Dr Robot ®

WiFi Mobile Robot Development Platform
with Multi-DOF Gripping Arms

Scout Pro

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, accidence could happen; you have to make sure that the robot always maintains a safe distance from people during operation.

The robot should be turn off (i.e. the power switch should be on OFF position) when not in used. 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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Table of Contents

Introduction

Scout Pro is a rugged wheeled WiFi robot equipped with two gripping arms that optionally provide the robot with either one or two wrist-mounted cameras. Combining mobility and a new ability to grasp and manipulate, Scout Pro 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. (640x480, 30fps)*

- *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 left 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 Pro robot.
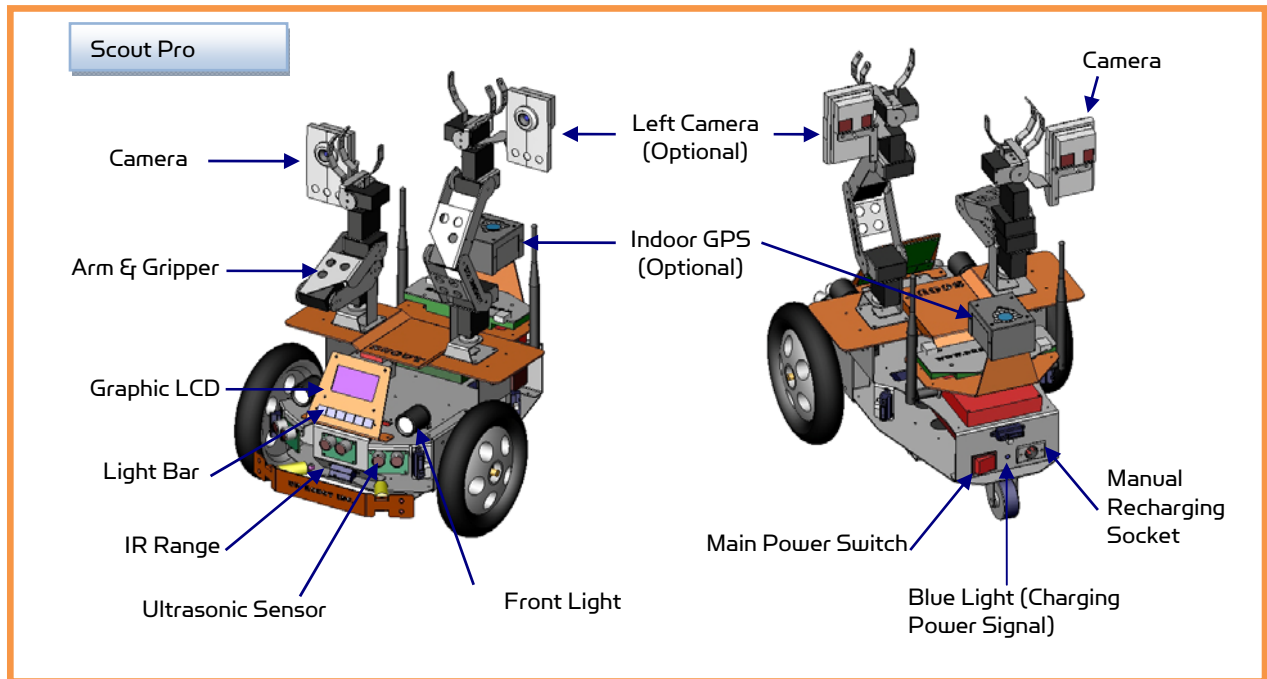
Scout Pro Overview

