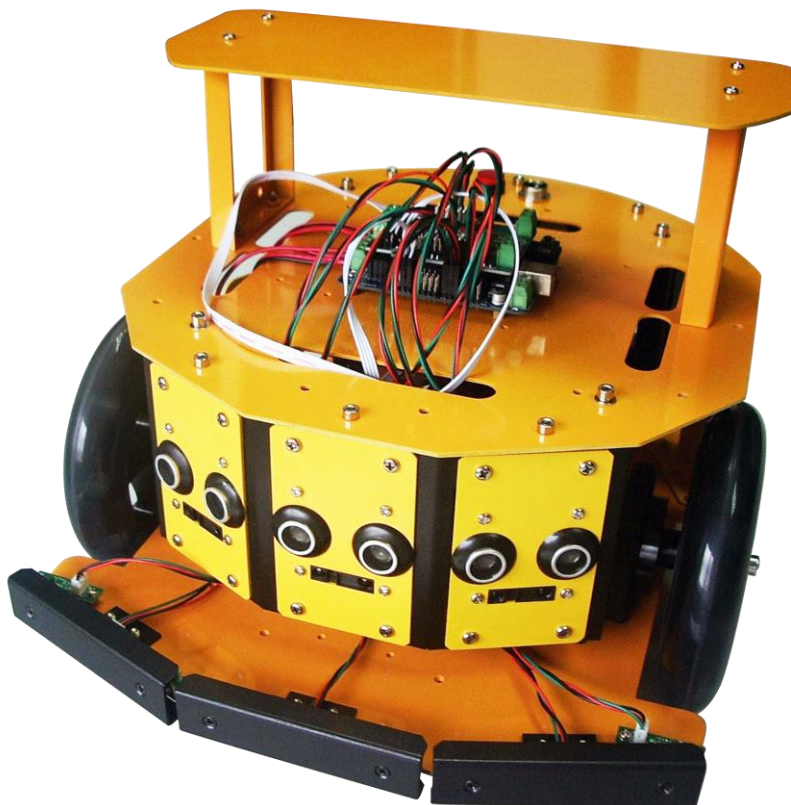# FiveBOT

Robotic Platform Solution

FiveBOT004 2 Wheel Drive Robotic Platform

Installation

Quick Start Guide

Fivebro International Corp.

Table of Contents

Version History

(mm/dd/yyyy)
v1.0 – 08/24/2010 – Author: JY
v1.1 – 03/07/2011 - Author: AJ
v1.2 – 03/16/2011 – Author: AJ, Updated: New components, wire colors.

1. FB004 Robotic Platform Overview

This manual will explain how to assemble and configure your FiveBOT robot. Please take your time to carefully read through this manual.

The FiveBOT004 Two Wheel robotic platform is designed for researchers and students working on robotic development.

The FiveBOT004 Two Wheel robotic platform comes with 1castor wheel and 2 wheels controlled by 2 DC motors, allowing rotation and movement in any direction. Three infrared rangefinders allow the FB004 to track and chase objects, follow walls, and avoid obstacles in 360 degrees.

The FiveBOT004 Two Wheel robotic platform's maximum of load capacity is 10kg which can be placed on the extra module on top of the platform.

2. FB004 2WD Parts List

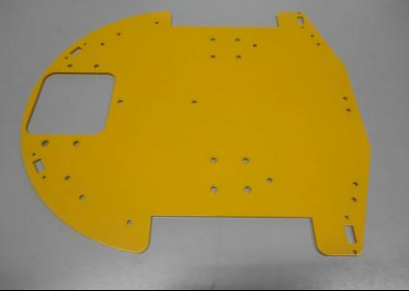| ID	Part Number	Part Name	QTY	Accessories
1	12032	Bottom chassis	1	
2	20001	Bumper Sensor	3	
3	12003	Battery mounting plate	1	
4	12004	Castor Wheel	1	
5	12005	Castor mounting bracket	1	
6	14002	Wheels	2	
7	18005	Wheel Hub Assembly	2	
8	12041	Motors mounting bracket	2	
9	16002	DC Motors	2	With encoders and cables
10	12042	Supporting pillar	4	
11	12033	Second layer mounting plate	1	
12	12011	Ultrasonic Mounting Kit	2	
13	12034	Top chassis side bracket	2	
14	12035	Top chassis	1	
15	12014	Servo Pan/Tilt Bracket	2	
16	12012	Sensors mounting bracket	2	
17	12015	Ultrasonic/Infrared Mounting Kit	6	
18	12016	Ultrasonic rubber grommet	16	
19	95002	Hex Screwdrivers	1	4 pieces set
20	95003	Spanner	1	8-10mm
21	80013	M4*8 steel Hex Socket Head Cap Screw	22	
22	80002	M5*12 steel Hex Socket Head Cap Screw	12	
23	80003	M6*15 steel Hex Socket Head Cap Screw	4	
24	80010	GP2Y0A21 Infrared Cable & Screws	3	
25	12040	Power switch Charging Socket	1	One Main Power switch, One Charge Socket, One Power switch
26	80006	Wheel Hub Screws Bag	1	

3. Electronic Components in FB004 2WD

ID	Part Number	Part Name	QTY	Accessories
1	22002	Arduino Board, Atmega328	1	
2	22004	Arduino Expansion V1.1	1	
3	20012	Dual Ultrasonic Sensor Module	3	
4	76001	NI-MH Battery 12V 1800mAh	1	
5	76002	NI-MH Battery Charger, 500mA	1	
6	20014	GP2Y0A21 Infrared Module	3	
7	71003	Bumper Cable	3	
8	71001	Motor Encoder Cable	2	
9	71005	Arduino USB Cable	1	
10	80004	M4*8 FHCS	42	
11	80011	Ultrasonic Cable & Screws	3	
12	71005	Arduino USB Cable	1	
13	80005	Controller Screws Bag	1	

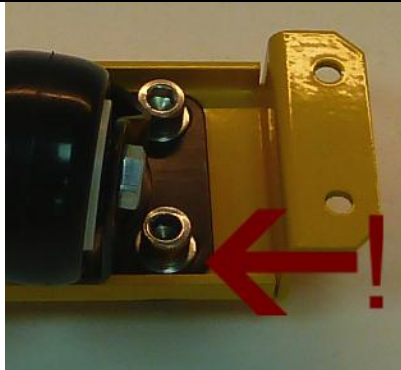## 4. FB004 2WD Chassis Construction

Welcome to your new FiveBOT004 2 Wheel Drive Robotic Platform! Please take a moment to remove all of chassis parts from the box and check all of parts against the parts list before commencing assembly.

