FaceWalker Part 2

By Michael Simpson

Important

Requires ZeusPro
V1.70 or later

Build the FaceWalker
Part 2, Wireless Connection *(V1.1)*
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In Part 1 of this series we built the base for FaceWalker. I provided you with a simple program that allowed you to test the assembly. One of the problems you have with a walker of this nature is that you need a great deal of control points to really push the robot to its limits. I originally attempted to use an RC radio to control the FaceWalker, but this approach presented multiple problems:

1. Ground based radios with more than 2 channels are very expensive.
2. They are slow to interface as you must poll each channel individually.
3. The transmitters are not very compact.
4. The transmitter's battery requirements can be greater than the device you are trying to control.

Kronos Robotics and Electronics

www.KronosRobotics.com

While I was researching other options I came across the PS2 controller. I have never owned a PS2 so it never occurred to me that this would be a viable option.

The PS2 controller has 2 full position analog joy sticks, and 14 additional buttons all within reach of your fingers while you are operating the joysticks.

You can pick up a wired controller for as little as $5.95 and a wireless for $24.95. Figure 2 shows a very popular wireless model called the Predator by Pelican.

Figure 2

The Madcatz 440 has been tested and works well. We have also tested varios Intek controlers and have not had any success with them.

The Predator runs on 2 AA batteries which will last several hours. The wireless controllers operate on the 2.4Ghz band. You lock a transmitter to the receiver so that you can operate multiple transmitters at the same time. I have a WiFi wireless network and Bluetooth and never had any problems using the Predator. While these wireless controllers are rated at 30 feet, I have used mine at ranges well over 100 feet outdoors.

The receiver module shown in Figure 3 is small and operates on 5v so it is well suited for use with microcontrollers.

Figure 3

You may connect directly to these pins if you like. I prefer using a PS2 extension cable that has been cut in half. The extension cable will cost you $5-$10 and will give you a cool way of connecting various controllers to your application. The pins on the extension cable are reversed for obvious reasons as shown in Figure 5.

The PS2 interface uses a SPI interface. There are 4 signal pins as well as Gnd and power needed for this interface. The SEL and CMD signals are used to place the controller into the correct mode. The Data signal lead is used to send or receive data depending upon the command. The Clock signal is used to clock the bits in or out.

To interface to a PS2 controller you need to use a microcontroller. For the FaceWalker, we will be using a DiosPro microcontroller. I am not going to go into the protocol details as they are outside the scope of this article. I created two DiosPro functions called PS2Init and PS2Read. These functions will take care of handling the various timing requirements of different controller types as well as the protocol needed for the actual hardware interface.

Update August 29, 2006

I have added the colors of the extension cable leads. Please note that these colors only apply if you use a Datel Extension Cable #PS22710D. These are very popular and can be purchased from Best Buy for under $10. If you are using a different cable you will need to use a meter to check the colors against the pins.