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.
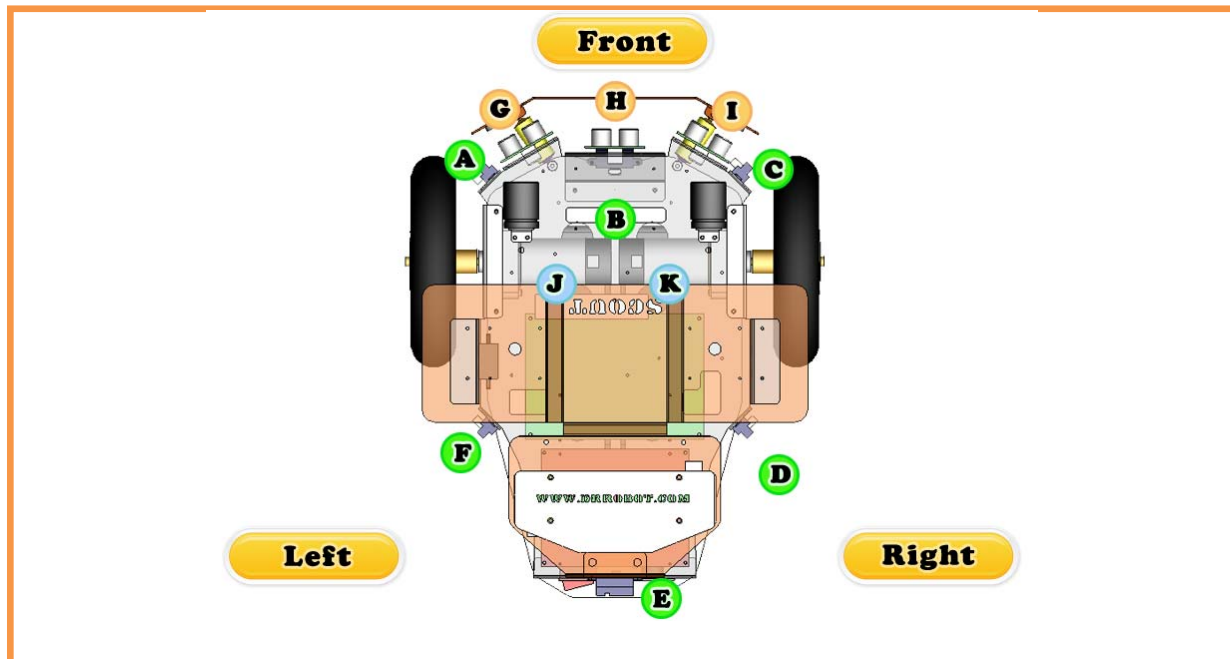
Scout Pro Sensor Module Location (Top View)

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 Pro 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 locate under default installation folder (such as "C:\Program Files\Dr Robot Inc\Dr Robot Scout Control\ArmControlSourceCode")

