



WiFi Mobile Robot Development Platform with Multi-DOF Gripping Arms

Scout

Quick Start Guide



WARNINGS

Do **NOT** power on the robot before reading and fully understanding the operation procedures explained in this manual.

Neither the robot, nor the program is bug free, accidents could happen; you have to make sure that the robot always maintains a safe distance from people during operation.

The robot should be turned off (i.e. the power switch should be on OFF position) when not in use. Battery should be fully charged before storage. Battery pack should be recharged every two weeks while in storage.

Failure to follow these warnings could cause serious injury or death and/or damage to the robot.

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Introduction

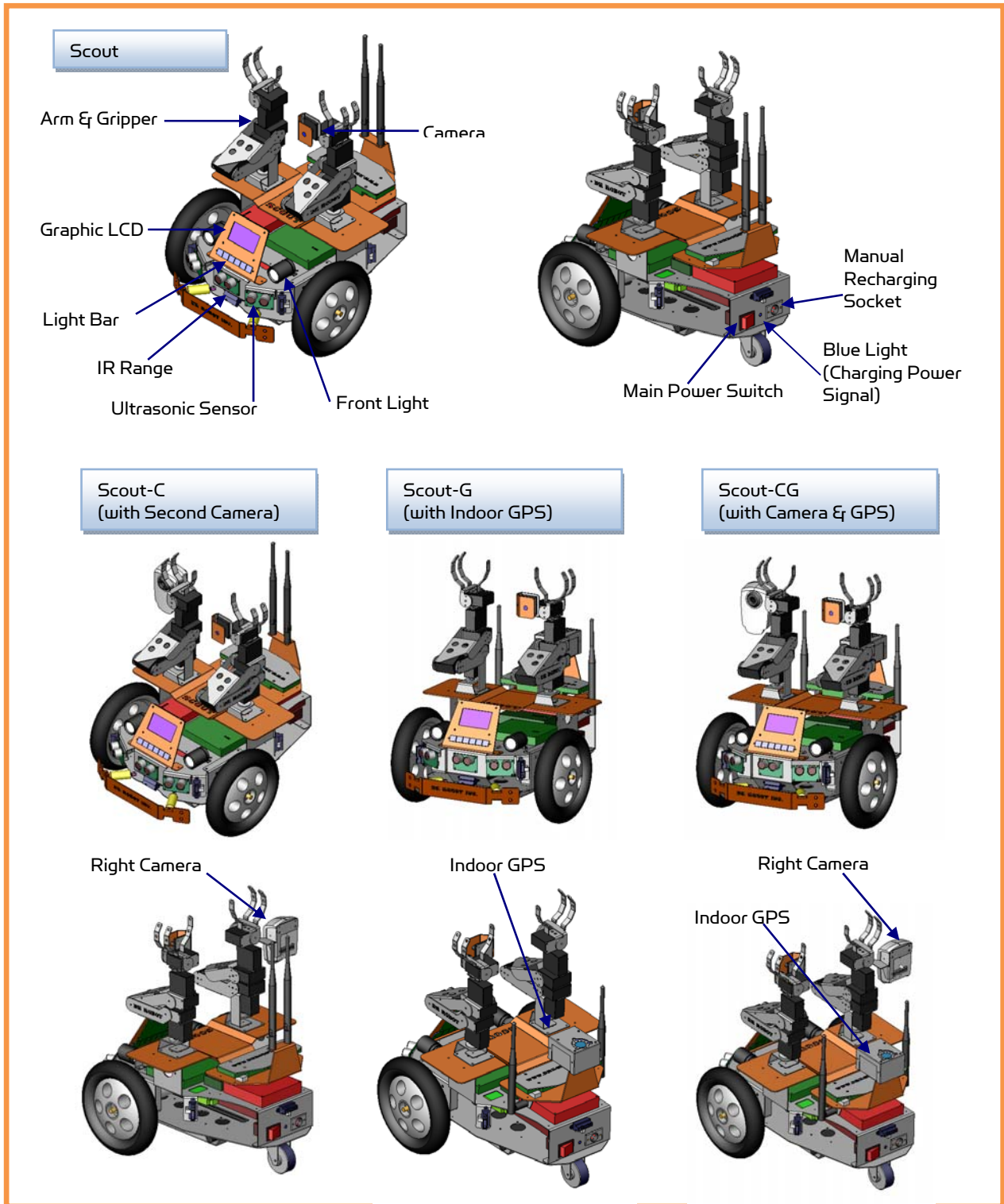
Scout is a rugged wheeled WiFi robot equipped with two gripping arms that optionally provide the robot with either one or two wrist-mounted CMOS cameras. Combining mobility and a new ability to grasp and manipulate, SCOUT offers users broad versatility in its application.