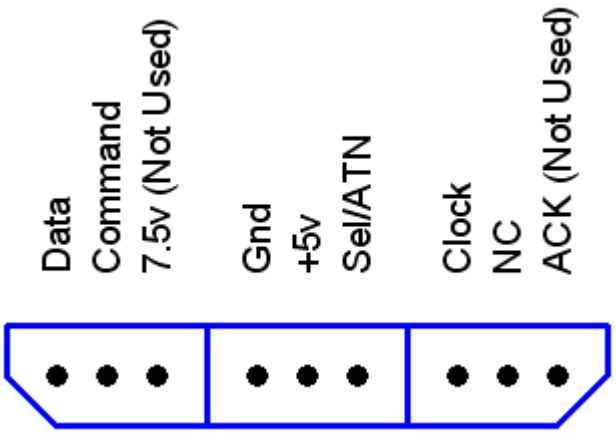


Figure 4

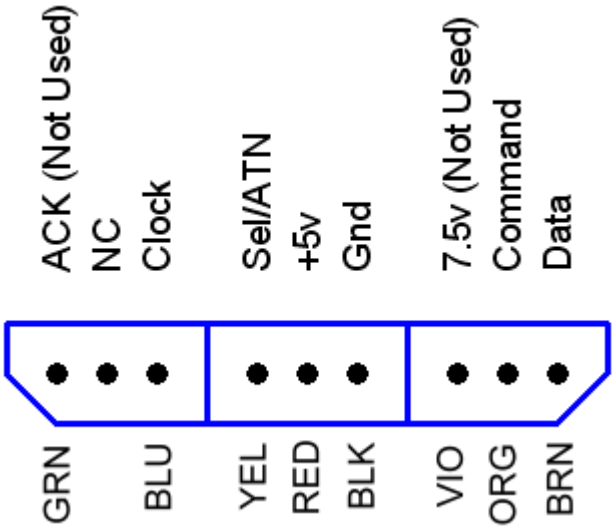
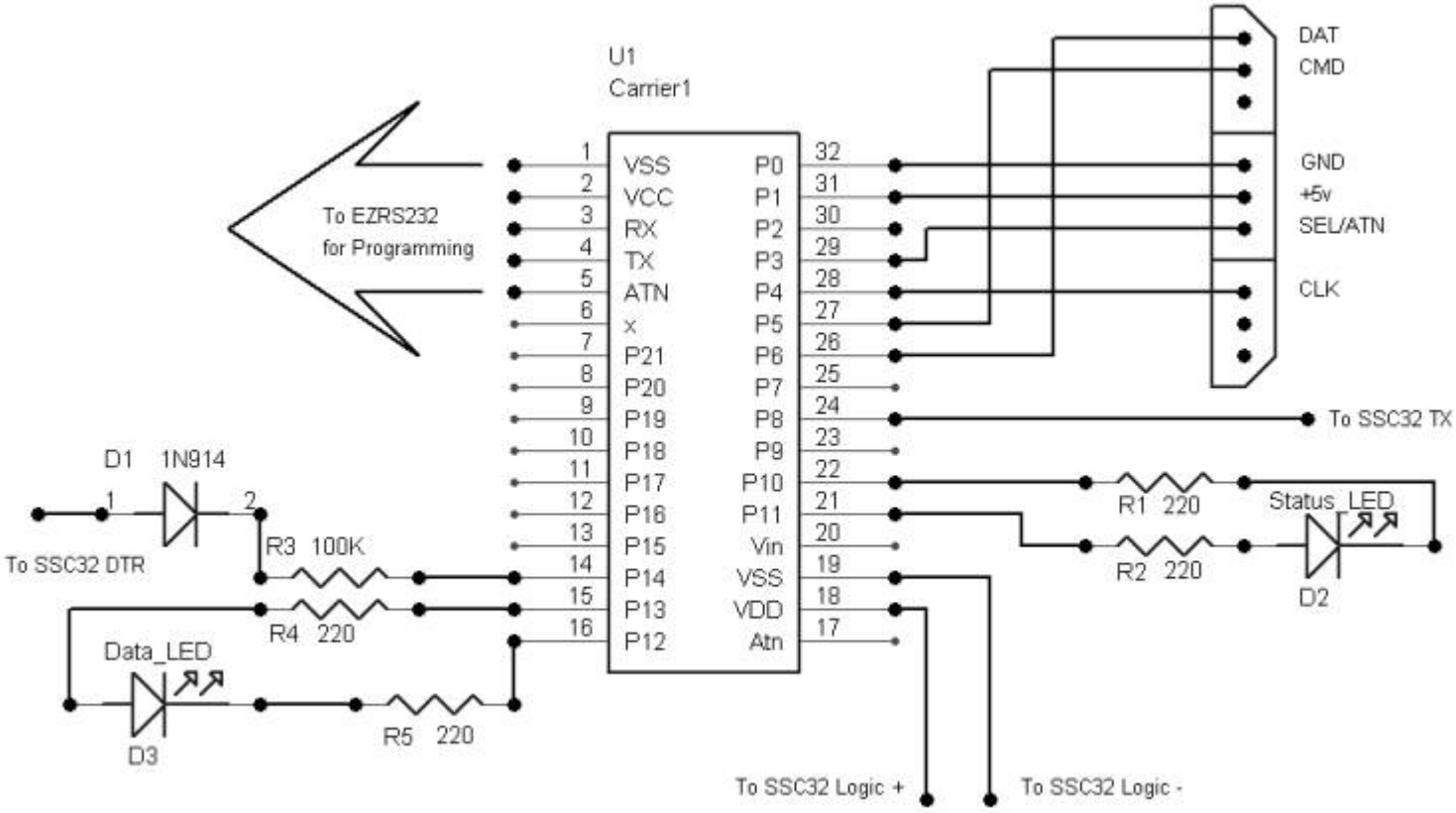


Figure 5

Figure 6

Interface Construction

Before we get started with the controller interface assembly, let's take a quick look at Schematic 1. We will be using a DiosPro chip to communicate with the PS2 controller. To make the construction as easy as possible I used a Dios Carrier 1 board. A couple of LED's were added for status. The remaining connections are connected to the SSC32 board's RS232 interface and the SSC32's regulated side of the logic power.



Schematic 1

Let's start by assembling the Dios Carrier 1 board. The kit comes with an assembly manual which we will follow until we get to Step 7. In Step 7 install the headers on the top of the board as shown in Figure 6.

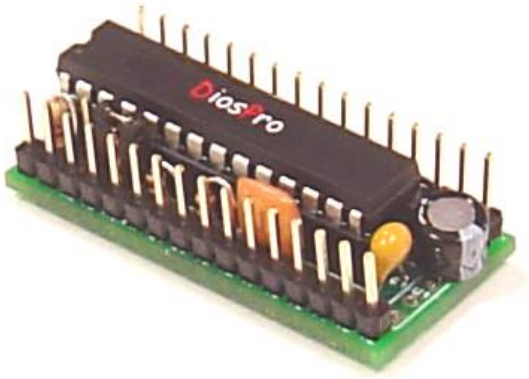


Figure 6

Once you have the carrier built, install the DiosPro chip and attach a small piece of foam tape to the bottom of the board. Attach the board to the EH3-R base as shown in Figure 7.