A set of Demo program locates in "ScoutDemo" folder in installation CD, "PowerManagement" and "ScoutMotion" sample code for Visual Studio 2008.
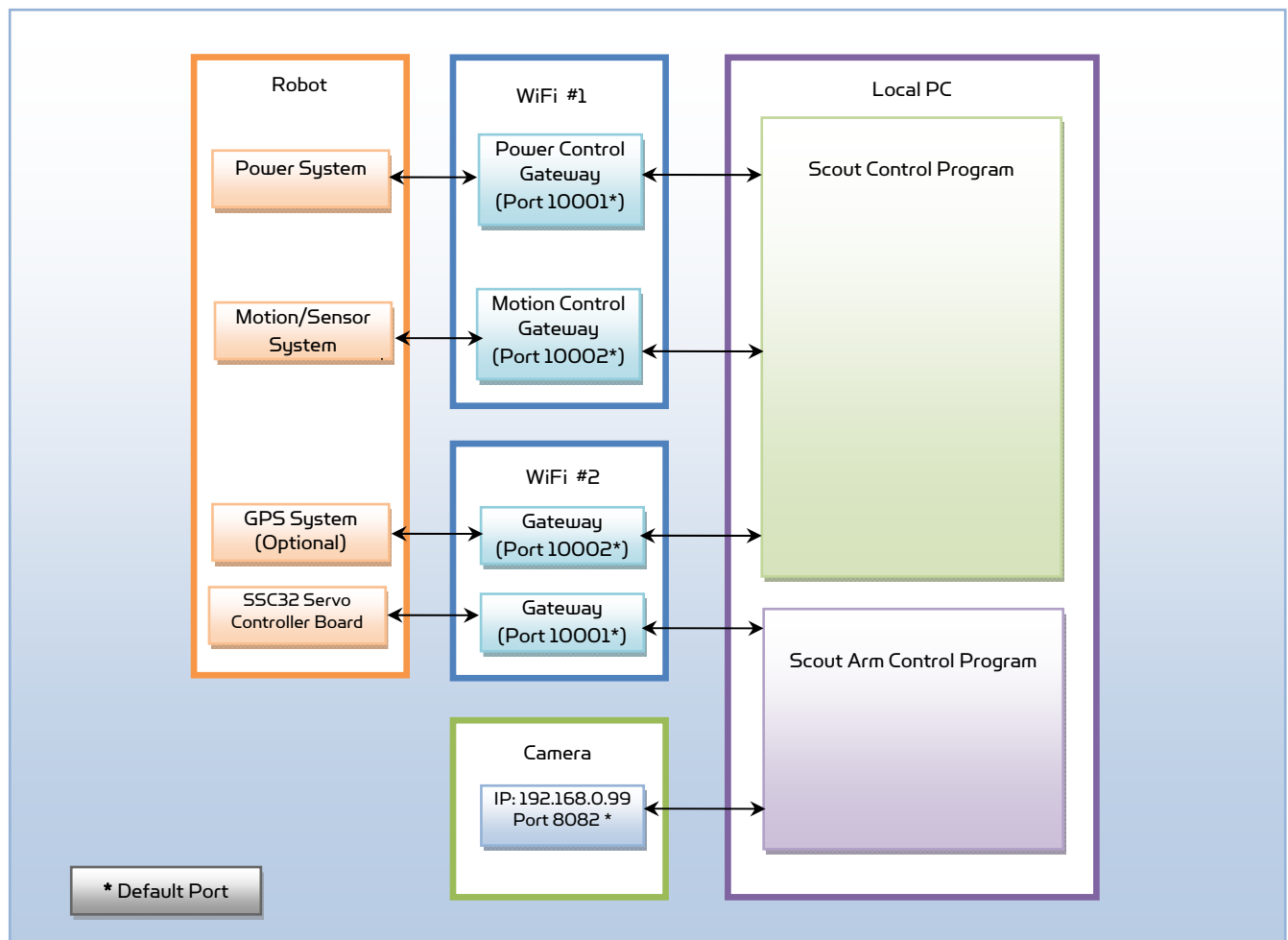
Robot Operations
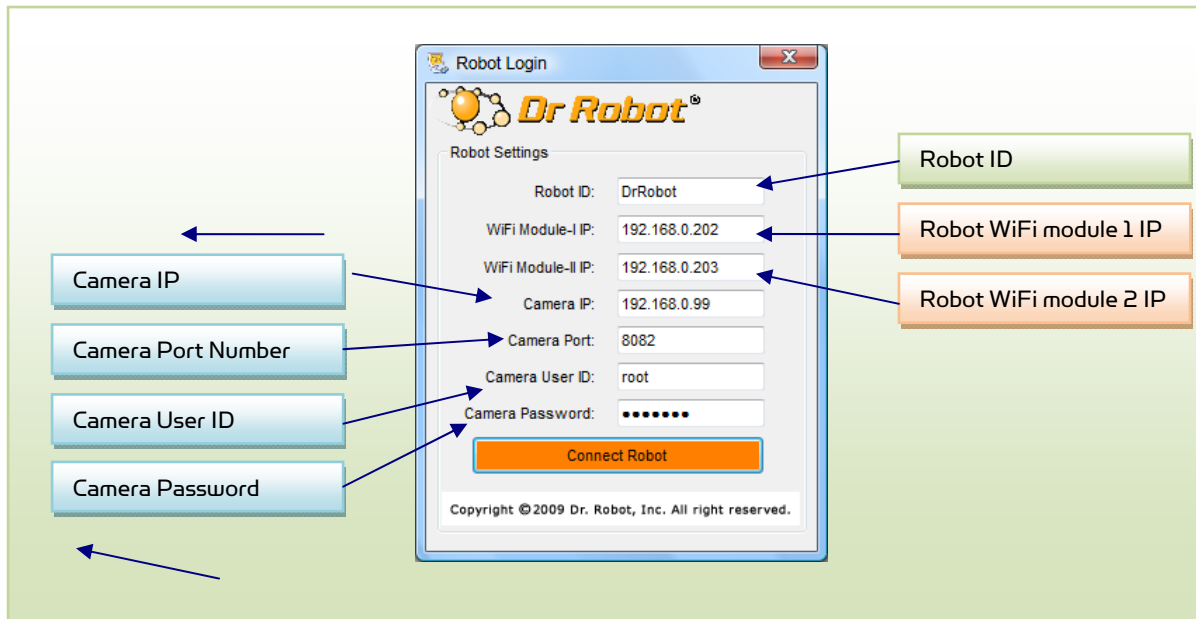
Robot Control Program

