Wireless (WiFi 802.11g), Dual 5DOF Arm and 1DOF Grippers, Internet Remote Monitoring Robot

Scout^2

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

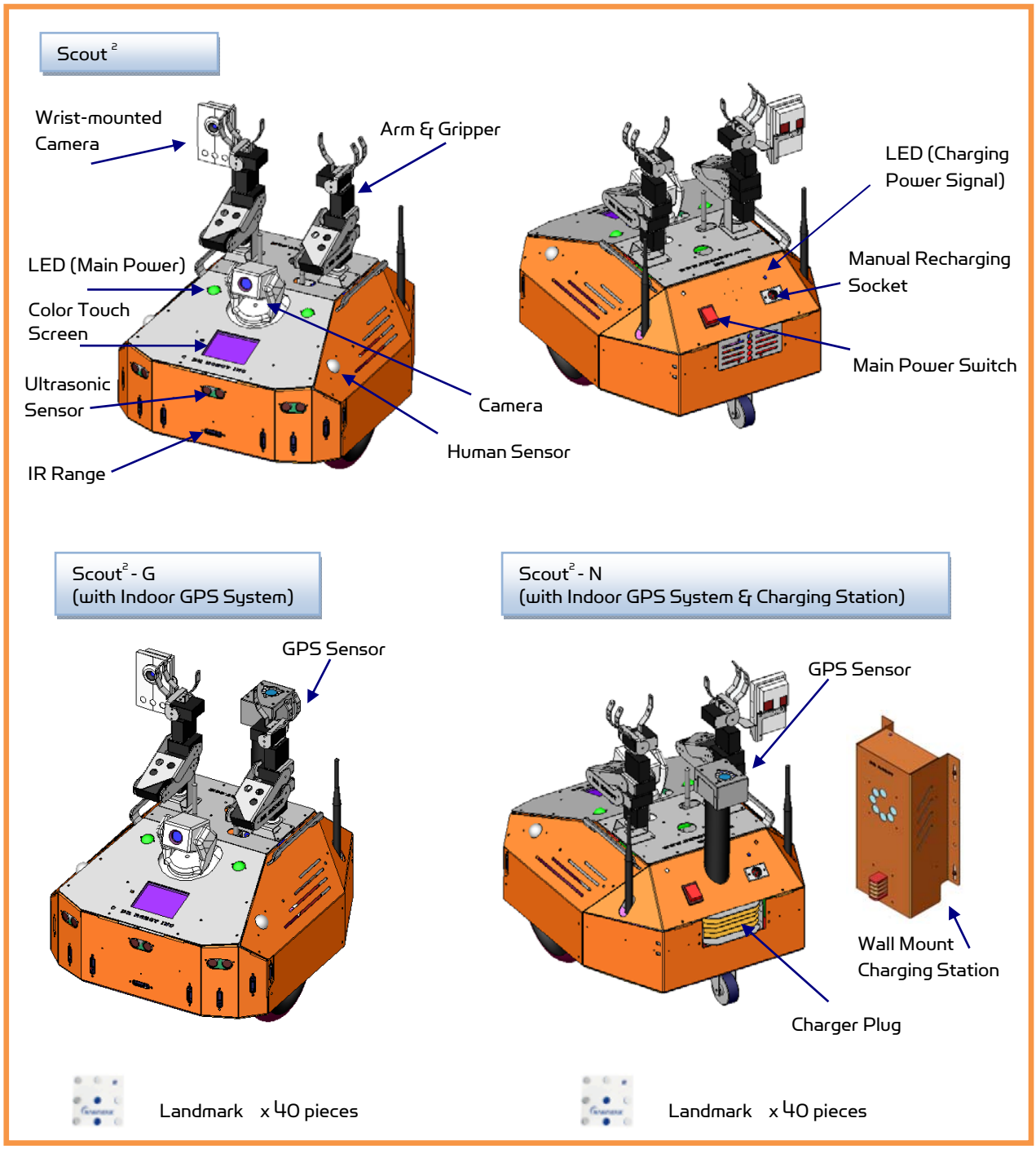
Scout^2 is a ready to use mobile robot platform designed for remote monitoring / patrolling applications requiring object manipulation or other direct physical interaction with the robot's surroundings.

Key Features

- *Max 704x480 pixels, max 30fps, Pan-Tilt-Zoom High Resolution Camera with 2-way audio on chassis*
- *2 Arms and grippers (5-DOF Arm x2 + 1-DOF Gripper x2)*
- *640x480 Wrist-mounted Camera*
- *550 oz.-inch(40 kg.cm) 12V DC motor with integrated optical encoder*
- *Fully wireless networked 802.11g*
- *OS independent application development tools*
- *Max speed of 0.75 m/sec*
- *320x240 Color Programmable Touch LCD, Display image, message or sensor data*
- *Collision detection sensors include 3 Ultrasonic range sensors and 9 IR range sensors*
- *Comprehensive circuit protection*
- *Max payload 15 kg (optional 40 kg) with robot weight of 7 kg*
- *Dimension: 43cm (L) x 38cm (W) x 54cm (H)*
- *Extended operating time. 3 hours nominal operation time for each recharging*
- *Gamepad 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*
    - *Laser scanner*
    - *Power and battery systems for 6 hours operation time are available*

Sensors and External Components

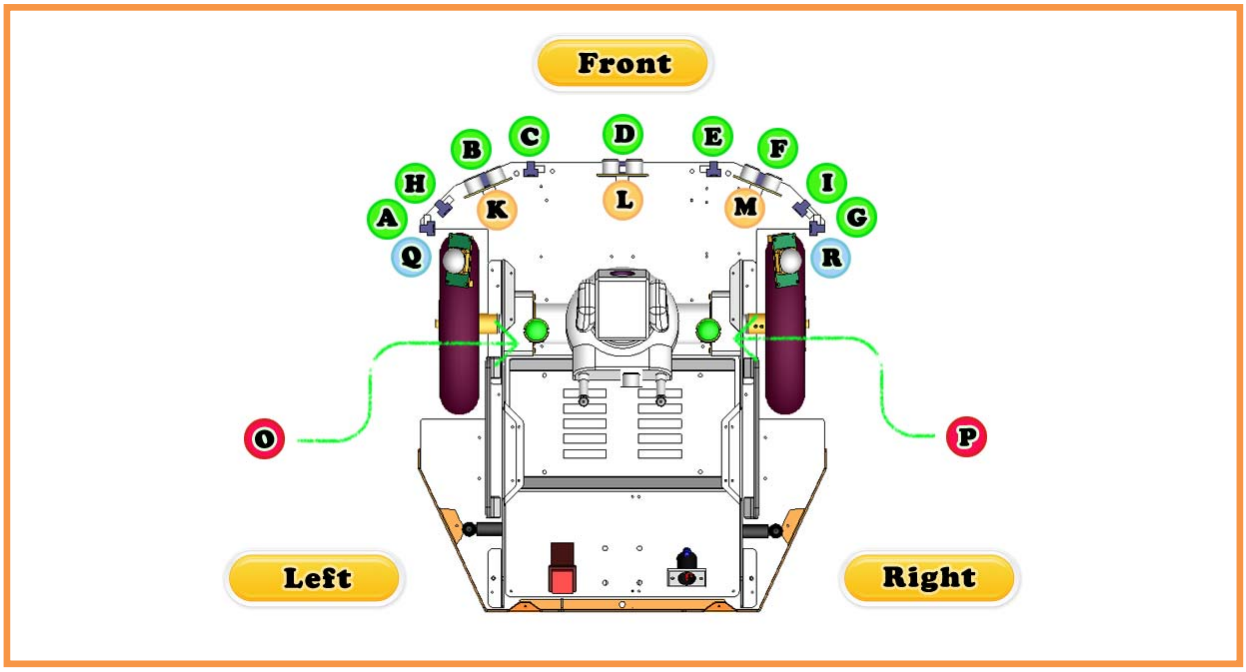
The figure below illustrates the key functional components you will identify on the outside of Scout^2 robot.