Key Features

- *2 Arms and grippers (5-DOF Arm x2 + 1-DOF Gripper x2)*
- *550 oz.-inch(40 kg.cm) 12V DC motor with integrated 800 count per cycle optical encoder*
- *Fully wireless networked 802.11g*
- *Full color video and two-way audio capability. (CMOS color image module and audio module are fully integrated.)*
- *OS independent application development tools*
- *Max speed of 0.75 m/sec*
- *128x64 graphic LCD, Display image , message or sensor data*
- *Collision detection sensors include 3 Ultrasonic range sensors and 6 IR range sensors*
- *Comprehensive circuit protection*
- *Max payload 15 kg (optional 40 kg) with robot weight of 4 kg*
- *Dimension: 40cm (L) x 32cm (W) x 46cm (H)*
- *Extended operating time. 3 hours nominal operation time for each recharging.*
- *Joystick Control included*
- *Upgrade options:*
 - *Vision-landmark base indoor localization (indoor GPS, position/orientation) sensor and the landmarks together provide precise position and direction information covering every inch of the floor.*
 - *Auto-docking and recharging station*
 - *Second camera at right arm*
 - *Laser scanner*
 - *Power and battery systems for 6 hours operation time are available*

Sensors and External Components

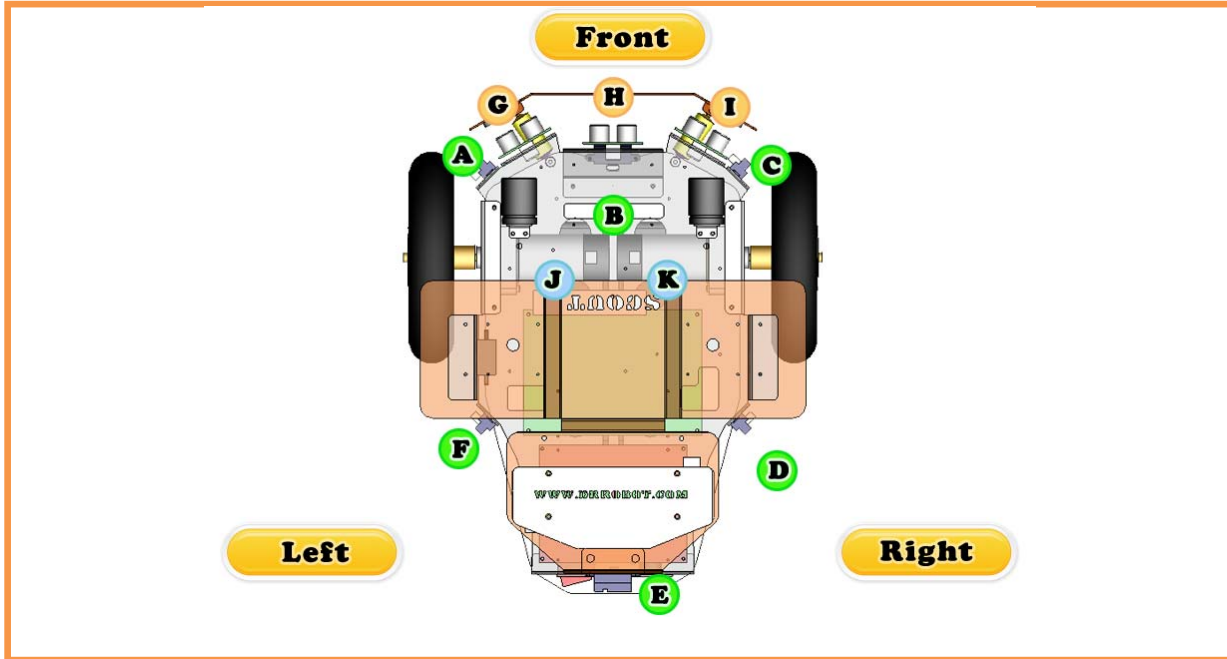
The figure below illustrates the key functional components you will identify on the outside of Scout robot.



Scout Overview

When the robot detects input power from the recharging socket, the charging power signal Blue Light will be lit.

The robot comes with 3 ultrasonic range sensors and 6 IR range sensors. These range sensors are for environment detection and collision avoidance.



