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i90

Robot Explorer Program

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I. Introduction

This manual will provide you information on using the i90 Robot Explorer program to operate the robot. Please refer to the i90 Quick Guide regarding other documents related to i90.

II. System Requirements

- Microsoft Windows XP Professional or Home Edition (Service Pack 1 or 2), Windows 2000 (Service Pack 2), Windows XP Tablet PC Edition, Windows Server 2003, or Windows NT (Service Pack 6 or 6a)
- 128MB of RAM (256MB recommended)
- Up to 300MB of available hard-disk space
- Microsoft Internet Explorer 5.5 (or higher), Netscape 7.1 (or 8.0), Firefox 1.0, or Mozilla 1.7
- Internet access is necessary for Internet remote control/monitoring use

III. Software Installation

Installing the i90 Robot Explorer Programs

Using the i90 Program CD to install:

- i90 Robot Explorer program on the Home/server PC
- i90 Robot Explorer Client program on the remote client PC (if Internet remote operation and monitoring is to be used)

Install the Joystick Controller

Please follow the installation instructions provided with the joystick controller and install the driver for the device on both the Server and Client PC (if applicable). XP and 2000 normally will recognize the device automatically with plug and play feature.

To verify the joystick installation, run Control Panel > Printers and Other Hardware > Game Controllers. Selecting this option will open a dialog box listing installed hardware typically used for gaming. The installed joystick will appear if it has been properly installed.

IV. Robot Operations

Note: Some of the functions and features are only working with the appropriate hardware upgrade options such as Constellation Navigation/position system (P/N CONST-NAV), Auto-docking Auto Recharging Station and etc., or appropriate robot model, e.g. Sentinel².

- Turn on the robot and place it on the ground
- Run the i90 Robot Explorer Program
- Type in the Pan-Tilt-Zoom Camera IP address, User ID and Password as provided in the first page
- Type in the robot IP address as provided in the first page, you don't need to change the **1st Port** entry if you have not modified the WiFi module settings.
- Select the default map "default.drn" from the Map file browser. Then click **Connect**.
- Type in your User ID and Password as provided in the first page. Both user ID and Password can be changed later in the program.

Connection

Camera Login

Camera IP: 192 . 168 . 0 . 199
Port: 8081
User ID: root
Password: *****

Robot Login

Robot IP: 192 . 168 . 0 . 208
1st Port: 10001
Map: hasis\ini\default.drn ...

User Login

User ID: root
Password: *****

Connect Cancel

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Using the Joystick Controls

If joystick is installed and connected, simultaneously pressing buttons FN and B1 (refers to Figure **Joystick Controls** below) on the joystick will activate joystick control.



Joystick Controls

Controlling Camera

Refers to the Figure above, the mini thumb control stick located atop the joystick control the camera pan and tilt motion.

Driving the Robot

The speed control paddle controls the robot's speed. Pushing the paddle upward increases the robot speed. Starting with slow speed is recommended, particularly if the user isn't familiar with the robot's performance.

When the joystick is pushed forward beyond the center, the robot is in FORWARD gear, when gas is applied, robot move forward. When the joystick is pushed backward beyond the center, the robot is in BACKWARD gear, when gas is applied, robot move backward. Pushing the joystick to the left or right changes the robot's direction. **Do not over-steer the robot.** Beginners are advised to apply a technique like discontinuous turning where adjustments to the robot's direction are made incrementally (i.e., releasing the joystick after every adjustment).

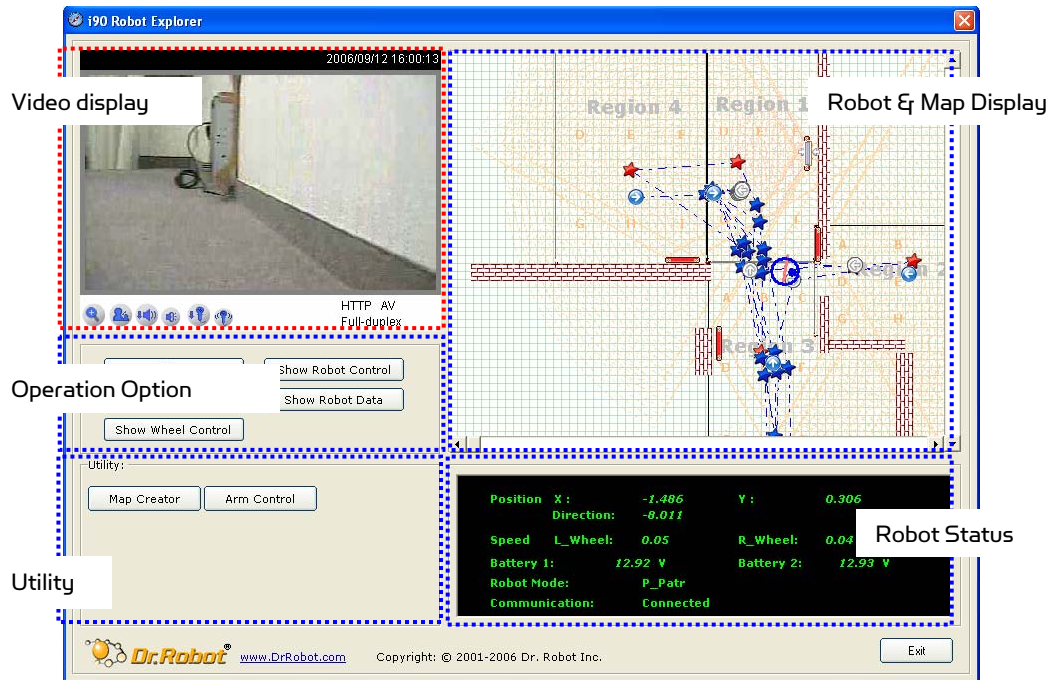
When the speed control paddle is at its zero velocity setting (completely down), the robot is free to spin in place by pushing the joystick to the far end of left or right.