Scout^2 Overview

When the main power switch is on, the main power LED will be lit. When the robot detects input power from the recharging socket, the charging power signal LED will be lit.

The robot comes with 3 Ultrasonic and 9 IR range sensors. These range sensors are for environment detection and collision avoidance.



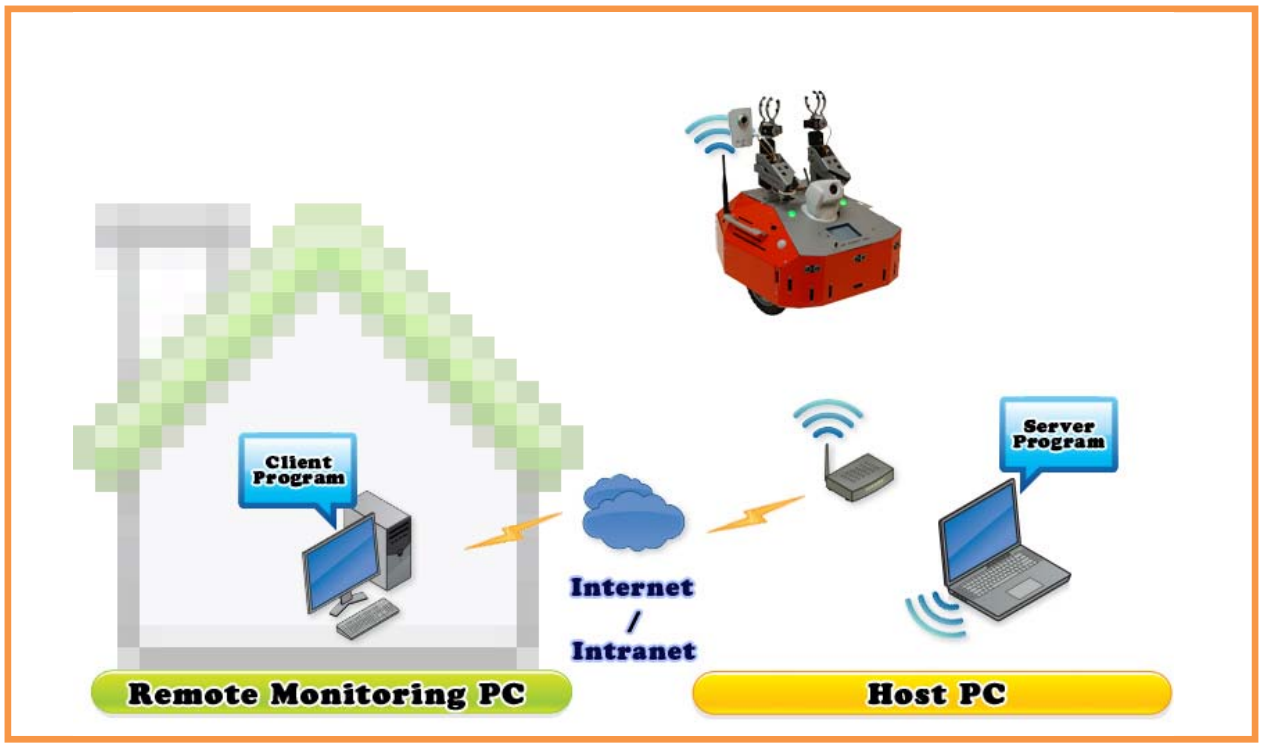
Scout² Sensor Module Location (Top View)

Sensor Module	Location
Ultrasonic #1	K - Left front
Ultrasonic #2	L - Middle front
Ultrasonic #3	M - Right front
Human Sensor #1	Q - Left front
Human Sensor #2	R - Right front
Infrared Range Sensor #1	A – Front left
Infrared Range Sensor #2	B – Front left
Infrared Range Sensor #3	C – Front middle
Infrared Range Sensor #4	D – Front middle
Infrared Range Sensor #5	E – Front middle
Infrared Range Sensor #6	F – Front right
Infrared Range Sensor #7	G – Front right
Infrared Range Sensor #9	H – Front left
Infrared Range Sensor #10	I – Front right
DC Motor #1 with quadrature encoder	O - Left , use channel 1
DC Motor #2 with quadrature encoder	P - Right, use channel 2

Operation Scenario

Diagram below shows the typical operation scenario. The Scout^2 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^2 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 host PC to the wireless router, configure the host PC's wireless settings using the default wireless configuration settings found in the Network Connection session of this manual.



Typical Operation Scenario

Note: The host PC (or called server PC) could also be mounted on 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 Remote Client program from anywhere around the world with Internet connection (refer to "Remote Monitoring and tele-operation" section for detail).

User could also play video, audio and displaying images on the Scout^2 color display.

Software Installation

Server PC

On the Server Computer, you should install the "Scout-II Control" 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-II Control

Application data folder is set to "C:\DrRobotAppFile\"

You will find the following files in this folder:

DrRobotServiceConfig.xml	It contains the IP and port information about the service programs.
RobotConfig.xml	It contains the robot information, such as WiFi modules' IP, Cameras' IP, robot ID, camera user ID and password.
gatewayConfig.xml	Control Center program will save communication settings in this file. Gateway program will use it to setup communication with the robot.
WiRobotGateway.exe	This communication program will setup communication with robot.
RobotHardWareConfig.xml	

Following sub-directories could be found under "C:\DrRobotAppFile\"

.\PathFile\	contains path script files.
.\SensorConfig\	contains the IR Range sensor location information file "IrSensorConfig.xml" and the ultrasonic sensor location information file "UsSensorConfig.xml ".
.\Record\	contains all camera video recording files.

PDA (Color Touch Screen) on the Robot

Programs have been pre-installed on the PDA (color touch screen) on Scout^2.

DrRobotPDASensorClient This program displays Scout^2 sensor information.