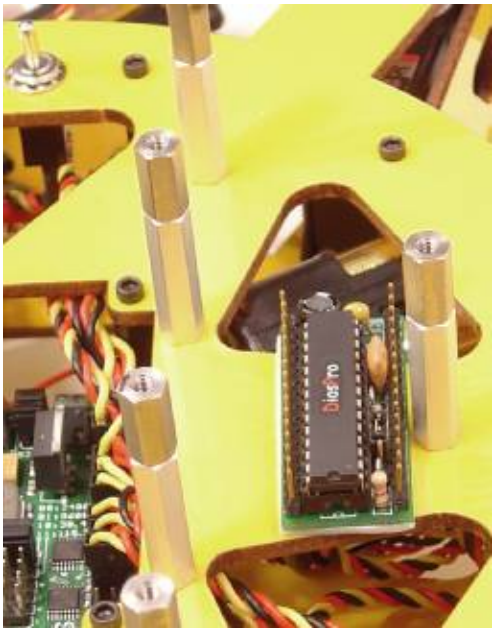


Figure 7

Center the carrier against the standoff. For orientation, notice the switches in the upper left side of Figure 7. Notice also that the notch in the chip is facing down.

In order to supply power to the Dios we need to build the small 2-conductor connector shown in Figure 8. Start by cutting two 5" wires. Since this is going to be a power connector, you need to make each conductor a different color. In this case I used red and black. Next, cut two 2-pin sections from the 36-pin female header. Cut 4 pieces of 1/16" heat shrink 1/2" long.

Figure 8

Start assembling the connector by soldering a wire to each of the pins on one of the 2-pin headers. Slip a heat shrink section onto the wire and slide it over the solder joint and heat. Now slip one of the two remaining heat shrink sections over each wire. Then solder the wires to the remaining 2-pin header. Slide the heat shrink down over the joints and apply heat.

Connect one end of the connector to the +- header pins on the SSC32 shown in Figure 9. This header is located next to the Baud Jumpers. Connect the other end of the connector to the +- header pins on the Dios Carrier 1 as shown in Figure 10.

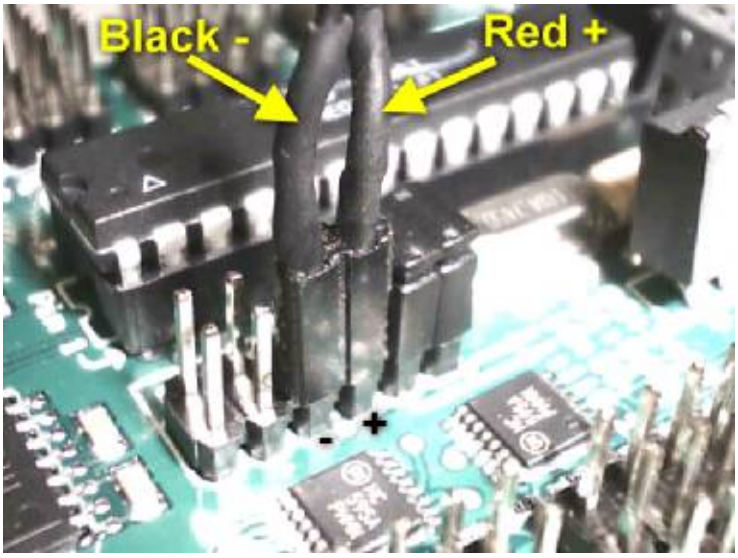


Figure 9

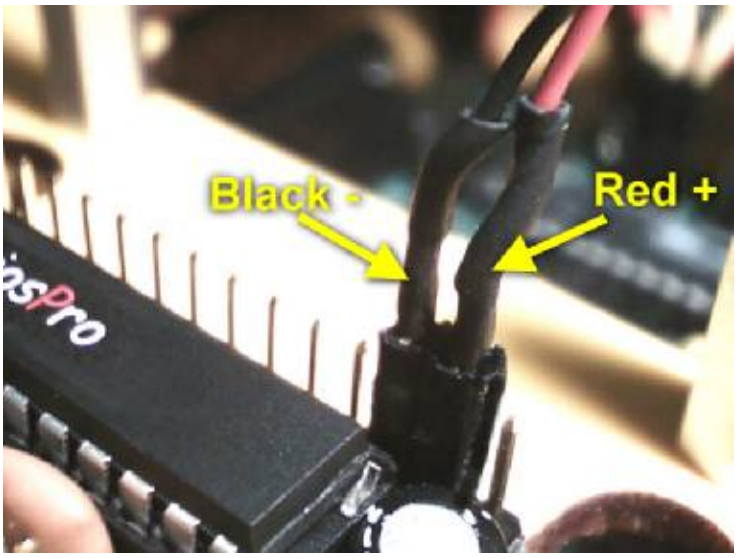


Figure 10

In order to create the status indicators you will need the components shown in Figure 11.