Please note: A Phillips head screwdriver is required for assembly and is not included.

Step 1. Check all parts and tools.	
Step 2. First lay down the bottom chassis (part #12032)	
Step 3. Attach castor wheel (part #12004) to castor mounting bracket (part #12005) using 4 x M6*15 hexagon screws (part #80003) (continued on next page).	

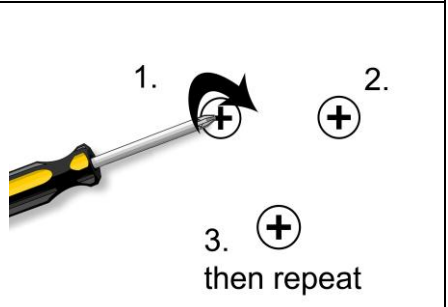|	
Note: Please pay close attention to the orientation of the screws as shown to the right. If the screws are driven in the wrong way, the body of the screw will interfere with the castor wheel movement. Additionally, the flat washer must be placed be placed beneath the head of the screw and the split washer beneath the nut.	
Step 4. Mount castor wheel bracket onto the bottom chassis using 8 x M5*12 hexagon screws (part #80002).	
Step 5. Take out 2 x motor mounting brackets (part #12041) and 8 x M5*12 hexagon screws (part #80002).	

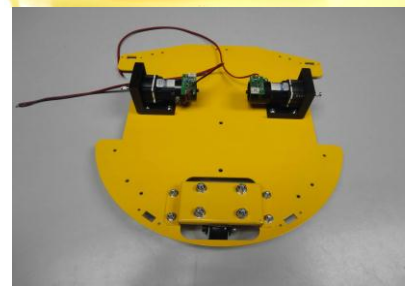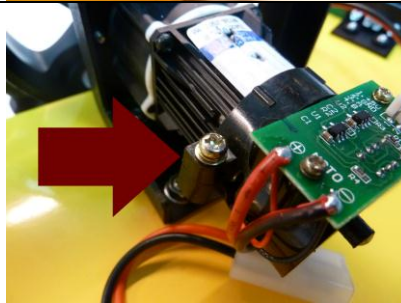|		
Step 6. Screw the motor mounting brackets onto the bottom chassis as shown.		
Step 7. Take out 2 x DC motors (part #16002).		
Step 8. Screw the DC motors onto motor brackets using the small black screws contained within the Wheel Hub Screws Bag (part #80006). Please take care that the encoders are screwed in with the green circuit board facing upwards. **Note:** The DC motors will need to be screwed in using a Phillips head screwdriver. Tighten each screw one at a time until the motor has come through the bracket as far as it can. The DC motor needs to be installed flush against the inside of the bracket – if it's not, the motor may not move properly.		 1. 2. 3. then repeat
Step 9. Take out couplers from Wheel Hub Assembly bag (part #18005) and screw these onto the DC motors using the small black screws from Wheel Hub Screws bag (part #80006). These are installed using the smallest hex screwdriver.		
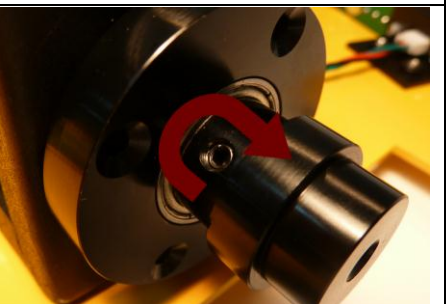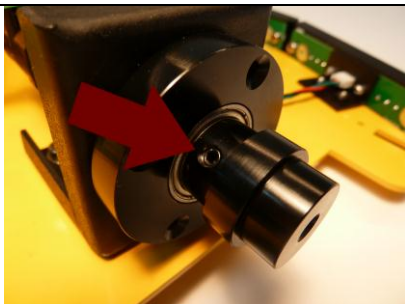
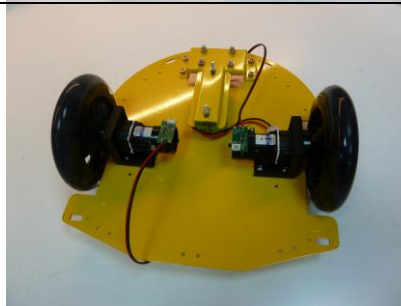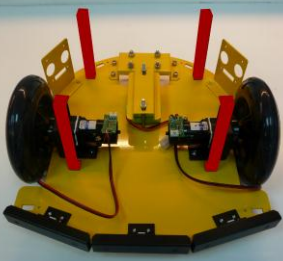|		
Step 10. Take out the 8 x silver screws contained within the Wheel Hub Screws bag (part #80006) and screw them into the coupler as shown.		
Note: At this stage you should be able to turn the DC motor by hand. If not, please return to the note in Step 8. You may optionally loosen the small brass-colored screw on the DC motor encoder 1/2 a turn (pictured right).		
Step 11. Attach the wheels to the lower chassis using the wheel hubs and large hexagon screws contained within the Wheel Hub Screws bag (part #80006).		
Step 12. Take out battery mounting plate (part #12003), then mount the 12V NI-MH battery onto the bottom chassis as shown.		
Step 13. Take out 3 x bumper sensors (part #20001).		
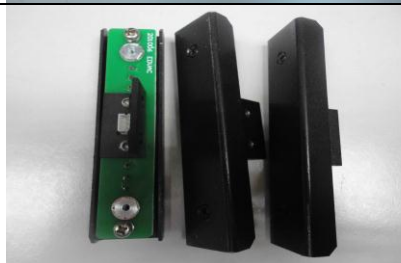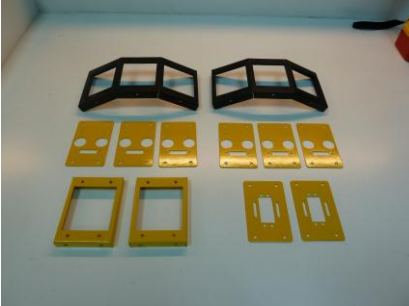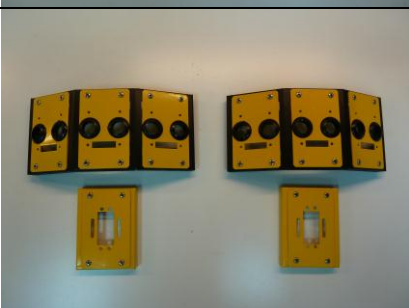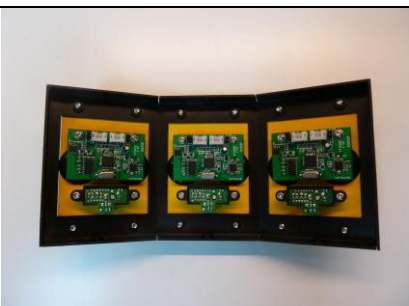
Step 14. Screw bumper sensors onto the front of bottom chassis using 6 x M4*8 hexagon screws (part #80013).		
Step 15. Take out the 2 x Sensor mounting brackets (part #12011).		
Step 16. Mount the 2 x sensor mounting brackets onto bottom chassis using 4 x M4*8 hexagon screws (part #80013).		
Step 17. Take out the 4 x supporting pillars (part #12042).		
Step 18. Lock 4 x supporting pillars to form a square shape as shown using M4*8 hexagon screws (part #80013).		

