

BFF Wi-Fi Bot – Construction Guidance Notes



Guidance notes on construction and set up sequence.

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BFF Wi-Fi Bot – Suggested project steps

1. Introduction

Although the BFF Wi-Fi Bot is a simpler project than many on the Built For Fun web site it still involves a fair amount of work. There are software, electrical and mechanical elements to the project and they all need to be in place and working properly for the robot to work. It is a good idea to approach the project in steps, establishing that each element is working before proceeding to the next – this way the project is manageable and provides a good learning curve.

These notes are intended only to give an indication of what a sensible sequence of activity might be – they are not a step-by-step set of build instructions. If you are an experienced DIY'er you may have your own ideas on how to go about things, if not these notes should be of assistance.

A sensible build sequence will introduce you to the main elements of the robot's systems, keep your spending under control by developing the least expensive parts first and make final setup and commissioning easier.

This is what I would suggest:

- Get the wi-fi driver software running first – the demo version is free. This lets you confirm that the software is compatible with your PC's and works over your Wi-Fi network before moving onto the stuff that needs money to be spent. If you are going to use an onboard laptop or notebook PC you will need it here. If you are using wireless serial telemetry units you will need to have the SPU running before you can test the comms.
- Build the PICAXE microcontroller based Signal Processor Unit (SPU) for the bot. This involves a modest outlay for the electronic kit and components and will introduce you to the flash programming of the microcontroller chips. A temporary logic power supply to the SPU could be rigged up.
- Get the SPU and driver software talking to each other – ie test the serial comms between the microcontroller and the BFF_Bot_Receiver element of the driver software.
- Add the two MD03 motor speed controllers and get them talking to the SPU. This will complete the main drive data loop and if you add the main power supply batteries will allow you to demonstrate the voltage output of the MD03's changing under the control of the joystick attached to your fixed Master PC.
- If you have not done so already add the main power batteries and the power supply you will use onboard for the electronics / servos.
- If you intend to add an onboard camera with servo driven pan and tilt you can also at this stage connect your servos up to demonstrate movement under the control of the joystick buttons.
- Connect the two 250W motors to the speed controllers and with them fixed to something secure demonstrate speed and direction control. At this stage your drive control system is pretty well complete and you should be able to see the motors running under the Wi-Fi network control using the joystick. You can also confirm the data readback functions on the software "Sender" program.
- Build the mechanical elements of the robot.
- Fit out the robot with your already proved electrical systems.
- Jack the wheels off the ground and test the full system carefully before letting it loose. With batteries the robot weights about 26 kgf – too heavy to have running about out of control!

In more detail.....

2. Get the Software Running

You'll need a joystick connected to your fixed PC and properly calibrated.

Ensure that the fixed PC and mobile PC can see each other on the network – the driver software will not work if the PC's are not properly set up on the network. You will need each PC's LAN IP Address.

Install the Bot_Sender software on the fixed PC and the Bot_Receiver on the mobile PC. Set the IP Address and COM port setting in the configuration files. Refer to the software user guide.

Start the programs and confirm that the joystick movements are being displayed on the Sender and Receiver windows on the two PC's.

3. Build the Signal Processor Unit

The SPU is built on the PICAXE Experimenter board which is available in kit form. The components needed are listed in the Materials and Components list. Two 28X1 chips are used, one acts as the main controller for the communications and motor drives and the second as a driver for the camera servos.

Refer to the SPU wiring diagram and chip pin designation diagrams for details of the wiring.

Once the Experimenter board has been constructed the 28X1 chips can be programmed (flashed) and moved onto its breadboard area for final wiring. The chip programming is done using the free programming software provided with the PICAXE kit and with the BFF_RBT_MASTER.BAS and BFF_RBT_SLAVE.BAS programs provided in the download package.

Note that 28X1 chips come with different firmware versions and there are slight differences in the programming for the A.2 and A.3 firmware versions – use the correct program for the chip you have.

The SPU will need a low current power supply and you will need to rig up a temporary one or set up the BEC supply to be used on the robot. Note that using flat batteries in a small battery pack power supply can lead to erratic behaviour when the MD03 speed controllers are added.

Once the SPU is operational the serial communications with the Bot_Receiver software can be confirmed. Serial traffic to the SPU can be confirmed however serial readback data may not be present until the MD03 speed controllers are connected.

4. Add the MD03 Speed Controllers

Refer to the Overall Wiring diagram. The MD03 speed controllers can be connected to the SPU. Ensure the MD03 dip switch settings are right for the I2C addresses required by the wiring diagram. Ensure also that the MD03's are located close to the SPU as described in the Overall Assembly drawing BOT1-A001. The I2C bus used for communications between the MD03's and the 28X1 chip is intended for use with closely located elements and will breakdown if the wire lengths are too long.