NOTE: Unless being turned off from the i90 Robot Explorer program or when the robot speed is very low, the robot's collision avoidance control will automatically initiate. This will help the user to easily manipulate the robot around by providing rough moving direction to the robot, and robot will find the best opening to go through. This is especially important when communication delay is large. However, this will also affect the user's ability to navigate the robot through very narrow openings. In this situation, reduced speed may be necessary to pass successfully.

To toggle off joystick control, press FN and B2 simultaneously, this will switch the robot back to its previous operation mode before using joystick control.

Using i90 Robot Explorer Program Control

The GUI of the i90 Robot Explorer program consists of five main areas /information groups as shown below.









Video display

Robot camera image/video is displayed here. Network status is also displayed.

- Double clicking on the video will cause the camera to pan and tilt to center on the clicking point.
- Using Camera Control Panel



-  for Zooming in image
-  for activating "Talk to Robot" function
-   for adjusting speaker sound level
-   for adjusting microphone level

Operation Option

- Turn Off Camera
 Turn Off / On Camera

- Show Camera Control

The screenshot shows a 'Camera Control' window with the following elements and callouts:

- Snapshot**: A yellow button with the text 'Snapshot'. A callout box labeled 'Snapshot' points to it.
- Motion control**: Two buttons labeled 'Pan' and 'Stop'. A callout box labeled 'Motion control' points to the 'Pan' button.
- Reset position**: A button labeled 'Reset'. A callout box labeled 'Reset position' points to it.
- Hor.:** Two arrow buttons (left and right) for horizontal movement.
- Vert.:** Two arrow buttons (up and down) for vertical movement. A callout box labeled 'Control camera' points to these buttons.
- Pan Speed:** A slider control with 'Slow' on the left and 'Fast' on the right.
- Tilt Speed:** A slider control with 'Slow' on the left and 'Fast' on the right. A callout box labeled 'Adjust the speed' points to these sliders.
- A close button with an 'X' icon is in the top right corner.

- Show Wheel Control

The screenshot shows a 'Wheel Control' window with the following elements:

- Gas Up:** A value of 10000 is displayed.
- Left:** A vertical column of three green arrow buttons (up, left, down).
- Right:** A vertical column of three green arrow buttons (right, down, up).
- Stop:** A button with a red stop icon and the text 'Stop'.
- Enable Keyboard Control:** A button with a keyboard icon and the text 'Enable Keyboard Control'.
- A close button with an 'X' icon is in the top right corner.

Click here to start controlling robot via keyboard. 4 Arrow keys are for direction control, click **Space bar** to **Stop**

■ **Show Robot Control**

Displays the robot target and current position and orientation, wheel speeds

You could change the Maximum Forward, Turn Speed and Wandering Speed for the robot

Click "Skip" to cancel the preset "Stop" action

i90 Robot Explorer program provides following operation modes:

Manual mode, the robot relies on instructions from a human user to navigate. In Manual mode, the robot can be controlled by the included joystick. If the joystick is installed and connected, simultaneously pressing buttons FN and B1 (refers to Figure **Joystick Controls**) on the joystick will activate joystick control. (See the **Using Joystick Control** section for further details.)

Alternately, the robot can be controlled by mouse/keyboard. Clicking the **Show Wheel Control** button, a navigation control panel will display.

Patrol mode, the robot will automatically patrol along the pre-defined path edited using the Map Creator program. Its built-in collision avoidance function will allow the robot to detect and steer away from hitting any nearby objects.

Wander mode, the robot will wander around its environment, using its built-in collision avoidance function to detect and steer away from hitting any nearby objects.

Idle mode, this will stop the robot right away and allow the robot to remain powered-on in a standby setting while minimizing power consumption. While in Idle mode, the robot can be awakened at any time and changed to any other operation modes.

Charge Mode, robot will return to charging station and batteries get re-charged. When re-charging is finished, the robot will resume the operation mode before switching to Charge Mode.

Docking Mode, robot will return to charging station and batteries get re-charged. When re-charging is finished, the robot will switch to idle mode and stay in the charger waiting for request of mode changes. **We recommend putting robot into Docking mode if the robot is not to be used for relatively long period of time (e.g. hours) to allow the batteries recharged and prepare the robot for next mission.**

Reset Mode, all electronic hardware and sensors on robot will be reset.

