Quick Start Guide

Thank you for choosing **WiFiBoT 4G** for your robotic application.

- Before using the robot, please read with care this manual
- Keep this manual in a safe place for any future reference
- For updated information about this product visit the official site of wifibot http://www.wifibot.com

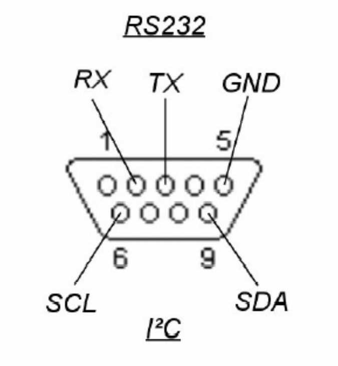
Index

Package contents

Make sure to be in possession of all the articles mentioned below. If any of them should be missing, contact your reseller as soon as possible.

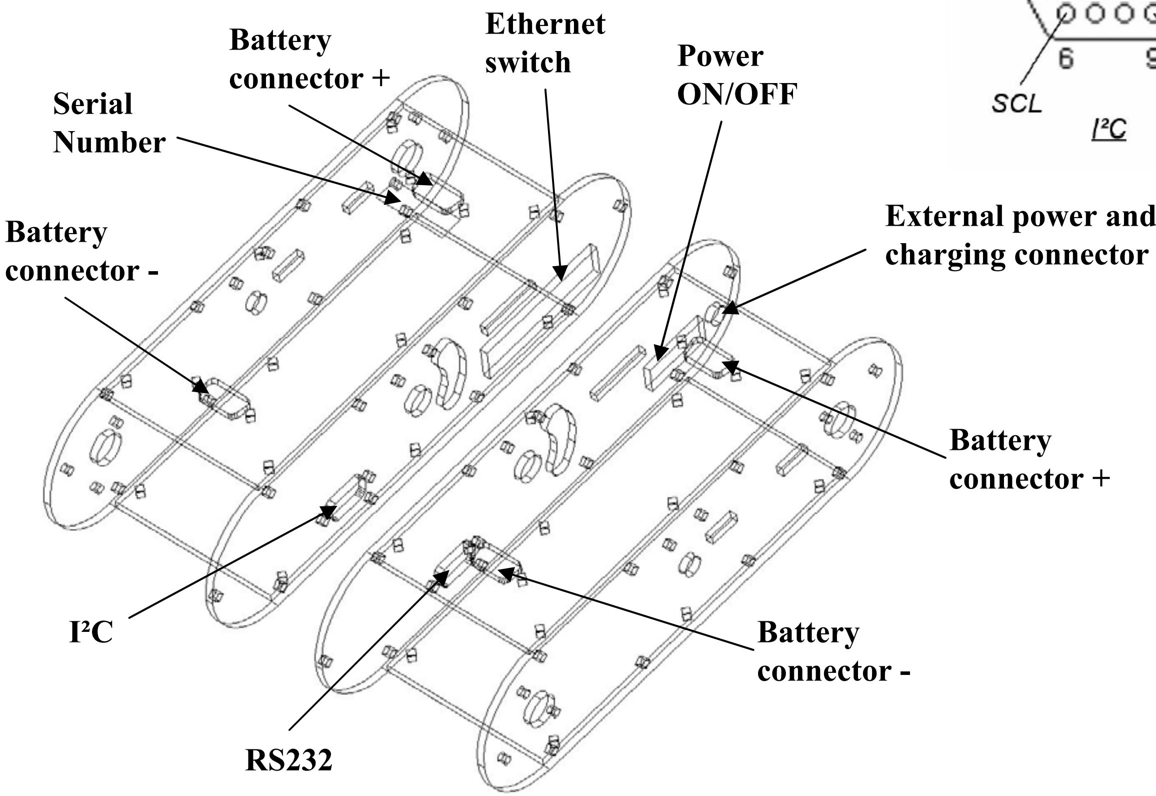
Robot
IP camera
Two battery packs
Battery charger
Wifibot CD-ROM
Camera CD-ROM and documentation
4x charging cables
1x RJ45 cable for the IP camera

This diagram shows the signal pinout of the DSUB-9 connectors. The RS232 signals are found on the connector located on the left while the I²C signals can be found on the connector located on the right of the robot. (see the other diagram below)



Connectors overview

The figure below shows the location of the different connectors of the robot:



Powering the robot

Powering the robot with batteries:

The robot gets its power normally from two battery packs with four Ni-MH cells each, with a capacity of 9500 mAH and a total nominal voltage of 9,6V. Located on the upper part of the platform, their location and clamping have been especially designed to facilitate their removal and replacement in an easy and simple way. It is enough to insert the packs in their connectors, their shape preventing any error, the only thing left is to close the clamps and the robot is ready to go. The robot comes with only two packs, additional packs are available separately.

Powering the robot from an external source:

When developing custom applications it is often more practical to use an external power source rather than to have to constantly charge the batteries. Take out the batteries, then plug the included cable into the connector located next to the power switch of the robot and connect the robot to a lab DC power source at a voltage between 9 and 12 V. Make sure the power source can deliver several amps, especially if you plan to test the motors.

Power connectors

The 5V/9.6V power output:

The robot is equipped with two 5V 2A DC/DC converters. One of the converters is reserved exclusively to power the different internal components of the robot. The second converter is available to the user through the general power connector dedicated to external modules such an IP camera. A direct connection to the batteries is made available on this connector as well. The 5V output can't give more than 2A and a maximum of 10A is recommended for the 9.6V output. An incorrect use of this connector beyond those values (short circuit or other) can provoke a malfunction of the robot or of the DC/DC converter and even damage those.

Note: The WiFiBoT company will not in any case be considered responsible for any damage provoked by any incorrect use of this connector. Any reparation necessary for any damage caused by the incorrect use of this connector will not be covered by the warranty.

The external power and charging connector:

This connector presents directly the + and – of the robot and has a double use. On one side it allows to directly power the robot with an external source without having to use the batteries. The second use is to charge the batteries on the robot itself when no additional packs are available.

Note : When charging the robot make sure the power switch is OFF so the charger does not find the robot in march.

Battery installation

Insertion:

Locate the connectors and their direction on both the robot and the two battery packs. Insert the batteries till the end and secure them by closing the lateral clamps.

Extraction:

Open the clamps and pull the battery packs up.

Charge:

A battery charger is included with the robot and can be used for charging the batteries in two different ways:

Externally: This charging mode allows a continuous use of the robot by doing a rotation of several battery packs. Insert first each plug in the corresponding color on the charger side and then connect the three cables included for this purpose to the batteries as shown on the photo. (red color with the battery +, see page 3)

On the robot: This mode is recommended when the user has only one set of battery packs. First make sure the robot is OFF, then connect the plugs of the charging cable on the side of the charger and then on the charging connector located next to the power switch of the robot.

Camera installation

The robot is sold with an IP camera which model can vary depending of the robot version, it is a complement and is not part of the robot itself. It is an independent peripheral which can be replaced by any other camera model or network peripheral. For more information about your particular camera please refer to its manual included in the CD-ROM. Nevertheless its installation is similar in all models.

Place the camera on the central support:

Screw the camera on its support and if it applies, adjust manually the desired position angle.

Connect the Ethernet cable to the camera :

Connect the included Ethernet cable to the RJ45 port located at the back of the camera and to one of the ports of the embedded switch.