- Red LED
- Green LED
- 4, 220 Ohm Resistors
- 4, Female Plugs
- 2, 3" Pieces of 1/8" heat shrink

Figure 11

Take the red LED and clip the leads so that they are 3/8" long. Clip resister leads to about 1/4" as shown in Figure 12. Solder one end of the resistors into the open end of a female plug as shown. Solder the other end to the led as shown in Figure 13.

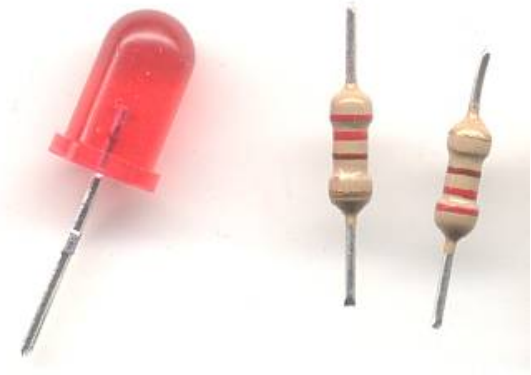


Figure 12

Figure 13

Cut just enough of the 1/8" heat shrink to cover the complete lead and slip it over the complete plug/resistor assembly and heat as shown in Figure 14. Repeat the same procedures for the green LED.

Figure 14

Insert the green status LED onto the Port 10 and Port 11 header pins as shown in Figure 15. Make sure the flat side of the LED is facing left. Insert the red data LED onto the Port 13 and Port 14 header pins as shown in Figure 16. Make sure the flat side of the LED is facing right.

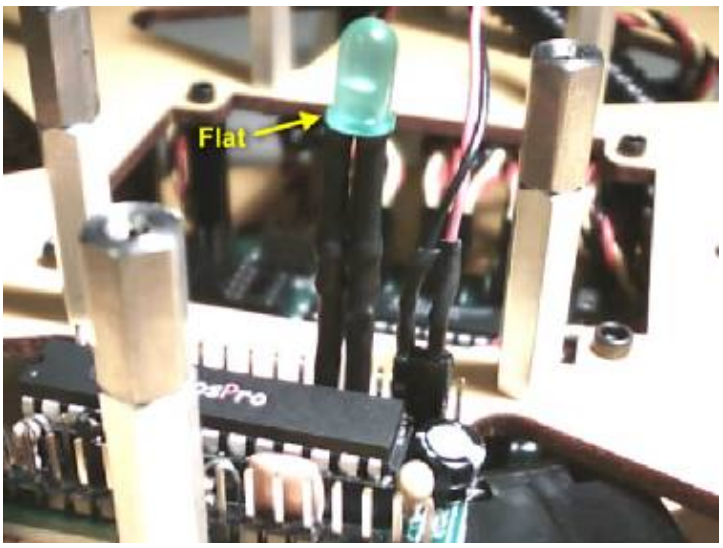


Figure 15

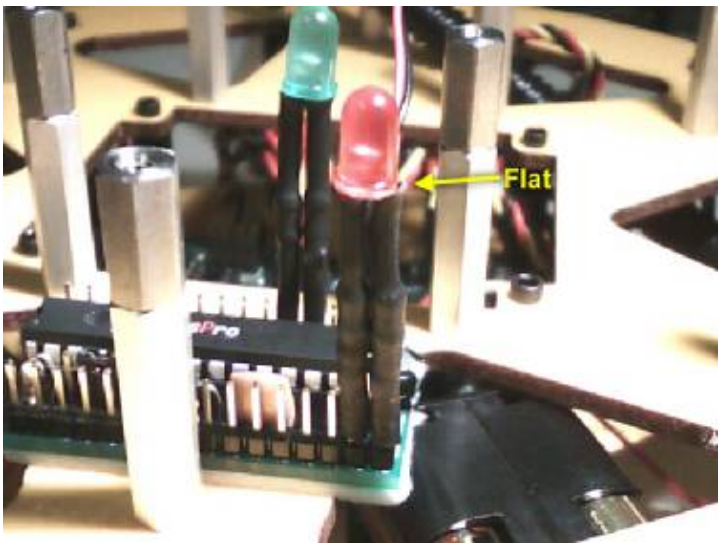


Figure 16

The Dios comes programmed with a test program that toggles all the IO ports. If everything is connected properly and we provide power to the SSC32, the status LED's should begin to flash.

Once we have a powered Dios we can program the PS2 controller firmware into the chip. In order to do this we need to create a small adapter by cutting two 5-pin sections from the 36-pin female header and solder them together as shown in Figure 17.

Figure 17

With the small adapter we can plug an EZRS232 board into the Dios carrier as shown in Figure 18. This will allow us to upload the firmware to the chip. There are a couple of ways to do this. You could download the free Dios software from the KronosRobotics web site or you can use the ZPU Firmware Updater form that is part of ZeusPro.

