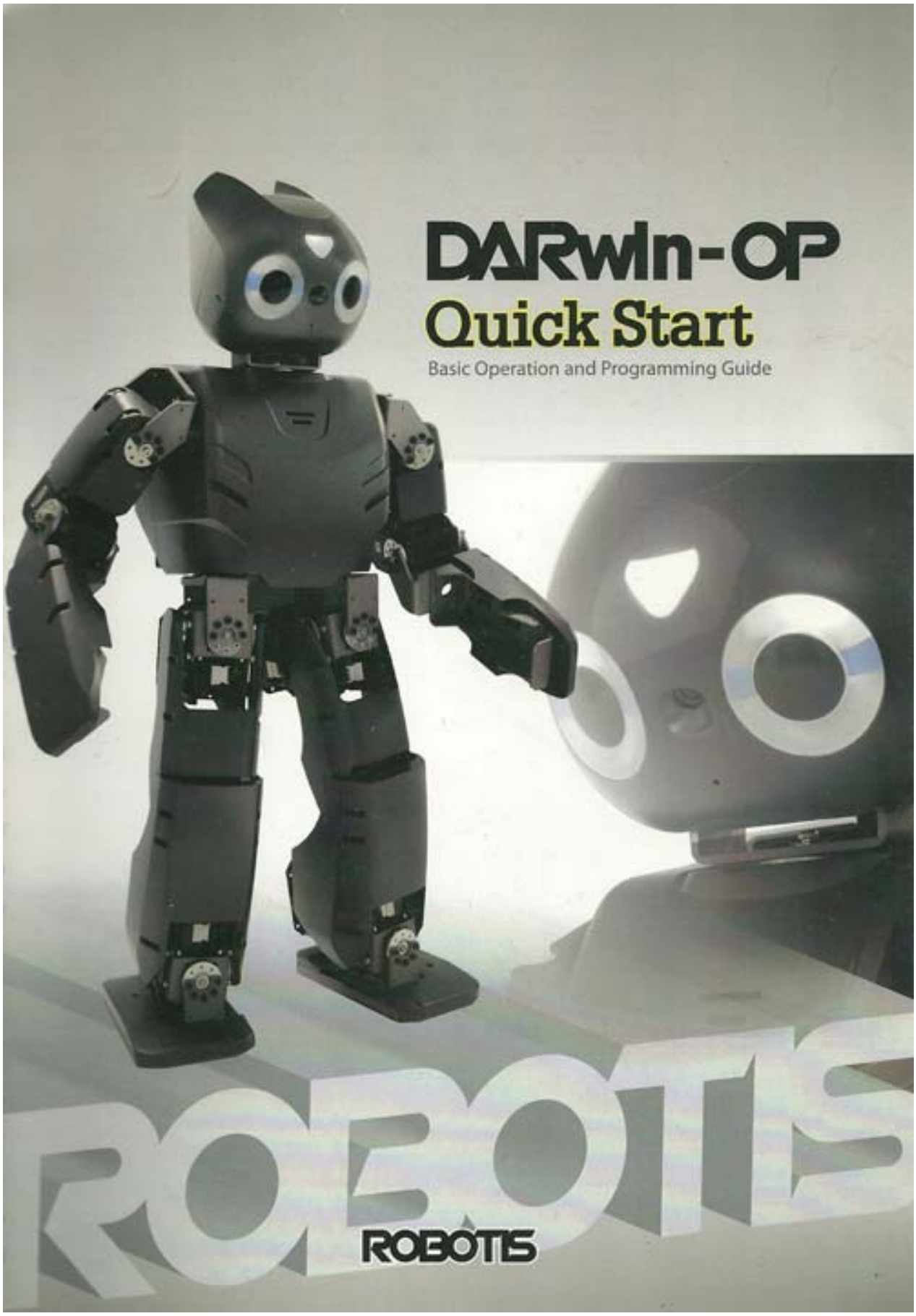

DARwIn-OP
Quick Start
Basic Operation and Programming Guide
ROBOTIS
ROBOTIS

Table of Contents

1 Introduction 3

1. What is DARwIn-OP? 4
2. Safety Information 4
3. Package Contents 5
4. Layout 6
5. Charging the Battery 7
6. Changing Battery without Shutting Down 8

2 Basic Operation 9

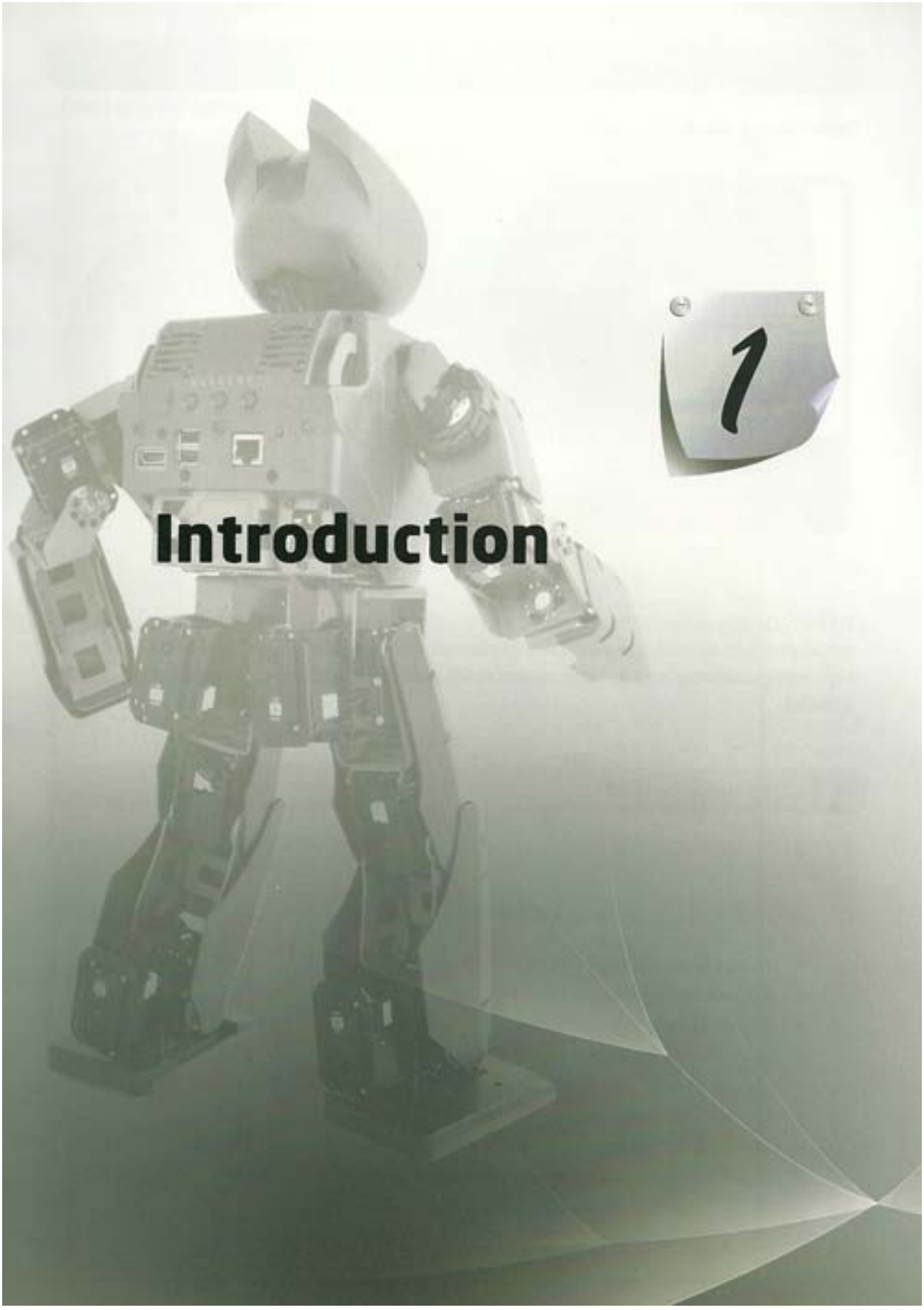
1. Ready Position and Powering On 10
2. Running the Demonstration Programs 13
3. Color and White Balance Calibration 18
4. Turning DARwIn-OP Off 20

3 Programming Guide 21

1. Connectting your PC to Main Controller 22
2. Development Environment 23
3. Source Code 23
4. DARwIn-OP Framework 24
5. S/W Utilities for Customizing and Diagnosis 25
6. Recovery Software 26
7. Useful Information 26

4 Miscellaneous 27

1. System Block Diagram 28
2. ID Map 29
3. Warranty 30

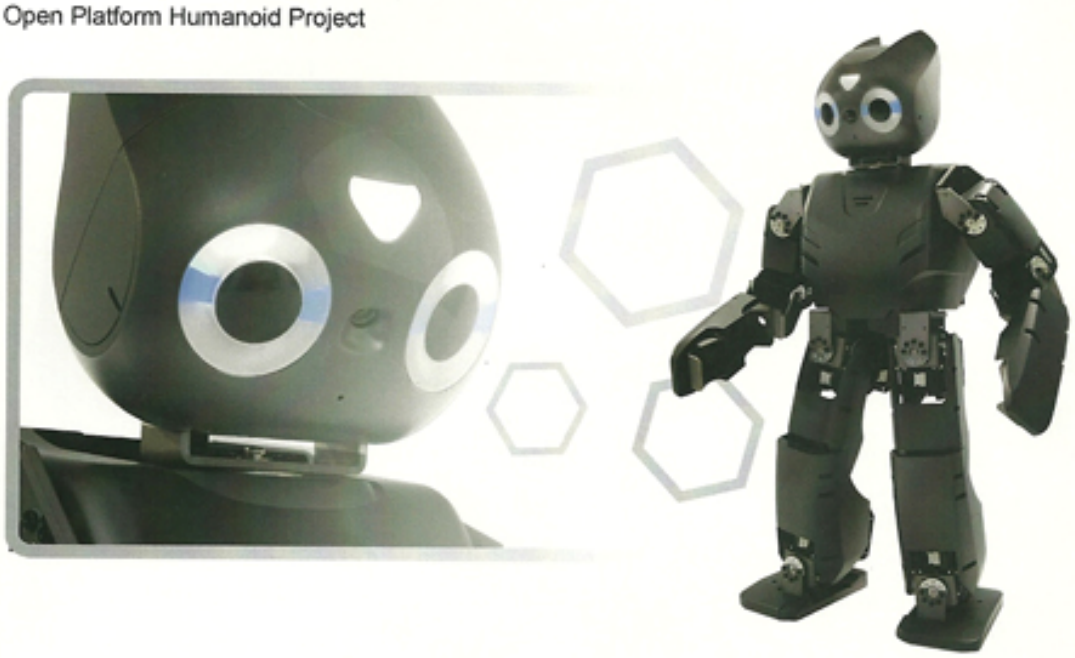


1

Introduction

1. What is DARwIn-OP?

Open Platform Humanoid Project



DARwIn-OP (Dynamic Anthropomorphic Robot with Intelligence–Open Platform) is an affordable, miniature-humanoid-robot platform with advanced computational power, sophisticated sensors, high payload capacity, and dynamic motion ability to enable many exciting research and education activities.