With the SPU operational and the MD03 connected and powered up the data readback through the Receiver to the Sender programs should operate and the data should show in the software windows. If the main 24V battery supply is connected to the MD03's it should be possible to demonstrate control over the MD03 output voltages for the drive motors in response to joystick movements at the fixed PC.

With the 24V battery supply connected it will also be possible to set up the onboard 5V power supply to be used for the SPU and MD03 logic supply and for the onboard camera servos.

5. Camera Pan/Tilt RC Servos

At this stage you can also add the pan and tilt RC servos if you intent to use them.

It is not possible to be specific about the mechanical arrangement here because it will depend on the servos you have available and the size and mounting arrangements for the camera you wish to use. The RC servos I used are listed in the Materials and Components list and camera was a Logitech Quickcam Cool. This camera did have difficulties adjusting to bright light conditions outdoors however. The mounting of the servos and camera is shown below – a simple arrangement using a plywood plate, some self-adhesive pads and the mounting elements that came with the servos. You may wish to try something different.

Refer to the Overall Wiring diagram and SPU wiring for the connections. It is possible that electrical noise from the servos may interfere with the operation of the SPU, this will depend on the servos and power supply used. I had no such problems with the HiTec HS-815BB servos I used but this may not be the case with others and may require a separate power supply to be provided for them or for additional isolation steps to be taken.

The limits of movement for the servos are defined in the BFF_RBT_SLAVE.BAS flash program – you may need to adjust them to suit your set up.



The remote vision software I used is described on the web site. It runs entirely on the two PC's and network and does not affect the SPU and bot driver software. You may wish to explore your own methods for getting the camera view back to the master PC.



6. Add the Drive Motors

At this stage the two 24V 250W drive motors can be connected electrically. Refer to the Overall Wiring diagram for details. Note that noise from electric motors can cause problems for the speed controllers so follow the MD03 manufacturer's recommendations for fitting noise suppression capacitors to the motors.

Before switching the system on with the drive motors connected make sure the motors are physically secured to a stable base – they are likely to jump about if unsecured.

With the motors connected and secured it will be possible to demonstrate proper function of the whole control and drive system with the motors running forwards and reverse and at different speeds in response to the movements of the joystick.

7. Build the Mechanical Elements of the Robot

Refer to the set of engineering drawings and the Materials and Components list for details. Leaving the mechanical build to last will allow you to proceed with the heavier work of building the mechanical elements in the knowledge that your drive system is operational.

You may of course have your own design for a skid steer robot. If so note that the current rating of the MD03 controllers is 20 Amps and they are rated for use with voltages up to 50V so a wide range of drive motor and bot designs is possible. At higher than 24V voltages the rating of other components (eg power supply BEC units) must be checked before connection and use.

Once you have built and assembled the mechanical elements of the bot the electrical systems can be fitted out. However before the electrical drive is powered up jack the wheels of the bot off the ground

and thoroughly test the system to ensure that it is behaving predictably and is fully under control. The robot with batteries weighs roughly 24 kgf (53 lbf) and can do damage if it runs out of control. The software and SPU programming is all arranged as much as is possible to cut the drive to the robot if any element is not working as expected, however this is a DIY build and can not be foolproof - you must proceed with caution when commissioning the robot.

8. SAFETY

WARNING The robot is heavy and can move quickly – keep it away from small children and pets, drive it with caution and make sure the emergency power disconnect is easily accessible.

Remember hitting \ (backslash) on the master PC will close the software and cut the drive instructions to the bot.

Take all necessary precautions when using powered or hand tools – always follow the manufacturers' operation instructions.

The risk of electrical shock is much reduced in low voltage battery powered designs compared to high voltage mains powered equipment. However high current flows can still be present and high temperatures can be present in connectors, wires and other equipment especially if not selected or fitted properly. Take care! Take particular care not to allow short circuiting of the main 24V battery system as this can damage equipment and generate high temperatures. Take care not to expose low voltage electronic components to the full 24V battery supply.

Do not solder on any “live” electronics equipment.

IMPORTANT The technical drawings do not include a design for a robot cover as this is likely to dependent on the intended use and is largely a matter of personal design as it substantially determines the appearance of the bot. **WHATEVER YOUR COVER DESIGN YOU MUST ENSURE THAT ADEQUATE COVERS ARE PROVIDED OVER THE EXPOSED CHAIN AND SPROCKETS OF THE DRIVE TO PREVENT ACCIDENTAL CONTACT AND INJURY.**

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