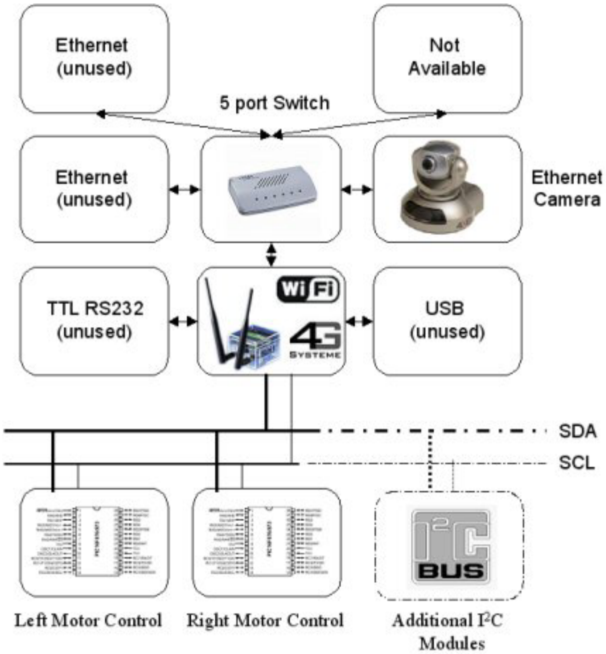
Connect the power cable of the camera:

Connect the proper power output (5V/9.6V) of the robot to the camera power input located at the back of the camera.

General structure of the robot

System architecture:

The system architecture is very simple, it is build around a double bus Ethernet-I²C and a CPU that acts as a bridge between the two. This same CPU works as an access point and makes the Ethernet bus accessible from the outside through Wi-Fi. In general the embedded LAN is used for peripherals of a certain importance such the IP camera while the I²C bus is useful for connecting more simple modules based on micro-controllers. To finish, the robot features one RS232 port which can be bridged to upper levels as well. This makes possible to add to the robot commercial modules as well as “home made” ones based on simple micro-controllers.



The embedded CPU:

The embedded CPU is a **4G Access Cube** from 4G-systems, some of its interesting features are:

- 400MHz MIPS processor AMD Alchemy Au1500
- 64 MB RAM
- 32 MB Flash
- 100Mbps Ethernet
- Power Over Ethernet Standard IEEE 802.3af
- USB host/USB device (no external plug on robot)
- Scope for installing up to 8 MiniPCI devices via 4 dual adapters.The robot has space for one MiniPCI.
- WLAN card with RP-SMA connection
- Dimensions 7 x 5 x 7 cm
- Power rating 4 W
- No moving parts

The operating software running on the Cube is a specially adapted Linux distribution “Nylon”. It provides several features including:

- Linux Kernel 2.4.27
- Mesh Routing (OLSR)
- Web Server
- DNS Server
- DHCP Server/DHCP Client
- Firewall (Shorewall)
- Perl
- Software updates via the Internet

It is totally programmable and all components are available in source text format. Some programming examples are included in the CD and the web page for the distribution can be found at: http://www.meshcube.org

Internal Communication Interfaces

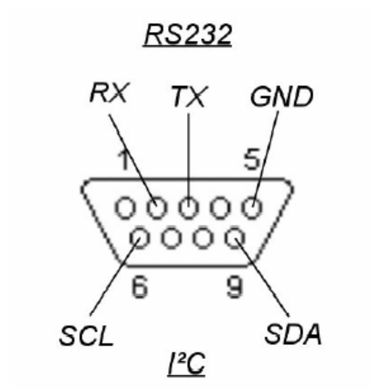
The Ethernet switch:

A 10/100 Ethernet 5 port switch interconnects the different high level peripherals of the robot forming an embedded LAN. From those 5 ports, one is not available and another is necessarily taken by the Access Cube. From the 3 left, one port is generally taken by the IP camera but can be made available depending of the application. This leaves normally two available ports where we can add other peripherals if needed. For those to be reachable from outside the robot, this one will have to be reconfigured (see pag 15).

The I²C bus:

The I²C bus interconnects the micro-controllers in charge of the low level modules to the central processor that acts as a bridge with the upper levels of the robot architecture. The central processor works always as the master and all communications necessarily pass by it. Up to 127 devices can be connected. The I²C is accessible on pin 5 (GND), 6(SCL) and 9(SDA) of the DSUB-9 connector located on the RIGHT of the robot. The program **../root/i2cdetect** that can be found in the CPU allows to detect the devices connected to the bus. The address of the chip in charge of the left wheels (0xA2) can be seen as 0x51, the one of the right wheels (0xA4) as 0x52 and the ADC can be seen as 0x9C.

This diagram shows the signal pinout of the DSUB-9 connectors. The RS232 signals are found on the connector located on the left while the I²C signals can be found on the connector located on the right of the robot.



The RS232 ports:

One RS232 port (RX,TX and GND) is available on the DSUB-9 connector of the left. This port presents a TTL signal, for peripherals using standard PC signals, an interface such as the MAX232 is needed.

Embedded sensors

Speed control:

The four motors can be controlled in open or close loop depending of the needs of the user. Every wheel has an external laser cut code wheel of 300 sectors which signal is recuperated by an optical sensor. The signal is then filtered and sent to four independent PID speed controllers. When remotely controlling the robot, the close loop is done by the operator and therefore is not very useful at the wheel level but it is generally needed in autonomous applications. In both open and close loop control, the speed of each wheel can be retrieved as the number of sector per 1/25 of second but we note here that the “tank like” design of the robot does not allow consistent odometry calculations from the wheel speed.

IR ranging sensors:

The robot is equipped with two IR sensors with a maximal range around 1,30m. They work by triangulation and give an analog output inversely proportional to the distance to the obstacle. The output voltage is then digitalized over 8bits by a micro-controller and sent to the central processor. Those sensors can have different uses like for example to trigger emergency stops or during docking procedures. The output of the sensors is not linear and follows a certain curb. For more information refer to the sensor datasheet.

Battery level:

The robot autonomy is around 2h but can vary depending of how it is used. For this and in order to monitor the battery level, an 8 bit A/D converter has been connected to the I²C bus providing us this information.

Networking

Network architecture:

In the WiFiBoT 4G, the embedded CPU works as a gateway between our internal wired LAN and the external wifi WLAN. The CPU has at least one ethernet card and one wireless card connected to two separate networks (LAN/WLAN).The LAN and the WLAN should have a different address class and therefore data needs to be routed between them. This is done through Dynamic NAT (Network Address Translation). This means, all local components will have their own IP address within the LAN, but from the WLAN they will all be seen as a single IP. In order to be able to access the separate devices we will need to assign to each of them a separate port (**Fig1** is a concrete example). This will require to configure the CPU with the proper routing table (see pag 15).