Scout Sensor Module Location (Top View)

Sensor Module	Location
Ultrasonic #1	G - Left front
Ultrasonic #2	H - Middle front
Ultrasonic #3	I - Right front
Infrared Range Sensor #1	A - Front left
Infrared Range Sensor #2	B - Front middle
Infrared Range Sensor #3	C - Front right
Infrared Range Sensor #4	D -Rear right
Infrared Range Sensor #5	E - Rear middle
Infrared Range Sensor #6	F - Rear left
Quadrature Encoder #1	J - Left , use channel 1
Quadrature Encoder #2	K - Right, use channel 2

Operation Scenario

Diagram below shows the typical operation scenario. The Scout is a wireless networked robot. It connects to the wireless AP or router via IEEE 802.11b/g network. The host PC (or called server PC) running the Scout Control program could connect to this network via either:

Network cable – Connect the host PC to one of the LAN ports on the back of the router (DO NOT connect to the WAN port), or

Wireless – To connect the Local PC to the wireless router, configure the Local PC's wireless settings using the default wireless configuration settings found in the Network Connection session of this manual.



Typical Operation Scenario

Note: The Local PC could also be mounted on the robot instead off the robot if your application requires so.

User could be able to control the robot, see, talk and listen through the robot via the Dr Robot[®] Control program.

Software Installation

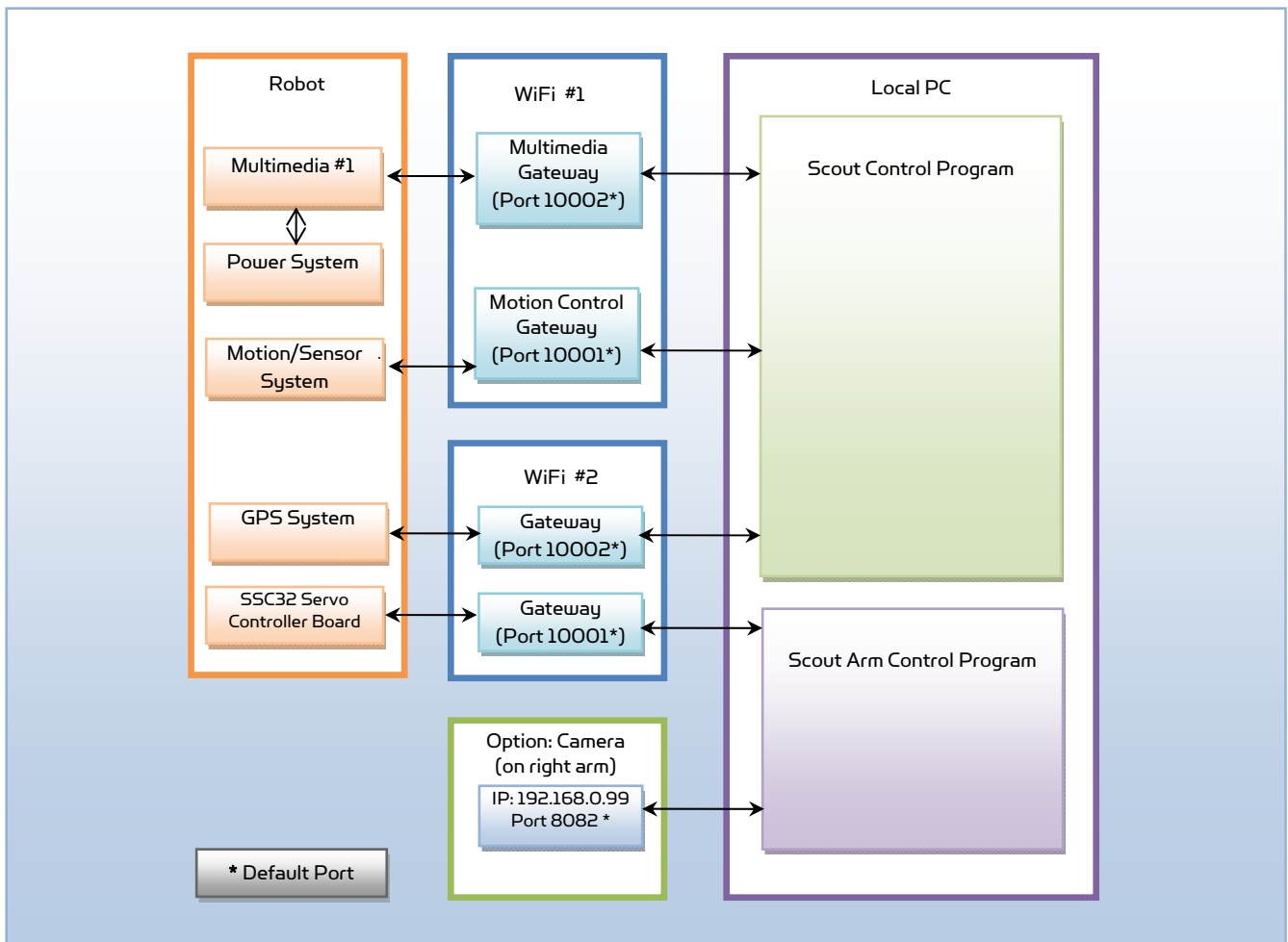
You should install the "ScoutControl" program from the installation CD.