Remote Client Program on Client PC

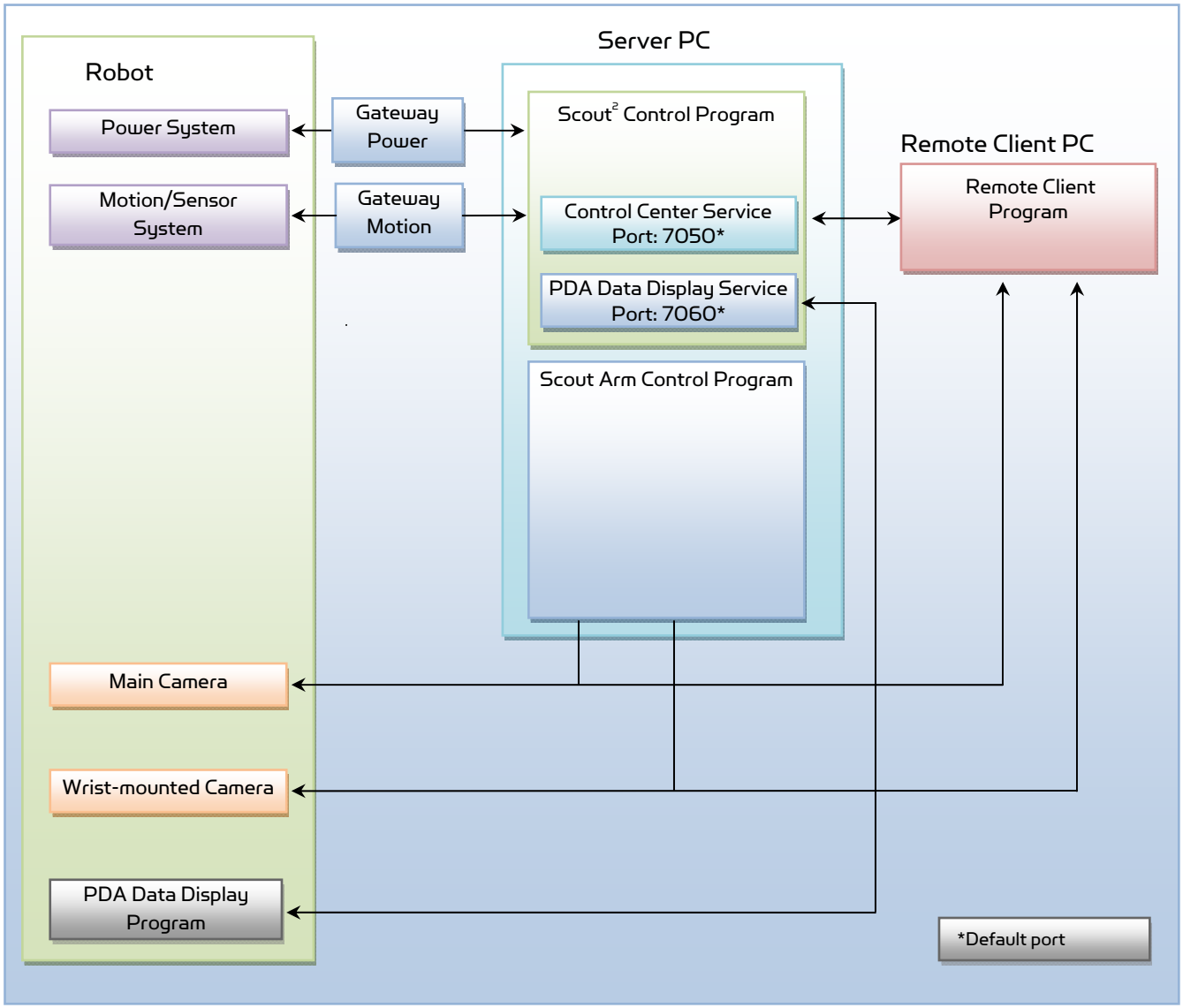
On the client computer, you should install the "Scout-II Remote Client" program from the installation CD.

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-II Client

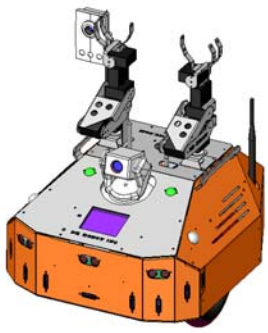
Application data folder is set to "C:\DrRobotAppFile\", following sub-directories could be found under "C:\DrRobotAppFile\"

.\Record\	contains all camera video recording files.
.\Scout-IIClient\	"DrRobotServerConfig.xml" contains the IP and port information about the server programs.



Robot Operations

Scout-II Control Program

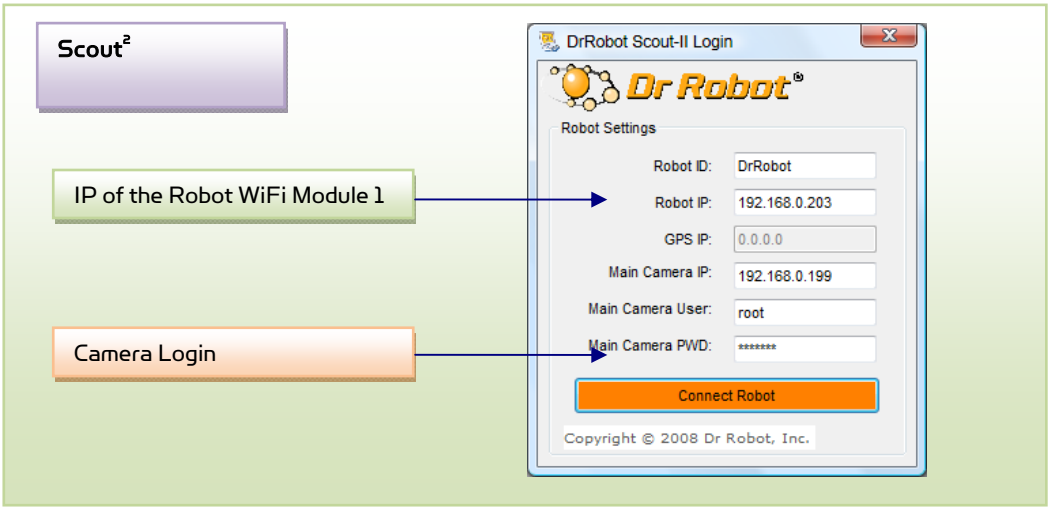


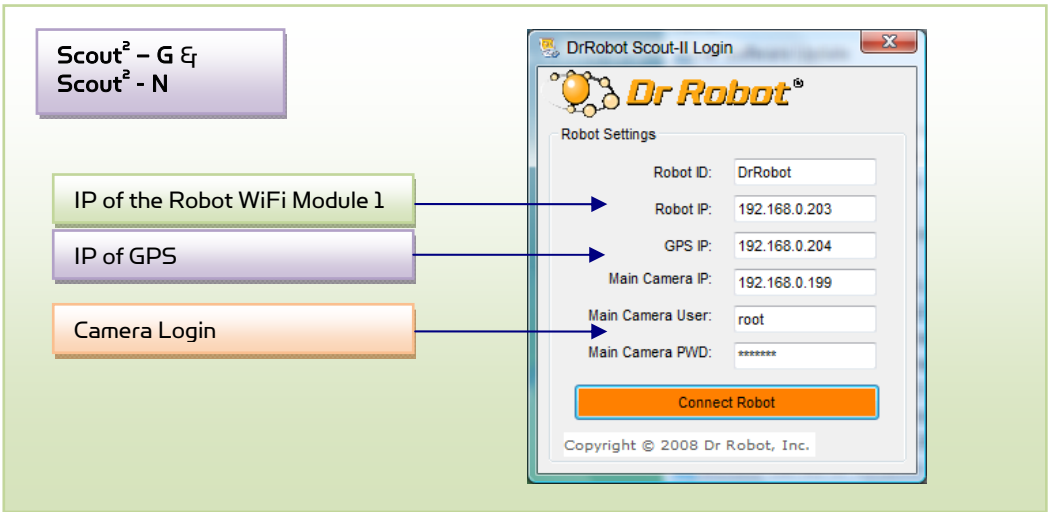
Step 1: If you have not installed the programs, insert the installation CD to CDROM and run the "Setup.exe" program which under "Scout-II Control Installation" folder to a PC (called server PC), set your PC IP to 192.168.0.104, Gateway: 192.168.0.200 and Subnet Mask 255.255.255.0.

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

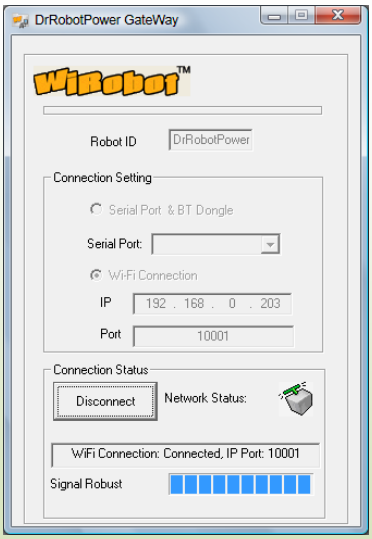
Step 3: Turn on the robot main power switch on the back. NOTE: Always keep a safe distance from the robot.