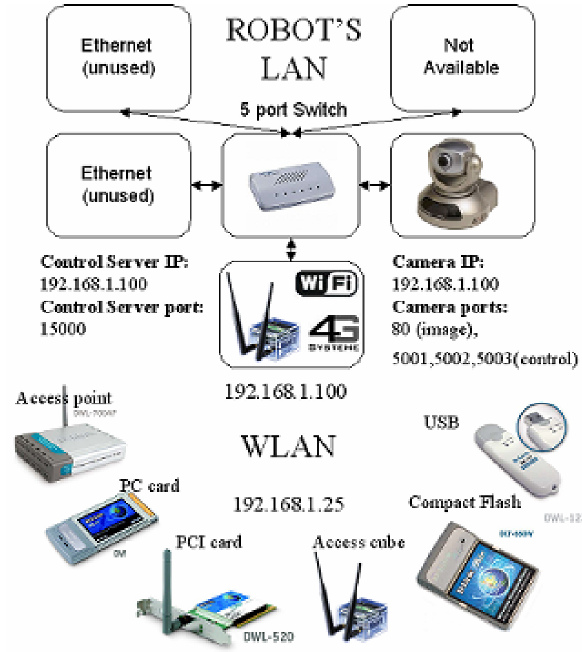


Fig 1

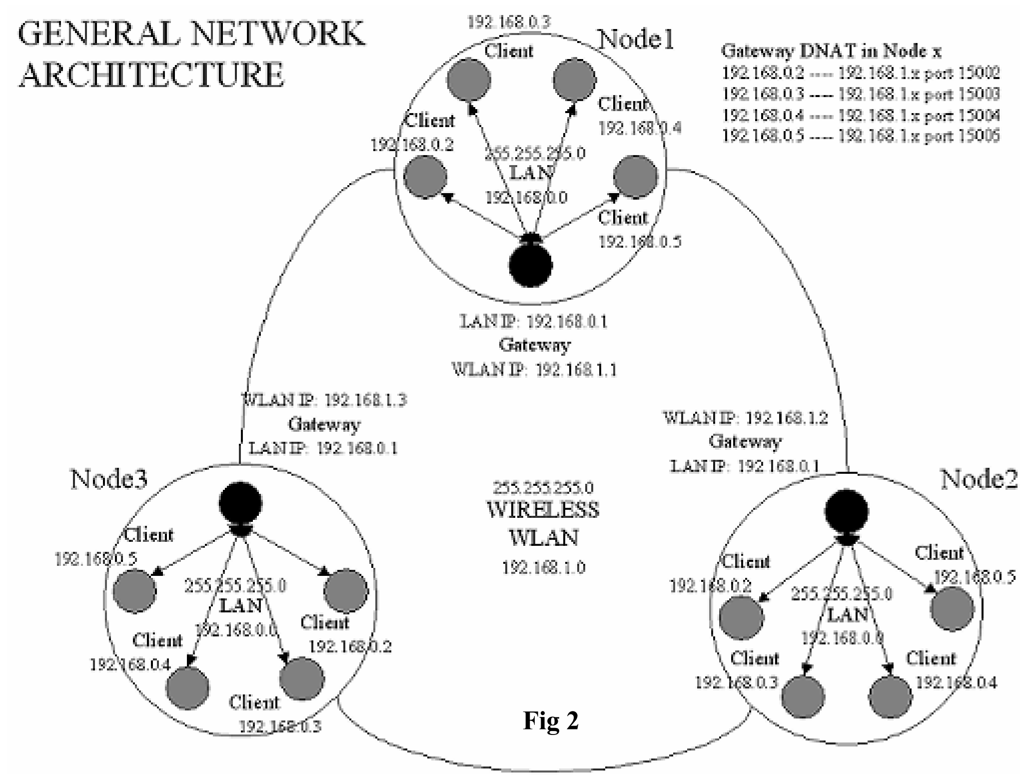


Fig 2

The WLAN modes:

The external Wi-Fi WLAN can be configured in 4 different working modes:

-Infrastructure Master (Access Point)
-Infrastructure Managed (Adapter/Bridge)
-Ad-hoc without routing algorithm
-Ad-hoc with the OLSR routing algorithm
(Mesh Networking)

In infrastructure mode we have a master/slave structure where all the data is centralized in one device called access point (server/master) to which different adapters (clients/slaves/managed) connect. A client cannot talk directly to another but has to pass by the access point which will forward the data to the destination. Several access points can be connected together with cables extending in this way the zone covered by the wireless network. This is the most common setup for a Wi-Fi network (see **Fig1**).

In ad-hoc mode we do not have any central management, each client can talk directly to the other. This mode works fine for networks with few elements. Without any routing algorithm, each element needs to have a direct radio link with the others in order to communicate, no data will be forwarded (see **Fig2**). If a routing algorithm such as OLSR is added, you obtain a self-organizing mesh network in which message forwarding is possible wirelessly between different nodes, connecting in this way devices which are not within direct radio range (see **Fig3**). This allows to extend the zone covered without the need of any cable.The network is completely dynamic, routing tables are rewritten automatically and dynamically as the network changes. If a new OLSR enabled device appears, it will be automatically detected and merged to the routing tables of each node. This is especially useful for mobile networks that can change over time like for example in a multi-robot application.

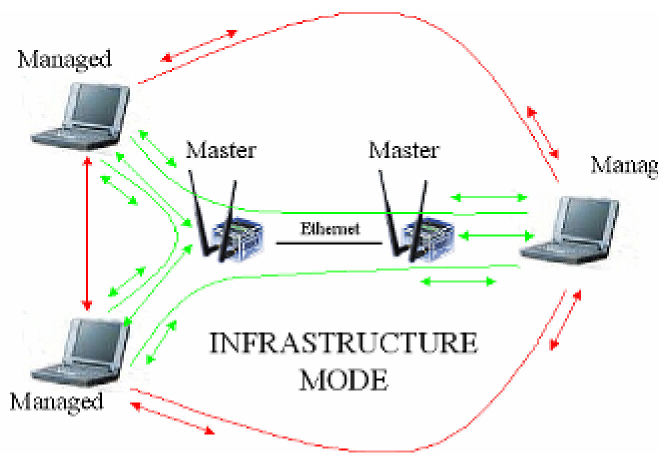


Fig 1

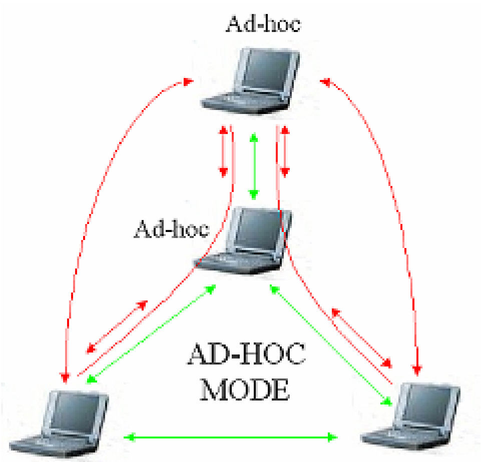


Fig 2

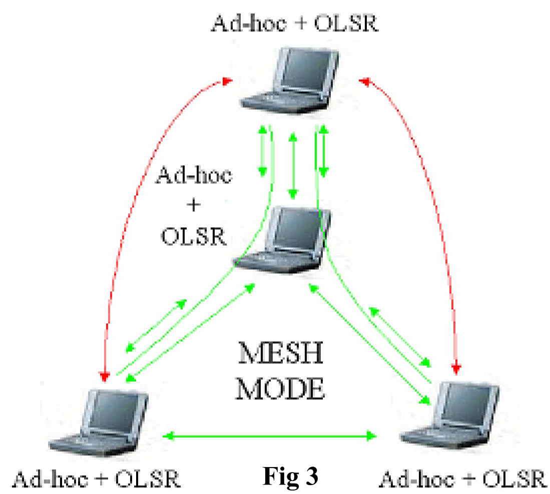


Fig 3

Configuring the robot:

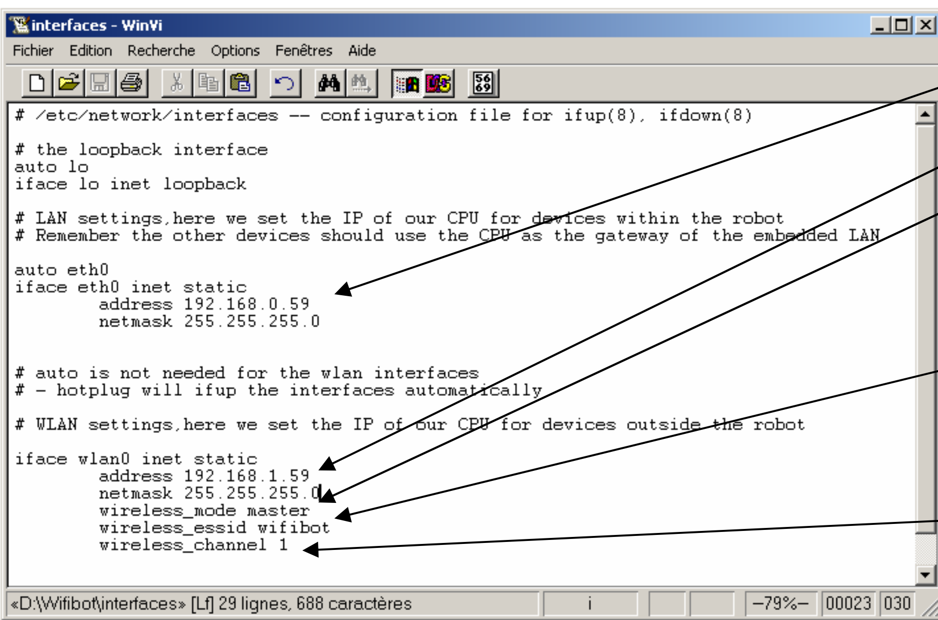
Now that we have seen the different networking issues we will see how to configure the different parameters involved on the robot. There are 3 important configuration files we need to manage in the robot:

../etc/network/interfaces
../etc/nylon/interfaces.conf
../etc/rc2.d/S31wifibot

These files can either be edited outside the robot and then transferred or directly edited on the robot. For clarity we will see here how to configure a WiFiBoT equipped with one wireless card only. For WiFiBoTs with two cards, the files are simply extended with the parameters of the second wireless card.