Step 19. Take out the following parts: ● Top chassis side bracket (#12034) ● Servo pan/tilt bracket (#12014) ● Sensor mounting bracket (#12012) ● Ultrasonic/infrared mounting kit (#12015).		
Step 20. Assemble sensor mounting plates as shown using M4*8 FHCS (part #80004) and rubber grommets (part #12016).		
Step 21. Add remaining rubber grommets to sensor brackets on chassis.		
Step 22.Take out the Dual Ultrasonic Modules (part #20012) then add the screws and spacers contained within the Ultrasonic Cable & Screws package (part #80011).		
Step 23. Repeat this for the infrared sensors (part #20011). Use the screws contained within the GP2Y0A21 Infrared Cable & Screws package (part #80010).		
Step 24. Add the ultrasonic and infrared sensors to the sensor mounting brackets assembled in Step 20.		

9

Step 25. Add power switch charging socket (part #12040) to second layer mounting plate (part #12033).	
Step 26. Screw sensor brackets onto second layer mounting plate using M4*8 FHCS (part #80004). Please note: The ultrasonic and infrared (IR) sensors should be mounted at the opposite end to the power switch.	
Step 27. Add cables to ultrasonic and infrared sensors. Please make connections as indicated by the blue and red colored dots (connect red to red and blue to blue). The white dot will be connected to the Arduino Expansion Board in the next section of the manual.	
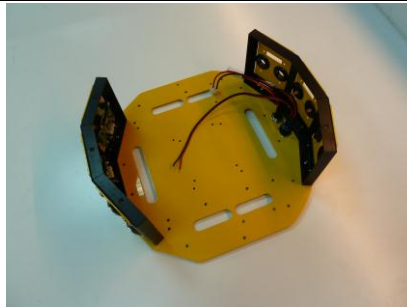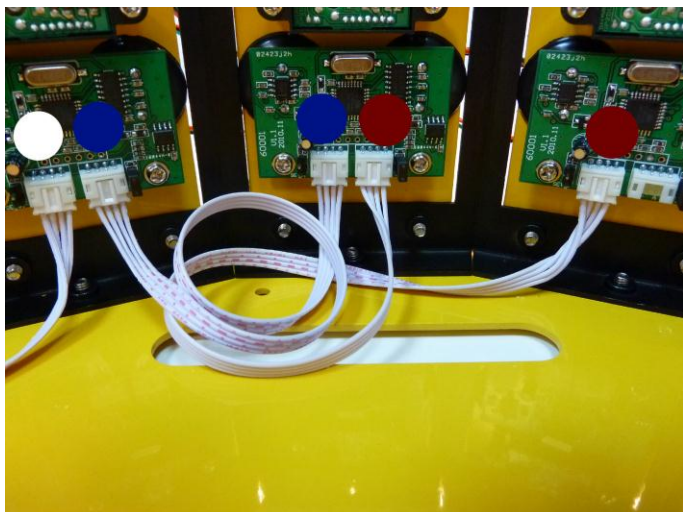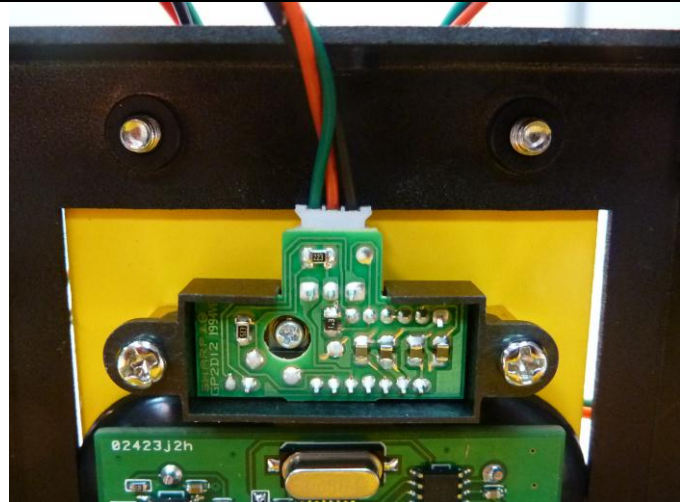
Step 28. Add cables to DC motor and bumper sensors.