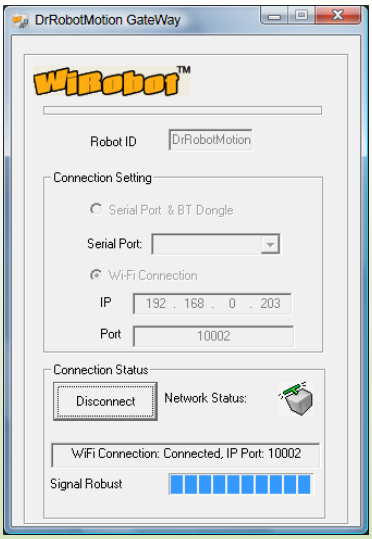
Step 4: Run the "DrRobot Scout-II Control" from Start -> All Programs -> Dr Robot Inc -> Scout-II Control. The "Scout-II Control" connects to robot via the DrRobotMotion gateway & DrRobotPower gateway programs. It requires robot information which can be found in "Networking Connection and Login Information" section in this manual. After entering or confirming the information, then click "Connect Robot".

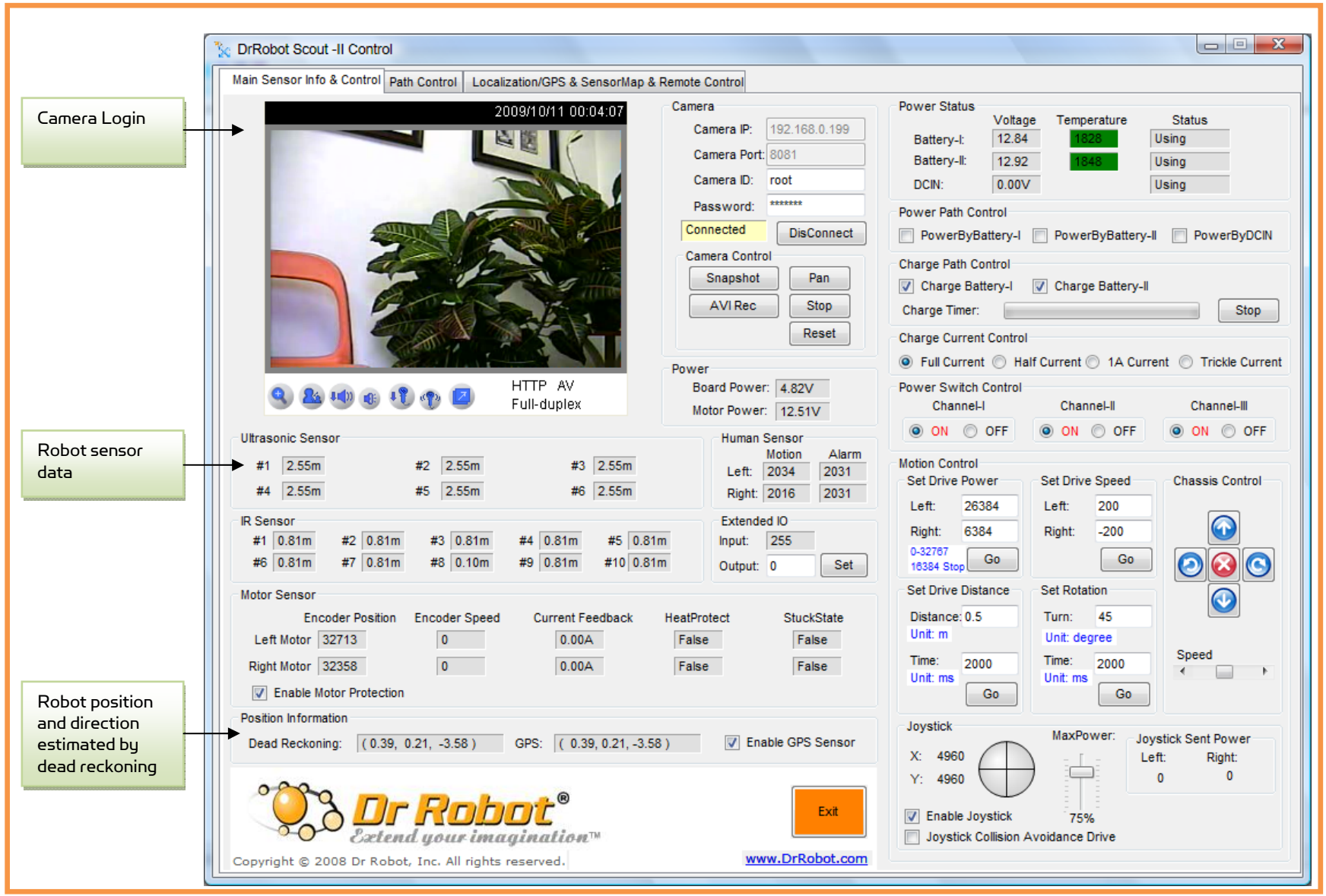




Two gateway programs will be called up to establish communication connections with the electronic system on the robot.