After program installation, you will find the following programs under the "Start-All Programs" list, and they are installed under the "Program Files" folder.

- Dr Robot Inc - Scout Control
- ScoutArm Control
- Dr Robot Inc - WiRobotGateway.exe

"ArmControlSourceCode" folder contains a copy of Scout Arm control sample code for Visual Studio 2008. It is located under default installation folder (such as "C:\Program Files\Dr Robot Inc\Dr Robot Scout Control\ArmControlSourceCode")

A set of Demo program located in "ScoutDemo" folder in installation CD, "PowerManagement" and "ScoutMotion" sample code for Visual Studio 2008.



Robot Operations

Robot Control Program

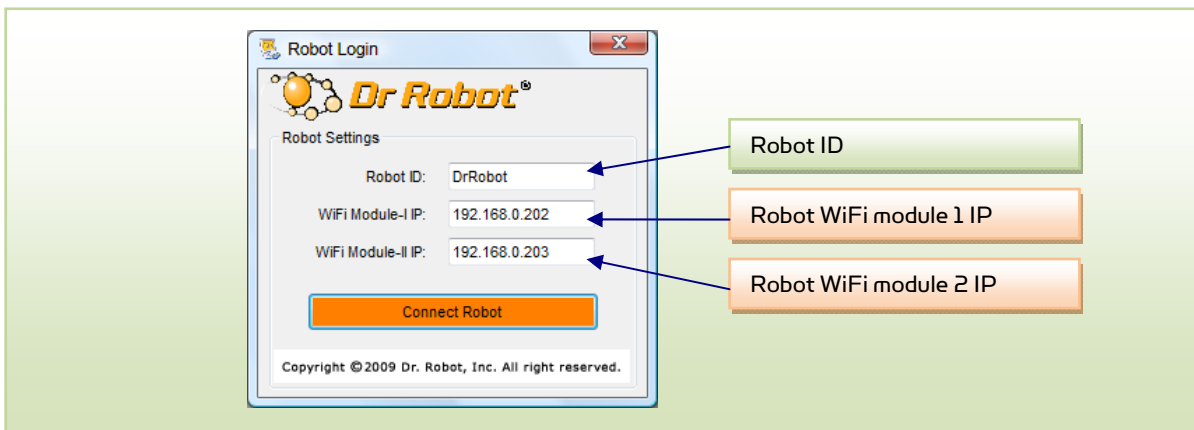


Step 1: If you have not installed the demo and support programs, insert the installation CD to CDROM and run the "Setup.exe" program that is under "Scout Control Installation" folder.