2. Safety information

We will not be held responsible for the result of any accidents caused by the user's negligence.

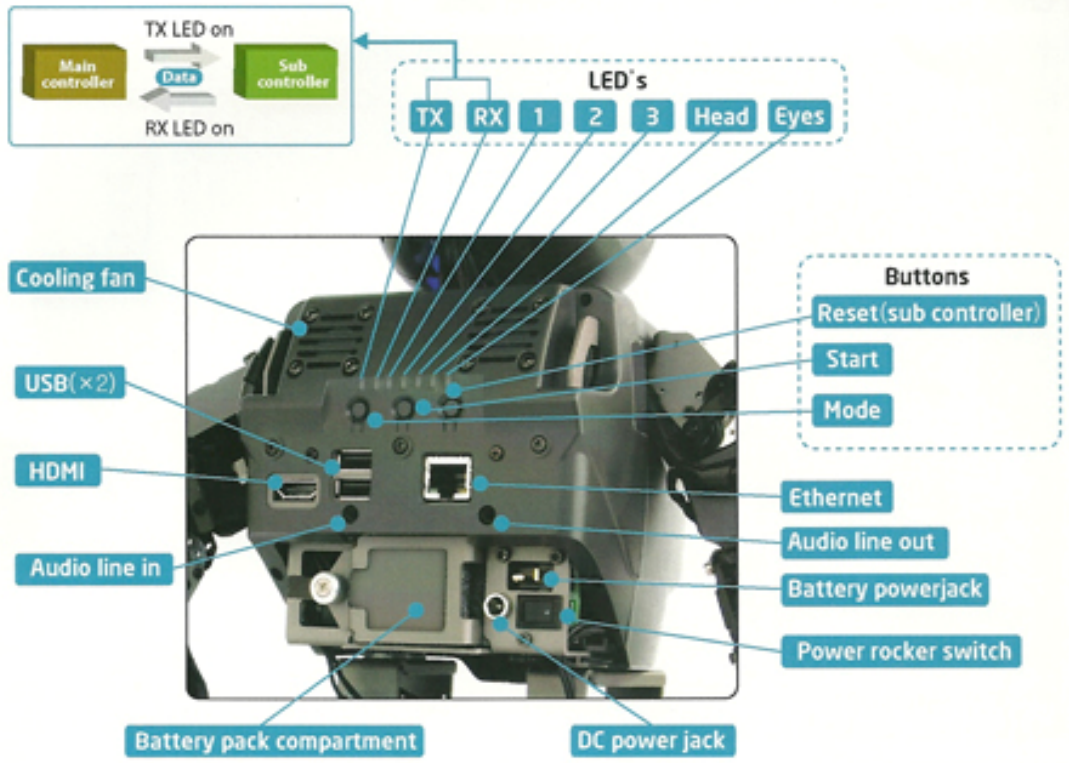
- Read the instructions carefully before getting started.
- Not suitable for children under 15 years of age.
- Do not use any other tools other than those provided in the kit.
- Keep robot away from your face and body when the robot is moving.
- Prevent from getting your fingers stuck between the servos.
- Do not place near water, heat, or fire.
- Only use the battery and charger included in the kit.
- Gears must be replaced after long excessive use.

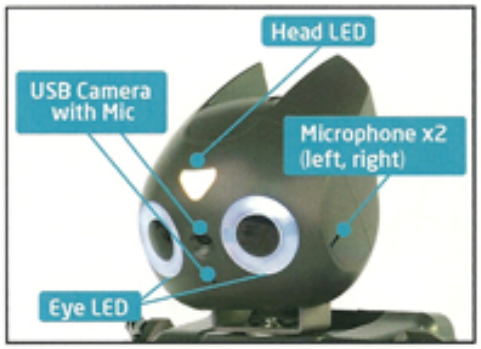
3. Package Contents

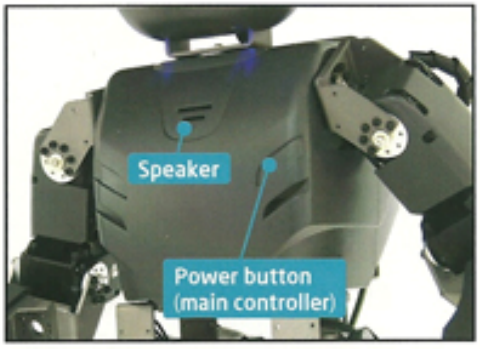
Check your DARwIn-OP package for the following items.

1. Fully-assembled DARwIn-OP robot x1
2. Battery packs x3
3. Battery charger x1
4. DC power supply x1
5. Power cable x1
6. Ethernet cable x1
7. Wrenches x2, screwdrivers x2
8. Spare cables
9. Spare bolts and nuts
10. Red ball x1
11. Color cards x7
12. USB thumb drive (with installed recovery software) x1
13. QuickStart x1
14. RoboPlus CD
15. Fuse x2

4. Layout

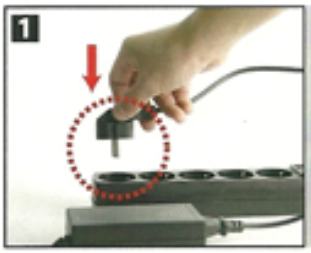

TX LED on
Main controller
Data
Sub controller
RX LED on
LED's
TX
RX
1
2
3
Head
Eyes
Cooling fan
USB(×2)
HDMI
Audio line in
Buttons
Reset(sub controller)
Start
Mode
Ethernet
Audio line out
Battery powerjack
Power rocker switch
Battery pack compartment
DC power jack


Head LED
USB Camera with Mic
Microphone x2 (left, right)
Eye LED


Speaker
Power button (main controller)

5. Charging the Battery

Please charge the battery pack according to the following procedure.



Insert the AC plug of DC power supply into the power socket

Connect the DC power supply to the battery charger

Connect the battery pack to the charger

Charging Status

Charging
(LED : Red)

Charging complete
(LED : Green)

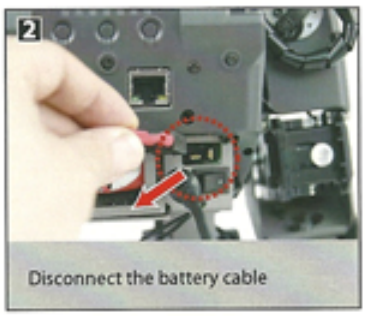
✓ If the connection is unstable, please unplug the battery completely and plug the battery in again.

⚠ Only use the supplied battery charger. Charging the battery pack with any other charger may cause damages.

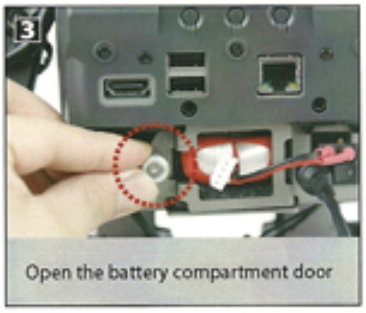
6. Changing Battery without Shutting Down

One distinguishing feature of DARwIn-OP is its ability to change the battery without the need of shutting down. To replace the battery during operation, please follow the procedures below.