Camera Login
Robot sensor data
Robot position and direction estimated by dead reckoning
DrRobot Scout -II Control
Main Sensor Info & Control
Path Control
Localization/GPS & SensorMap & Remote Control
2009/10/11 00:04:07
HTTP AV
Full-duplex
Camera
Camera IP: 192.168.0.199
Camera Port: 8081
Camera ID: root
Password: *******
Connected
DisConnect
Camera Control
Snapshot
Pan
AVI Rec
Stop
Reset
Power
Board Power: 4.82V
Motor Power: 12.51V
Power Status
Voltage
Temperature
Status
Battery-I: 12.84 1828 Using
Battery-II: 12.92 1848 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
Charge Current Control
Full Current
Half Current
1A Current
Trickle Current
Power Switch Control
Channel-I
Channel-II
Channel-III
ON
OFF
Ultrasonic Sensor
#1 2.55m
#2 2.55m
#3 2.55m
#4 2.55m
#5 2.55m
#6 2.55m
Human Sensor
Motion
Alarm
Left: 2034 2031
Right: 2016 2031
IR Sensor
#1 0.81m
#2 0.81m
#3 0.81m
#4 0.81m
#5 0.81m
#6 0.81m
#7 0.81m
#8 0.10m
#9 0.81m
#10 0.81m
Extended IO
Input: 255
Output: 0
Set
Motion Control
Set Drive Power
Left: 26384
Right: 6384
0-32767
16384 Stop
Go
Set Drive Speed
Left: 200
Right: -200
Go
Chassis Control
Speed
Set Drive Distance
Distance: 0.5
Unit: m
Time: 2000
Unit: ms
Go
Set Rotation
Turn: 45
Unit: degree
Time: 2000
Unit: ms
Go
Motor Sensor
Encoder Position
Encoder Speed
Current Feedback
HeatProtect
StuckState
Left Motor 32713 0 0.00A False False
Right Motor 32358 0 0.00A False False
Enable Motor Protection
Position Information
Dead Reckoning: (0.39, 0.21, -3.58)
GPS: (0.39, 0.21, -3.58)
Enable GPS Sensor
Joystick
X: 4960
Y: 4960
MaxPower:
75%
Joystick Sent Power
Left: Right:
0 0
Enable Joystick
Joystick Collision Avoidance Drive
Exit
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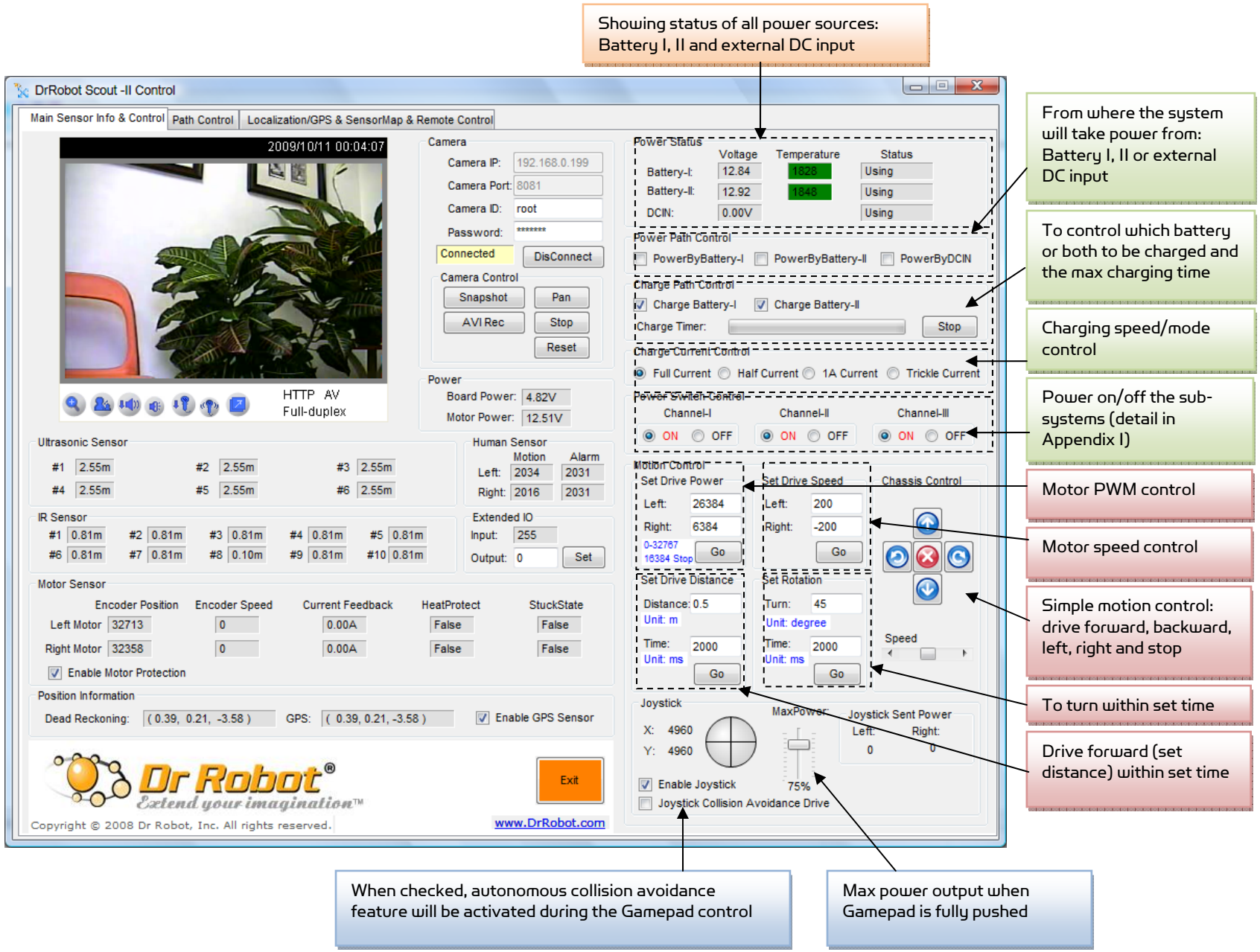
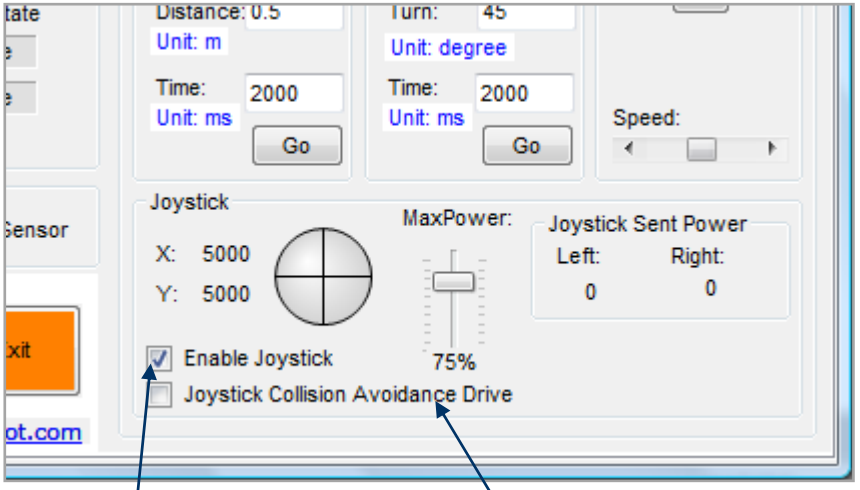
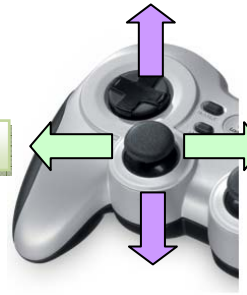