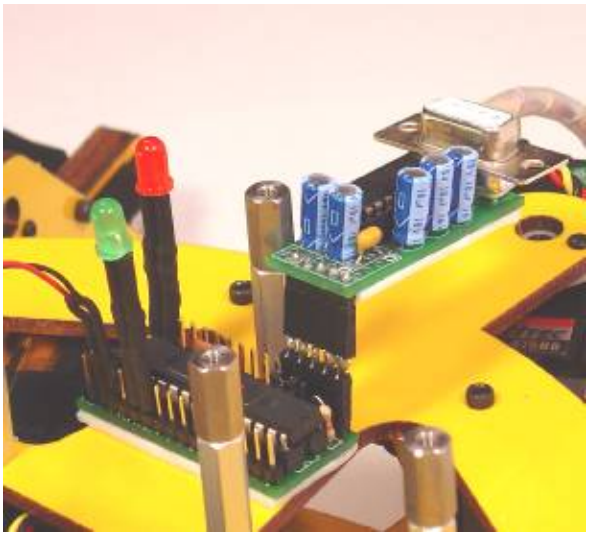


Figure 18

If you plan on making modifications to the firmware you should use the Dios software as this will give you access to the source code. If you decide to use the ZeusPro method, the Upload menu lists the File as FaceWalkerPS2IO. You will need to power up the SSC32, which in turn will power the Dios carrier. Connect a 9-pin cable between the EZRS232 board and your PC and program. Open the ZPU FirmWare Updater form and select Upload FaceWalkerPS2IO ZPU File as shown in Figure 19. The file will load and present you with some basic information about the file. Click the Upload button also shown in Figure 19.

Important
If the FaceWalkerPS2IO ZPU file does not appear in the DiosPro uploads list simply place the FaceWalkerPS2IO.ZPU file in the firmware folder in the directory you installed ZeusPro.

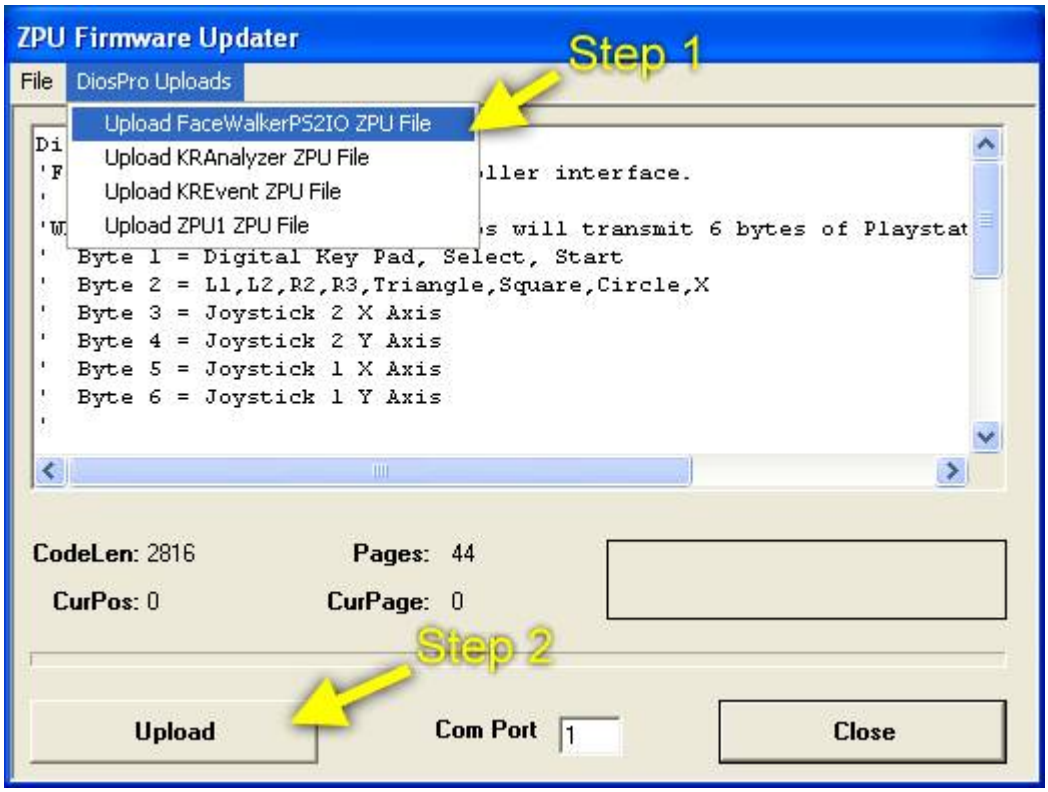


Figure 19

If you want to program the Dios directly you will need to load the Dios Software (Free from the Kronos Robotics website) and select the Open DiosPro File option from the Dios File Manager as shown in Figure 20. You will be presented with a file dialog. Point to the location where you placed the downloaded FaceWalker support files and load the FaceWalkerPS2IO.txt file. A window will open up with the source file. At this point you can make any changes or just program the code into the chip by hitting the Program button shown in Figure 21.