Connect the DC power to the DC jack



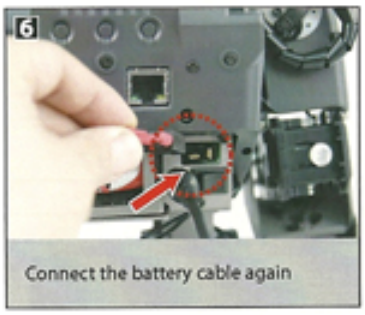
Disconnect the battery cable



Open the battery compartment door

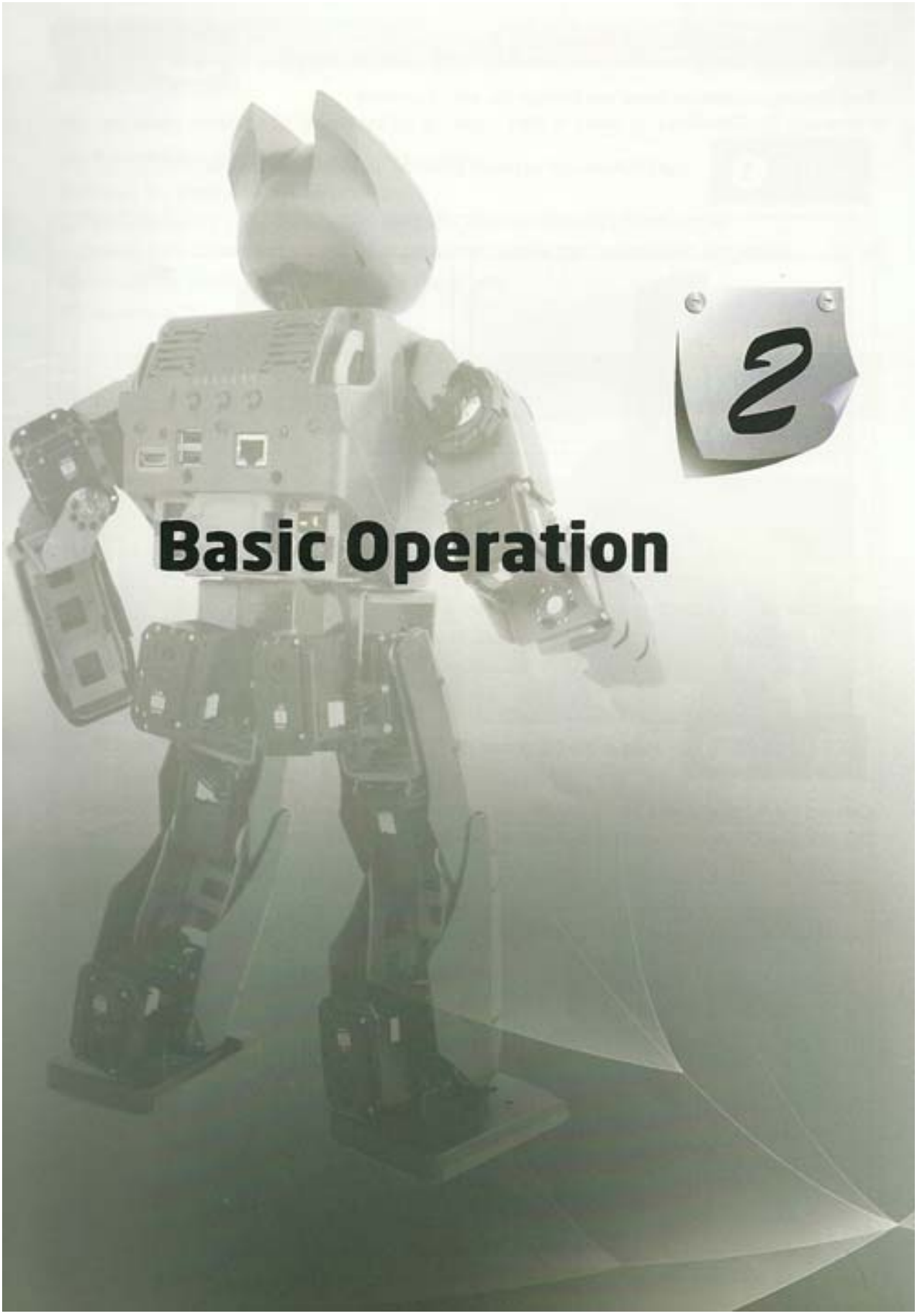
Remove the battery pack

Insert a new battery pack and close the door



Connect the battery cable again

Remove DC power from the DC jack



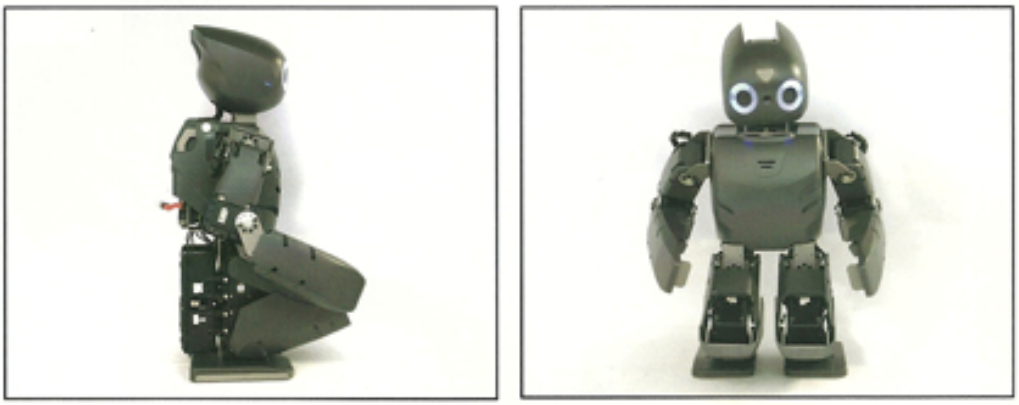
2

Basic Operation

1. Ready Position and Powering On

The following procedure takes you through the set up process.

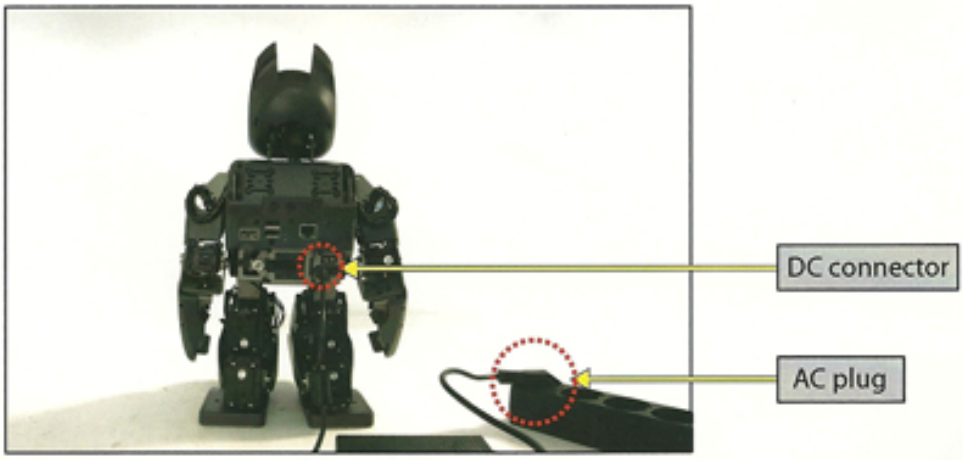
STEP 1 **Set DARwIn-OP in ready position as illustrated below.**



Setting DARwIn-OP other than this ready position may cause physical damages.

STEP 2-A **Plug in the DC power (12V) supply to provide power to DARwIn-OP**

Connect the AC plug of your power adapter into a power outlet and the DC connector into DARwIn-OP's DC jack. The DC jack is located at the back and lower right side of DARwIn-OP

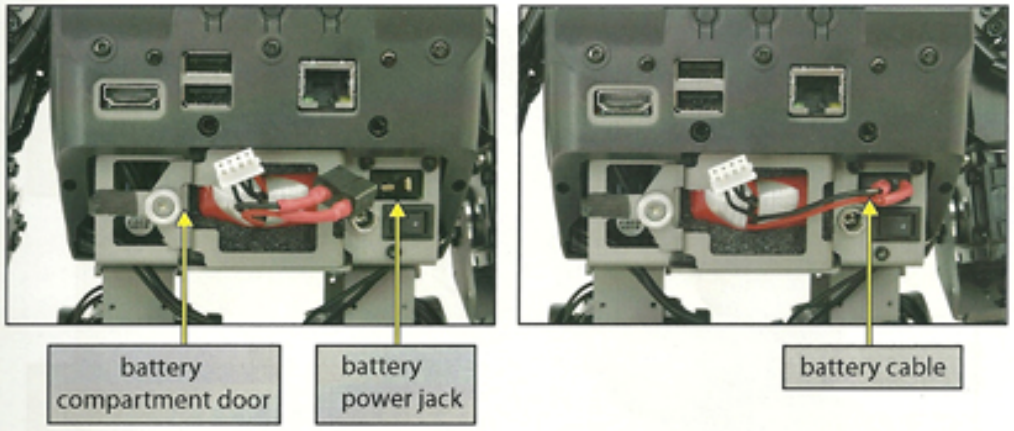


STEP 2-B Using Battery Pack (11.1V) instead of the DC power supply

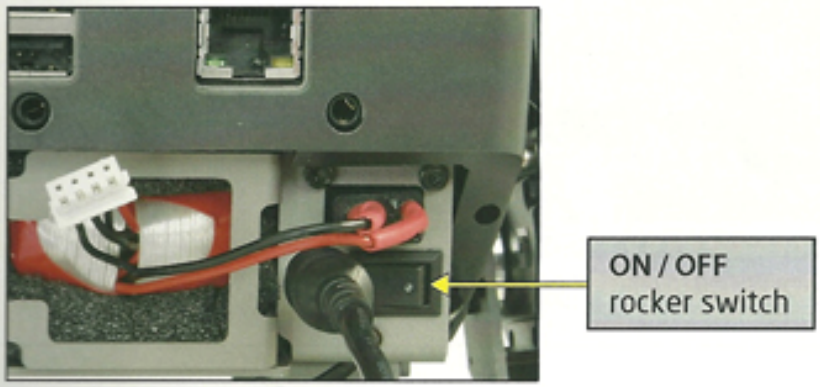
You can select either the DC power supply or battery pack to power on DARwIn-OP. If you want to use the battery pack please follow the steps below.

① Ensure the battery pack is fully charged.
② Open the battery compartment door (unscrew the thumbscrew) and insert the battery pack. Close and secure the compartment (screw the thumbscrew) afterwards.
③ Connect the battery cable to the battery power jack
④ Disconnect DC power supply.

> ⚠ To prevent unexpected shutdown, ensure that DARwIn-OP is connected to at least 1 active power source.



STEP 3 Switching On



Once power is on, the following will take place sequentially.