Driving with Gamepad

Go Forward
More you push, faster the robot goes



Turn Left

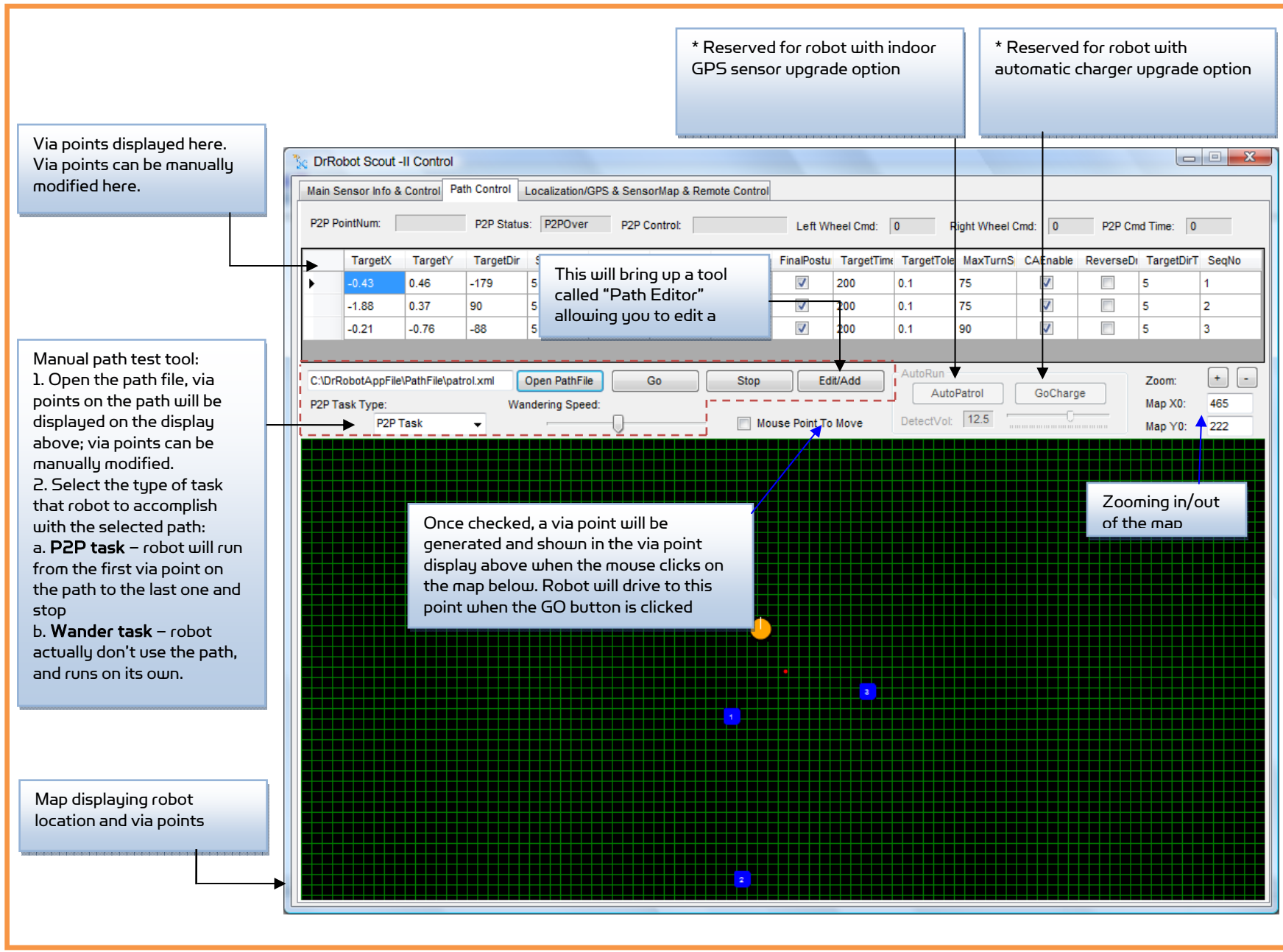
Turn Right

Go Backward
More you push, faster the robot goes

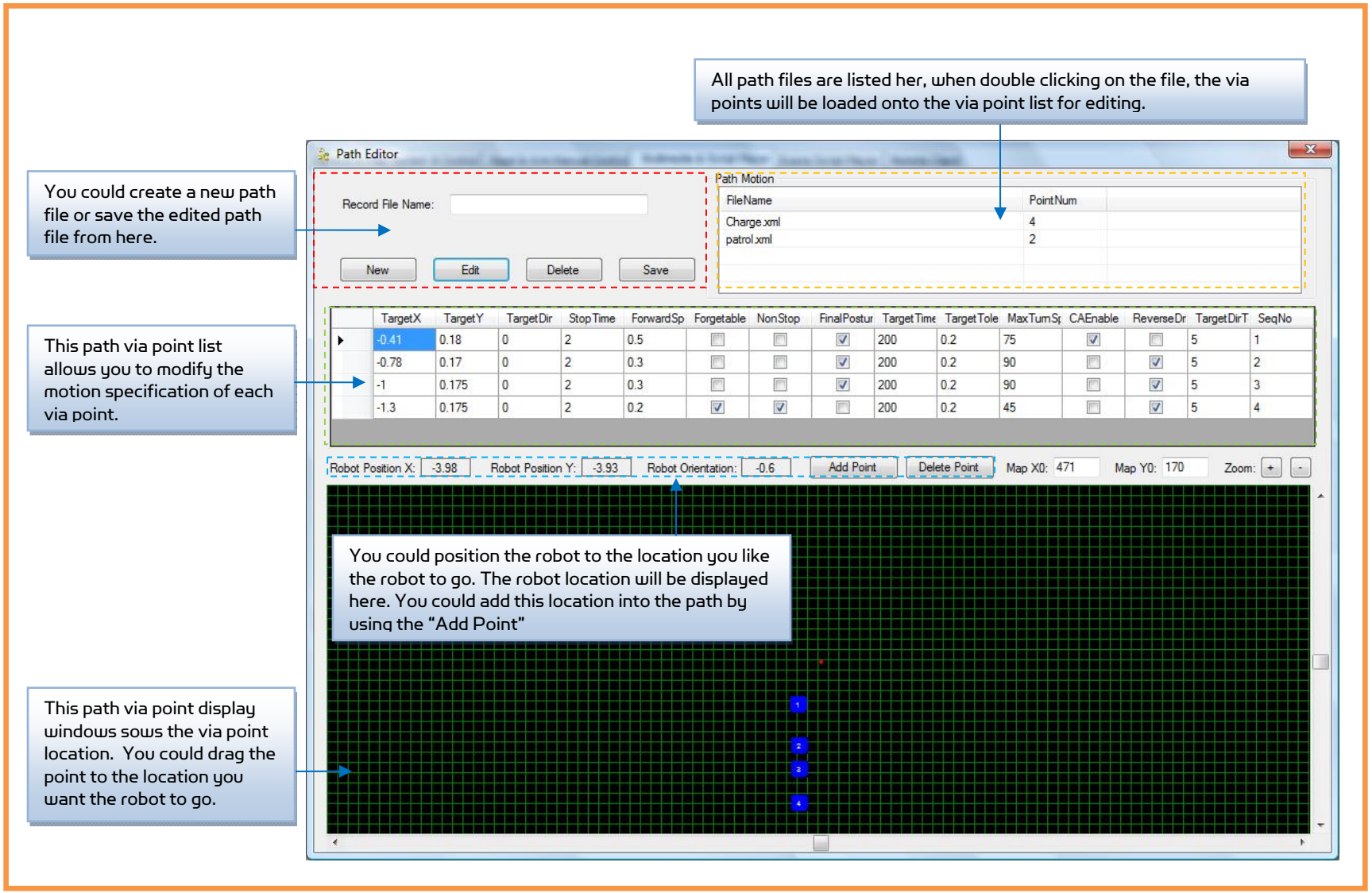
To Enable Gamepad

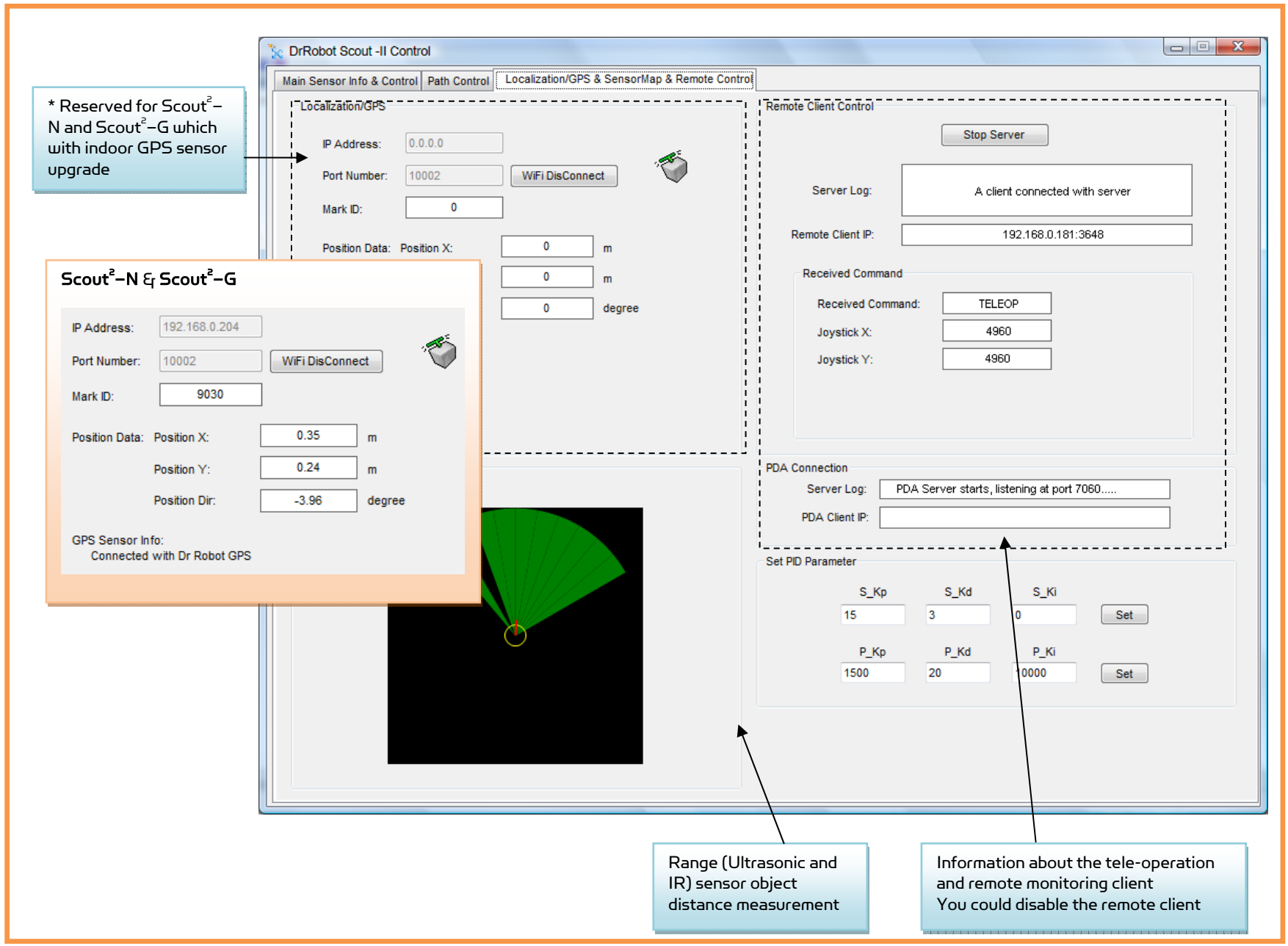
Robot base collision avoidance feature is enabled by default. During Gamepad operation, you could temporally disable this feature by holding the red button (#B) on the Gamepad handle (as shown above)