Show Robot Data

1. Power & Battery

The screenshot shows the 'Power & Battery' configuration window. It displays the following information:

- Battery 1:** Vol. (V) 12.29, Temperature (Green dot)
- Battery 2:** Vol. (V) 12.14, Temperature (Green dot)
- DCIN:** 0.00
- CHG VolTH:** 12 (with a slider bar)
- Alarm VolTH:** 12.5 (with a slider bar)
- Settings:** Voltage Detection, PowerSave Mode
- Current battery Status:** [Warning icon]
- Power Status:** (Green dot)
- Power Path:** Battery1, Battery2, DCIN
- Charge Path:** Battery1, Battery2, Charge
- ChargeTimer(min):** 120 (with a slider bar)

Callouts provide additional context:

- Battery temperature status:** Points to the green temperature indicator dots.
- When checked, the system will monitor the battery voltage status and auto recharge when the battery voltage low. (Default- Checked):** Points to the 'Voltage Detection' checkbox.
- Checked: during recharging, the system will turn off the camera in 5 minutes and switch to fast charge. Unchecked: camera will stay on during recharging. (Default: Checked):** Points to the 'PowerSave Mode' checkbox.
- Maximum charging timer setting:** Points to the 'ChargeTimer(min)' slider.

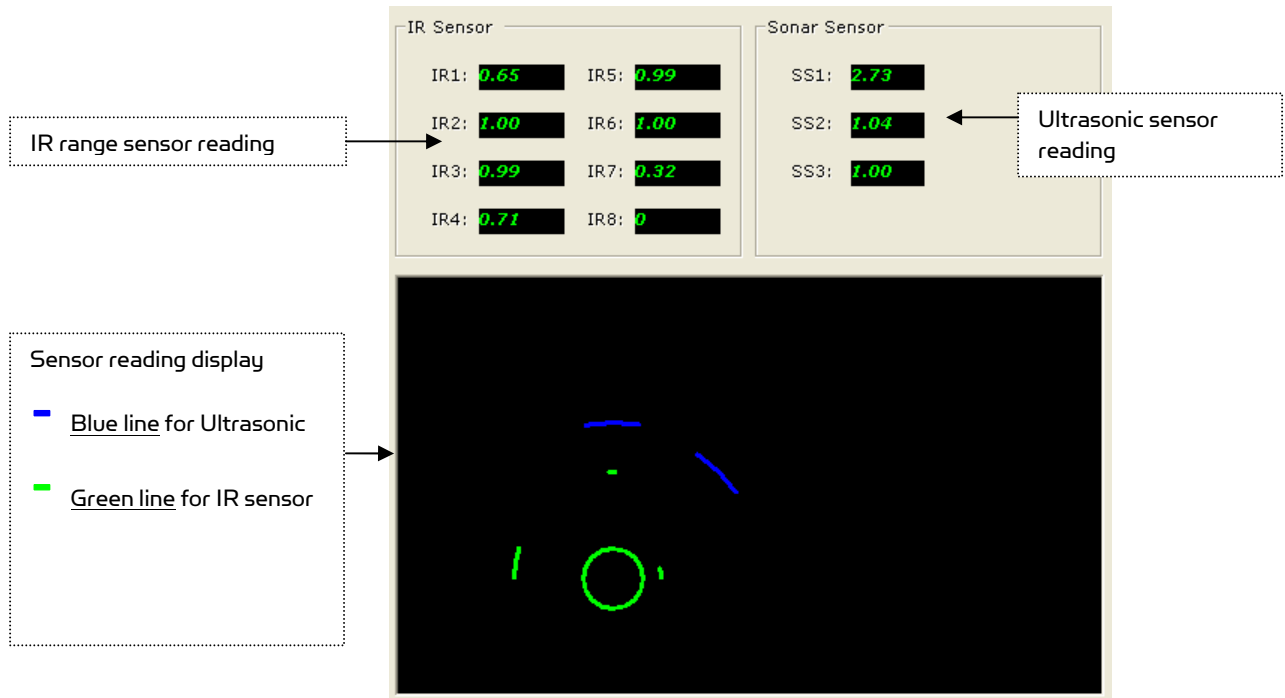
It displays the voltage of the two batteries, **Battery 1**, and **Battery 2**. When fully charged, the voltage of the battery will reach around 14V or over. During re-charging, the voltage of the batteries could reach 14.8V or over. **DCIN** shows the charger circuit input voltage which should be around 16.5-17.5V.

When the robot is in auto Patrol Mode, if the robot detects the average battery voltage is lower than the **CHG_VolTH** (default value is 12V, this could be changed using the slide bar), the robot will automatically return to charger for recharging. When the robot detects the average battery voltage is lower than the **Alarm_VolTH** (default is 12.5V, this could be changed using the slide bar), the navigation program will signal with Critical Low Battery Alert.

By default, Battery Level Auto Monitoring mechanism is enabled, however, you could disable it by un-checking the **Voltage_Detection** option.