The “interfaces” configuration file:

This file allows to specify the IP settings of the different network interfaces present on the robot and the wireless settings when it applies. All the WiFiBoTs 4G have the eth0 interface for the LAN and the wlan0 interface for the WLAN connection, an additional wlan1 interface can be added if requested. As we have seen there are four possible wireless modes, here we will show an example of configuration of this file for each one of those modes.


interfaces - WinVi

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```
# /etc/network/interfaces -- configuration file for ifup(8), ifdown(8)

# the loopback interface
auto lo
iface lo inet loopback

# LAN settings,here we set the IP of our CPU for devices within the robot
# Remember the other devices should use the CPU as the gateway of the embedded LAN

auto eth0
iface eth0 inet static
        address 192.168.0.59
        netmask 255.255.255.0


# auto is not needed for the wlan interfaces
# - hotplug will ifup the interfaces automatically

# WLAN settings,here we set the IP of our CPU for devices outside the robot

iface wlan0 inet static
        address 192.168.1.59
        netmask 255.255.255.0
        wireless_mode master
        wireless_essid wifibot
        wireless_channel 1
```

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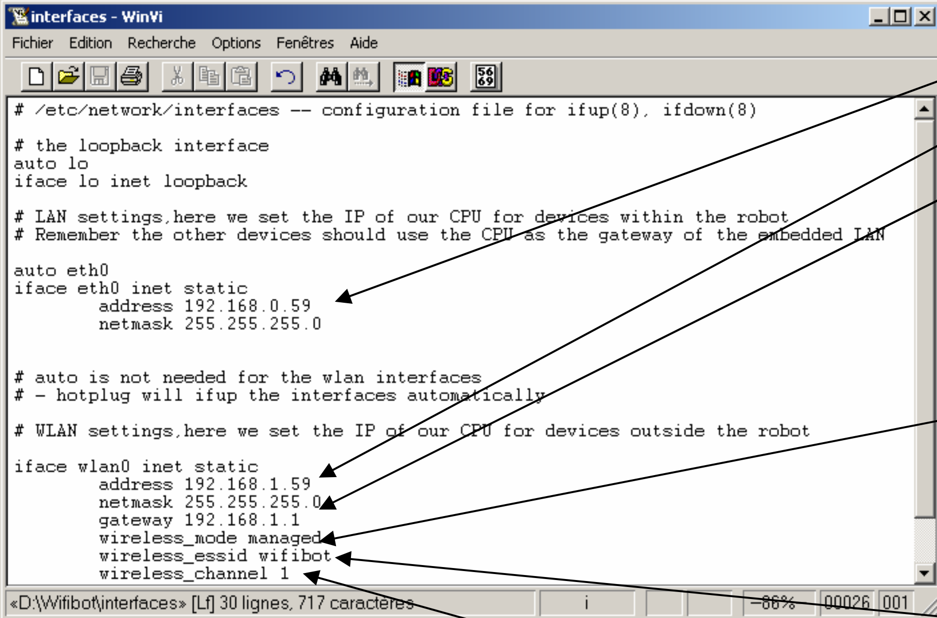
Infrastructure Master:

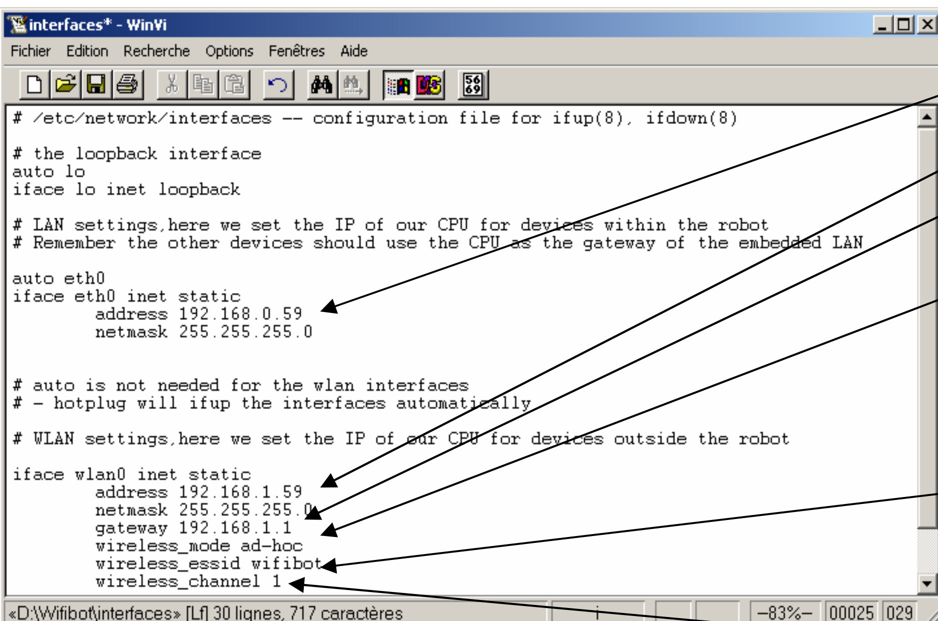
- LAN IP settings
- WLAN IP settings
- wireless mode specified to **master,** that is, it will create a wireless network.
- SSID, that is the name of the wireless network the robot will create.
- channel to be used, important to avoid interferences if several wireless networks are present.




```
# /etc/network/interfaces -- configuration file for ifup(8), ifdown(8)

# the loopback interface
auto lo
iface lo inet loopback

# LAN settings,here we set the IP of our CPU for devices within the robot
# Remember the other devices should use the CPU as the gateway of the embedded LAN

auto eth0
iface eth0 inet static
        address 192.168.0.59
        netmask 255.255.255.0


