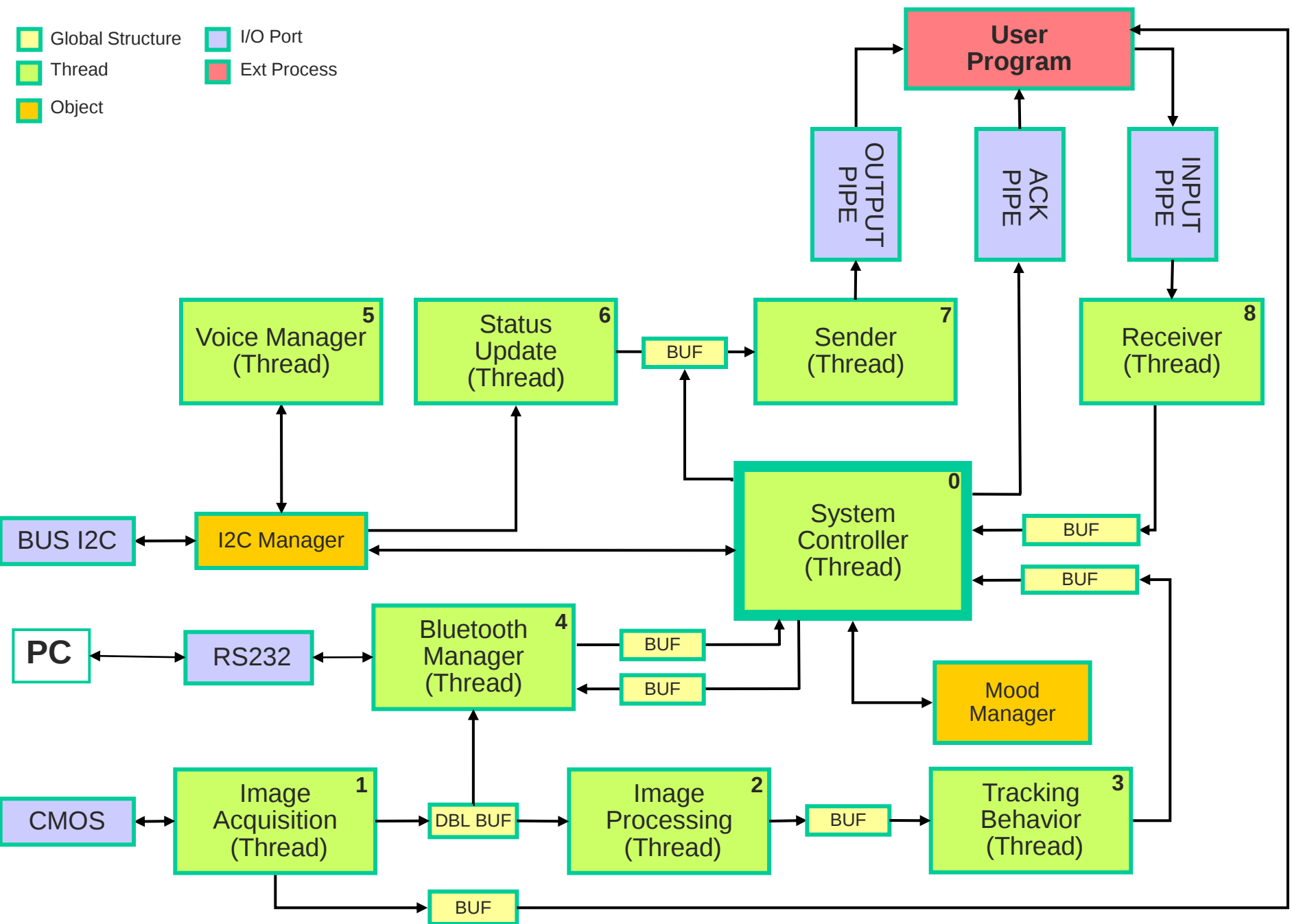


Hand Module

Software Architecture

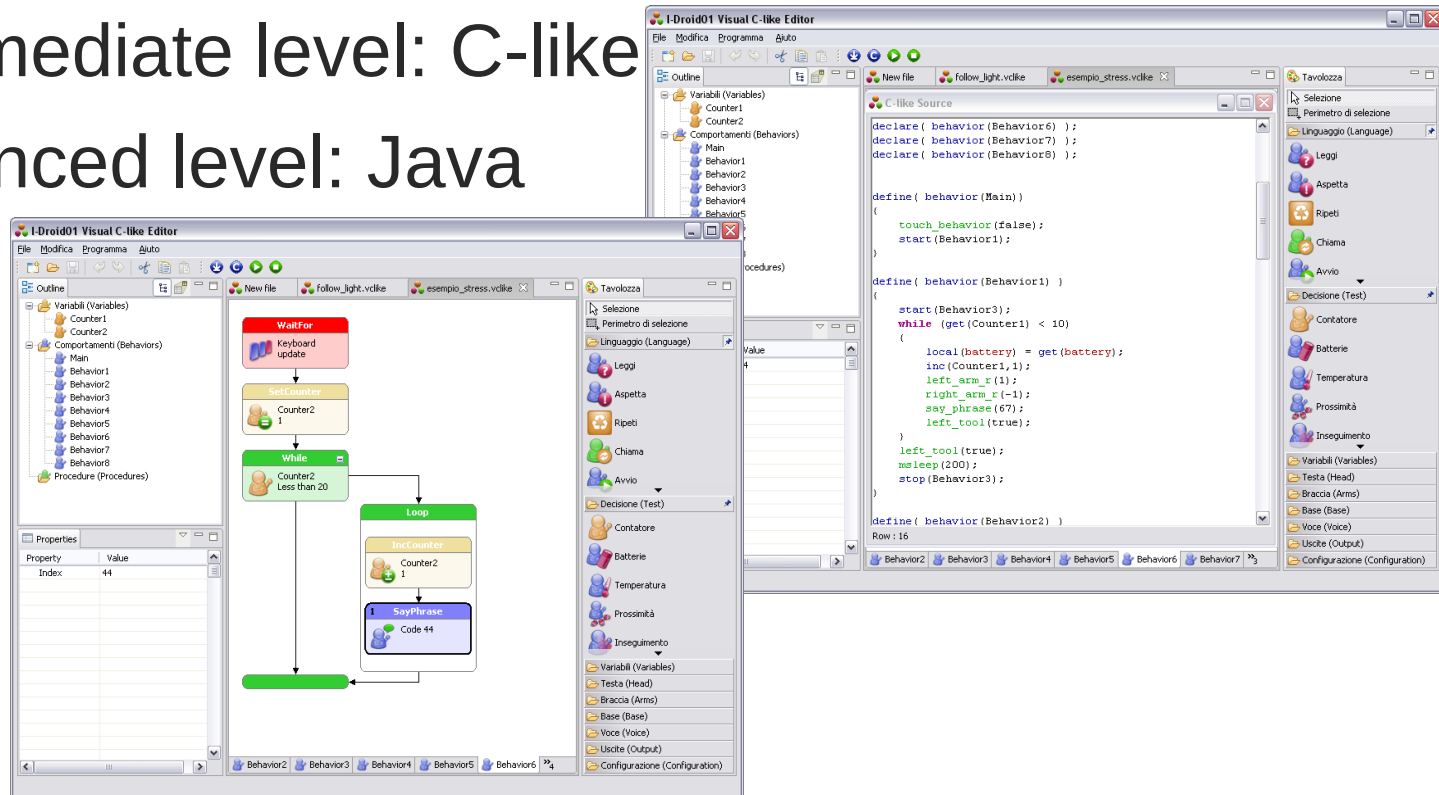
- Operative System:
 - Linux 2.4 for Arm Processors with C Compiler (Tyni C) on-board
- Two Main Process:
 - *System Controller* for running robot behaviours
 - *User Process* for running user programs
- Multi Treads Architecture
 - A process run for each behaviour and for the main robot functionalities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