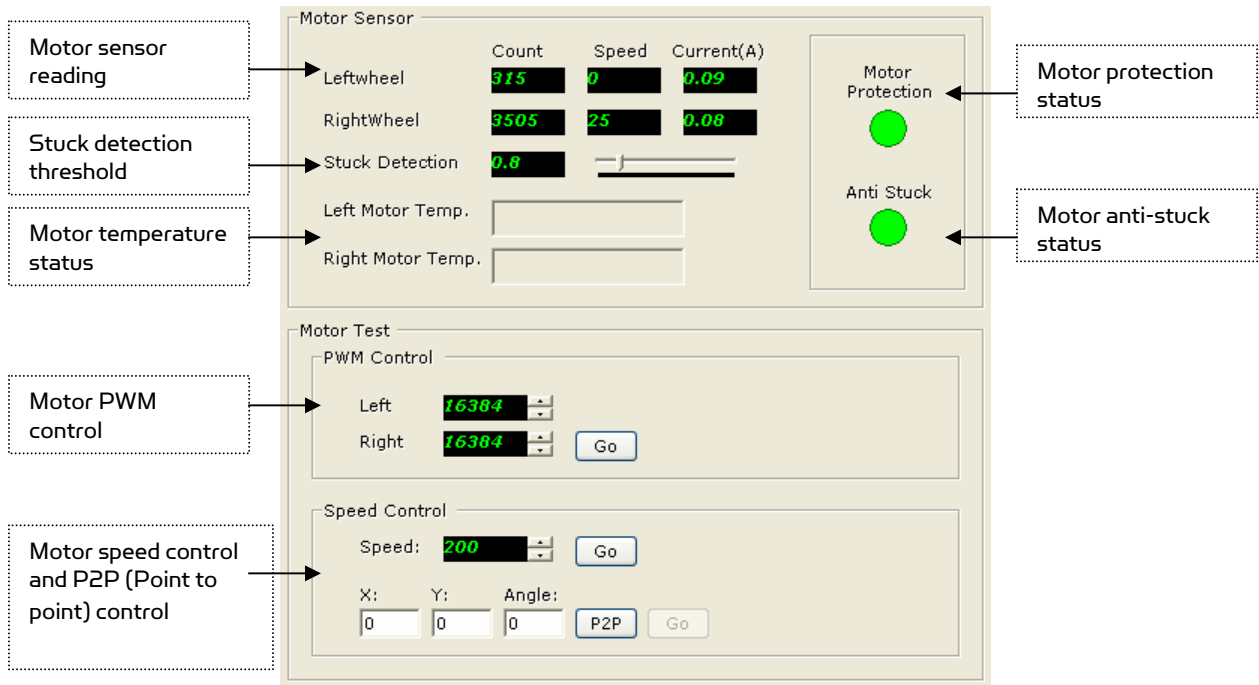
When the batteries are fully charged, the charging process will automatically stop. This may take up to 4.5 hours if the robot batteries were completely used off before recharging. However, you could also set the maximum charging time **Charge_Timer** (default is 120 minutes, and this can be changed by using the slide bar) to reflect the maximum time you prefer the robot to stay in the charger according to your task requirement. When the specified maximum charging time is reached, the charging process will stop, and the robot will resume previous task.

2. IR & Sonar



This panel displays the range measurement of the 8 infrared sensors and 3 sonar sensors in graph and text. The displayed range/distance data are projected to the center of the robot rather than from the sensor surface.

3. Motor & Drive



This panel displays the motor encoder sensor readings (count and count/sec) and motor current for left and right wheel. Each wheel equips with a 1200 count per cycle optical encoder.

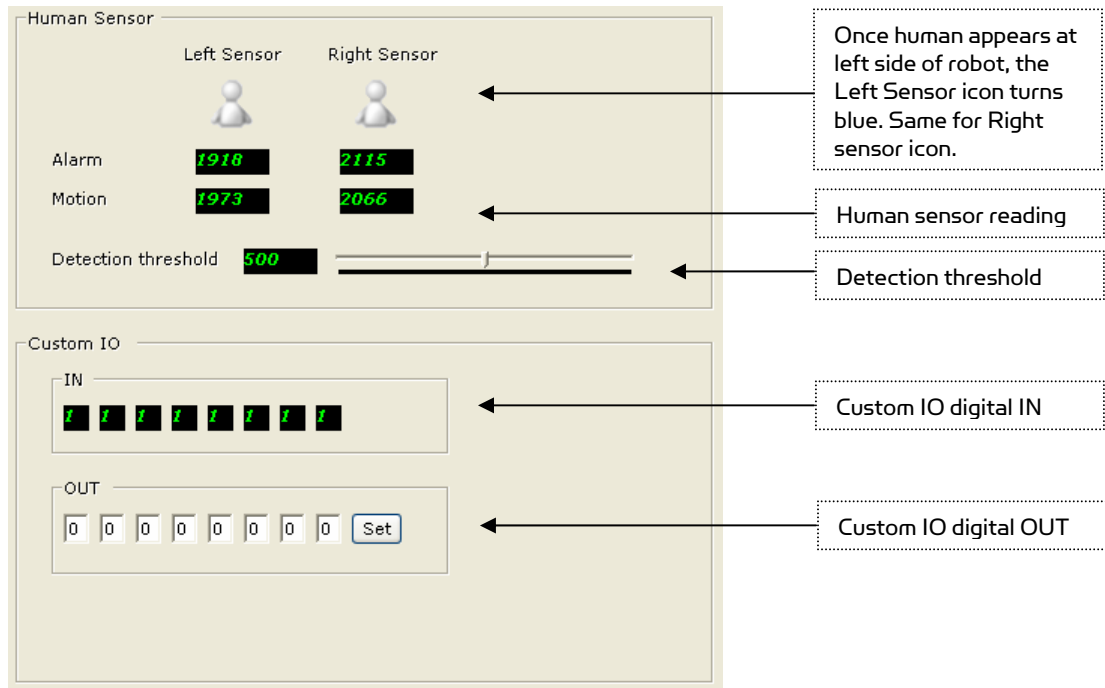
Two motor protection schemes are used:

1. **Anti-stuck** protection - In the occasion, when built-in collision avoidance function fails, the robot wheel/wheels may be getting stuck with obstacle, e.g. chair legs. The robot motor current may exceed the **Stuck_Detection** threshold (unit of Amp, which can be adjusted by using the slide bar), with the **Anti-stuck** protection feature, robot will back up to recover from the *stuck* situation.
2. **Over-heated** protection - The Left and Right Motor Temperature bars display the estimated motor temperature/heat condition, when the motors are detected to be overheated, motor will be automatically disabled. Motor operation will be resumed when the motor temperature is dropped back to normal.

For testing purpose, you could use the **PWM Control** to send down PWM command to individual motor. When the PWM value is 16384, motor will stop, PWM value of 0 and 32767, representing full speed in opposite direction respectively.

Or, you could use the **Speed Control** to send down speed (count/sec) command to both motors. You could also specify the target position and orientation in the input box and click the **P2P** button. When the **GO** button is clicked, the internal robot control scheme will manage to drive the robot from the current position to the specified target.

4. Human Sensor & IO



This panel displays the Human Left/Right Sensor output in AD value. When Motion of human body heat (caused either by the motion of human or robot) is detected (you could adjust the **Detection_Threshold** to change the sensitivity), the respective human icon will turn blue.

Digital input is shown with the **IN** display and the digital **OUT** can be set bit by bit using the input boxes and the **Set** button.

5. Video & Audio (reserved)

The screenshot shows a software interface with three main sections:

- Image Capture:** Contains a "Start" button.
- Review Captured Video:** Contains a dropdown menu, a "Play" button, a video player window showing the Windows Media logo, and playback controls.
- TTS:** Contains a large empty text area and a "TTS" button.

Annotations with arrows point to the following elements:

- "Start" button: "Once connected to camera, click 'Start' to record the video"
- Dropdown menu and "Play" button: "Select the video clip from dropdown list, click 'Play' to playback the recorded video"
- "TTS" button: "Reserved"

6. Network Setting

The screenshot shows the "Network Setting" window with the following sections and annotations:

- Client Side Network Status:**
 - Remote Access: (Annotation: "Un-check 'Remote Access' option to disable Internet remote robot control")
 - Remote IP: (Annotation: "When remote client program connects to robot, its IP will display")
- Reset Login Name & Password:**
 - Old User ID:
 - Old Password:
 - New User ID: (Annotation: "You could change the robot login user ID and password here")
 - New Password:
 - Retype Password:
 - Set:
- Camera Configuration:**
 - Server Date/Time (FMT:YYYY/MM/DD hh:mm:ss):
 - Date: (Annotation: "Configure camera Date/Time")
 - Time:
 - Set:
- Reconnect Camera:**
 - Camera IP: (Annotation: "Reconnect camera if needed")
 - Port:
 - User ID:
 - Password:
 - Start:

At the bottom, there is a tabbed interface with "Network Setting" selected. Other tabs include "Video & Audio", "Constellation", "Utility Config", "Power & Battery", "IR & Sonar", "Motor & Drive", and "Human Sensor & IO".

7. Constellation

The image shows two panels from a software interface. The top panel, titled "Transponder Data", displays the following information:

Transponder ID	5	6	9	10
Robot Left Receiver	2.53	2.50	00R	00R
Robot Right Receiver	2.49	2.52	00R	00R
Zone Code	3			

The bottom panel, titled "Transponder ID Setting", contains four input fields with values 1, 2, 3, and 4, a "Set" button, and a checked checkbox labeled "Transponder Auto Switch".

Callouts with arrows point to the following elements:

- Shows transponder ID that Robot receives signal currently (points to the value 5 in the Transponder ID row).
- Receiver reading, "00R" means "out of range" (points to the 00R values in the Receiver rows).
- Shows Zone ID that Robot currently located (points to the value 3 in the Zone Code row).
- Specifies the Transponder ID (points to the input field containing 1).
- Specifies the transponder auto switch mode (points to the checked Transponder Auto Switch checkbox).

This panel is for testing and debugging the Constellation transponder purpose only. Use this panel control, only if you are familiar with the Constellation transponder working mechanism.

By specifying the Transponder ID (always come in pair, e.g. 1 and 2, 3 and 4, etc.), and pressing **Set**, if Transponders with the specific ID are presented within the reception range of the robot Constellation Receivers, the measured range information will be displayed with respect to individual receiver.

By un-checking the **Transponder Auto Switch** option, program will not automatically switch to receive signal from Transponders with ID other than the specified ones.

8. Utility Configuration

Here you could change and create shortcut buttons (called Utility Buttons). Utility Buttons shown on the Utility Panel on the GUI will allow quick activation of related programs such as the Map creator or third party programs.

Button 1 ~ 5 | Button 6 ~ 10 | Button 11 ~ 12

Button 1 Button Caption: Map Creator (Max. 14 CHAR)
Map Creator Tooltip: Map Creator Program
Executable: c:/map.exe ...

Button 2 Button Caption: Arm Control (Max. 14 CHAR)
Arm Control Tooltip: Left Arm Control Program
Executable: C:\YING-Development Issue\Sof ...