Status	Robot Action
 The eye LED's will turn on	Power is on
 The head LED will turn on green	The PC inside DARwIn-OP operating system is booting
 The head LED will switch from green to amber	Demo program is loaded, and DARwIn-OP is ready to operate
	

2. Running the Demonstration Programs

DARwIn-OP comes pre-configured with the follwing 4 modes of operations :

1) Demonstration-Ready Mode

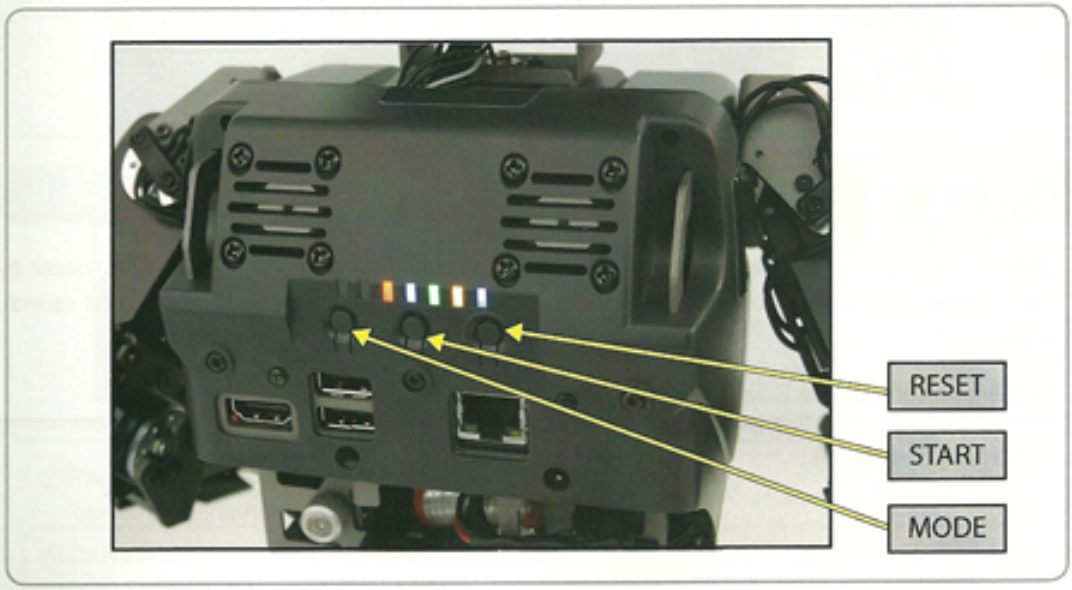
2) Autonomous Soccer Mode

3) Interactive Motion Mode

4) Vision Processing Mode

DARwIn-OP defaults to Demonstration-ready mode when turned on.

To switch between modes, press the MODE button. DARwIn-OP announces each mode with each pressing. Each mode has its own indicating LED.
To run each mode press START button. After pressing START DARwIn-OP will stand up and begin operations.



RESET button

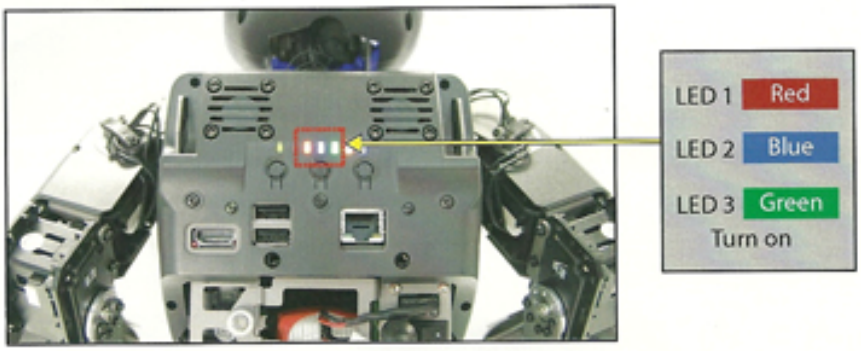
The RESET button resets the actuators, not the entire robot. Please keep in mind that the demo program is still running in the main controller.

The RESET button powers off all actuators. It is highly recommended that DARwIn-OP is set at kneeling position before pressing RESET or hold DARwIn-OP by its carrying handle.

2-1. Demonstration-Ready Mode

The Demonstration-Ready Mode is the default mode when you turn DARwIn-OP on. LED 1 (red), LED 2 (blue) and LED 3 (green) are on; the head LED changes from green to amber, and DARwIn-OP announces "Demonstration-ready mode." DARwIn-OP is ready for action!

DARwIn-OP remains in kneeling position and does not move under this mode. This is the best-suited mode to change the power source.

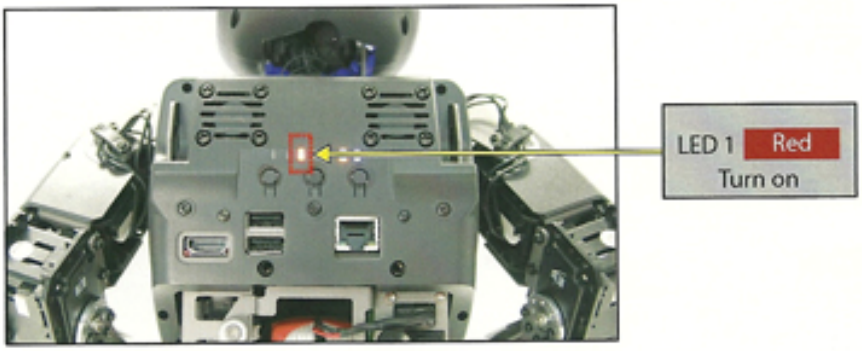


2-2. Autonomous Soccer Mode

DARwIn-OP pursues and kicks a red ball (you can change the ball color) and plays a soccer by itself. When DARwIn-OP falls down (either on its back or belly) it gets up, resumes ball search, and pursuit.

1) Start Autonomous Soccer Mode

① Press the MODE button until the LED 1 (red) is on.
DARwIn-OP announces "Autonomous soccer mode."



② Press the START button to begin. DARwin-OP will stand up and announce "Start soccer demonstration."

③ When DARwIn-OP sees the ball it walks towards the ball.
Once the ball is close DARwIn-OP kicks the ball with either its left or right foot. If DARwIn-OP falls during pursuit or kick, it gets back up.

2) Stop Autonomous Soccer Mode

If you press the MODE button, DARwIn-OP returns to Demonstration-Ready Mode.

2-3. Interactive Motion Mode

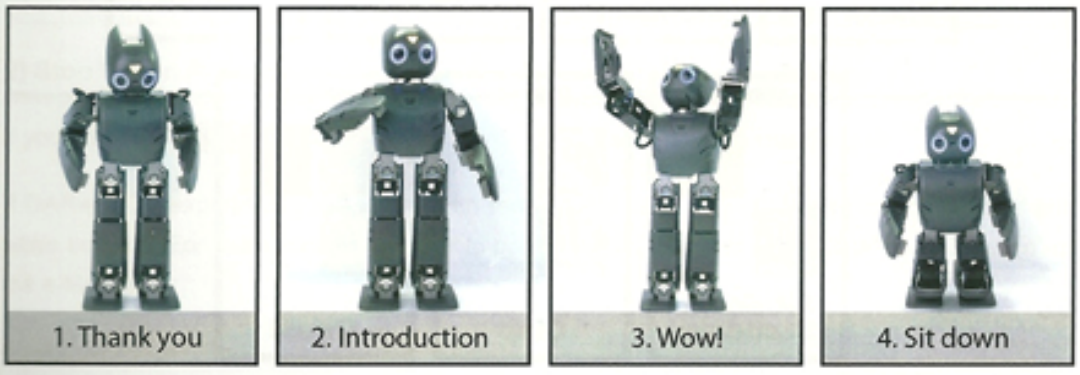
DARwIn-OP performs pre-programmed motions sequentially while talking.

1) Start Interactive Motion Mode

① Press the MODE button until the LED 2 (blue) is on. DARwIn-OP announces "Interactive motion mode."

② Press the START button to begin. DARwin-OP will stand up and announce "Start motion demonstration."

③ DARwIn-OP performs the following actions sequentially.




5. Stand up


6. Clap please


7. Oops!


8. Bye bye

2) Stop Interactive Motion Mode

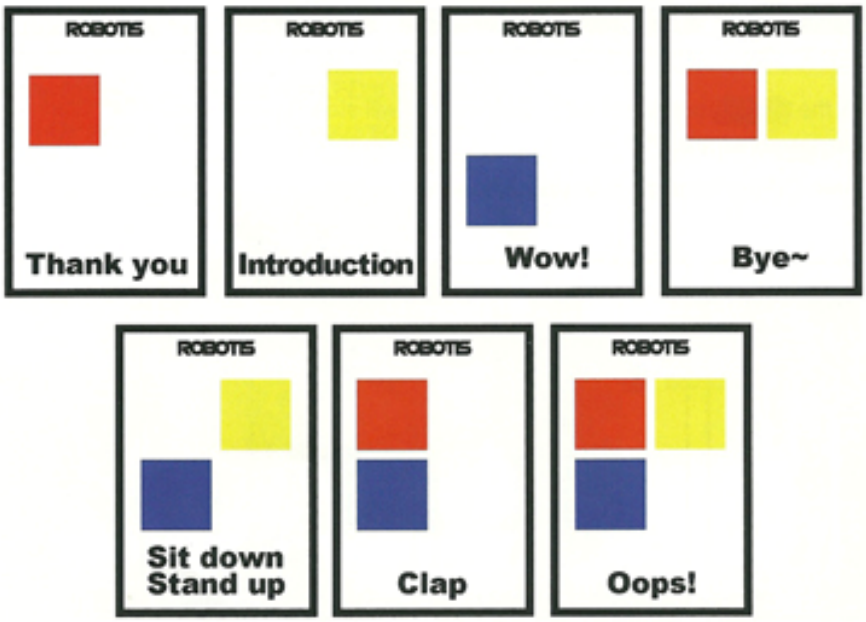
If you press the MODE button, DARwIn-OP returns to demonstration-ready mode.