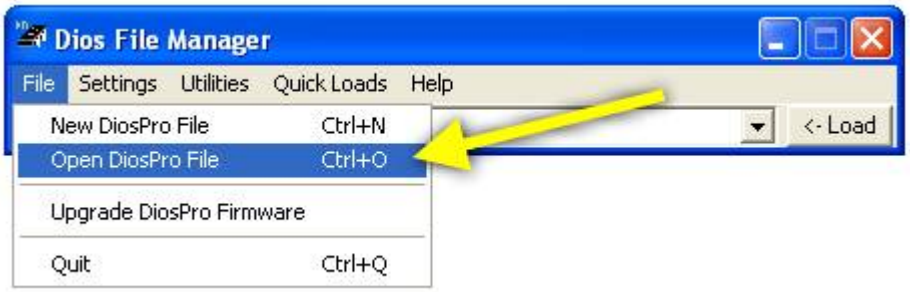


Figure 20

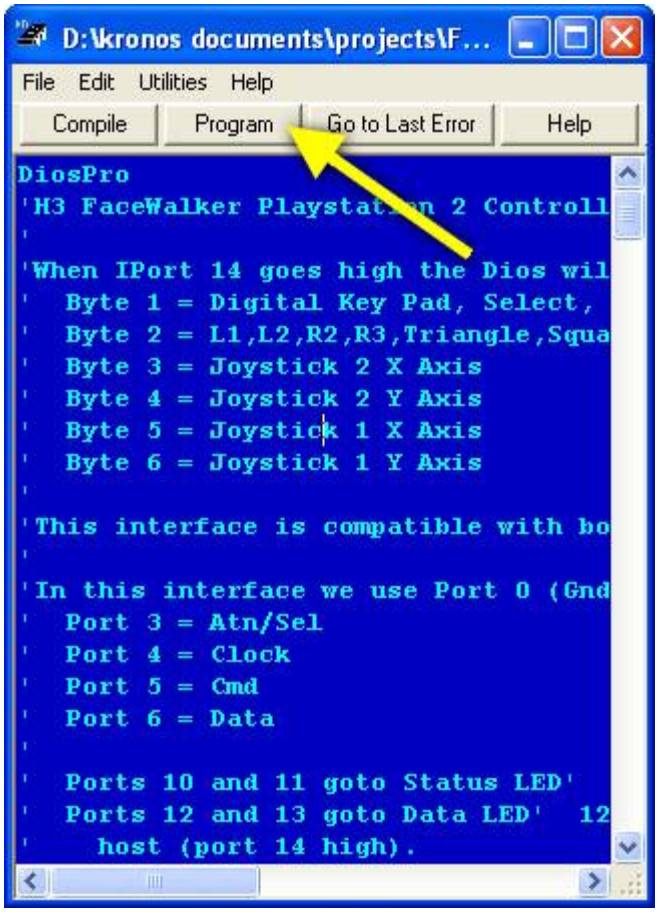


Figure 21

It is important to note that any program created for the DiosPro Chips can be written to a ZPU file so that they may be uploaded with ZeusPRo software as well. By simply placing the ZPU file in the Zeus firmware directory they will show up on the menu.

Now that the chip is programmed you should have noticed that the LED's have started to blink. This is because they have not detected a controller and the firmware is in an error state.

It is time for you to make the final connections so that you can communicate with the firmware you just loaded into the chip. Let's start by creating a small jumper. You will need a piece of hookup wire about 6" long, 2 female plugs and 2 pieces of 1/6" heat shrink about 3/4" long. Solder the wire to the open end of the female plugs, then slip the heat shrink over the ends a shown in Figure 22.

Figure 22

If you have not done so already, remove the TX shunt (jumper) from the SSC32 board and slip one end of the jumper cable you just made onto the header pin closest to the edge of the board as shown in Figure 23. Slip the other end of this jumper cable onto the header pin next to the green LED on the Dios Carrier as shown in Figure 24. This is Port 9 on the Dios. What this does is to connect the Dios TX UART to the TTL side of the SSC32 RS232 driver.