Button 3 Button Caption: (Max. 14 CHAR)
Tooltip:
Executable: ...

Button 4 Button Caption: (Max. 14 CHAR)
Tooltip:
Executable: ...

Button 5 Button Caption: (Max. 14 CHAR)
Tooltip:
Executable: ...

Submit Setting

Configure utility button:

To Add Button

1. Type in max 14 char. For button caption
2. Type in Tooltip for button
3. Select the associated executable program
4. Click "Submit Setting" button

To Delete Button

Clear out all words from the text box and click "Submit Setting"

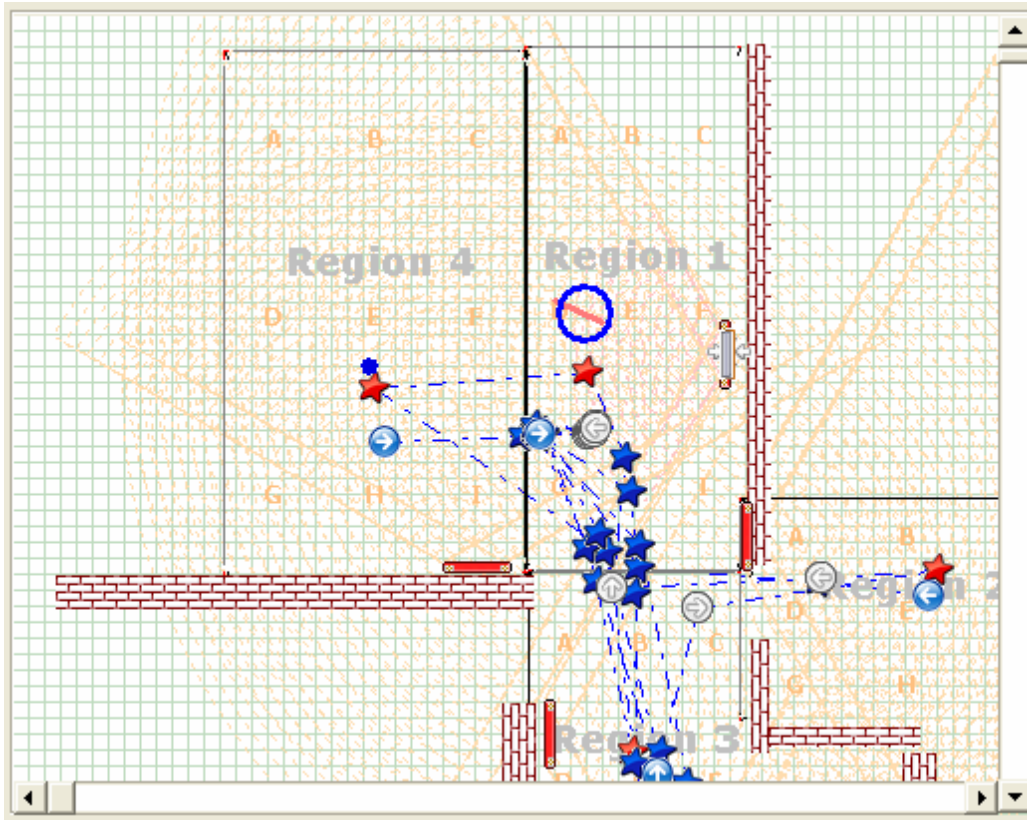
Utility Panel

Utility:

Map Creator Arm Control

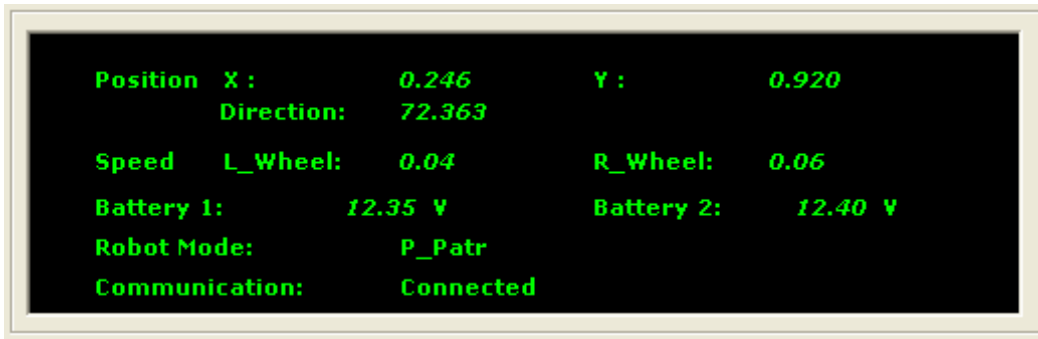
User can configure up to 12 utility buttons.