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.

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

Dr Robot Scout Control

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

Hand Camera

Speakers | Microphone

Light Control

LightBox
- Red
- Green
- Blue
- Orange
- Flash

Front Light

Signal Light
- LeftSignal
- RightSignal
- Flash

LightOn

Power Status

	Voltage	Temperature	Status
Battery-I:	13.35	2149	Using
Battery-II:	13.46	2160	Using
DCIN:	0.00V		Using

Power Path Control
- ☐ PowerByBattery-I   ☐ PowerByBattery-II   ☐ PowerByDCIN

Charge Path Control
- ☐ Charge Battery-I   ☐ Charge Battery-II

Charge Timer: [_____]   Stop

Power
- Board Power: 4.84V   Motor Power: 12.93V

Power Switch Control

Channel-I	Channel-II	Channel-III
⦿ ON ○ OFF	⦿ ON ○ OFF	⦿ ON ○ OFF

LCD Display

File Name: [_____]   Image   Voltage Display   View Camera

Human Sensor (On)

	Motion	Alarm
Left:	3031	3018
Right:	3038	3027

Ultrasonic Sensor

#1 0.64m   #2 2.55m   #3 2.1m

IR Sensor

#1 0.81m   #2 0.60m   #3 0.81m
#4 0.81m   #5 0.81m   #6 0.44m

Extended IO
- Input: 255
- Output: 0   Set

Motor Sensor

	Encoder Position	Encoder Speed	Current Feedback	HeatProtect	StuckState
Left Motor	0	0	0.01A	False	False
Right Motor	0	0	0.01A	False	False

☑ Enable Motor Protection

Position Information

Dead Reckoning: (0.00, 0.00, 0.00)   GPS: 0   ☐ Enable GPS Sensor

Motion Control

Set Drive Power
- Left: 26384
- Right: 6384
- 0-32767
- 16384 Stop   Go

Set Drive Speed
- Left: 200
- Right: -200
- Go

Chassis Control

Set Drive Distance
- Distance: 0.5   Unit: m
- Time: 2000   Unit: ms   Go

Set Rotation
- Turn: 45   Unit: degree
- Time: 2000   Unit: ms   Go

Speed:

Joystick
- X: 0
- Y: 0

MaxPower:
75%

Joystick Sent Power
- Left: 0   Right: 0

☐ Enable Joystick
☐ Joystick Collision Avoidance Drive

Exit

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Dr Robot Scout Control

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

Hand Camera

Speakers | Microphone

LightBox (Light Control)

Red
Green
Blue
Orange
Flash

Front Light

Signal Light

LeftSignal
RightSignal
Flash
LightOn

Power Status

	Voltage	Temperature	Status
Battery-I:	13.35	2149	Using
Battery-II:	13.46	2160	Using
DCIN:	0.00V		Using

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

Power Path Control

☐ PowerByBattery-I ☐ PowerByBattery-II ☐ PowerByDCIN

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

Charge Path Control

☐ Charge Battery-I ☐ Charge Battery-II

Charge Timer: [_____] Stop

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

Power

Board Power: 4.84V   Motor Power: 12.93V

Power information

Power Switch Control

Channel-I	Channel-II	Channel-III
◉ ON ○ OFF	◉ ON ○ OFF	◉ ON ○ OFF

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

LCD Display

File Name: [_____] Image Voltage Display View Camera

Ultrasonic Sensor

#1 0.64m   #2 2.55m   #3 2.1m

IR Sensor

#1 0.81m   #2 0.60m   #3 0.81m
#4 0.81m   #5 0.81m   #6 0.44m

Human Sensor(Opt)