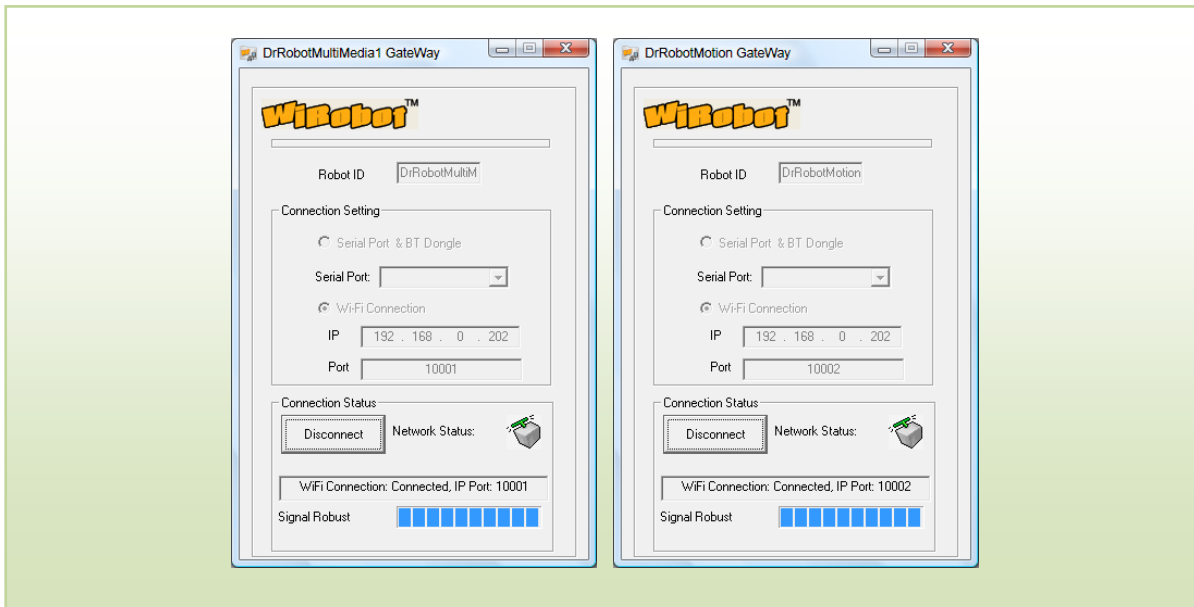
Step 2: Connect the PC to the wireless router (one of the LAN ports) (the router has IP 192.168.0.200) included in the package.

Step 3: Push red power switch on the front to turn on the robot.

Step 4: Run the "DrRobotScoutControl.exe" from Start -> All Programs -> Dr Robot Inc -> Scout Control, and then click "Connect Robot".



Two gateway programs will be called up to establish communication connections with the electronic system on the robot.



The screenshot shows the Dr Robot Scout Control software interface. A blue callout box at the top points to the 'Light Control' section, which includes 'LightBox' (Red, Green, Blue, Orange, Flash), 'Signal Light' (LeftSignal, RightSignal, Flash), and 'Front Light' (LightOn). An orange callout box on the left points to the 'Hand Camera' section, which includes a camera display, 'SnapShot', 'Start Listen', 'Talk to Robot', and 'Play' buttons. Another orange callout box points to the 'LCD Display' section, which has a 'File Name' field and 'Image' and 'Voltage Display' buttons. A green callout box at the bottom left points to the 'Motor Sensor' section, which displays 'Power :12.84V' and 'Dr Robot Inc.' on a simulated LCD screen. A green callout box at the bottom right points to the 'Sensor data' section, which includes 'Ultrasonic Sensor', 'IR Sensor', and 'Motor Sensor' data. The interface also features 'Power Status', 'Power Path Control', 'Charge Path Control', 'Power Switch Control', 'Motion Control', and 'Joystick' sections.

LightBox, Signal Light and Front Light control

Camera display and multimedia control

Select 128x64 monochrome bitmap file to display on LCD

Voltage display on LCD

Sensor data



Showing status of all power sources: Battery I, II and external DC input

From where the system will take power from: Battery I, II or external DC input

To control which battery or both to be charged and the max charging time

Power information

Power on/off the sub-systems (detail in Appendix I)

Motor PWM control

Motor speed control

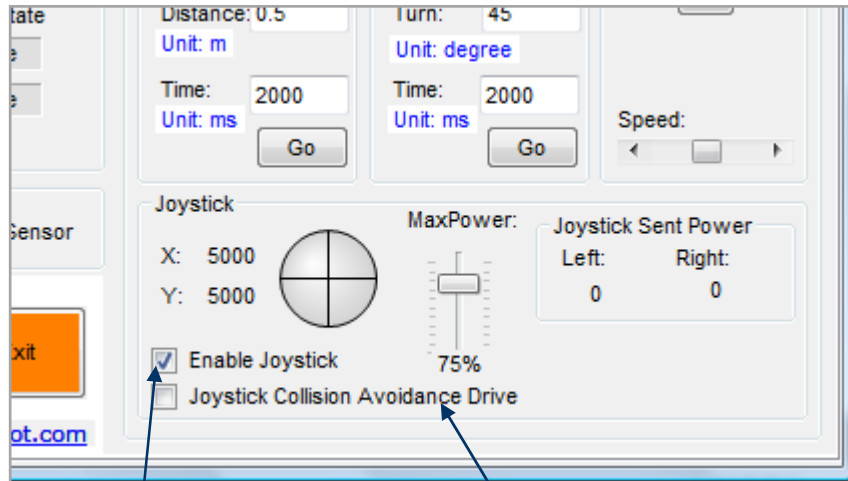
Simple motion control: drive forward, backward, left, right and stop