Note: Please pay close attention to the white clips on all of these plugs to ensure they are not plugged in upside down.
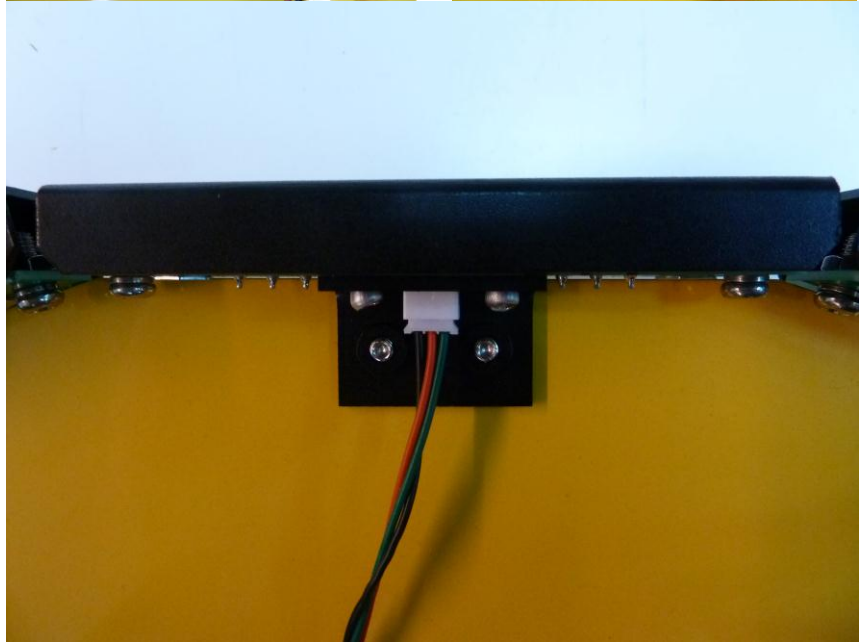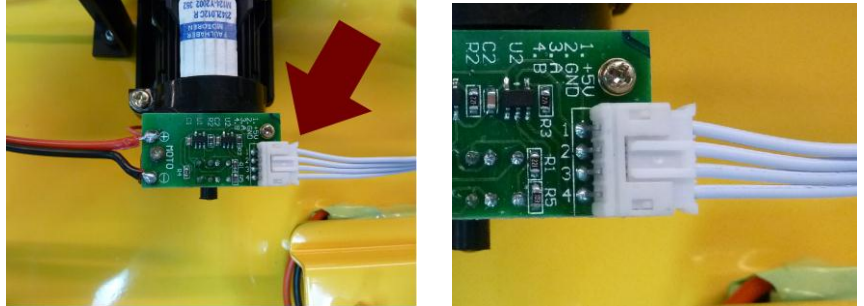
Step 29. Add top chassis side brackets to the second layer mounting plate using M4*8 FHCS (part #80004). Please ensure that these screws are driven in the direction of the red arrow shown.
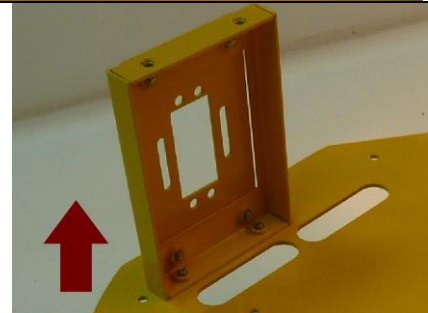
Step 30. Attach the Arduino control board (part#22003) to the bottom chassis using the screws and spacers contained within the Controller Screws Bag (part #80005).
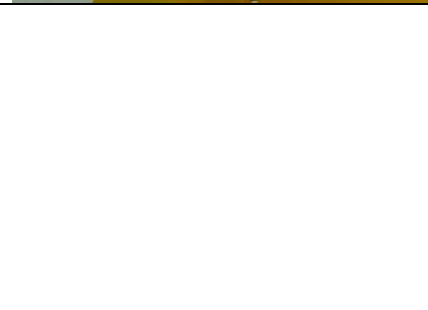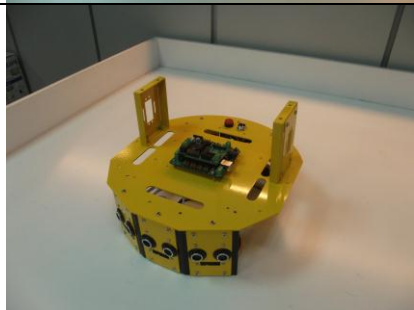
Step 31. Add second layer mounting plate onto bottom chassis using M4*8 hexagon screws (part #80013).		
Step 32. Take out top layer (top chassis part #12035)		
Step 33. Screw on the top layer and your chassis building is now complete!		
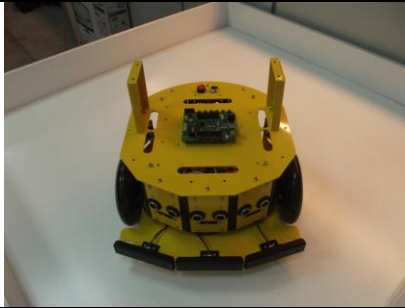
5. Sample Wiring Installation