2-4. Vision Processing Mode

DARwIn-OP will perform the same motions as when in interactive motion mode, but individually, depending on the color(s) card. Use the supplied color cards

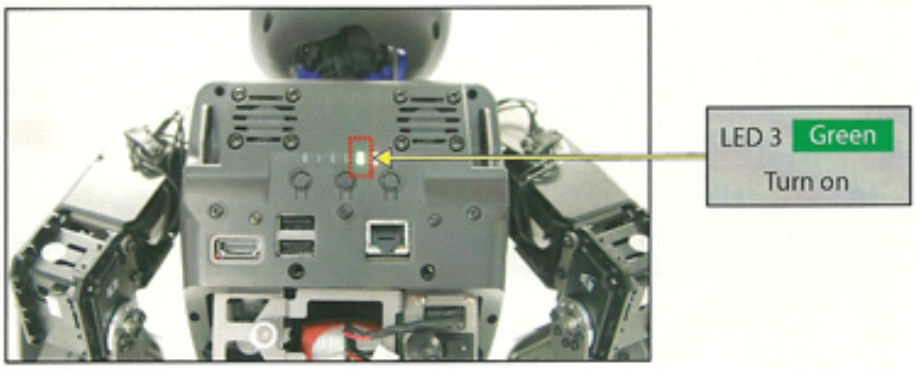
Color Cards

(Cards downloadable at http://sourceforge.net/projects/darwinop)



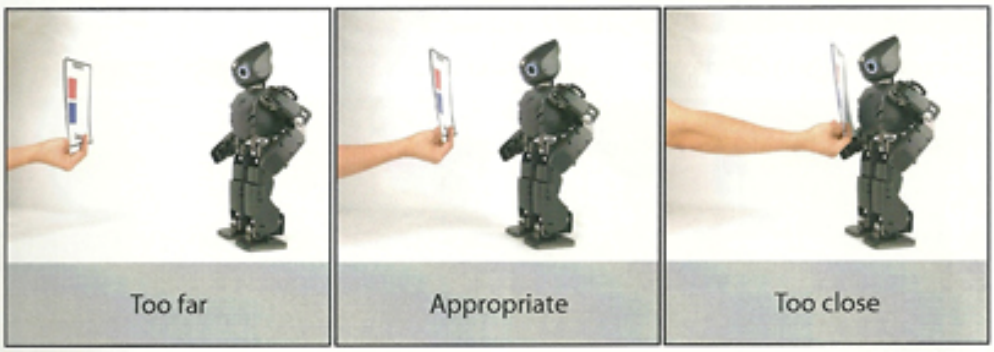
1) Start Vision Processing Mode

① Press the MODE button until LED 3(green) is on. DARwIn-OP announces "Vision processing mode."



② Press the START button to begin. DARwin-OP announces "Start vision processing demonstration" and gets up.

③ Select a color(s) card and place it in front of DARwIn-OP. The color card should be approximately 15cm (about 6in) in front of DARwIn-OP.



2) Stop Vision Processing Mode

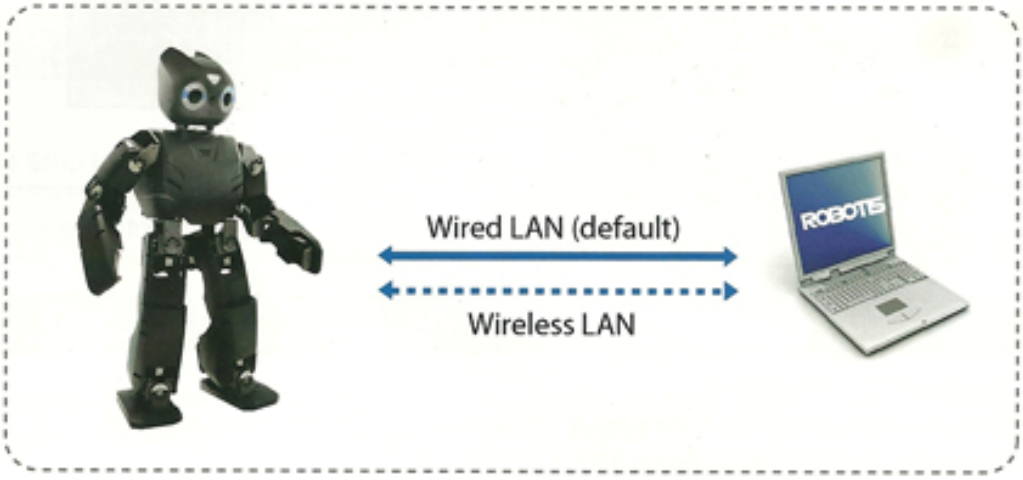
If you press the MODE button, DARwIn-OP returns to demonstration-ready mode.

If DARwIn-OP experiences difficulties with reading the card, you may need to adjust color and white balance. For more information refer to page 18 on "Color and White Balance Calibration" or the e-Manual.

3. Color and White Balance Calibration

If it the lighting around DARwIn-OP is too bright or too dark, it may be difficult to operate DARwIn-OP. You may change settings for color and white balance, and modify color settings to change ball color for soccer mode.

Connect DARwIn-OP via ethernet cable for calibration

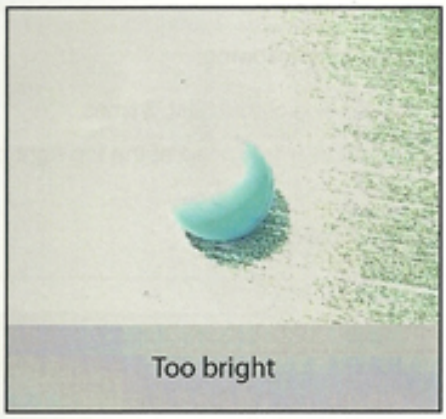


To be able to manipulate color settings you must

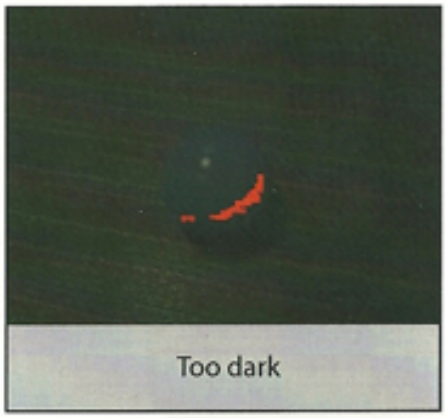
1) Connect to DARwIn-OP via ether wired or wireless LAN.
2) Check on the 'Obtain an IP address automatically' menu from the Internet Protocol (TCP/IP) properties of 'Local area connection properties'
3) Have a web browser Firefox (recommended) or Internet Explorer.

The following procedure to access color settings assumes a connection via wired LAN

1) Ensure you have a proper connection with DARwIn-OP.
2) Open up your computer's web browser.
3) On the address line type: http://192.168.123.1:8080
4) Click on the increment/decrement buttons until you have desired settings. You can see the changes visually.

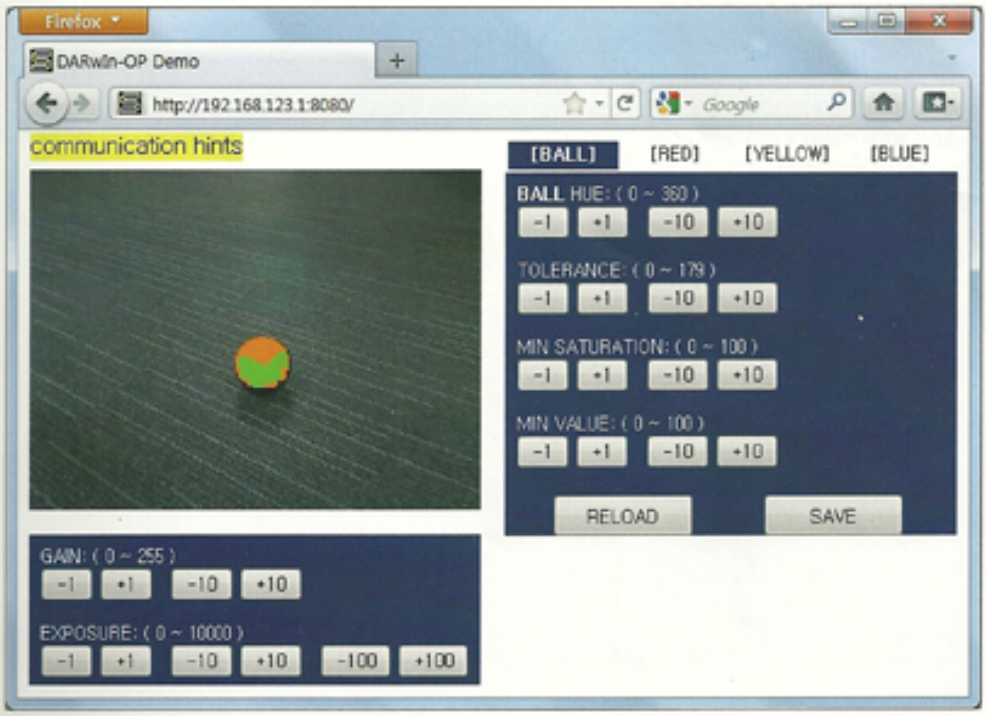


Too bright



Too dark

Calibration



For more detailed information on Color and White Balance Calibration please refer to the e-Manual.

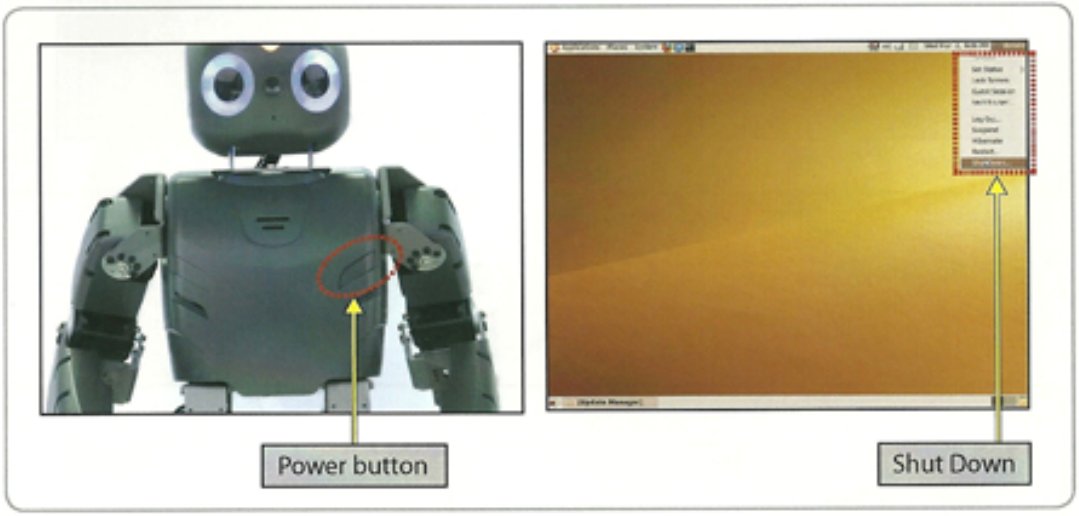
4. Turning DARwIn-OP Off

To shut down the computer inside DARwIn-OP perform one of the following:

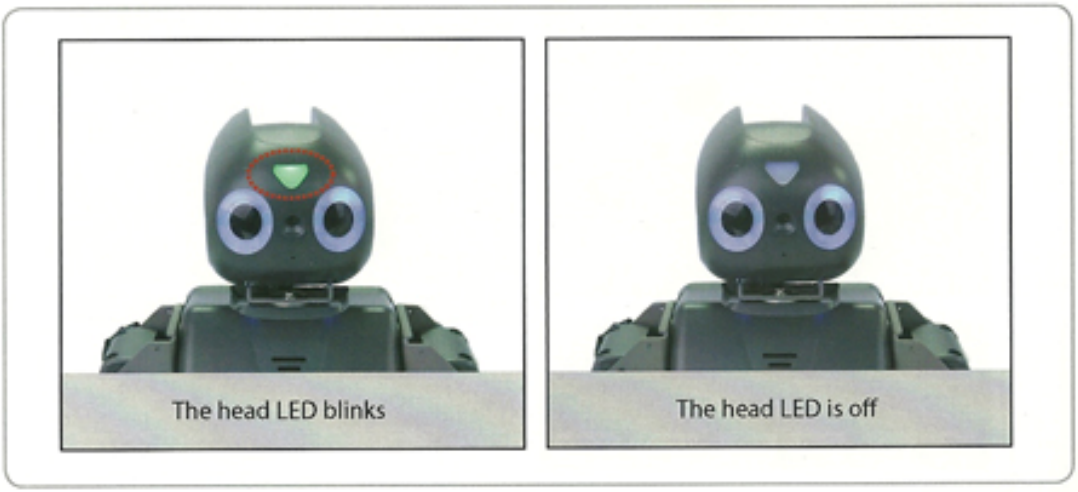
1) Press the power button (1st depression), located on the front left side of the chest, 3 times.

2) If you can connect a monitor and see the screen, click on "darwin" (located at the top right corner of the screen) and then click on "Shut Down."

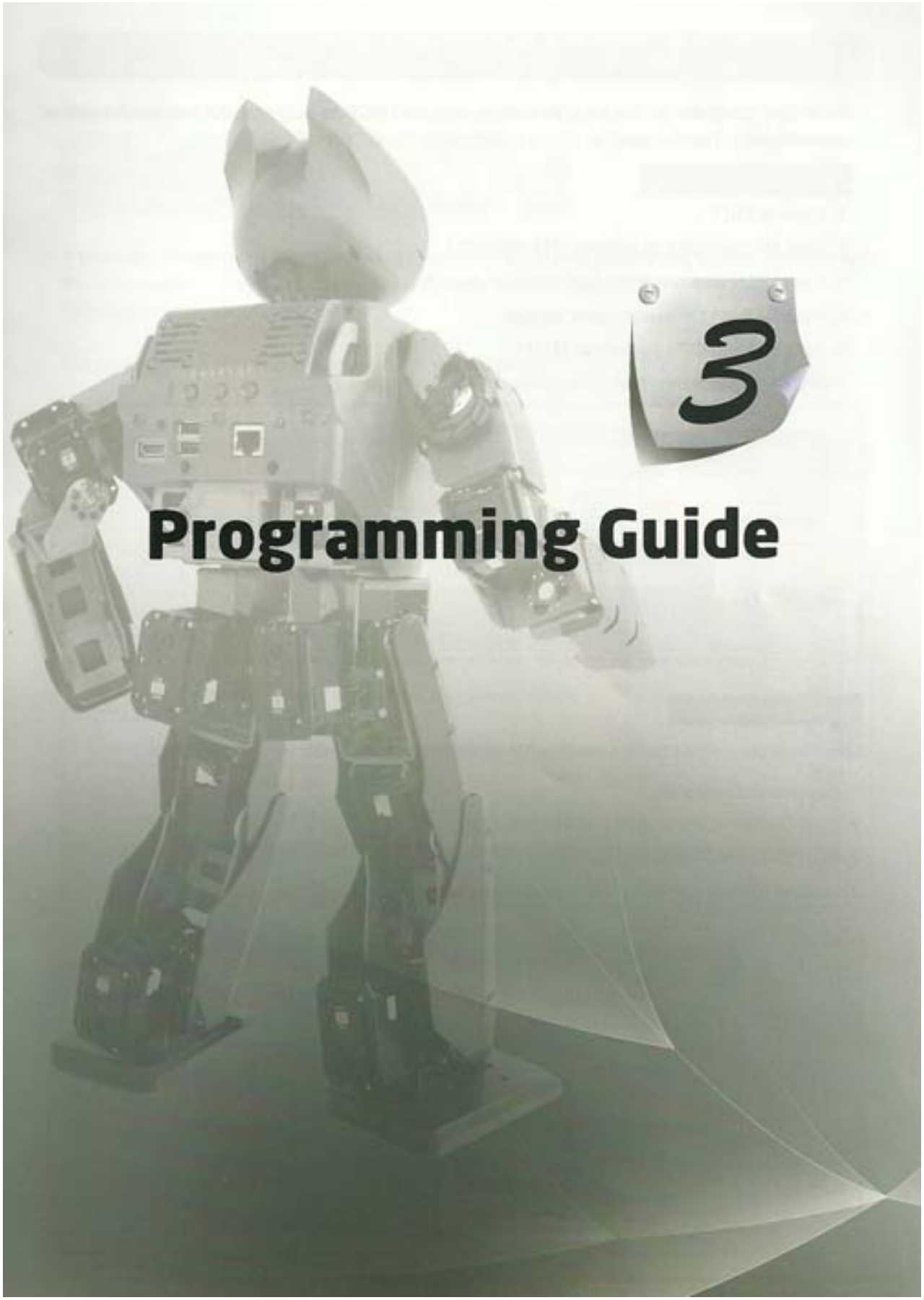
DARwIn-OP will announce 'bye-bye" and begin the shut-down procedure.



DARwIn-OP's head LED will blink on and off (OS shutdown). Once the head LED stops blinking and remains off, you may cut the power off.



If you cut the power off while the head LED blinks, DARwIn-OP may have problems powering the next time.



3

Programming Guide

1. Connect your PC to Main Controller

From your computer go to your LAN settings and set DHCP to automatic (Obtain an IP address automatically). Then connect an ethernet cable from PC to DARwIn-OP.

Example with PuTTY

1) Execute PuTTY.

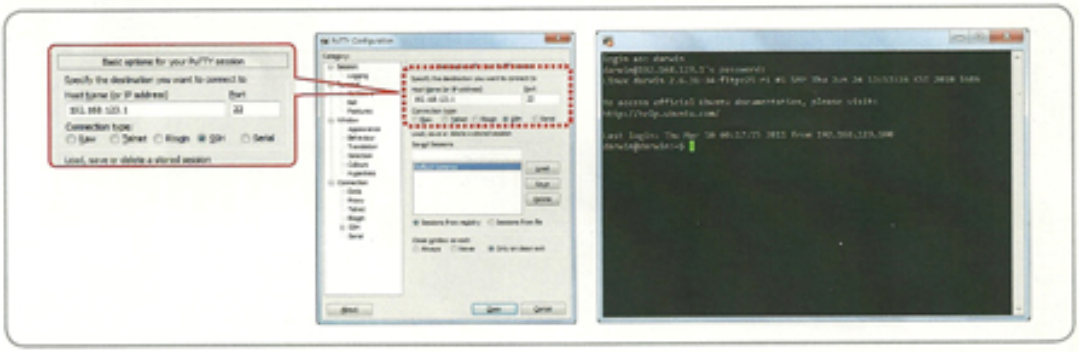
2) Input DARwIn-OP's IP address: **192.168.123.1**

3) Select **SSH** as a correction type and then open it.

4) Input DARwIn-OP's user name: **darwin.**

5) Input DARwIn-OP's password: **111111**

ROBOTIS recommends that users connect via terminal client.



Example with VNC

Users may connect via remote desktop if graphical interface is better accommodating.

1) Execute VNC program

2) Input DARwIn-OP's IP address: **192.168.123.1**

3) Input DARwIn-OP's password: **111111**

Accessing DARwIn-OP via remote desktop may result in slower performance.

2. Development Environment

The following list is information on tools for source code development

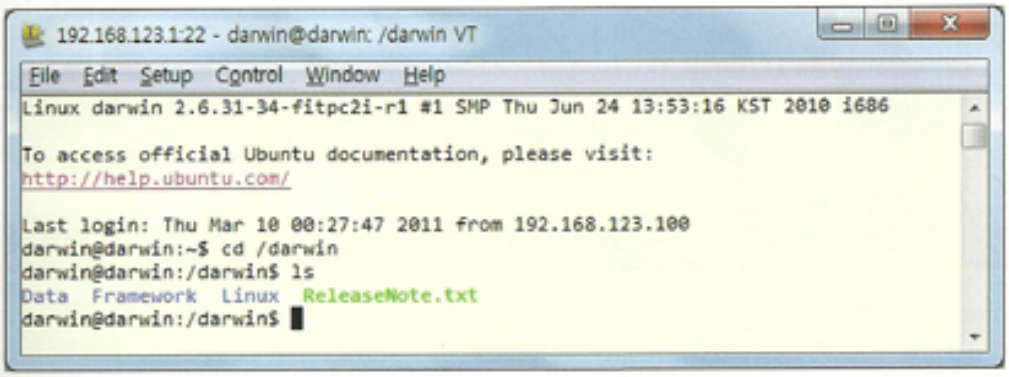
- Compiler : GNU C++ Compiler (g++)
- Language : C++
- OS : Linux Ubuntu v9.10 (2.6.31, "Karmic Koala")

If you wish to learn more about DARwIn-OP operations you may perform the tutorials provided with the source code. Tutorial files can be found at
/darwin/Linux/project/tutorial

For more detailed information please refer to the e-Manual.

3. Source Code

You may find the source code directory at '/darwin' from DARwIn-OP's PC.