# auto is not needed for the wlan interfaces
# - hotplug will ifup the interfaces automatically

# WLAN settings,here we set the IP of our CPU for devices outside the robot

iface wlan0 inet static
        address 192.168.1.59
        netmask 255.255.255.0
        gateway 192.168.1.1
        wireless_mode managed
        wireless_essid wifibot
        wireless_channel 1
```


Infrastructure Managed:

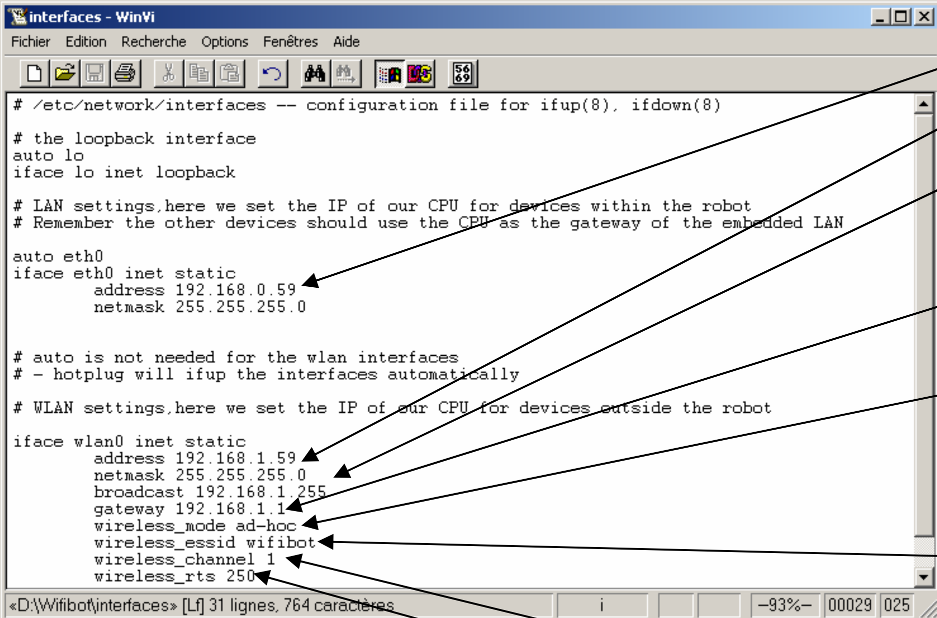
- LAN IP settings
- WLAN IP settings
- If the wireless network is further to be connected to another network (i.e Internet) we need to specify the gateway.
- wireless mode specified to **managed,** that is, it will connect to an existing wireless network.
- SSID, that is the name of the wireless network the robot will connect.
- channel to be used,




```
# /etc/network/interfaces -- configuration file for ifup(8), ifdown(8)

# the loopback interface
auto lo
iface lo inet loopback

# LAN settings,here we set the IP of our CPU for devices within the robot
# Remember the other devices should use the CPU as the gateway of the embedded LAN

auto eth0
iface eth0 inet static
        address 192.168.0.59
        netmask 255.255.255.0


# auto is not needed for the wlan interfaces
# - hotplug will ifup the interfaces automatically

# WLAN settings,here we set the IP of our CPU for devices outside the robot

iface wlan0 inet static
        address 192.168.1.59
        netmask 255.255.255.0
        gateway 192.168.1.1
        wireless_mode ad-hoc
        wireless_essid wifibot
        wireless_channel 1
```


Ad-hoc:

- LAN IP settings
- WLAN IP settings
- The gateway IP if there is one.
- wireless mode specified to **ad-hoc,** that is,all devices will talk directly to each other.
- SSID, that is the name of the wireless network the robot will connect.
- channel to be used,



interfaces - WinVi

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```
# /etc/network/interfaces -- configuration file for ifup(8), ifdown(8)

# the loopback interface
auto lo
iface lo inet loopback

# LAN settings,here we set the IP of our CPU for devices within the robot
# Remember the other devices should use the CPU as the gateway of the embedded LAN

auto eth0
iface eth0 inet static
        address 192.168.0.59
        netmask 255.255.255.0


# auto is not needed for the wlan interfaces
# - hotplug will ifup the interfaces automatically

# WLAN settings,here we set the IP of our CPU for devices outside the robot

iface wlan0 inet static
        address 192.168.1.59
        netmask 255.255.255.0
        broadcast 192.168.1.255
        gateway 192.168.1.1
        wireless_mode ad-hoc
        wireless_essid wifibot
        wireless_channel 1
        wireless_rts 250
```

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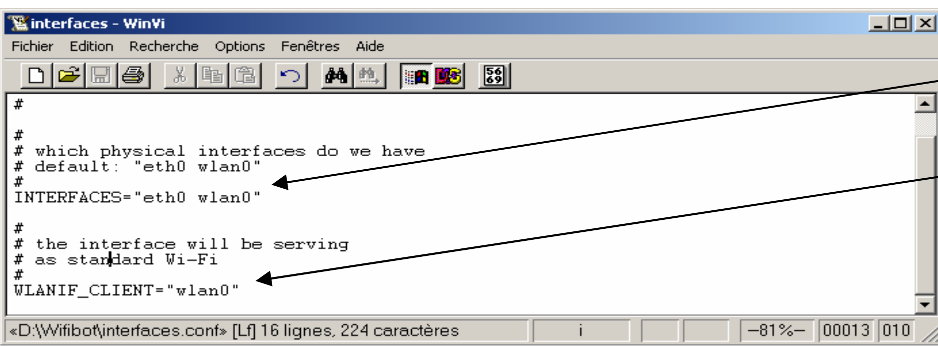
<u>Ad-hoc + OLSR:</u>

- LAN IP settings
- WLAN IP settings
- In **mesh** mode we need to specify the broadcast address.
- The gateway IP if there is one.
- wireless mode specified to **ad-hoc** (**mesh** is built over ad-hoc).
- SSID, that is the name of the **mesh** network the robot will connect.
- channel to be used,
- RTS parameter needed in **mesh** mode.

The "interfaces.conf" configuration file:

This file is very simple, all it does is to indicate what interfaces we have and if the wireless ones will work as standard Wi-Fi or doing Mesh networking.



interfaces - WinVi

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```
#

#
# which physical interfaces do we have
# default: "eth0 wlan0"
#
INTERFACES="eth0 wlan0"

#
# the interface will be serving
# as standard Wi-Fi
#
WLANIF_CLIENT="wlan0"
```

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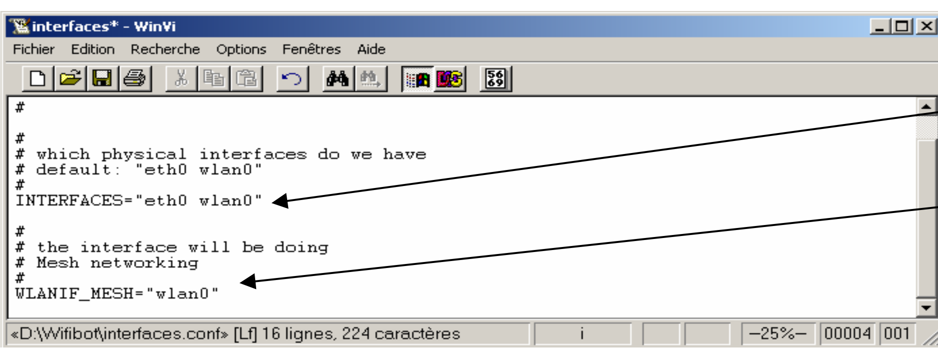
<u>Normal Wi-Fi:</u>

- We specify here the network interfaces.
- We then specify that the wireless interface will work as a normal Wi-Fi device.



interfaces* - WinVi

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```
#

#
# which physical interfaces do we have
# default: "eth0 wlan0"
#
INTERFACES="eth0 wlan0"

#
# the interface will be doing
# Mesh networking
#
WLANIF_MESH="wlan0"
```

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<u>Mesh Networking:</u>

- We specify here the network interfaces.
- We then specify that the wireless interface will make use of OLSR and work within a mesh network.

The “S31wifibot” configuration file:

This is the last step of configuration, we will first specify the routing tables of the NAT address translation, this is needed to make the embedded devices visible from outside the robot.Then we set the commands to set up the low level I²C interface and launch the control server at boot time.