Red Button (#B)
Suspend collision avoidance feature



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





Remote Monitoring and Tele-operation

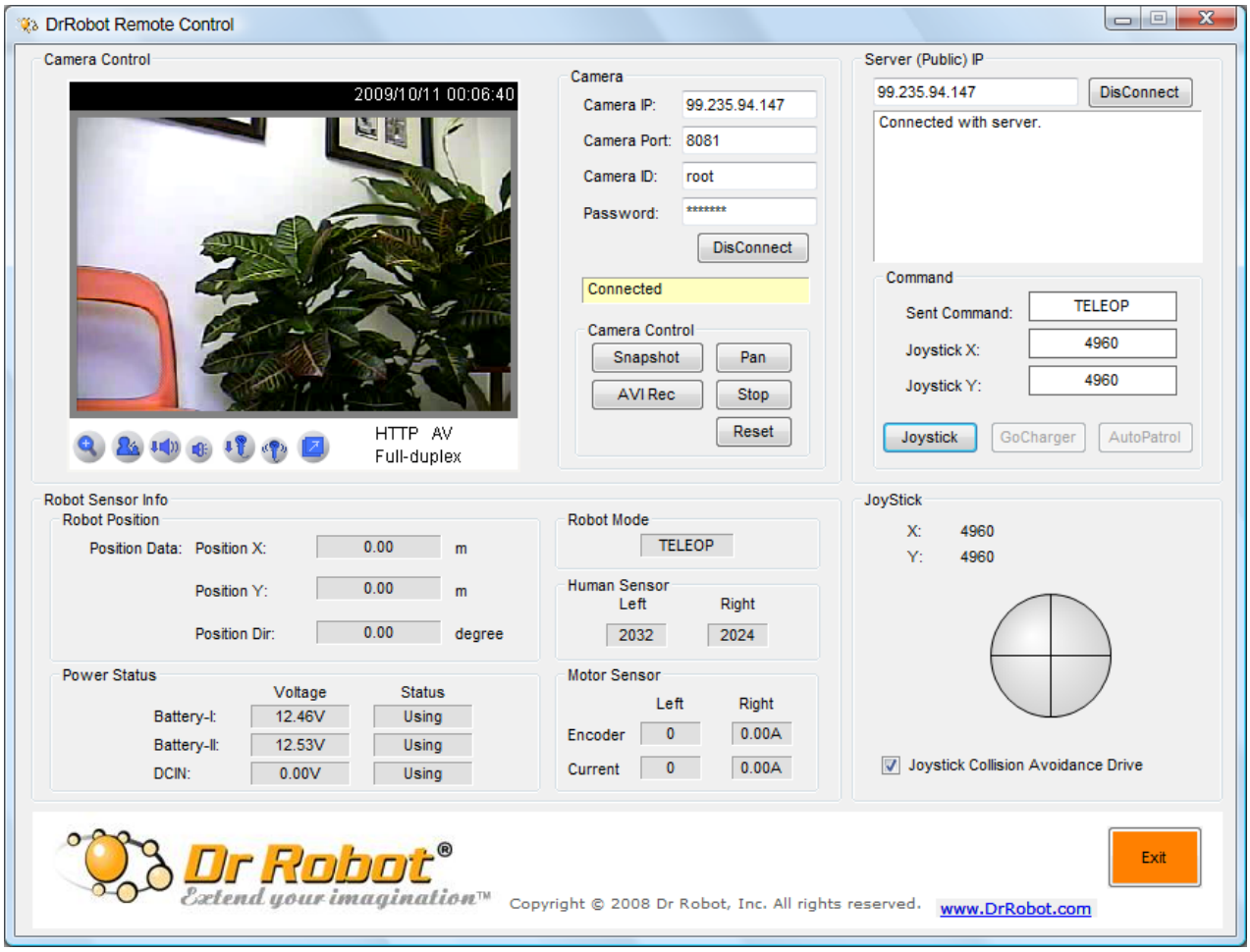
Step 1: If Internet remote monitoring/control is required, you need to connect the wireless router WAN port to your broadband Internet modem. You need to find out the public IP assigned by your ISP. (You should be able to find this information from the router status page) This IP will be used by the remote client to connect to the host PC and the devices on the robot.

If firewall is in-place in your network, you also need to make sure all the network ports used by the wireless devices (8081, 8082 for cameras, 7050 for server program) on the server and remote client sides are not blocked for the Internet remote monitoring/control tasks to operate properly. Proper "Virtual Application" settings should be in place on the router (the robot side). The included router already has these settings pre-configured to direct the outside traffic to appropriate devices (cameras and server PC) behind router. Please refer to "Network Connection and Login Information" section for detail.

Step 2: Installing the Scout^2 Remote Client program from the installation CD. "Scout-II Client" program allows you to remotely control the robot, obtain main robot sensor information, view, listen and talk through robot.