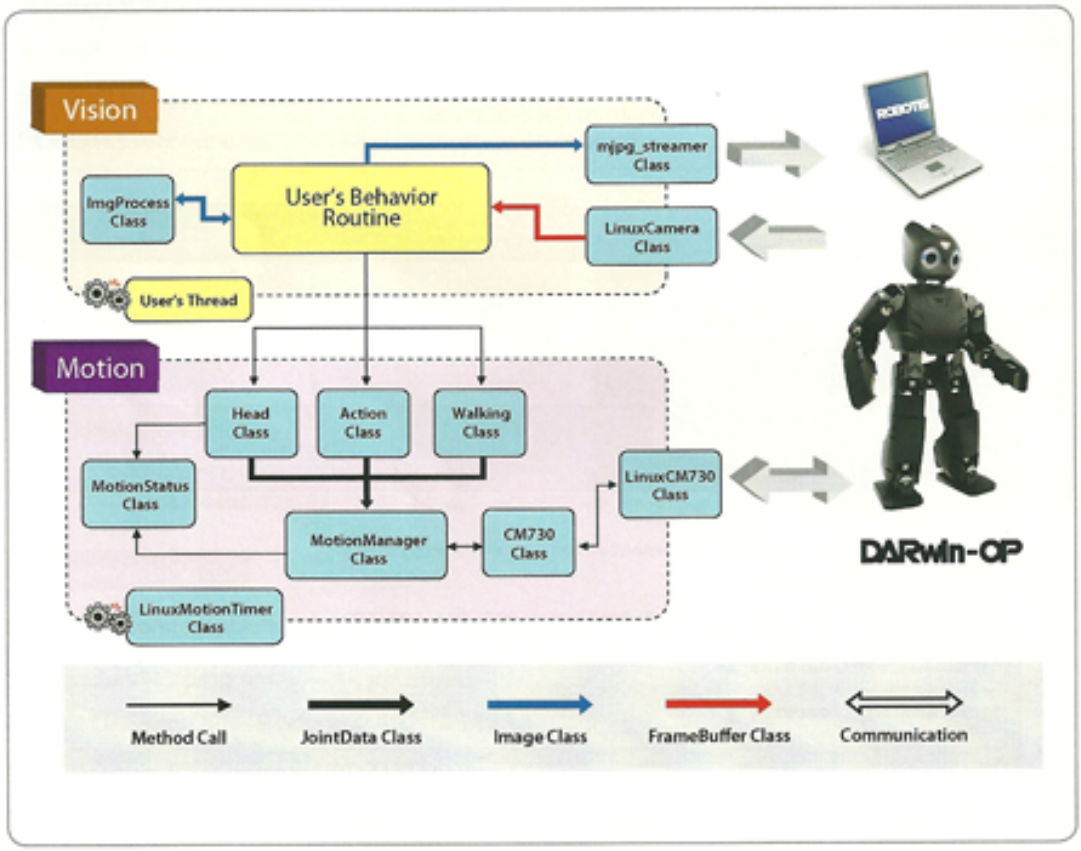


The pre-installed source code may be updated without prior notice. Please check for updates periodically. You may obtain updated source code via the following :
Download from http://sourceforge.net/projects/darwinop
Subversion.

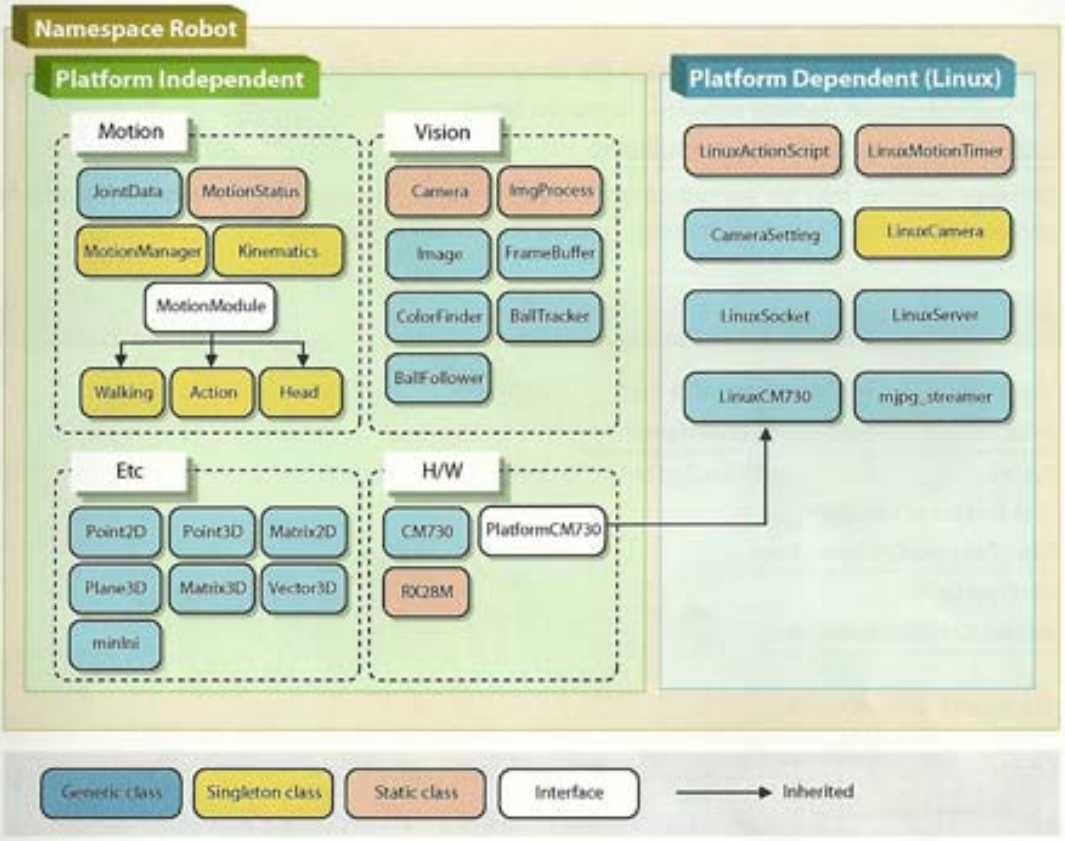
4. DARwIn-OP Framework

The following flowchart diagrams represent class breakdown and data pipelines. You may modify the framework at
/darwin/Framework
For more information please refer to the e-Manual.

[DARwIn-OP Framework Pipeline]



[DARwIn-OP Framework Class Diagram]



5. S/W Utilities for Customizing and Diagnosis

Users who wish to either customize or diagnose DARwIn-OP should establish a connection via SSH. The tools are located at the directory:
/darwin/Linux/project

From there you can find code for :

Customizing	**roboplus** (motion editing with RoboPlus) **action_editor** (motion editor through terminal) **walk_tuner** (edit walking parameters
Diagnosis	**dxl_monitor** (actuator and sub controller monitoring) **firmware_installer** (sub controller and actuator firmware installer)

For further information refer to the e-manual :
http://support.robotis.com

6. Recovery Software

The supplied USB thumb drive contains the same software that comes preinstalled with DARwIn-OP. You may obtain updates softwares at the link below.

http://sourceforge.net/projects/darwinop

Software updates may be performed without prior notice. Please check the site periodically for update information. For more information please refer to the e-Manual.

7. Useful Information

You may download the source code from

http://sourceforge.net/projects/darwinop

For more detailed information on DARwIn-OP please refer to the e-Manual.
The e-Manual can be found at :

http://support.robotis.com

or email us at :

contactus2@robotis.com

Third party terminal client

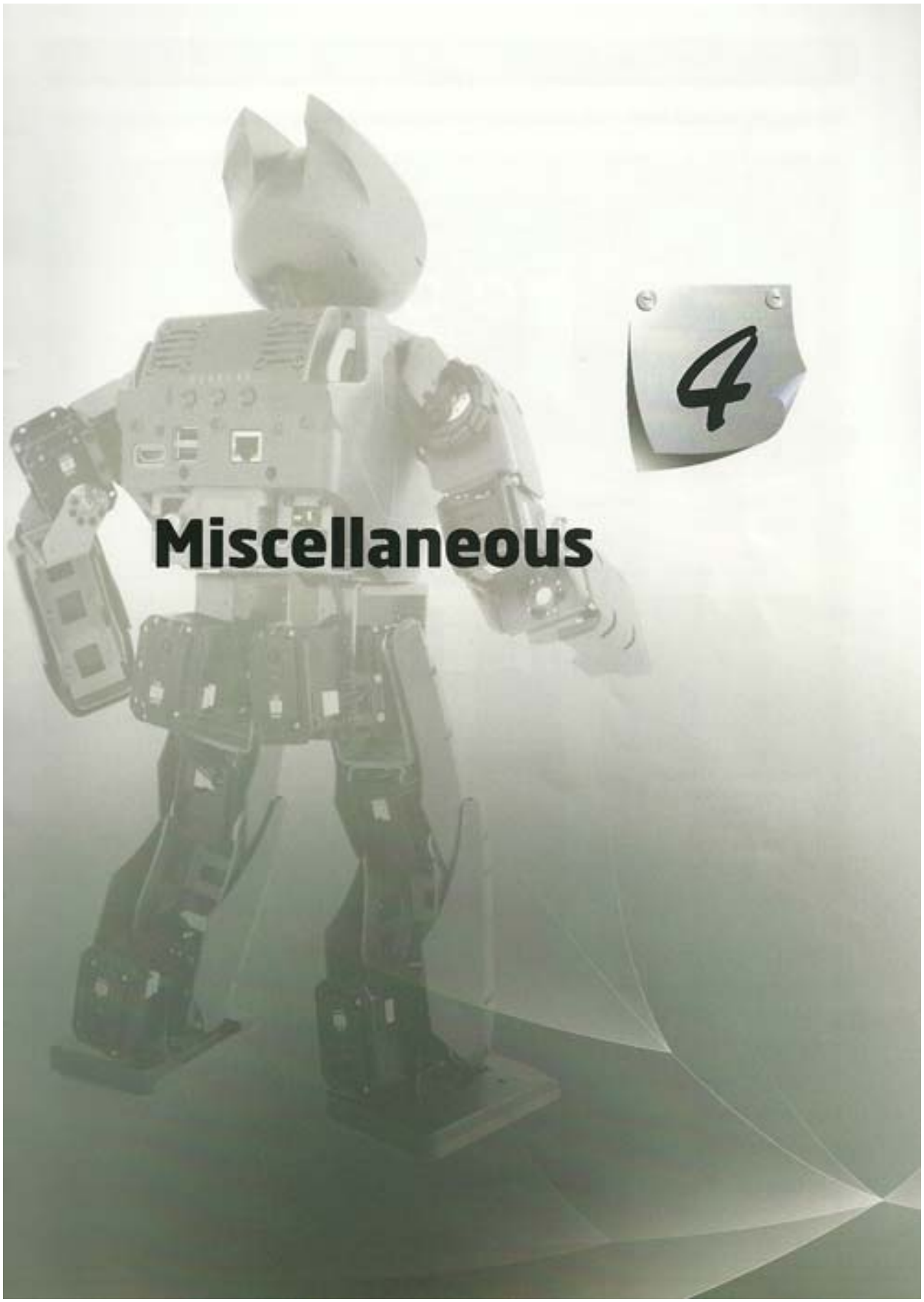
PuTTY : ***http://www.chiark.greenend.org.uk/~sgtatham/putty/***