To turn within set time

Drive forward (set distance) within set time

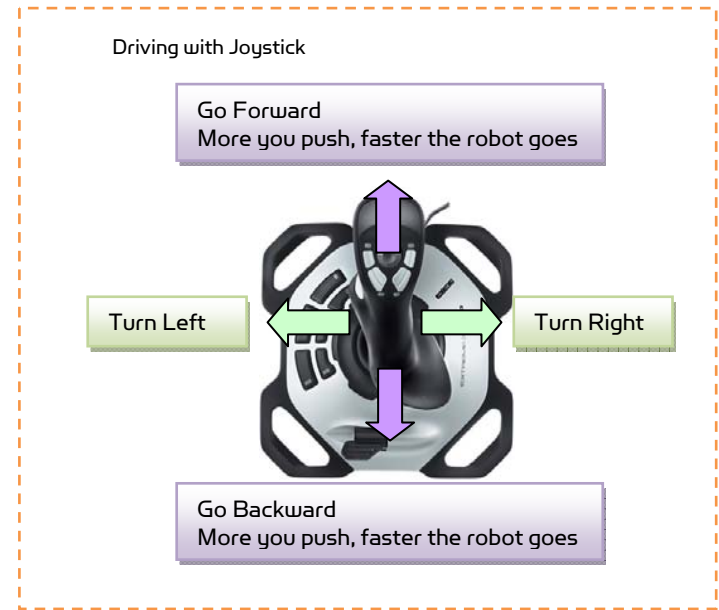
Max power output when joystick is fully pushed

When checked, autonomous collision avoidance feature will be activated during the joystick control



To Enable Joystick Control

Robot base collision avoidance feature is enabled by default. During joystick operation, you could temporarily disable this feature by holding the side button (#2) on the joystick handle (as shown above)



Side Button (#2)
Suspend collision
avoidance feature



Via points displayed here. Via points can be manually modified here.

This will bring up a tool called "Path Editor" allowing you to edit a path

The screenshot shows the 'Dr Robot Scout Control' application window. At the top, there are tabs for 'Main Sensor Info & Control', 'Path Control', and 'Localization/GPS & SensorMap & Remote Control'. Below the tabs, there are fields for 'P2P PointNum', 'P2P Status' (set to 'P2POver'), 'P2P Control', 'Left Wheel Cmd', 'Right Wheel Cmd', and 'P2P Cmd Time'. A table displays path data with columns: TargetX, TargetY, TargetDir, StopTime, ForwardS, Forgetable, NonStop, FinalPostu, TargetTime, TargetTol, MaxTurnS, CAEnable, ReverseDir, TargetDirT, and SeqNo. The table contains three rows of data. Below the table are buttons for 'Open PathFile', 'Go', 'Stop', and 'Edit/Add'. There are also fields for 'P2P Task Type' (set to 'P2P Task'), 'Wandering Speed', 'Reset Position', and 'Mouse Point To Move'. On the right, there are zoom controls and 'Map X0' (465) and 'Map Y0' (222) coordinates. The bottom half of the window is a map with a green grid, showing a robot (yellow circle) and several via points (blue circles with numbers 1, 2, 3).

TargetX	TargetY	TargetDir	StopTime	ForwardS	Forgetable	NonStop	FinalPostu	TargetTime	TargetTol	MaxTurnS	CAEnable	ReverseDir	TargetDirT	SeqNo
-0.35	0.03	-2.52	0	0.3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	0.1	90	<input type="checkbox"/>	<input type="checkbox"/>	5	1
1.16	-1.16	5.11	0	0.3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	0.1	90	<input type="checkbox"/>	<input type="checkbox"/>	5	2
1.16	1.11	0	0	0.3	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	0.1	90	<input checked="" type="checkbox"/>	<input type="checkbox"/>	5	3

Manual path test tool:
 1. Open the path file, via points on the path will be displayed on the display above; via points can be manually modified.
 2. Select the type of task that robot to accomplish with the selected path:
 a. **P2P task** – robot will run from the first via point on the path to the last one and stop
 b. **Wander task** – robot actually don't use the path, and runs on its own.