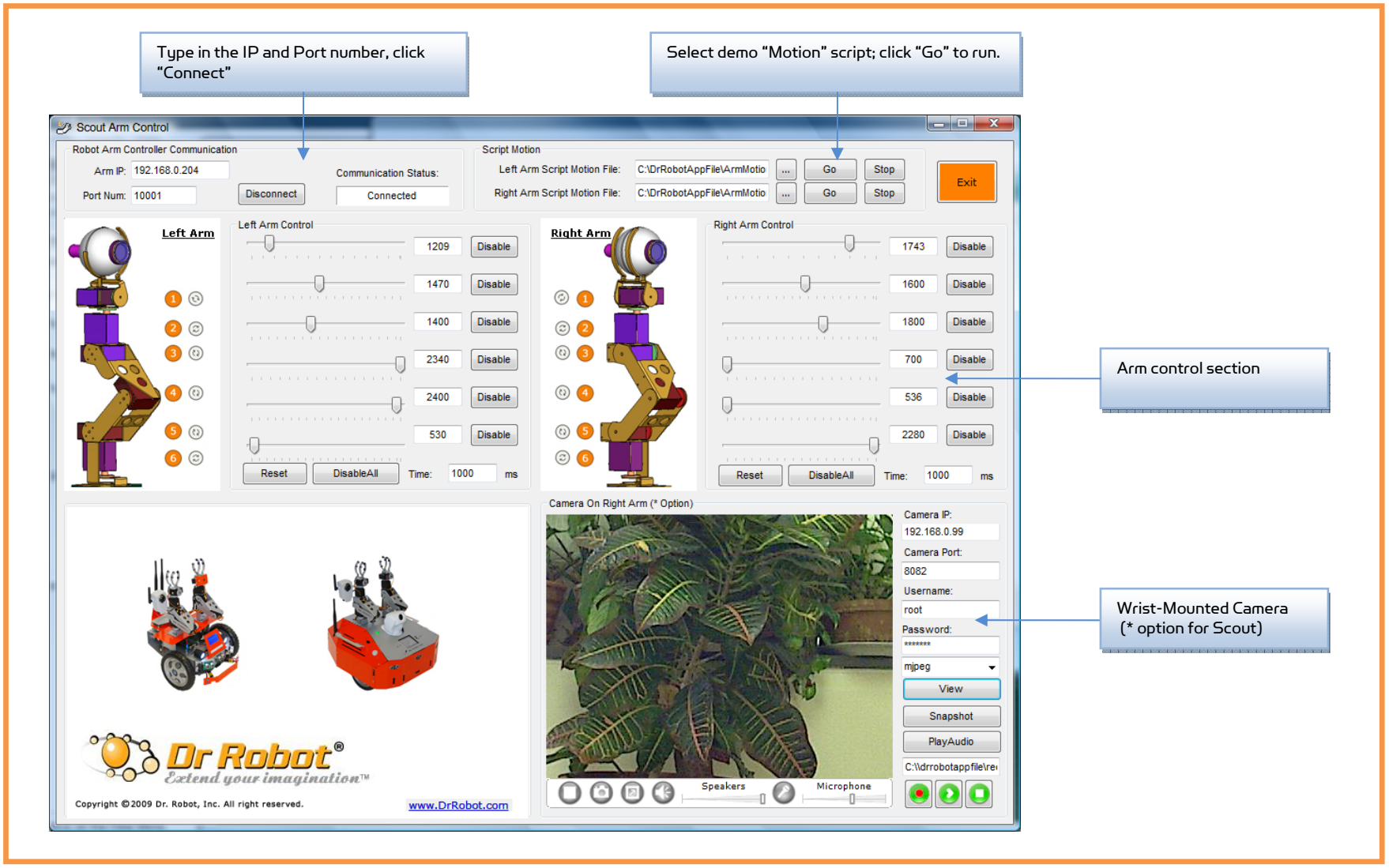
Step 3: Run the Scout^2 Client program.

Step 4: Enter or confirm the remote server and other devices' IP. When you are connecting from public network, your server IP must be a public IP, and with the pre-configured router settings, all the devices on the robot will share the same public IP with the server IP. Then click the "Connect".



Arm Control Program

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



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^2 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:

1. **DRROBOTSentinelCONTROL.OCX:** Please refer to "WiRobot SDK API Reference Manual.pdf" for detail.
2. **WiRobotGateway.exe**
3. **DrRobotSensorMapBuilder.dll:** This dll file provides functions to build the environmental map for collision avoidance feature.
4. **DrRobotP2PSpeedDrive.dll:** This dll file provides functions to drive a robot form one specific point to another.
5. **DrRobotConstellation.dll**: Scout^2 robot uses the ultrasonic based Constellation indoor GPS localization system (option). This dll file provides the functions to locate the robot position with the Constellation system.
6. **DrRobotGPS.dll** Scout^2 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.
7. **VitaminControl.dll** This is the camera control component for the Pan-Tilt-Zoom camera (P/N: AV-PTZ-VH) used for i90 series robots such as Sentinel^2, Sentinel^3, Scout^2, Sputnik^2 and Sputnik^3. Please refer to "PTZ Camera ActiveX Control Reference Manual.pdf" for detail.
8. **AXIS Media Control Library Set** These are the camera control component for the AXIS Mini Camera used for the Dual-camera Head and Scout arm. Please refer to "AXIS Media Control SDK Help" for detail.

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

As default, your PC running the Scout^2 Control program should have IP settings as below:

Name	**Server PC**	**IP (Port)**	192.168.0.104
Gateway	192.168.0.200(Router IP)	**Subnet Mask**	255.255.255.0

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	11223344556677889 9AABBCCDD	**Password**	drrobot
Key Type	Open Key		

with virtual server settings as followings:

Virtual Server	Port	Protocol	Server IP
Scout^2 Client program	7050	TCP/IP	192.168.0.104
Main Camera	8081	TCP/IP	192.168.0.199
Hand Camera	8082	TCP/IP	192..168.0.99

WiFi module 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**	192.168.0.203 (or labeled on robot)
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, flow control, UDP, Datagram 01, remote IP:0.0.0.0

Name	**Robot WiFi Module 2**	**IP**	192.168.0.204(or labeled on robot)
Channel-I (10001)	115200,,8,N,1, no flow control, TCP, remote IP:0.0.0.0	**Channel-II (10002)**	115200, 8,N,1, no flow control, TCP, remote IP:0.0.0.0

Other wireless devices settings are listed below:

Name	IP (Port)	Login	Password
Main Camera	192.168.0.199 (8081)	root	drrobot
Hand Camera	192.168.0.99 (8082)	root	drrobot

Advanced Network Settings

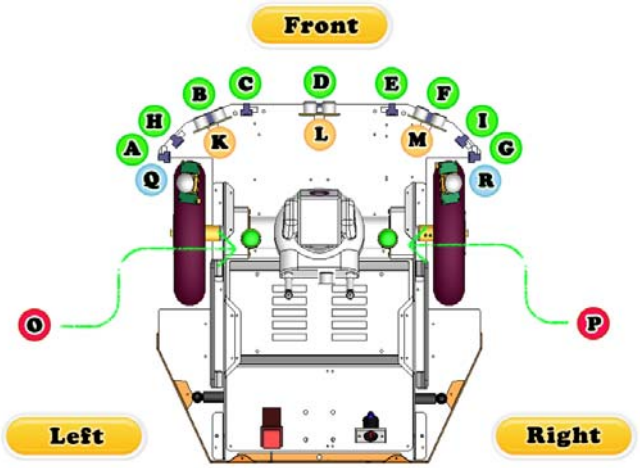
It's possible to use different network settings (e.g. IP) for the server PC, in this case, the "Virtual Server" settings on the router must also be changed accordingly in order for the Internet remote monitoring feature to work properly. You could also change the router settings such as IP and SSID etc. 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 turn on or off individually through the "Scout-II Control" or "Scout-II Client" Program.

Channel-I	DC-DC board –I	Main Camera (12V)
Channel-II	DC-DC board –I	1. PMS5005 Main power (5V), GPS (5V) power, Arm Servo Control Board (5V)
		2. PDA, LED 5V, Hand Camera 5V
	DC-DC board-II	3.3V for WiFi module 2
Channel-III	DC_DC board –I	6V left arm servo power
		6V right arm servo power

Appendix II IR Sensor Control Reference



Using AD Extended Port
A--- IR Range sensor
B--- AD extended port 3
C--- AD extended port 4
D--- AD extended port 5
E--- AD extended port 6
F--- AD extended port 7
G--- AD extended port 8
H--- Tilting sensor X
I--- Tilting Sensor Y

Appendix III SSC-32 Board Connection

Right Arm using channel 0 – channel 5

Left Arm using channel 16 – channel 21

Support Team Contact Information:

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