Robot & Map Display



The robot current position and orientation is presented here overlaying with the Constellation Transponder and environment map which is built/edited using the Map Creator program

Robot Status

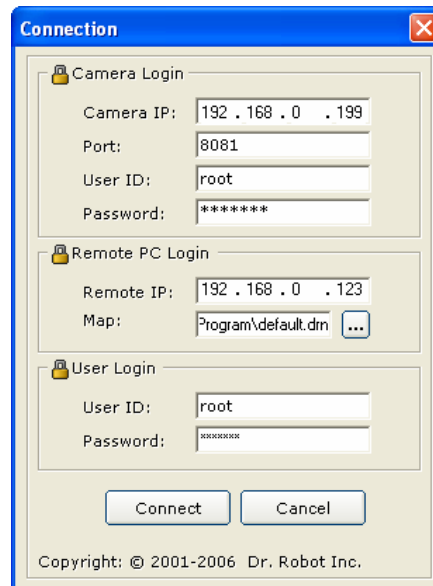


Position X :	0.246	Y :	0.920
Direction:	72.363		
Speed L_Wheel:	0.04	R_Wheel:	0.06
Battery 1:	12.35 V	Battery 2:	12.40 V
Robot Mode:	P_Patr		
Communication:	Connected		

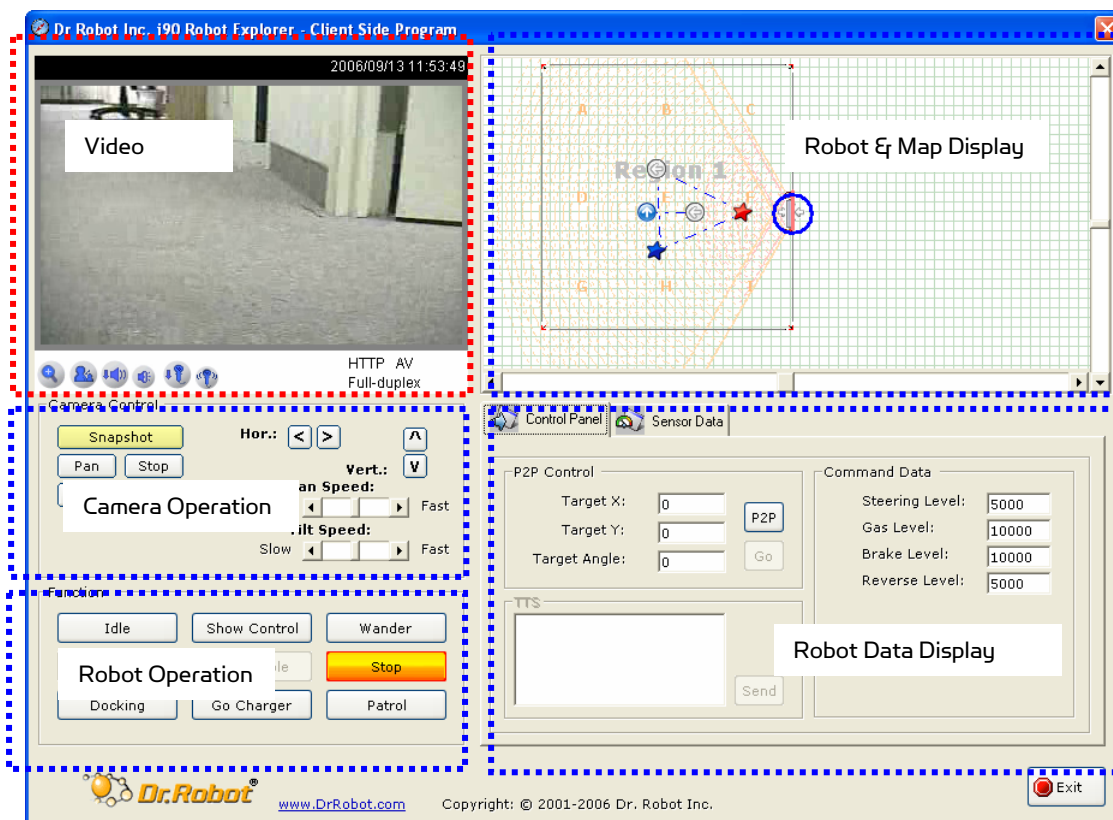
Various robot information is listed in this section

Using i90 Robot Explorer Client Program Control

i90 Robot Explorer Client Program allows Internet remote access and control of the robot. You need to login with the robot Camera and remote PC IP and User ID, Password provided on the first page.



The GUI of this Client program consists of five main area/information groups as shown below

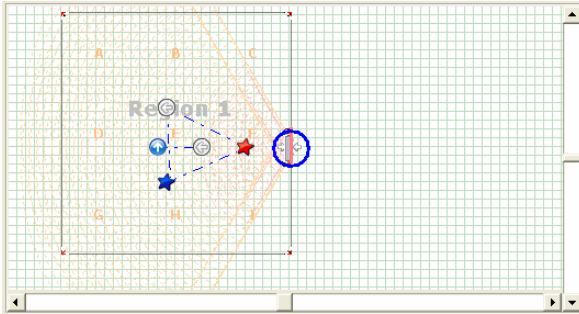


Video

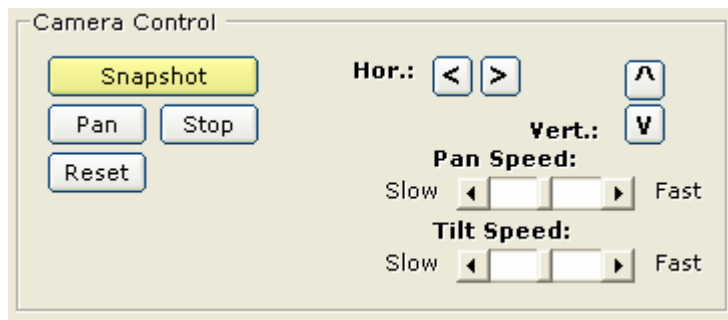
Robot camera image/video is displayed here.