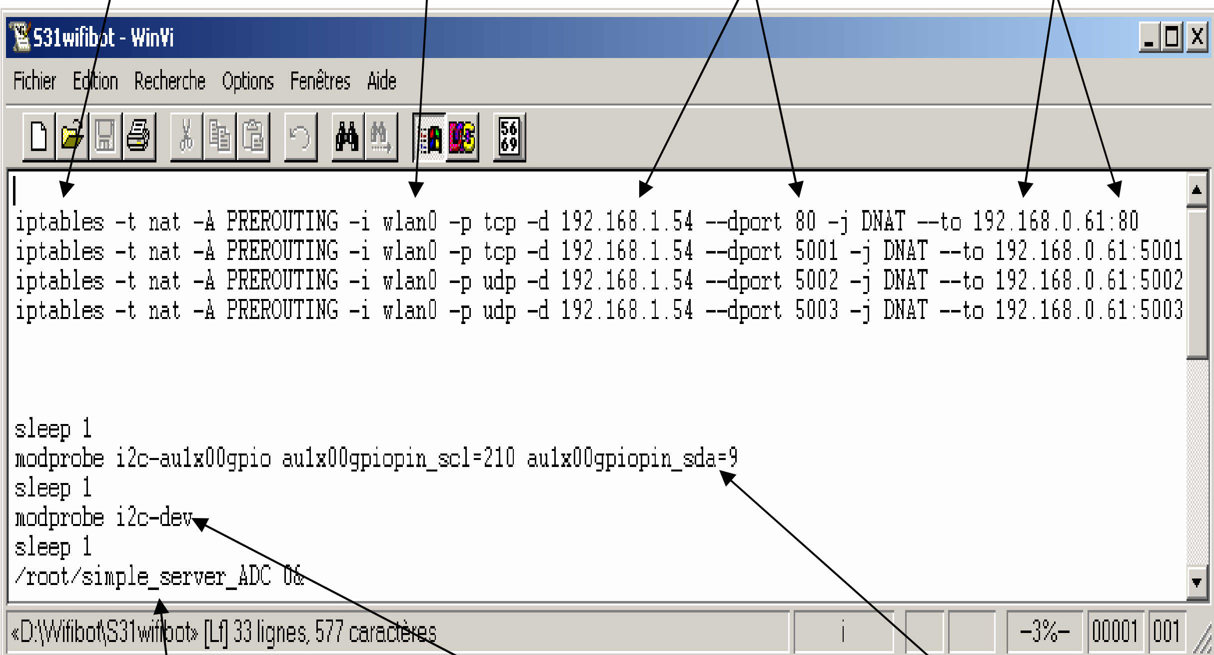
Information about IPTABLES/NAT can be found at http://www.netfilter.org/

We use « iptables » for seeting the NAT

The interface we are « NATting »

The WLAN interface **IP** and **ports** we will connect to from outside.

The LAN device **IP** and **ports** we want to reach (i.e the camera)



Start the control server to wait for connections

Creates the interface in order to get access the I²C bus

Installs the I²C driver

IMPORTANT NOTE!!!!: When editing the configuration files under windows, use the “WinVi32.exe” text editor ONLY, it is included in the CDROM at **..\software\WinVi32**
It is important to use it to respect the Linux format, specially when editing configuration files. Another option is to edit the files directly on the CPU under Linux with the installed “vi” editor, check http://www.linuxfibel.de/vi.htm for more information.

Connecting to the robot:

Configuring your ethernet/wireless adapter:

By default, the robot has been pre-configured with certain IP addresses. Before connecting to the robot you may need to adjust the IP settings of the network adapter of your computer. Make sure all the devices in a same network having to communicate with the robot have the same class of address.

To adjust the TCP/IP settings of the network adapter:

1- Right-click on **My Network Places** in the **Start** menu, then select **Properties** from the pop-up menu. **The Network and Dial-up Connections** window appears.(**Fig1**)

2 - Disable all the network adapters except the one you want to use for connecting to the robot (Ethernet or Wi-Fi). Right-click the network adapter, then select **Properties** from the pop-up menu. (in **Fig1**)

3 - Double-click the **Internet Protocol (TCP/IP)** item to display the **Internet Protocol (TCP/IP) Properties** window. (in **Fig2**)

4 - Check the **Use the following IP address** option, then enter the IP address for the network adapter. **Set IP address** depending on the case : (in **Fig3**)

If you are connecting to the robot with a cable directly on its embedded switch, that is to the LAN, then enter 192.168.0.x (x can be any number between 1 and 254 except 250 and those used by the CPU and the camera of the robot). For example, a Wifibot Serial Number: S/N Y-AXX will have as IP for the CPU 192.168.0.1XX and 192.168.0.XX for the camera, those number are therefore not available. Set the **Subnet Mask** to 255.255.255.0 and leave **Default gateway** and **DNS** empty.

Fig 1

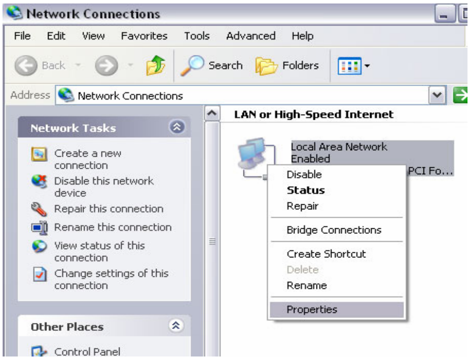


Fig 2

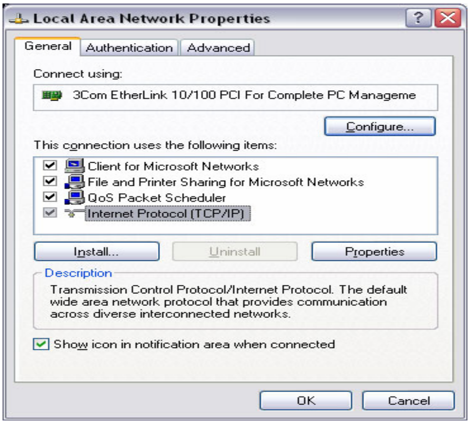
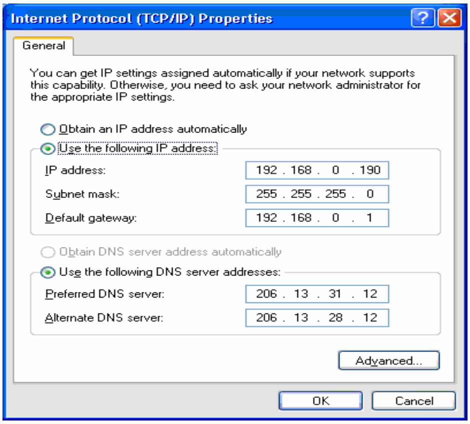


Fig 3



If you are connecting to the robot wirelessly, that is to the WLAN, then enter 192.168.1.x (x can be any number between 1 and 254 except those used by robots or other devices). For example, a Wifibot Serial Number: S/N Y-AXX will have as IP 192.168.1.1XX. Set the **Subnet Mask** to 255.255.255.0

5 - Click **OK** when finished.

Connecting your wireless adapter to the robot:

Once you have adjusted the TCP/IP settings, if you are using a cable and providing the robot is switched **ON** then you are already connected but if you are connecting wirelessly you have to make sure your wireless adapter is connected to the robot and not to something else. This can be done through windows or using the software provided with your adapter.