Subsequent assembly instructions will make references to this figure.
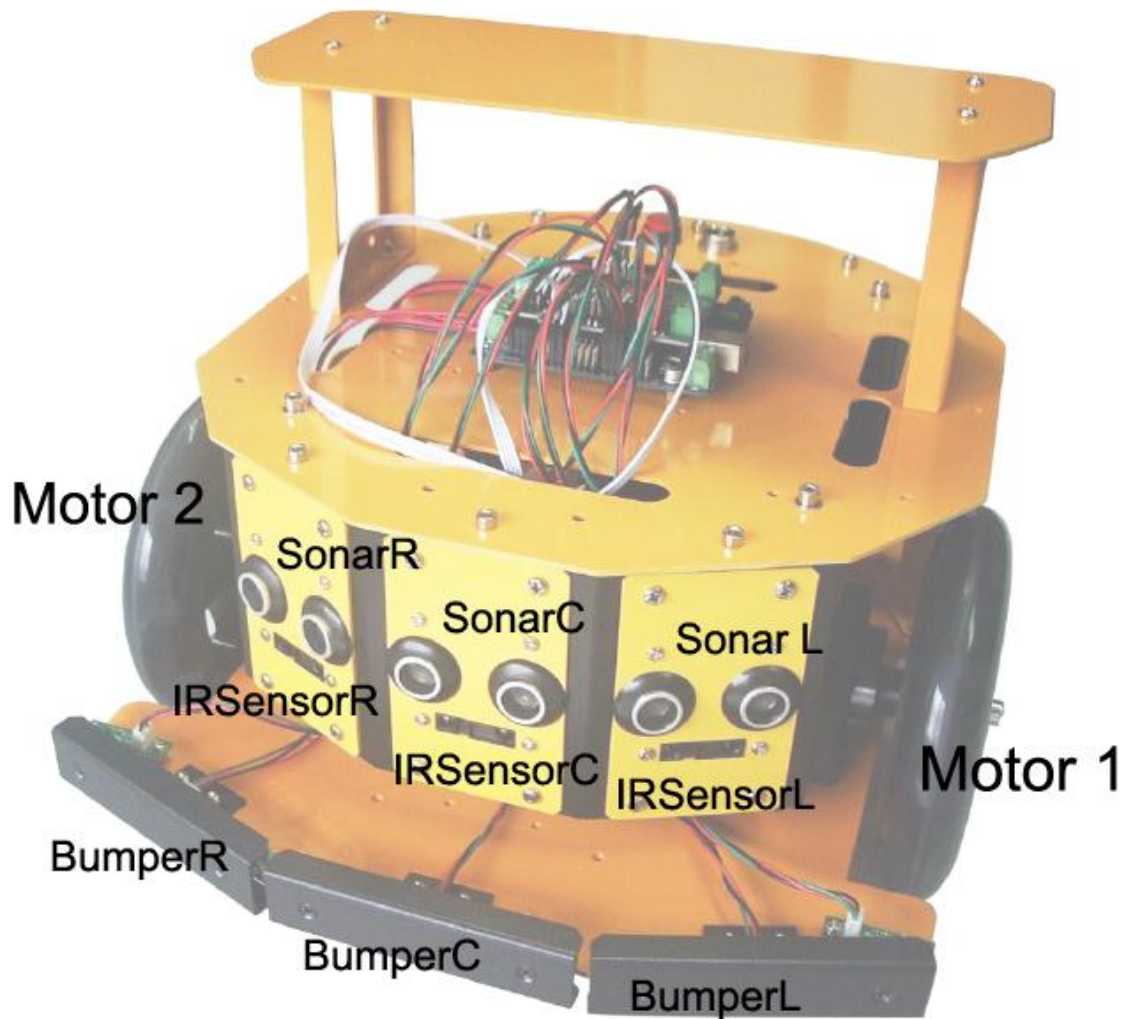
The diagram below illustrates one example of how to connect the Arduino control board to the sensors, motors and battery. Please pay particular attention to the battery connections. Wiring these incorrectly will cause damage to the controller. Please note the wire colors used in the diagram.

Please note: Some newer models of the 2WD robotic platform may be shipped with different wire colors. **Bumpers:** Black → brown, red → red, green → pink. **IR Sensors:** Green → blue, red → Green, black → yellow.

Sample Wiring Diagram for FB004 2WD Robotic Platform

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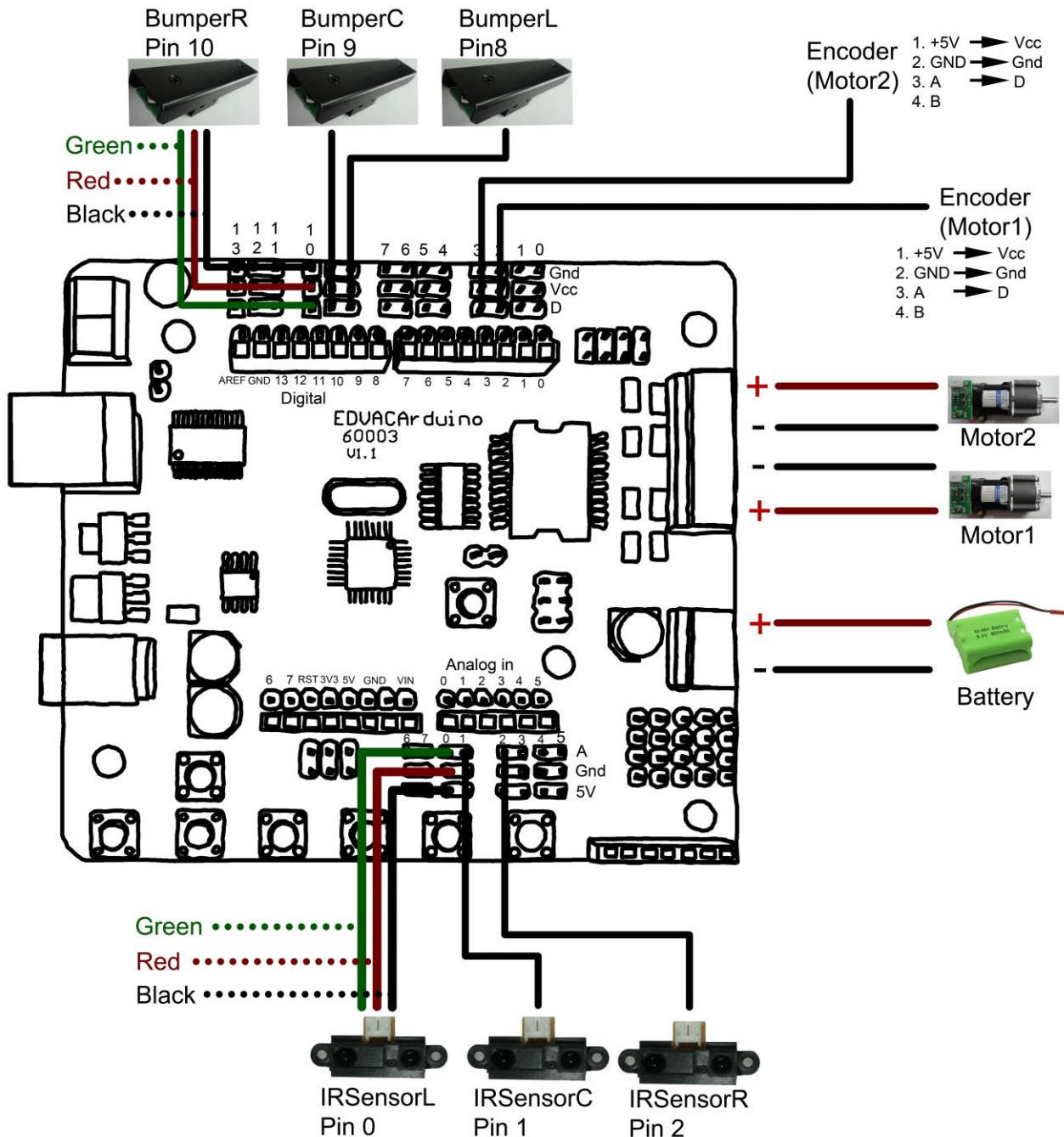
Sample wiring diagram - Expansion Board