	Motion	Alarm
Left:	3031	3018
Right:	3038	3027

Extended IO

Input: 255
Output: 0   Set

Motor Sensor

	Encoder Position	Encoder Speed	Current Feedback	HeatProtect	StuckState
Left Motor	0	0	0.01A	False	False
Right Motor	0	0	0.01A	False	False

☑ Enable Motor Protection

Position Information

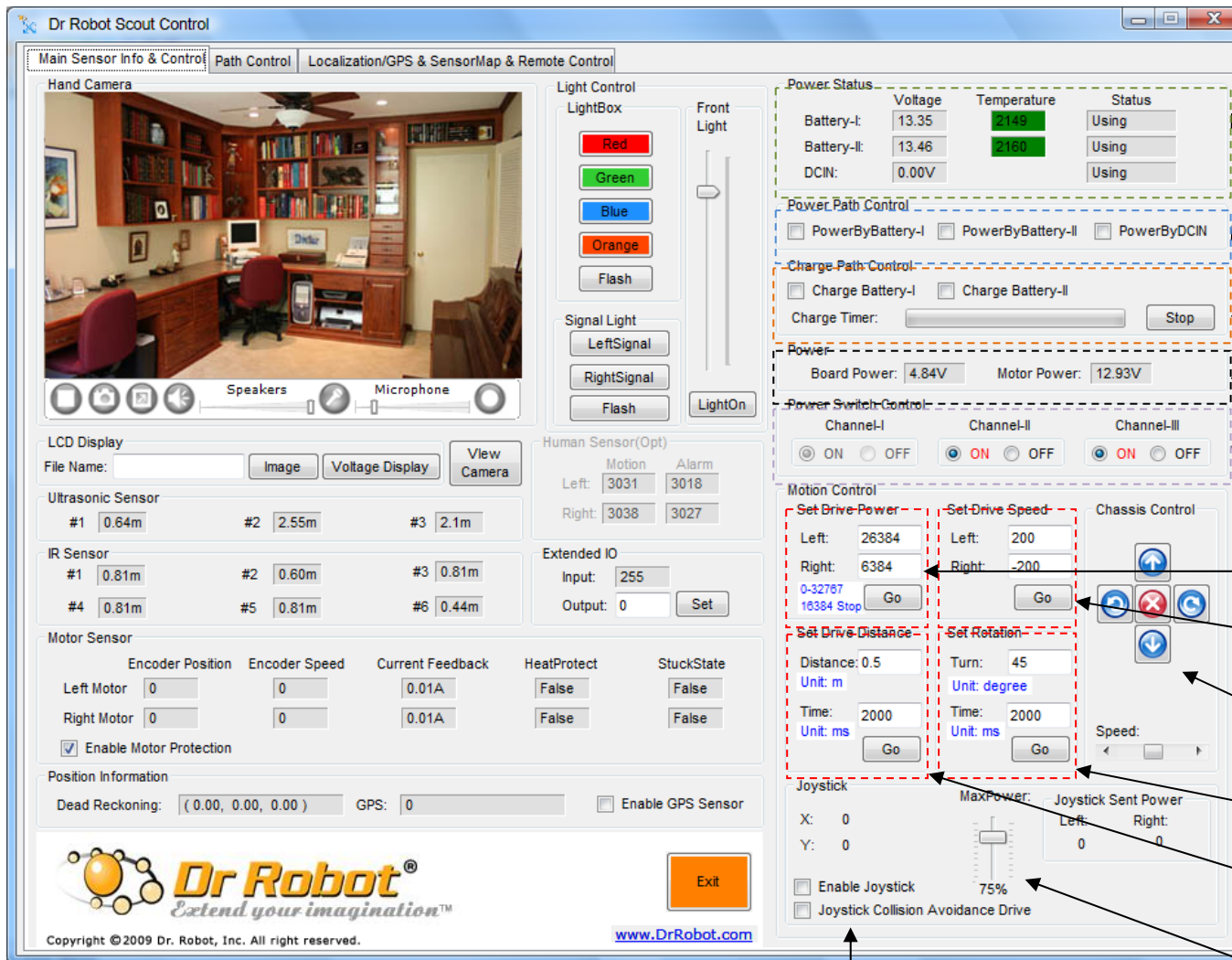Dead Reckoning: (0.00, 0.00, 0.00)   GPS: 0   ☐ Enable GPS Sensor