To connect your wireless adapter to the robot using windows, follow these steps:

1. Switch **ON** the robot and wait a few seconds.
2. In the **Network and Dial-up Connections** window,right-click on the wireless network adapter,then select **Properties** in the pop-up menu. The **Wireless Network Connection Properties** window appears.(**Fig1**)
3. Click the **Wireless Networks** tab. A list of wireless access points appears in the **Available networks** box. (in **Fig1**)
4. If the wifibot network is not listed in the **Available networks**, then click **Refresh** till it is. (in **Fig1**)
5. Check the **Use Windows to configure my wireless network settings** option.(in **Fig1**)
6. Click **OK** when finished.
7. Right-click on the wireless network adapter again, then select **View Available Wireless Networks** from the pop-up menu (in **Fig2**). The **Connect to Wireless Network** dialog box opens with a list of available networks in the **Available networks** box. (in **Fig3**)
8. Select the wifibot network from the list, then check **Allow me to connect to the selected wireless network, even though it is not secure** option. (in **Fig3**)
9. Click **Connect** (in **Fig3**), a pop-up window at the bottom of the screen should appear indicating you are connected. (in **Fig4**)

Fig 1

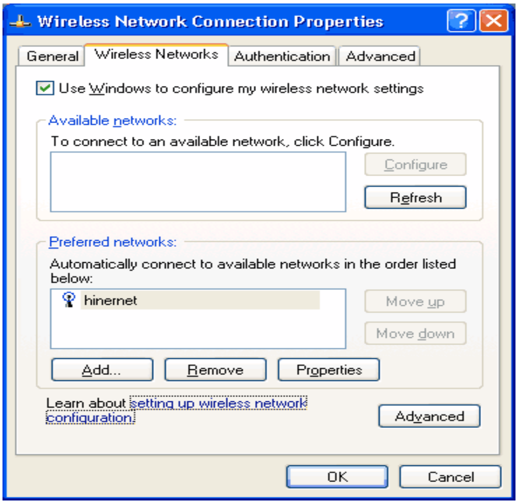


Fig 2

Fig 3

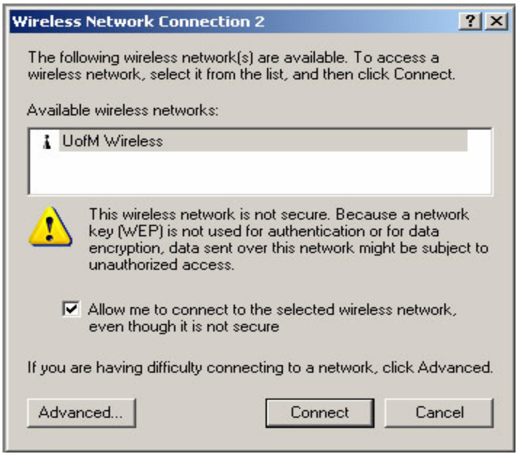


Fig 4

Whether you are connected to the robot directly though a cable or wirelessly you can now decide to:

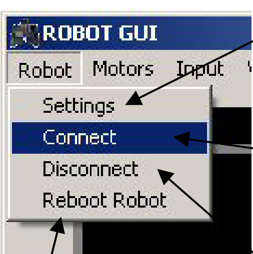
- Control the robot through our control software.
- Access to the robot's operating system to configure the robot.
- Transfer files between your computer and the robot's flash memory.

The control software:

The control software can be found in the CDROM in **..\Software\control software**

1. Install if necessary the **Video Decoder** present in the same folder.
2. Launch the **WifibotGUI** program.
3. Click on **Robot** then **Settings**. The **Robot Settings** window appears.
4. Set the **Control Server IP** and the **Control Server Port** which by default is **15000**.
5. Set the **Camera IP** and the **Camera Port** which for the image is by default **80**.
6. Select the proper **Camera Type**.
7. Click on **Video**, then select **VideoOn**. The image from the camera will appear.
8. Click on **Robot** then **Connect.**
9. Click on **Input** then select **Joystick** or **Virtual_joy**. The robot can now be operated.

The menu options:

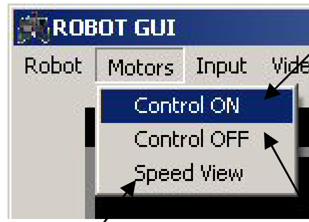


Settings: IP settings of the Control Server and the Camera.

Connect: Starts the communication with the Control Server.

Disconnect: Stops the communication with the Control Server.

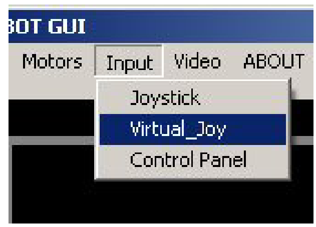
Reboot: Reboots the robot's CPU.



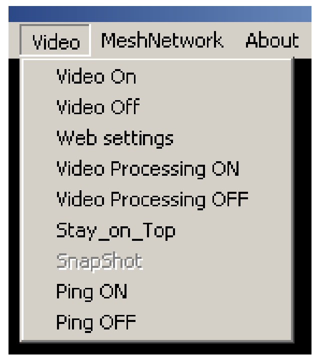
Motor Control ON: Activates the speed control, Input_Left and Input_Right set o the dialog will be applied.

Speed View: Plots in real time the speed signal from the code wheels.

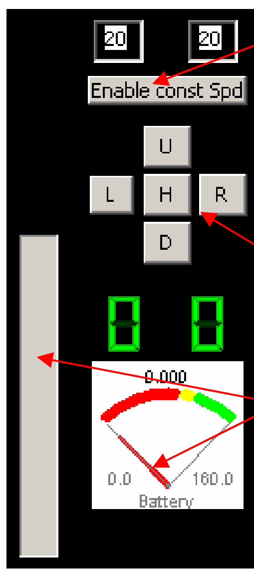
Motor Control OFF: Deactivates the speed control.



Input Selections (control panel for calibrating the joystick)



Video selections: Allows to configure and control some options of the camera.



Current input: shows the current input or allows to set it manually with keyboard.

Pan-Tilt camera control: The red button takes the camera to the default positio You can click on the image too for moving the camera.

Sensor feedback: shows the data retrieved from the range sensors, the battery level and the speed of the robot.

Accessing the embedded operating system:

To remotely log into the robot's operating system we will make use of a protocol called SSH (Secure Shell) which facilitates encrypted communication across networks. This requires a SSH client program. Whichever the SSH client you use, the procedure is similar:

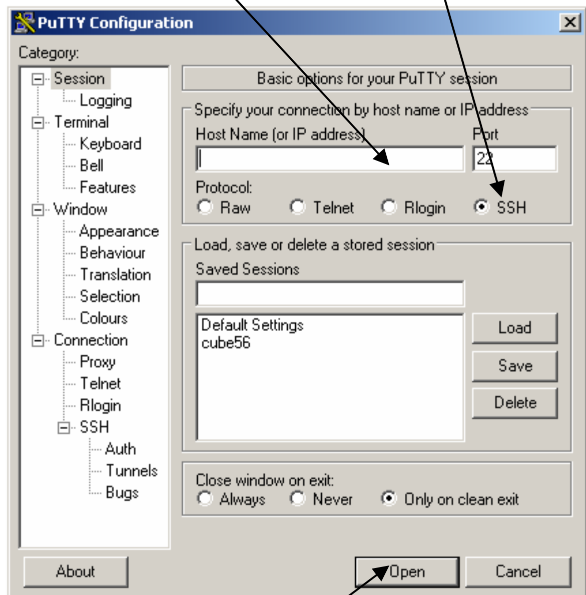
1. Open the SSH client.
2. Enter the CPU IP address (the default port is 22) and then start the connection.
3. The first time a connection is established, the program will ask for confirmation.
4. Enter login: **root**.
5. Enter password: **wifibot**

For your convenience the CDROM includes a free SSH client you can find in **..\software\putty**

Connect to the robot in the following steps:

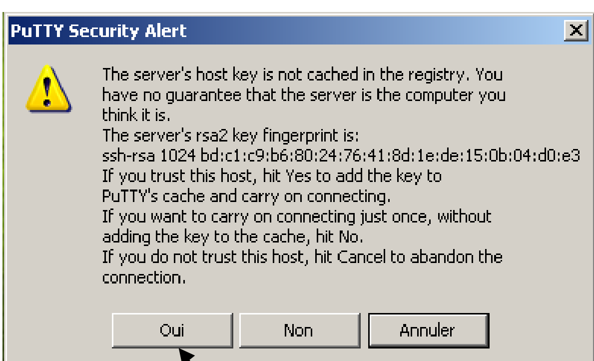
1 - Enter the **IP address** here.