Ultrasonic Sensors

0x13   0x12   0x11
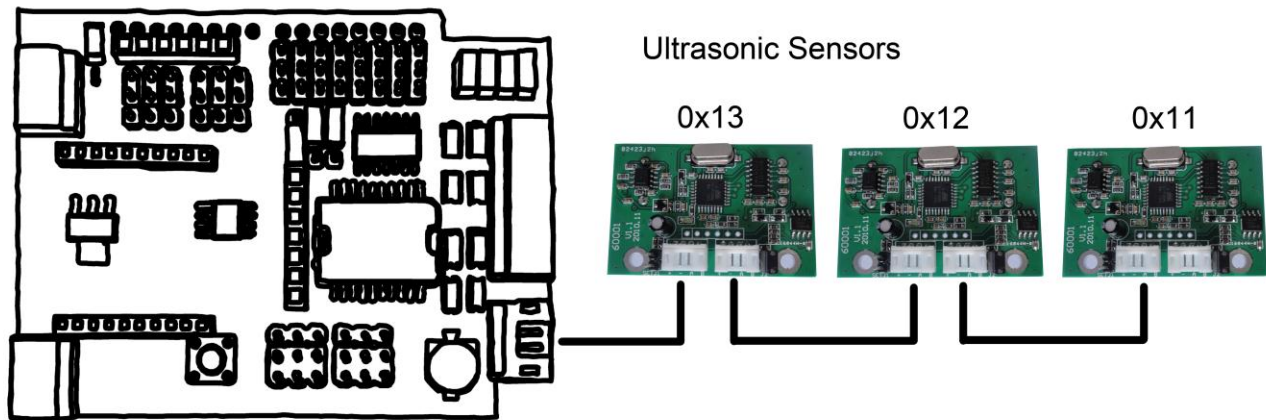
Please note: This wiring sample corresponds to the FB004 v1.0 example code found on the Fivebro website and on the CD included in this package.

By uploading your own code or modifying the example code, pin numbers may change and you will need to make your connections accordingly.

6. Arduino control board & sample code

Introduction

The FB004's Arduino control board is a specially modified Arduino control board designed especially for robotics applications. Built from the Arduino open source platform, it is supported by thousands of open source codes and can be easily expanded with most Arduino Shields. The integrated 2 way DC motor driver and wireless socket gives you a much easier way to start your robotic project.

Specification

- Atmega328 microcontroller

- 14 Channels Digital I/O

- 6 PWM Channels (Pin11,Pin10,Pin9,Pin6,Pin5,Pin3)