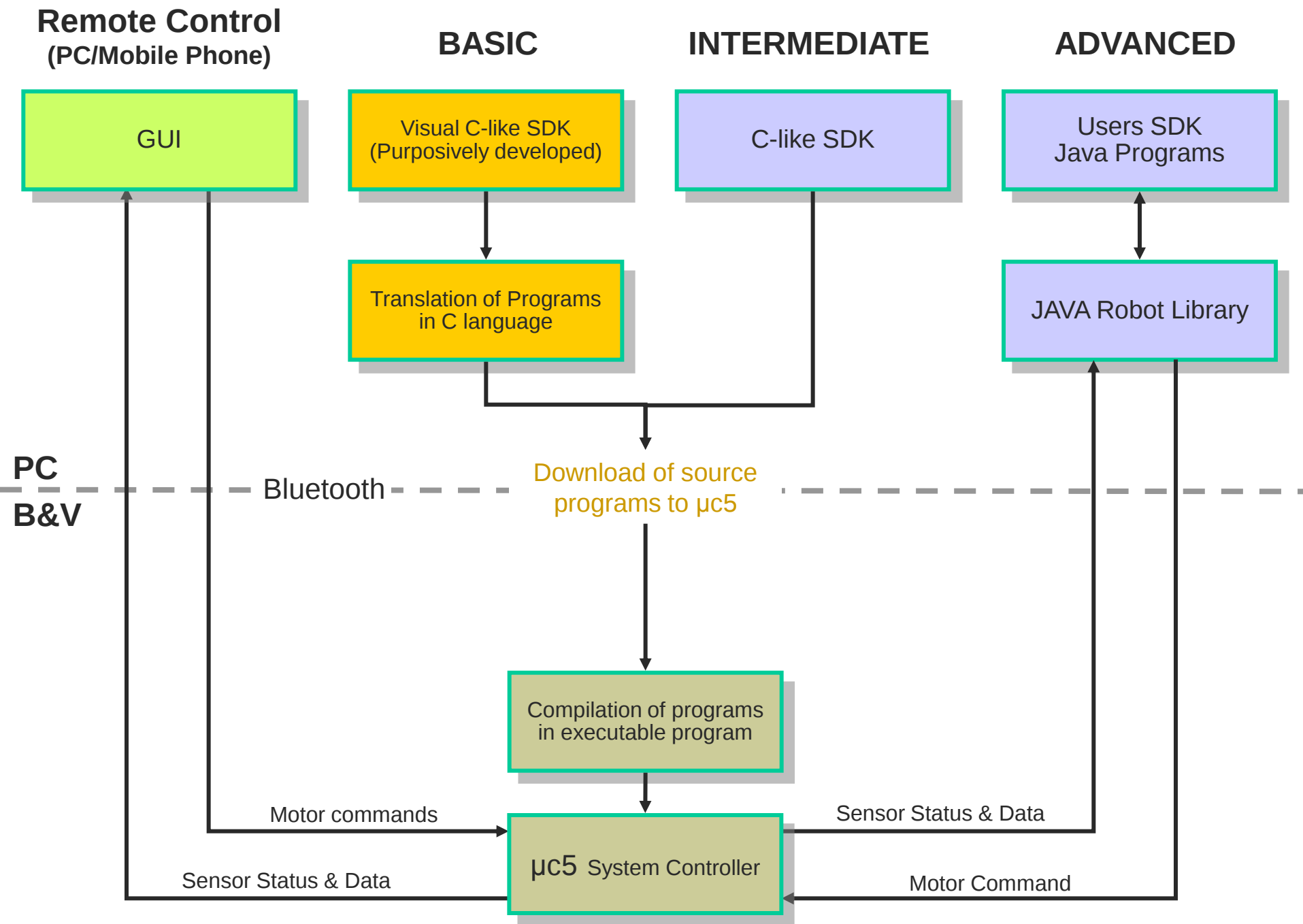
I-DROID01 SOFTWARE ARCHITECTURE



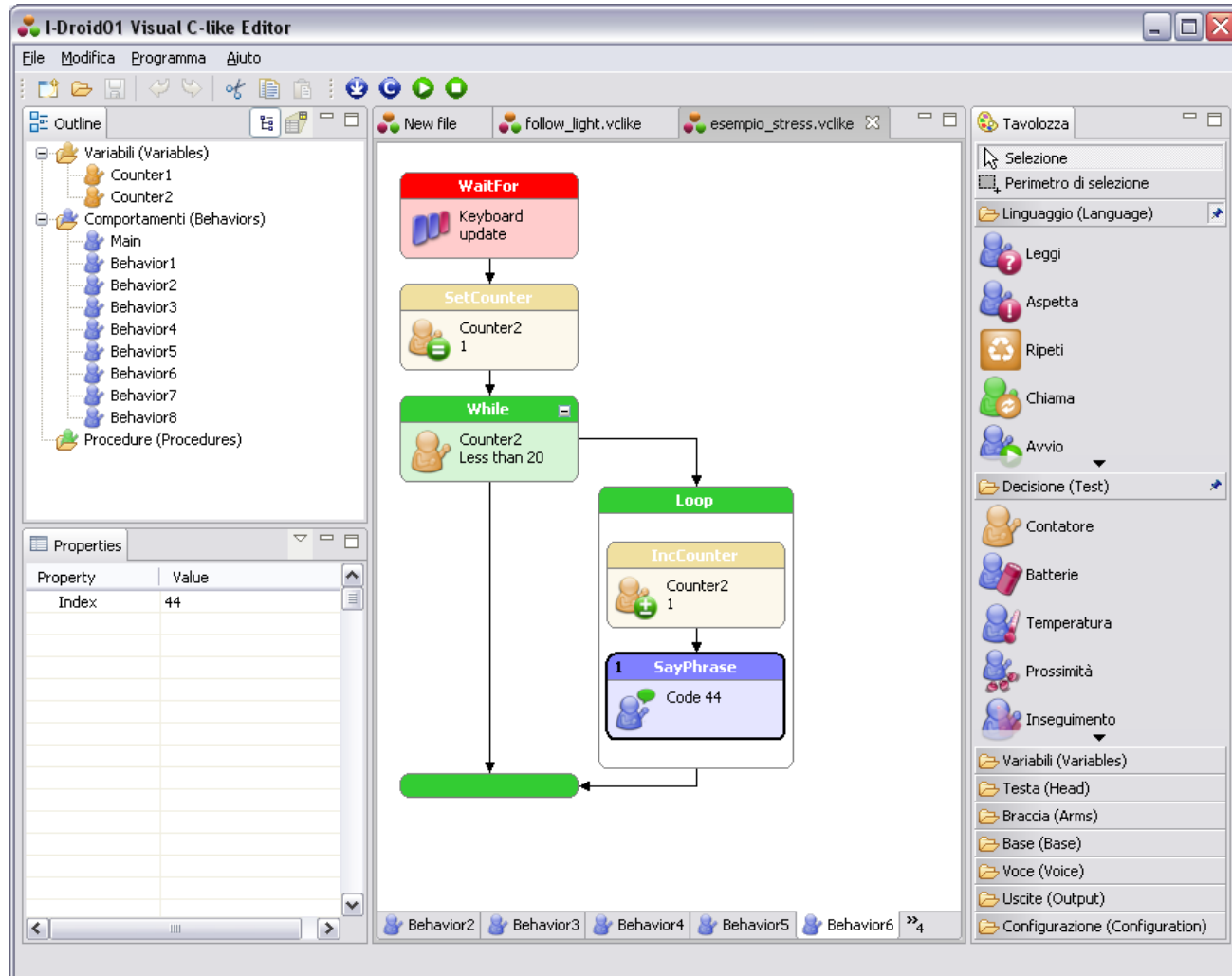
I-Droid 01 Programming

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