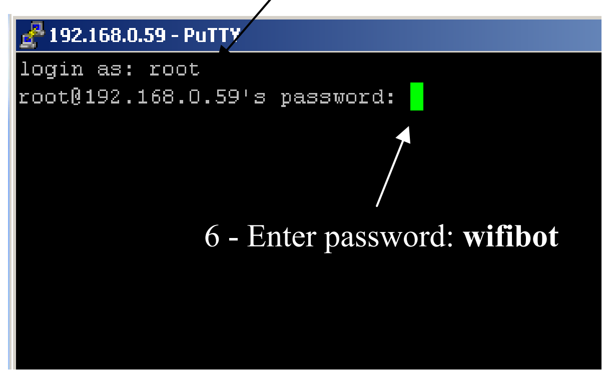
2 - Check the **SSH** option.



3 - Click **Open** to start the connection.

5 - Enter login: **root**





6 - Enter password: **wifibot**

4 - Confirm the connection.

Transferring files to the robot:

For transferring files we will use the SFTP protocol,this requires an SCP client program. For your convenience you will find in the CDROM a free SCP client in **..\software\WinSCP**

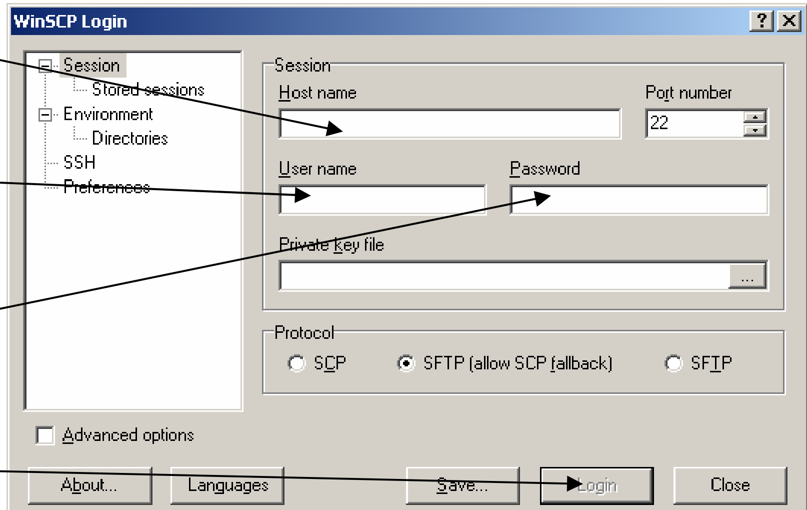
Connect to the robot in the following steps:

1 - Enter the **IP address** here.

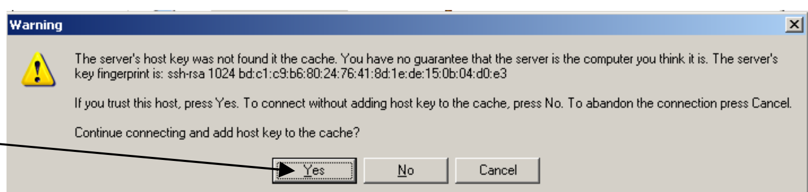
2 - Enter User name : **root**

3 - Enter password: **wifibot**

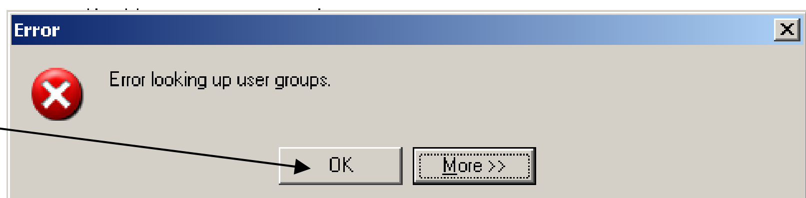
4 - Click **Login** to initiate the connection.



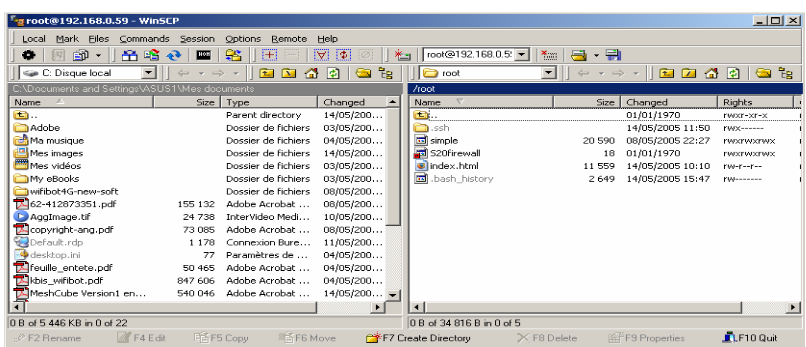
5 - Confirm the connection.



6 - Confirm again.



You are now connected and you can start transferring the files.



Robot programming

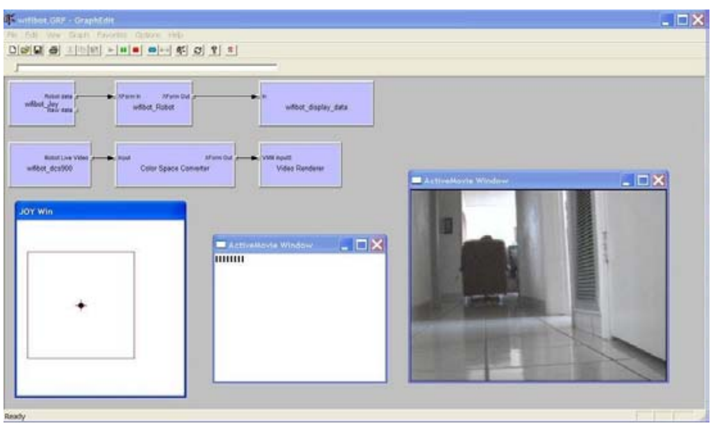
WiFiBoT 4G has been designed in order to make it an open robotic tool that could be used for experimentation in the computer science and electronic fields. There are three main possible ways to work with a WiFiBoT 4G:

Users interested in programming embedded applications can program the embedded Access Cube with a gcc compiler and give the robot autonomous behaviors. Source code in C is given showing how to set the speed and how to retrieve the signal from the code wheels, the battery level and the range value from the sensors. The CD-ROM includes programming examples of the different communication interfaces of the CPU (bus I²C, RS232, TCP/IP).

A wide range of resources for developers can be found at http://www.meshcube.org/meshwiki/

Another way to see the robot is as just a network peripheral. A detailed description of the communication protocol with the embedded server of the robot is included in the CD-ROM (**wifibot-pc protocol.pdf**) so the user can communicate with the robot via TCP/IP without having to even enter into the programming of the embedded processor. Commands can be sent and sensor data retrieved from one or more robots to a remote computer and in this way realize complicated processes and calculations that would be impossible to do on the Access Cube.

To finish, we have developed an interface based on DirectShow filters that has the advantage to be modular and used in the form of graphs inside a graphical interface (graphedit) or integrated within the user software as COM objects. The user can further program his own filters for controlling the robot or for processing the video feedback etc. using the free SDK from Microsoft and then interconnect those with the ones of the robot.



The CD-ROM

The companion CD includes documentation, programs and programming examples. The root folder contains the most important manuals and documentation for configuring the robot. For the rest the CD is structured in six folders:

Access Cube Documentation:

In this folder you will find the original documentation of the embedded Access Cube.

Software:

This folder contains the robot control software, graphedit from DirectShow, the embedded server as well as the tools necessary to manage the robot.

Code Samples:

Here you can find code samples for both the programming of embedded applications and external ones on a remote computer.

DirectShow filters:

This contains the different filters that form the robot interface under DirectShow. The installation program installs and declares the filters automatically. The filters can be used in graphedit or in your own software application.

Datasheets:

Here you will find the datasheets of some of the components of the robot.

Miscellaneous:

Different documentation that can be useful when making mechatronic projects.