- 8 Channels 10-bit Analog I/O

- USB interface

- Auto sensing/switching power input

- ICSP header for direct program download

- Serial Interface TTL Level

- Supports AREF

- Supports Male and Female Pin Header

- Integrated sockets for APC220 RF Module

- Five IIC Interface Pin Sets

- Two way Motor Driver with 2A maximum current

- 7 key inputs

- DC Supply：USB Powered or External 7V~12V DC。

- DC Output：5V /3.3V DC and External Power Output

- Dimensions：90x80mm

Arduino control board layout
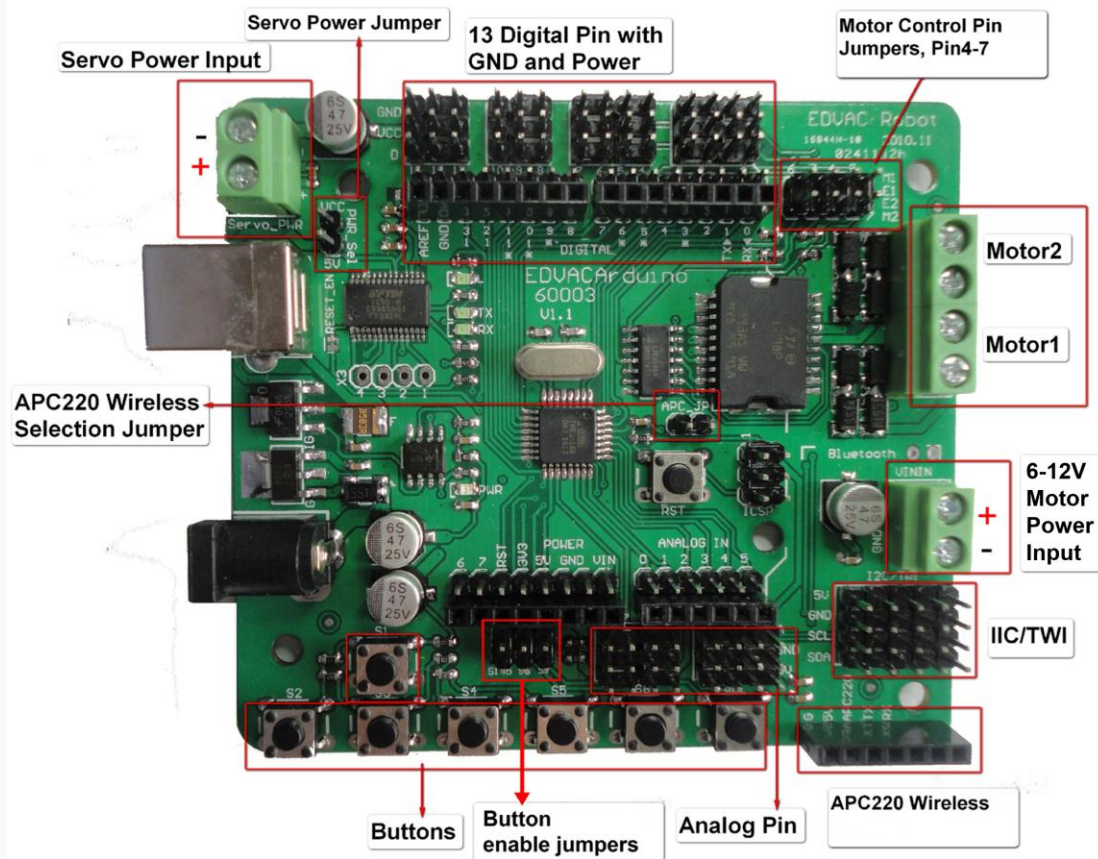
Arduino Board V1.1, Atmega328P

The picture above highlights some important features of the control board, which includes:

- One Regulated Motor Power Input Terminal (6v to12v)

- One Unregulated Servo Power Input Terminal (you supply regulated 4v to 7.2v)

- One Servo input power selection jumper

- One Serial Interface Module Header for APC220 Module

- Two DC Motor Terminals – Handles motor current up to 2A, each terminal

- One IIC/TWI Port – SDA, SCL, 5V, GND

- One Analog Port with 8 analog inputs – one input is tied internally to the supply voltage

- One General Purpose I/O Port with 13 I/O lines – 4,5,6,7 can be used to control motors

- One Reset Button

- Jumper bank to Enable/Disable Motor Control

Arduino control board pin jumpers

Servo power select jumper

As most servos draw more current than the USB power source can supply, a separate servo power terminal is provided to power the servo individually which can be Enable/Disable by the Servo Power Select Jumper.

When the Servo Power Select Jumper is applied, the servo is powered by an internal 5V.

When the Servo Power Select Jumper is not applied, the servo is powered by an external power source.

Motor control pin jumper

Applying the Motor Control Pin Jumpers will allocate Pins 4, 5, 6 and 7 for motor control.

Removing the jumpers will release the above pins.

Wireless select jumper

Applying the Wireless Select Jumper will allow the controller to communicate via a wireless module such as the APC220.
If no wireless module is plugged in, this jumper will not make any difference.

Removing the jumper will disable wireless module and allows the sketch to be uploaded.

Button enable jumpers

Applying these jumpers will enable push buttons S1 through S7.

Powering the Arduino control board

Applying power

This is one of the most important steps in getting your control board up and communicating with your host controller. Your control board can be powered from its USB port (connected to your computer), from its motor power input or from its servo power input. Power from the USB port will provide the control board with enough power to upload and run sketches, but not enough power to drive servos or DC motors; for these applications, power from the servo power input or the motor power input is required.

Please note: When applying power to either the Motor Power Input or the Servo Power Input, please ensure you use the correct polarity. Reverse Polarity will damage the controller. *We are not responsible for such damage, nor does our warranty cover such damage.* Please make sure you take time to apply the power correctly!

Power from the servo power Input:

Connect the battery to the Servo Power Input. You MUST make sure that you apply power to the Power Terminal using the correct polarity (refer to "Arduino control board Layout" on page 15).

Power from motor power input: Connect the battery to the Motor Power Input. You MUST make sure that you apply power to the Power Terminal using the correct polarity (refer to "Arduino control board Layout" on page 15).

From USB: Simply connect your control board to your computer via USB cable, and the controller is able to work. Please note that the USB can supply a maximum current of 500 mA. It should be able to meet the most requirements for LED applications, however it is not enough to power servos or DC motors.

Uploading sample code to the Arduino Control Board

For this section you will need:

- Arduino IDE (Integrated Development Environment) software
- The FB004 sample code

The Arduino IDE (Integrated Development Environment) is a piece of software that allows you to write programs on your computer and then upload them onto the Arduino control board. The control board included in this package can be programmed using Arduino IDE version 0014 and above. It is included on the CD but can also be downloaded directly from the Arduino website at http://arduino.cc/en/Main/Software.

You will also need the FB004 2WD sample code file. It is located on the accompanying CD and it is also supplied on the Fivebro international website (http://www.fivebro.com.tw) under the support section.