Motion Control

Set Drive Power
Left: 26384
Right: 6384
0-32767
16384 Stop   Go

Motor PWM control

Set Drive Speed
Left: 200
Right: -200
Go

Motor speed control

Set Drive Distance
Distance: 0.5
Unit: m
Time: 2000
Unit: ms   Go

Set Rotation
Turn: 45
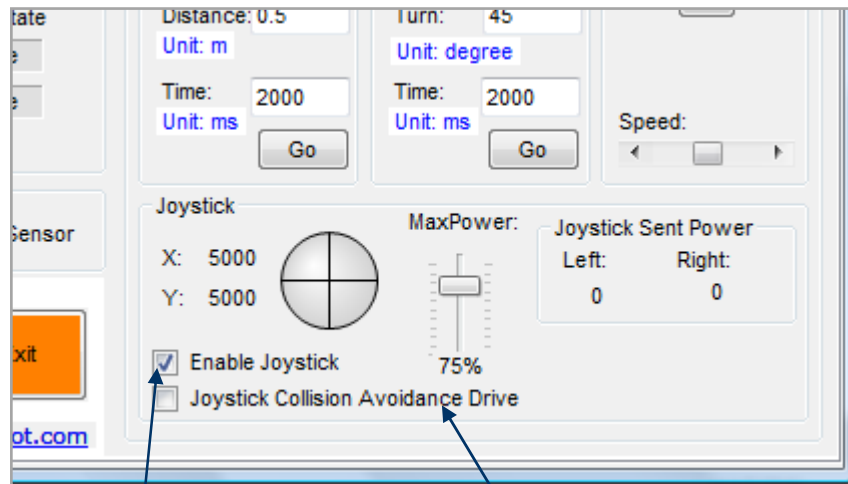Unit: degree
Time: 2000
Unit: ms   Go

Chassis Control

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

To turn within set time

Drive forward (set distance) within set time

Speed:

Joystick

X: 0
Y: 0

MaxPower: 75%   Joystick Sent Power
Left: 0   Right: 0

☐ Enable Joystick
☐ Joystick Collision Avoidance Drive

Max power output when joystick is fully pushed

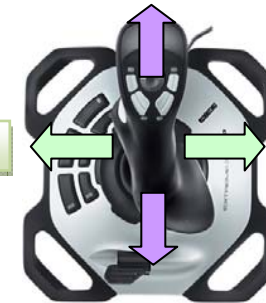**When checked, autonomous collision avoidance feature will be activated during the joystick control**

Exit

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Driving with Joystick

Go Forward
More you push, faster the robot goes

Turn Left

Turn Right

Go Backward
More you push, faster the robot goes

Distance: 0.5
Unit: m

Turn: 45
Unit: degree

Time: 2000
Unit: ms

Time: 2000
Unit: ms

Speed:

Go

Go

Joystick

X: 5000
Y: 5000

MaxPower:

75%

Joystick Sent Power
Left: Right:
0   0

☑ Enable Joystick
☐ Joystick Collision Avoidance Drive

Side Button (#2)
Suspend collision avoidance feature

To Enable Joystick Control

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

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

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.