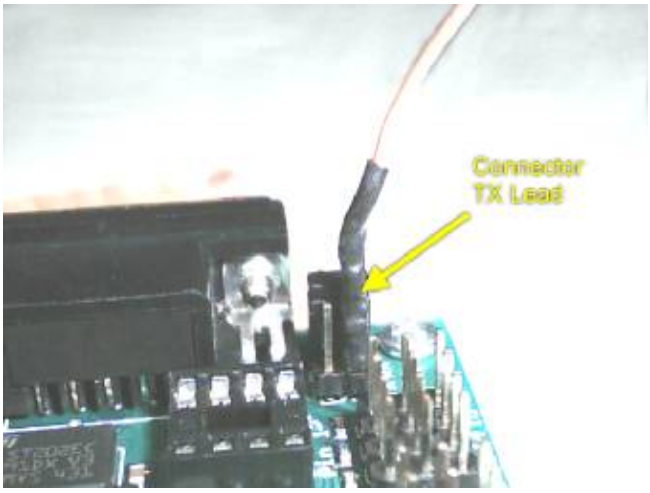


Figure 23

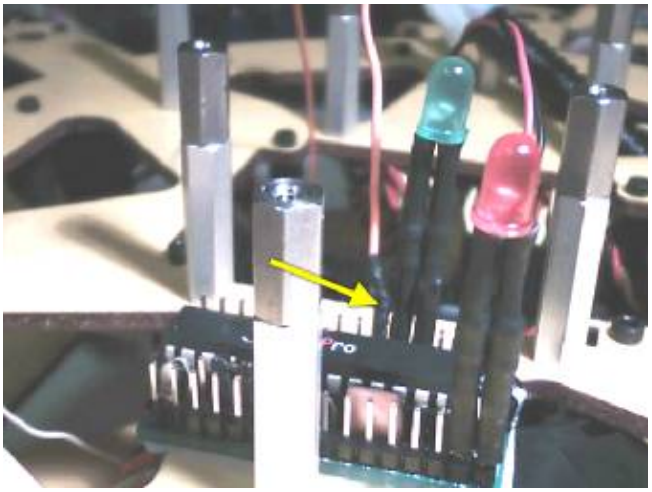


Figure 24

Now we need to connect the DTR on the SSC32 to the Dios. Back in Part 1 of this article I had you connect a wire to the back of the board. This is DTR as it comes directly from the host. Since this is a raw RS232 level signal we have to condition it a bit. Connect a 100K resistor to the open end of a female plug, then connect the cathode side (Band) of a 1N914 diode to the other end of the resistor. Now connect the free end of your DTR wire to the Anode side of the diode. If this was as confusing for you to read as it was for me to write then you had better take a look at Figure 25. Cut off enough 1/8" heat shrink to cover the female plug and all the solder connections and heat. Plug this connector onto the header next to the red LED as shown in Figure 26. This DTR signal connected to the Dios gives us a way to signal the Dios that we want a new set of PC2 controller values.

Figure 25

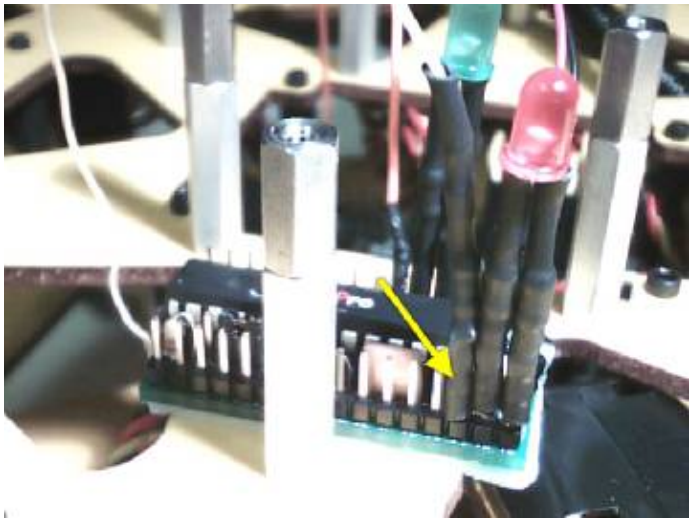
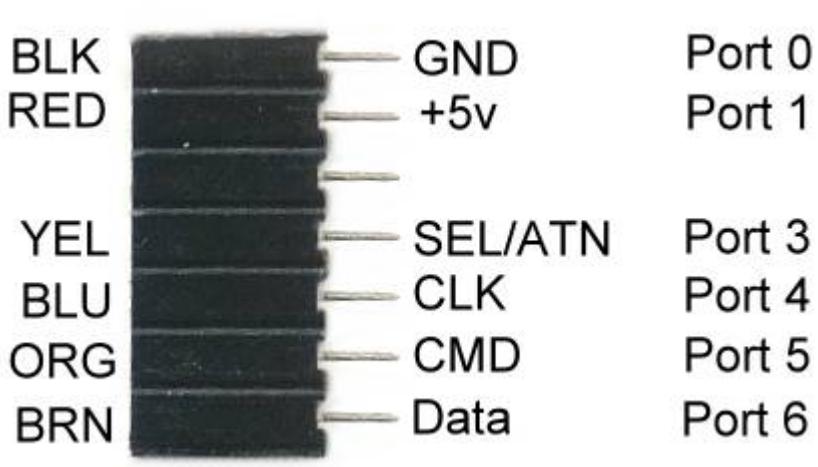


Figure 26

We have come a long way, but it is time for our final connection. For this you will need a PS2 controller extension cable, some heat shrink, and a 7-pin female header.