Zooming in/out of the map

Once checked, a via point will be generated and shown in the via point display above when the mouse clicks on the map below. Robot will drive to this point when the GO button is clicked

Map displaying robot location and via points

The Path Editor opened from the "Path Control" allows you to edit a path file such as the charging and patrol path

The screenshot shows the Path Editor window with several callout boxes:

- Top Callout:** "All path files are listed her, when double clicking on the file, the via points will be loaded onto the via point list for editing." (Points to the Path Motion table)
- Left Callout 1:** "You could create a new path file or save the edited path file from here." (Points to the Record File Name field and buttons)
- Left Callout 2:** "This path via point list allows you to modify the motion specification of each via point." (Points to the main data table)
- Bottom Callout:** "You could position the robot to the location you like the robot to go. The robot location will be displayed here. You could add this location into the path by using the "Add Point" (Points to the robot position fields and buttons)
- Bottom Callout:** "This path via point display windows shows the via point location. You could drag the point to the location you want the robot to go." (Points to the map area)

Path Motion Table:

FileName	PointNum
Charge.xml	4
patrol.xml	2

Main Data Table:

TargetX	TargetY	TargetDir	Stop Time	ForwardSp	Forgetable	NonStop	FinalPostur	TargetTime	TargetTole	MaxTurnSr	CAEnable	ReverseDr	TargetDirT	SeqNo
-0.41	0.18	0	2	0.5	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	200	0.2	75	<input checked="" type="checkbox"/>	<input type="checkbox"/>	5	1
-0.78	0.17	0	2	0.3	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	200	0.2	90	<input type="checkbox"/>	<input checked="" type="checkbox"/>	5	2
-1	0.175	0	2	0.3	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	200	0.2	90	<input type="checkbox"/>	<input checked="" type="checkbox"/>	5	3
-1.3	0.175	0	2	0.2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	200	0.2	45	<input type="checkbox"/>	<input checked="" type="checkbox"/>	5	4

Robot Position Fields: Robot Position X: -3.98, Robot Position Y: -3.93, Robot Orientation: -0.6

Map Area: Shows a grid with four numbered points (1, 2, 3, 4) representing the path via points.

Dr Robot Scout Control

Main Sensor Info & Control Path Control Localization/GPS & SensorMap & Remote Control

Localization/GPS

IP Address:

Port Number: WiFi Connection

Mark ID:

Position Data: Position X: m

Position Y: m

Position Dir: degree

GPS Sensor Info:

SensorMap

Range (sonar and IR) sensor object distance measurement

* Reserved for Sputnik with indoor GPS sensor upgrade option

Arm Control Program

Run the "scout_arm.exe" from Start -> All Programs -> Dr Robot Inc -> ScoutArm Control

The screenshot shows the Scout Arm Control software interface. At the top left, a callout box says "Type in the IP and Port number, click 'Connect'", pointing to the "Robot Arm Controller Communication" section where "Arm IP: 192.168.0.203" and "Port Num: 10001" are entered. At the top right, a callout box says "Select demo 'Motion' script; click 'Go' to run.", pointing to the "Script Motion" section where "Left Arm Script Motion File" and "Right Arm Script Motion File" are both set to "C:\DrRobotAppFile\ArmMoto...", with "Go" buttons highlighted. The main interface is divided into "Left Arm Control" and "Right Arm Control" sections, each with six sliders and "Disable" buttons. A callout box labeled "Arm control section" points to the sliders in the right arm control area. At the bottom right, a "Camera On Right Arm (* Option)" section has fields for "Camera IP: 192.168.0.99", "Camera Port: 8082", "Username: root", and "Password: *****". A callout box labeled "Right arm camera (* option)" points to the "Username" field. The bottom left of the window features the Dr Robot logo and the slogan "Extend your imagination™".

Recharging

To keep the battery at ideal condition, we recommend recharging the robot at least once every two weeks during storage (e.g. robot is not in use).

Plug the charging plug from the portable charger onto the secondary recharging socket on the back of the robot, **and then turn on the robot**. The charging process will normally take about 2 hours if the battery power is totally exhausted. The charging process will automatically stop when completed.

Further Development & Programming

The Scout Control program is written with C# program with Visual Studio 2008 express under .Net 3.5 framework. You could download the development tools (Visual Studio 2008 express under .Net 3.5 framework) free from Microsoft. Please refer to the "Dr Robot Application Development Notes on C# Programming for Robot Control" for further information.

The control program uses the supporting components and libraries that should have been installed when you install the control program from the installation CD:

DRROBOTSentinelCONTROL.OCX: Please refer to "WiRobot SDK API Reference Manual.pdf" for detail.

WiRobotGateway.exe

DrRobotSensorMapBuilder.dll: This dll file provides functions to build the environmental map for collision avoidance feature.