Map displaying robot location and via points

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

Dr Robot Scout Control

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

P2P PointNum: [ ]   P2P Status: [P2POver]   P2P Control: [ ]   Left Wheel Cmd: [0]   Right Wheel Cmd: [0]   P2P Cmd Time: [0]

	TargetX	TargetY	TargetDir	StopTime	ForwardS	Forgetable	NonStop	FinalPostu	TargetTime	TargetTole	MaxTurnS	CAEnable	ReverseDi	TargetDirT	SeqNo
▶	-0.35	0.03	-2.52	0	0.3	☐	☑	☐	200	0.1	90	☐	☐	5	1
	1.16	-1.16	5.11	0	0.3	☐	☑	☐	200	0.1	90	☐	☐	5	2
	1.16	1.11	0	0	0.3	☑	☑	☐	200	0.1	90	☑	☐	5	3

C:\DrrobotAppFile\PathFile\patrol.xml   [Open PathFile]   [Go]   [Stop]   [Edit/Add]   Zoom: [+] [-]

P2P Task Type: Wandering Speed: [Reset Position]   Map X0: [465]
[P2P Task ▾]   ———○———   ☐ Mouse Point To Move   Map Y0: [222]

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

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.

You could create a new path file or save the edited path file from here.

Path Editor

Record File Name: _____

| New | Edit | Delete | Save |

Path Motion

FileName	PointNum
Charge.xml	4
patrol.xml	2

This path via point list allows you to modify the motion specification of each via point.

	TargetX	TargetY	TargetDir	StopTime	ForwardSp	Forgetable	NonStop	FinalPostur	TargetTime	TargetTole	MaxTurnSp	CAEnable	ReverseDr	TargetDirT	SeqNo
▶	-0.41	0.18	0	2	0.5	☐	☐	☑	200	0.2	75	☑	☐	5	1
	-0.78	0.17	0	2	0.3	☐	☐	☑	200	0.2	90	☐	☑	5	2
	-1	0.175	0	2	0.3	☐	☐	☑	200	0.2	90	☐	☑	5	3
	-1.3	0.175	0	2	0.2	☑	☑	☐	200	0.2	45	☐	☑	5	4

| Robot Position X: -3.98 | Robot Position Y: -3.93 | Robot Orientation: -0.6 | Add Point | Delete Point | Map X0: 471 | Map Y0: 170 | Zoom: + - |

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"

This path via point display windows sows the via point location. You could drag the point to the location you want the robot to go.

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: [0   ]

Position Data: Position X: [0   ] m

Position Y: [0   ] m

Position Dir: [0   ] degree

GPS Sensor Info:

* Reserved for Sputnik with indoor GPS sensor upgrade option

SensorMap

Range (sonar and IR) sensor object distance measurement

Arm Control Program

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

Type in the IP and Port number, click "Connect"

Select demo "Motion" script; click "Go" to run.

Arm control section

Camera

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 form one specific point to another.

DrRobotGPS.dll Scout Pro use the vision-landmark based indoor GPS localization system (***** optional). 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, no flow control, UDP, Datagram 01, remote IP:0.0.0.0	Channel-II (10002)	115200, 8,N,1, no 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	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
		Camera (5V)	Reset only
		PMS5005 Main Power (5V)	Reset only
		SSC-32 Board (5V)	Reset only
		GPS Sensor (5V) (*Optional)	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.
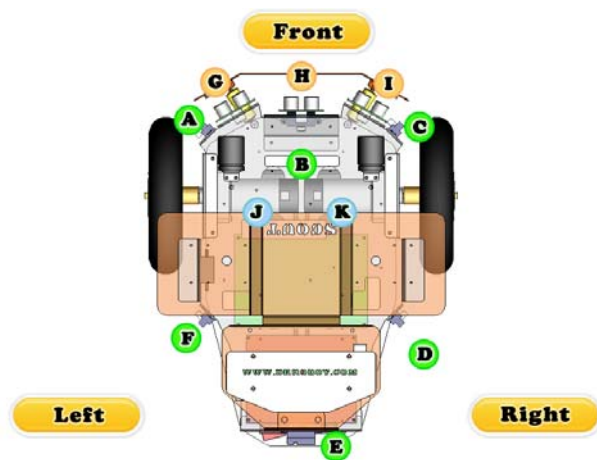
Extended IO output	Light
Bit0	Not used
Bit1	Not used
Bit2	Red Led '1' – On, '0' Off
Bit3	Left Turn Led '1' – On, '0' Off
Bit4	Blue Led '1' – On, '0' Off
Bit5	Right Turn Led '1' – On, '0' Off
Bit 6	Green Led '1' – On, '0' Off
Bit7	Not used