Robot & Map Display

The robot position and orientation are presented here overlaying with the Constellation Transponder and environment map which is built/edited using the Map Creator program.

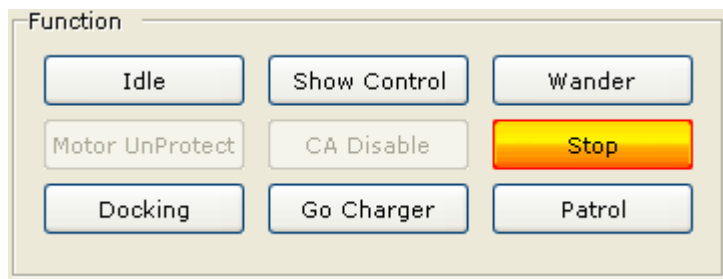


Camera Operation



Same as sever side control.

Robot Operation



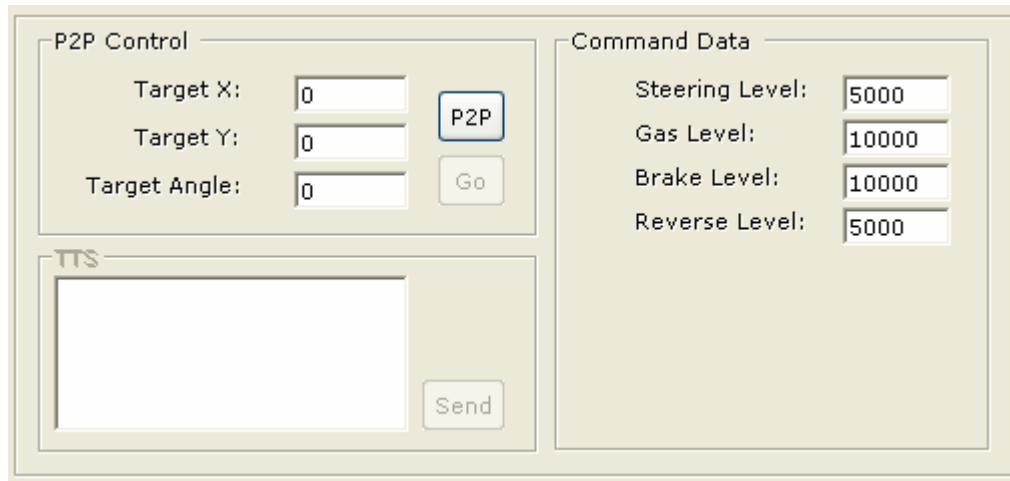
Same as sever side control. From here, you could change the robot operation modes, including Patrol, Wander, Go_Charger, Docking, and Idle here. See sever side program for details on operation modes.

When in manual control mode (e.g. using joystick), you could also disable the motor protection and robot collision avoidance functions (which are all enabled by default) in order to accomplish some special tasks (e.g. using the robot to push open a door, or navigate around a very narrow opening)

Robot Data Display

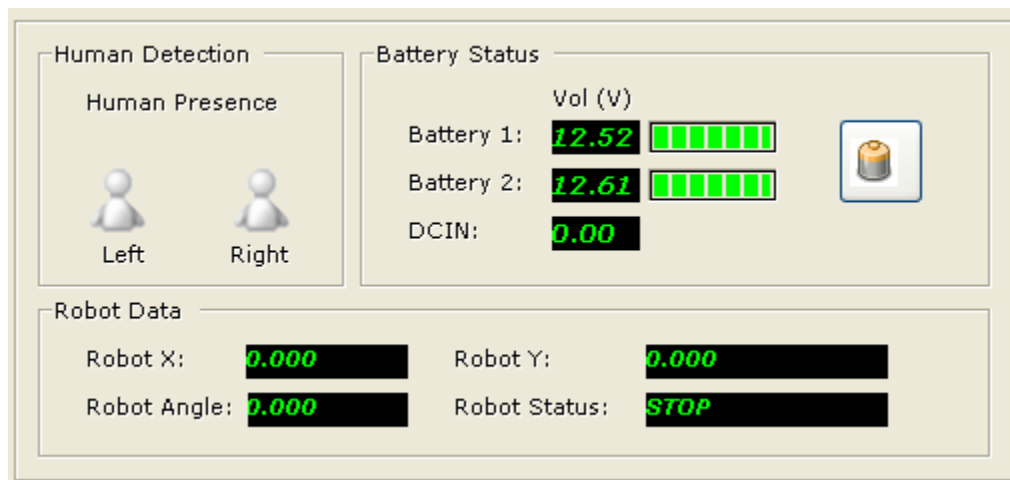
In this group, you have 2 Panels to choose from:

• **Robot Control Panel**





When robot is under manual control (including joystick, keyboard and mouse control) the **Command Data** display will show the command value received from the mouse, keyboard or joystick.

• **Sensor Data**



It displays the voltage of the two batteries, **Battery 1**, and **Battery 2** and the charger input voltage **DCIN**. When human motion is detected, the human icon will display in color.

The battery status icon will change from  to  when battery is running low.