- Cut the end of the extension cable that mates to your PS2 controller. You want about 12" of cable. Don't confuse this with the end that plugs into the PS2.
- Strip about 2" of the plastic insulator back revealing the small colored wires.
- Trim about 1/8" off each of these wires.
- Take a multi-meter and using Figure 5 determine which wire is mated to each pin.
- Using Figure 27 connect the various wires to the header. Slip a 1" piece of 1/6" heat shrink over each wire before you solder it in place. Once a wire is soldered, pull the heat shrink over the connection and heat.



When all the wires have been connected you should end up with the cable assembly shown in Figure 28. I secured the ends with a small tie wrap. Now you can connect the female header to the header pins on the Dios carrier as shown in Figure 29. Notice that the first two pins are the Gnd and +5v. These mate up with Ports 0 and 1 on the carrier. Port 0 is indicated with the yellow arrow in Figure 29.

Figure 28

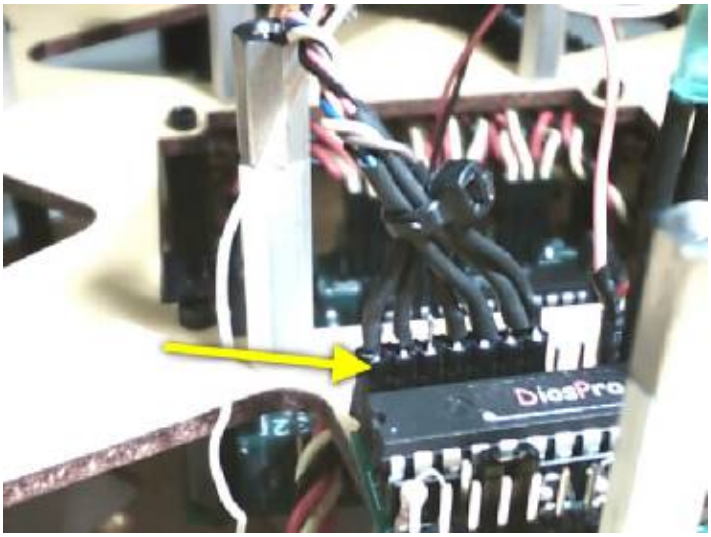


Figure 29

Testing

Plug in a controller to the extension cable. Attach a serial cable from your PC to the SSC32 board. Do Not apply power to the servos at this time. I have included a test program that talks to the Dios chip. The InterfaceTest program shown in Figure 30 will allow you to test the two joysticks and all the buttons. Start up the InterfaceTest program and turn on the Logic Power to the SSC32.

When the power is applied you should see the LED's flash, then the green status LED should light solid. The red LED will flash on each time the program asks for a set of data. If you don't get the Status OK label then it's time to start troubleshooting all your connections.

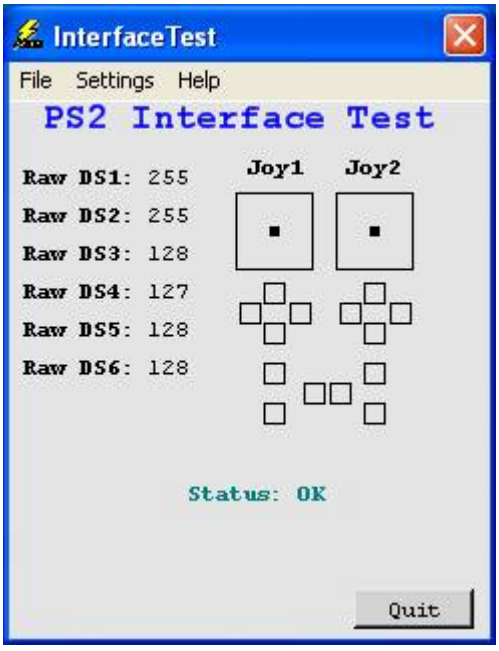


Figure 30

What's Next?

In the final article in this series I will show you how to mount a Pocket PC and interface it to your FaceWalker. We will add some final touches to the construction. I will go into detail about the software so you can customize it to meet your own needs.

All the source code as well as project updates can be downloaded from the Kronos Robotics web site at http://www.kronosrobotics.com/Projects/FaceWalker.shtml

Parts

Kronos Robotics www.kronosrobotics.com

- Dios Carrier 1 #16170
- Dios Pro 28 #16429
- EZRs232 #16167
- 36-pin Female Header #16291
- 2, 3" Pieces of 1/16" heat shrink#16287
- 2, 3" Pieces of 1/8" heat shrink#16288
- 10, female Plugs #16261
- Red LED #16234
- Green LED #16235
- 4, 220 Ohm Resistors #16188
- 100K Resistor #16195
- 1N914 Diode #16134
- Dios Compiler (Free Download) http://www.kronosrobotics.com/downloads/DiosSetup.exe

KRMicros www.krmicros.com

- ZeusPro http://www.krmicros.com/Development/ZeusPro/ZeusPro.htm

Other

- Double stick foam tape. Two 1" pieces should do it. Any department store or home center will carry this. A popular brand name is 3M.
- Pelican Predator Wireless PS2 Controller.
- Hookup Wire 22-26Ga. Different colors will be helpful.