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

Appendix V Camera Control AV Recording and Snapshot Path Setting
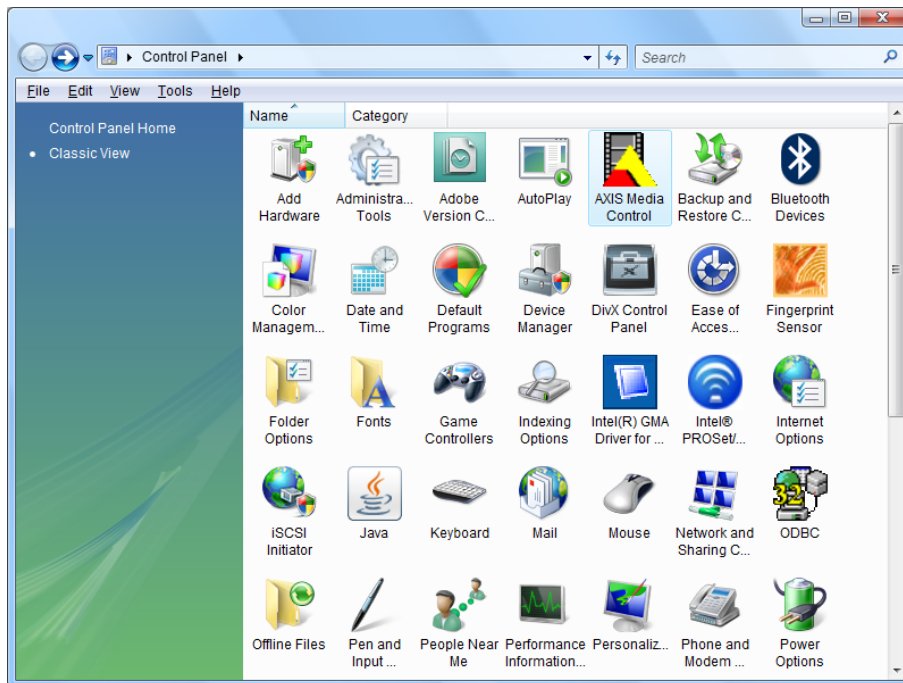
Axis Camera Control AV Recording and Snapshot Path Setting:
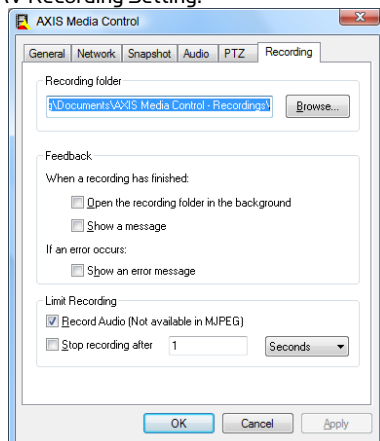
Default: (XXX is user name)

AV Recording Path: C:\Documents and Settings\XXX\My Documents\AXIS Media Control - Recordings\

Snapshot Image Path: C:\Documents and Settings\XXX\My Documents\AXIS Media Control - Snapshots\
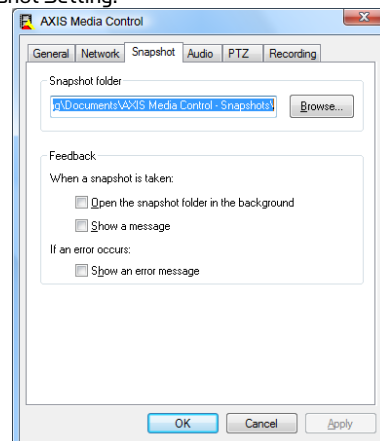
If you want to change the Path, you could set Axis Media Control from Control Panel.

For AV Recording Setting:

For Snapshot Setting:

Support Team Contact Information:

Email: support@drrobot.com
Phone: 1-(905) 943-9572