VNC : ***http://www.realvnc.com/***

ZOC : ***http://www.emtec.com/zoc/***

RBrowser (for Mac users) : ***http://www.rbrowser.com/***

Chicken of the VNC (for Mac users) : ***http://sourceforge.net/projects/cotvnc/***

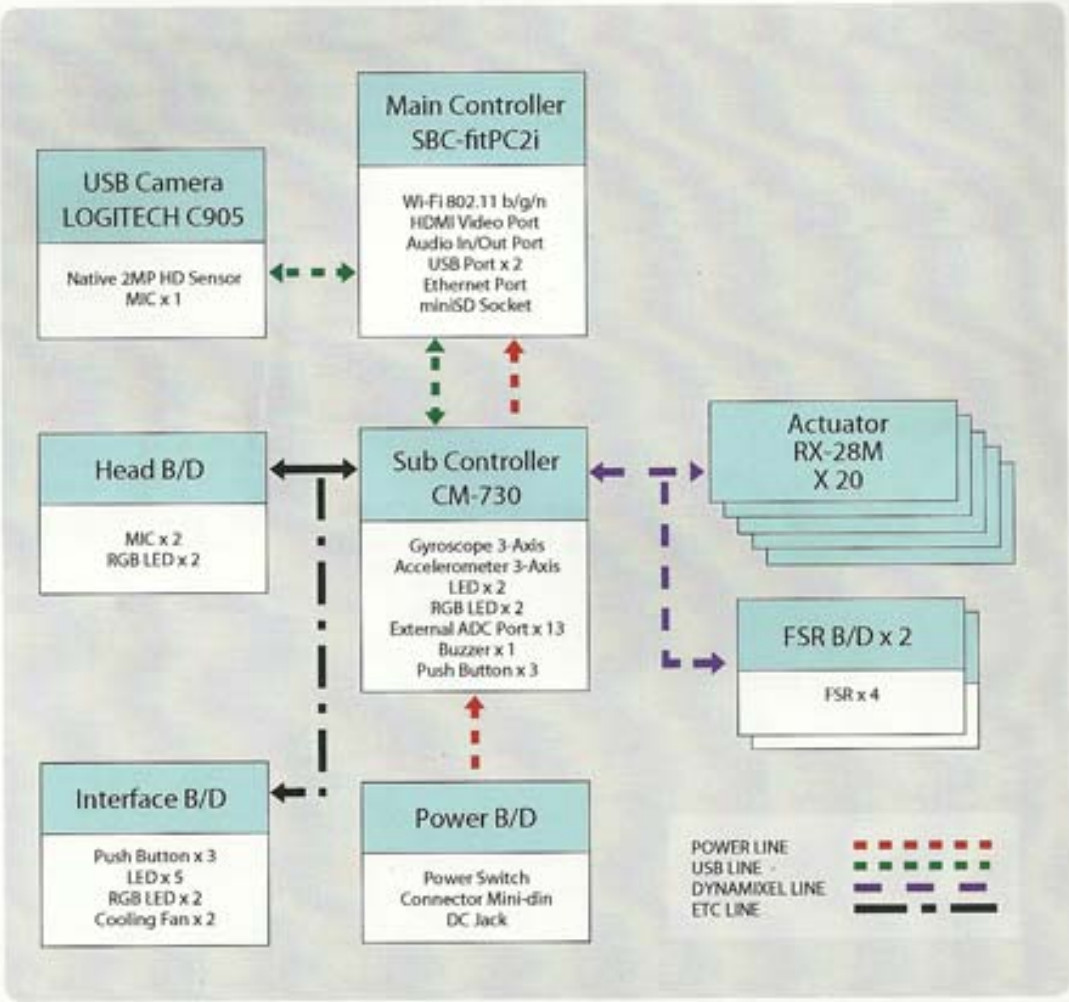


4

Miscellaneous

1. System Block diagram

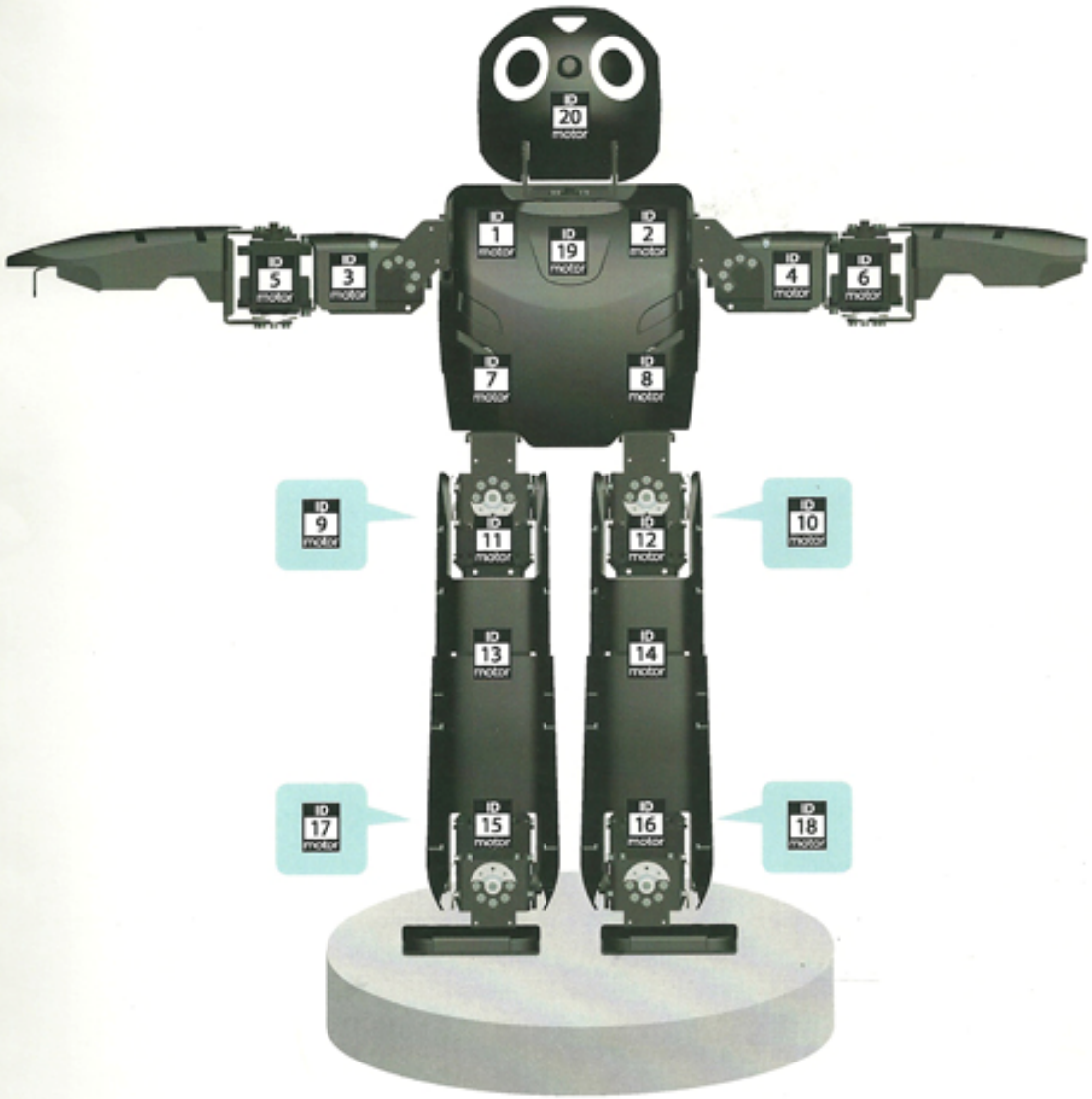
The diagram below illustrates the overall structure of DARwIn-OP's system.



1) **Main controller** powered by Intel Atom Z530 CPU (clocked @ 1.6GHz)
2) **Sub controller** powered by STMicroelectronics Cortex-M3 STM32F103RE (clocked at 73MHz).
3) **Camera**
   ① 2MP HD webcam with up to 1600x1200 resolution (720p-capable)
   ② 1600×1200@10fps, 1280×720@30fps
   ③ Output : YUYV, MJPG
   ④ Carl Zeiss® optics with autofocus

2. ID Map

The following diagram illustrates the actuators ID numbers in DARwIn-OP's default configuration.



3. Warranty

1) Basic Warranty for DARwIn-OP is 1 year from the date of purchase.

2) Any malfunction caused by user's fault is subject to RMA process. (additional fee applies)

A. Physical damage equivalent to dropping the robot from +20cm in height.

B. Disabling system safety function (DYNAMIXEL Overload Shutdown)

C. Dangerous movement (jump, roll, fight) or excessive operation without rest

D. Any liquid or unauthorized chemical material to the robot

E. Unauthorized power or electric shock applied to the robot

F. Improvising core system programming area.

3) For RMA process, all users are required to register at **http://support.robotis.com**