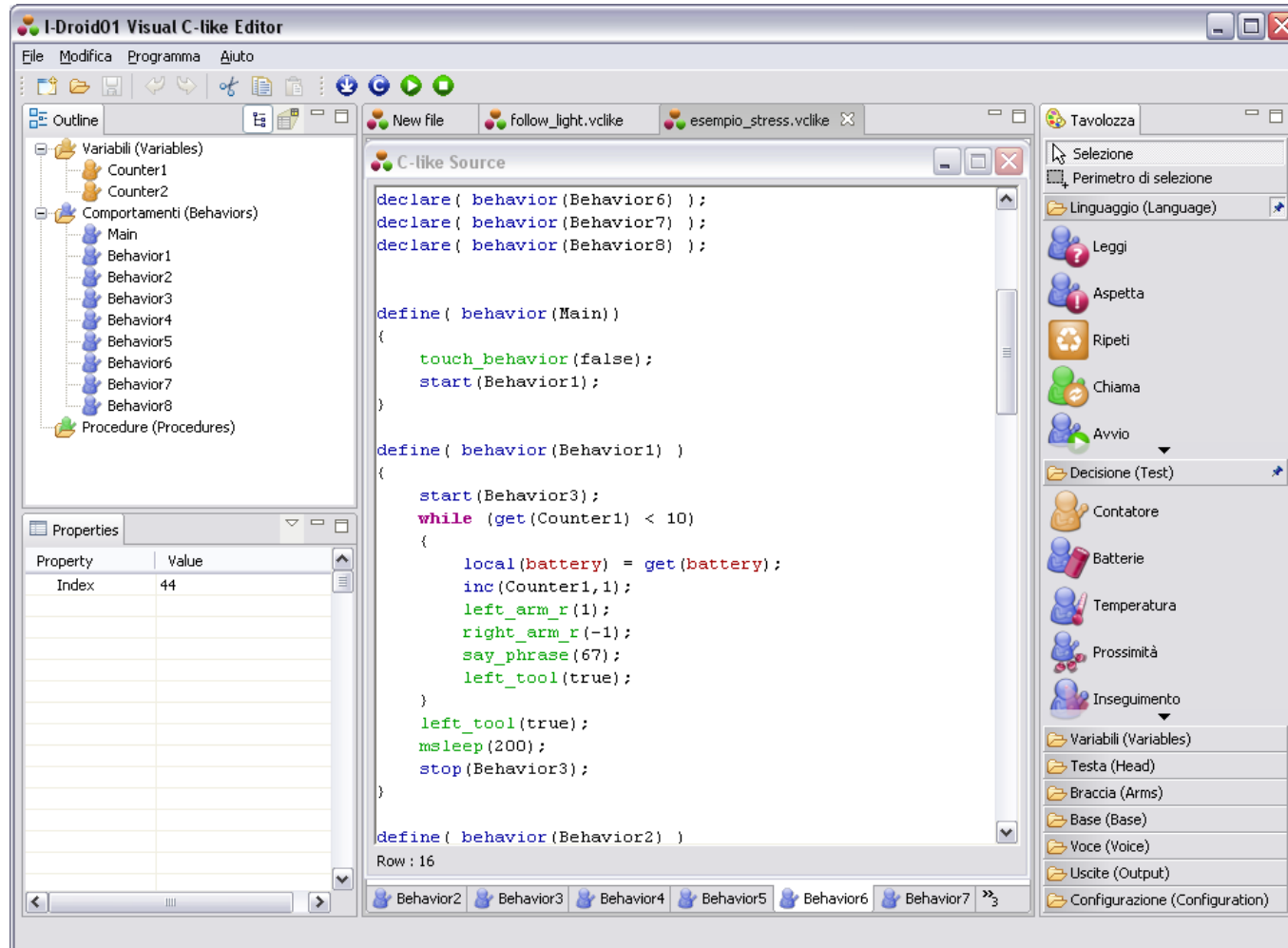


Robot Programming: Visual C-like



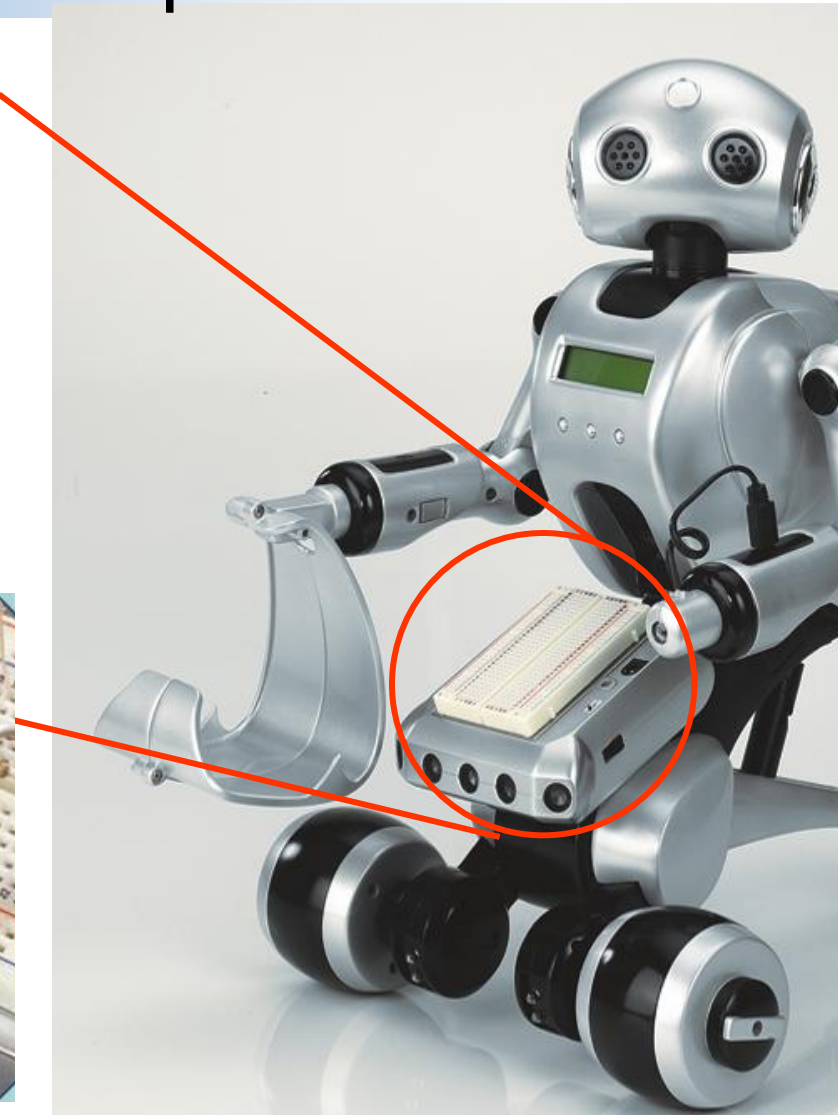
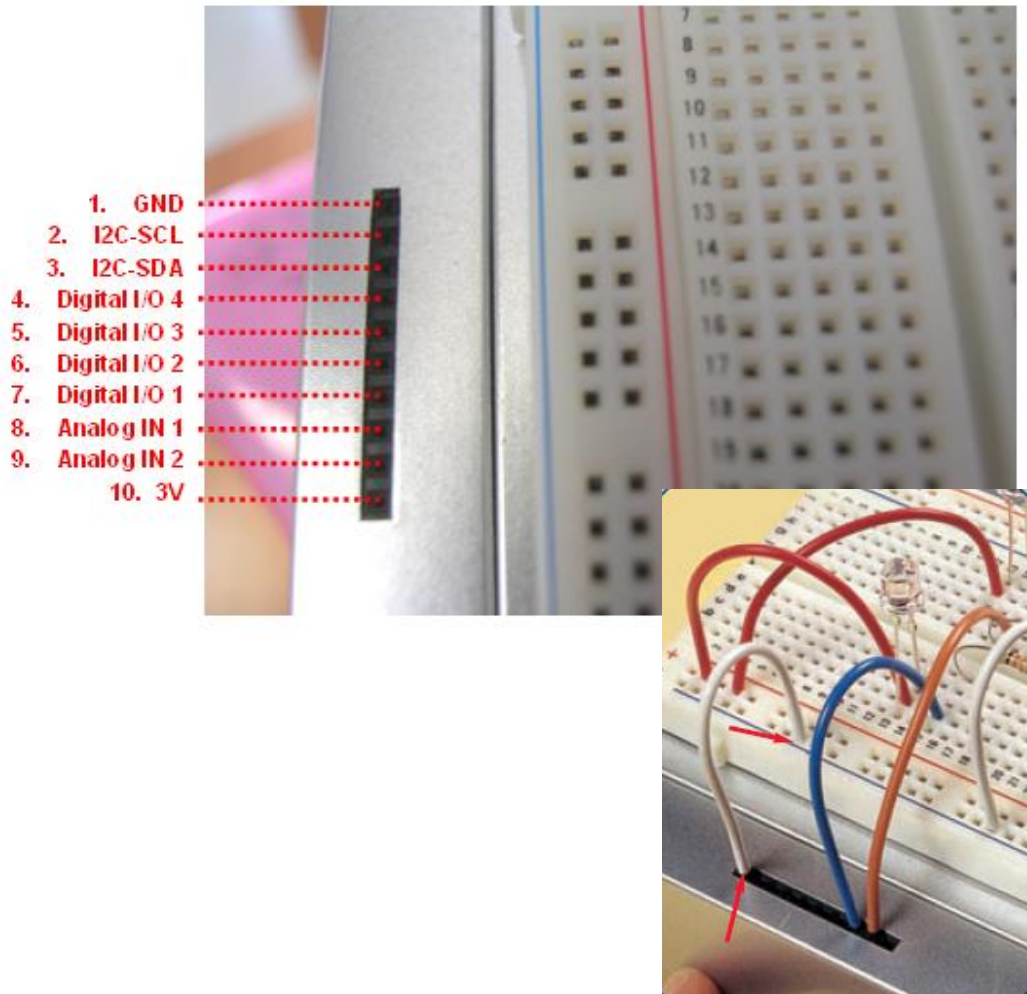
Behaviour based

Robot Programming: C-like



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

Additional GPIO and breadboard for user custom circuits development



I-Droid 01 games: follow a colored object



I-Droid 01 games: find a colored object



Contacts



Giancarlo Teti
RoboTech Srl
Via Boccioni 1,
I-56037 Peccioli (Pisa), Italy

e-mail: g.teti@RoboTechsrl.com

Phone: +39 0587 672027

Fax: +39 0587 670936

URL: <http://www.RoboTechsrl.com>