DrRobotP2PSpeedDrive.dll: This dll file provides functions to drive a robot from one specific point to another.

DrRobotGPS.dll Scout use the vision-landmark based indoor GPS localization system (* option). This dll file provides the functions to locate the robot position with vision based GPS system.

For support on development using Microsoft Robotics Studio, operation system other than MS Windows, or raw communication protocol, please contact support@DrRobot.com.

Network Connection and Login Information

Network Settings

The included pre-configured wireless 802.11 b/g router has the following pre-set settings:

SSID	dri	Router LAN	192.168.0.200
WEP	128bits	Login ID	admin
KEY	112233445566778899AABBCCDD	Password	drrobot
Key Type	Open Key		

WiFi module 1 connects to two serial devices through channel I and II (TCP/IP port 10001 and 10002 respectively). They are pre-configured as below:

Name	Robot WiFi Module 1	IP	192.168.0.202
Channel-I (10001)	115200, 8,N,1, flow control, UDP, Datagram 01, remote IP:0.0.0.0	Channel-II (10002)	115200, 8,N,1, flow control, UDP, Datagram 01, remote IP:0.0.0.0

WiFi module 2 connects to serial devices through channel II (TCP/IP port 10002). It is pre-configured as below:

Name	Robot WiFi Module 2 (* Option)	IP	192.168.0.203
Channel-I (10001)	115200, 8,N,1, no flow control, TCP, Datagram 01, remote IP:0.0.0.0	Channel-II (10002)	115200, 8,N,1, no flow control, TCP, Datagram 01, remote IP:0.0.0.0

Advanced Network Settings

It's possible to use different network settings (e.g. IP) for the server PC, but the "Virtual Server" settings on the router must also be changed accordingly in order for the Internet remote monitoring feature to work properly.

You could also change the router settings such as IP and SSID etc. If you need to do so, you are required to change the network settings on the WiFi modules on the robot by following the guidelines as illustrated on the WiFi Module manual.

Appendix I Power Switching Control

Three power sub-systems as defined below could be turned On / Off or reset individually through the "DrRobotScoutControl.exe" program.

Channel-I			
Channel-II	DC-DC board	WiFi Module Power (3.3V)	Reset only
		PMB5010 Main Power (5V)	Reset only
		PMS5005 Main Power (5V)	Reset only
		SSC-32 Board (5V)	Reset only
		GPS Sensor (5V) (*Option)	Reset only
Channel-III	DC-DC board	Servo Power (6V)	On / Off

Appendix II LightBox, Signal Light and Front Light control reference

LightBox & Signal Light

Using Extended Output IO port, 8 bit

"1" – on, "0" -off

Tri-Color LED and Turning Signal Lights are controlled by extended IO port.

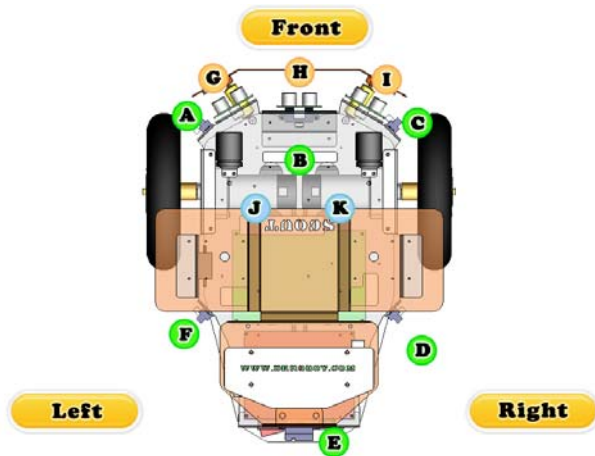
Extended IO output	Light
Bit0	Not used
Bit1	Not used
Bit2	Red Led '1' – On, '0' Off
Bit3	Left Turn Led '1' – On, '0' Off
Bit4	Blue Led '1' – On, '0' Off
Bit5	Right Turn Led '1' – On, '0' Off
Bit 6	Green Led '1' – On, '0' Off
Bit7	Not used

Front Light

Using PWM channel 3

Use "motionControl.DcMotorPwmNonTimeCtr" to control it. The value should be bigger than 22000.

Appendix III IR Sensor control reference



Using AD Extended Port

A--- AD extended port 3

B--- AD extended port 4

C--- AD extended port 5

D--- AD extended port 6

E--- AD extended port 7

F--- AD extended port 8

Appendix IV SSC-32 Board connection

Right Arm using channel 0 – channel 5

Left Arm using channel 16 – channel 21



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