Once you have downloaded and extracted both of these files, you can execute the file named "arduino.exe" and you will be presented with a screen that looks like this:

FIVEBRO Fivebro International Corp.
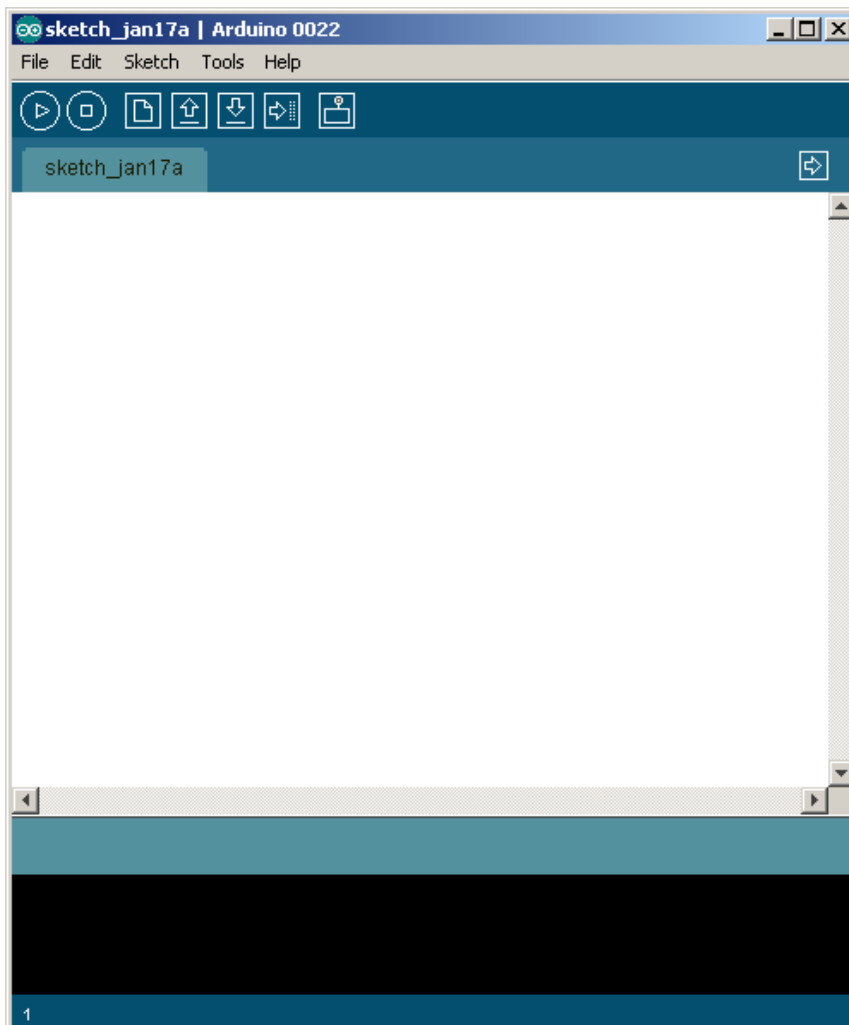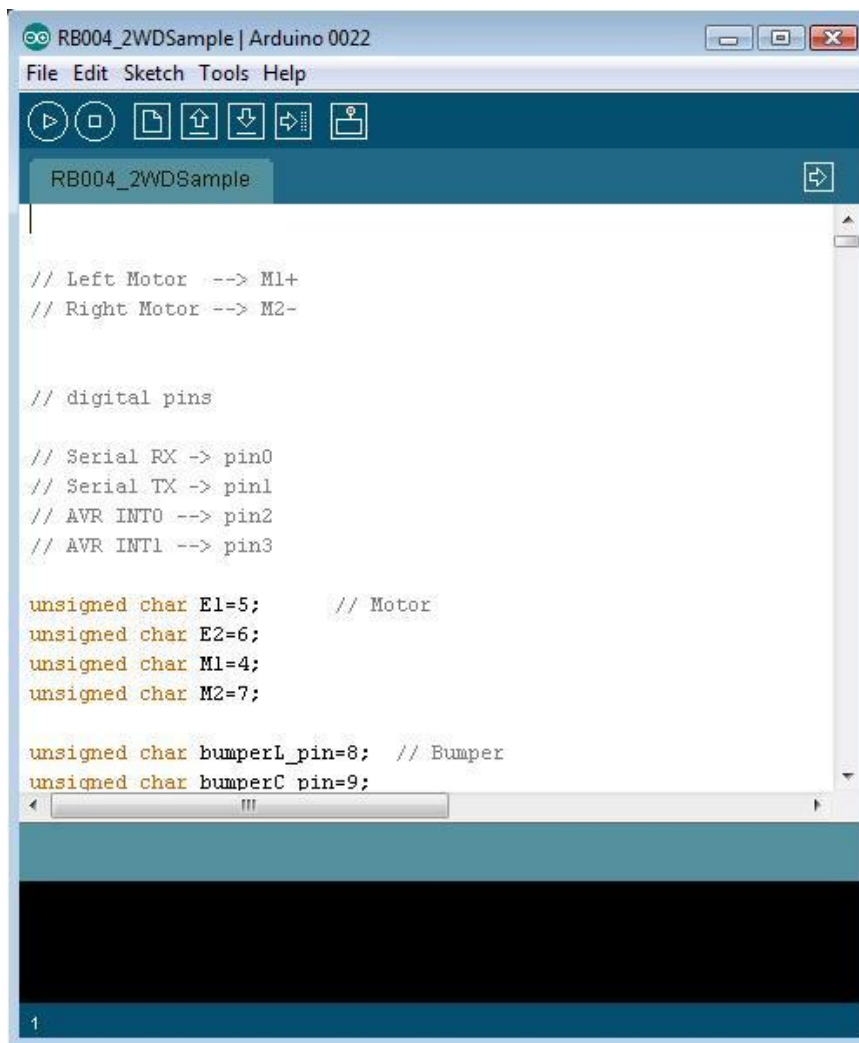
The next step is to simply connect the Arduino control board to your computer using the USB cable supplied (part #71005).

Please note: The Arduino expansion board cannot be plugged in while uploading any programs.

Using your Arduino IDE software, click File > Open > and then point the browser to the location where you have downloaded the FB004 2WD sample code. The sample code file is called "*FB004_2WDSample.pde*".

After doing so your Arduino IDE software should look like this:

Now click Tools > Board > then select "Arduino Diecimila, Duemilanove, or Nano w/ ATMega328".
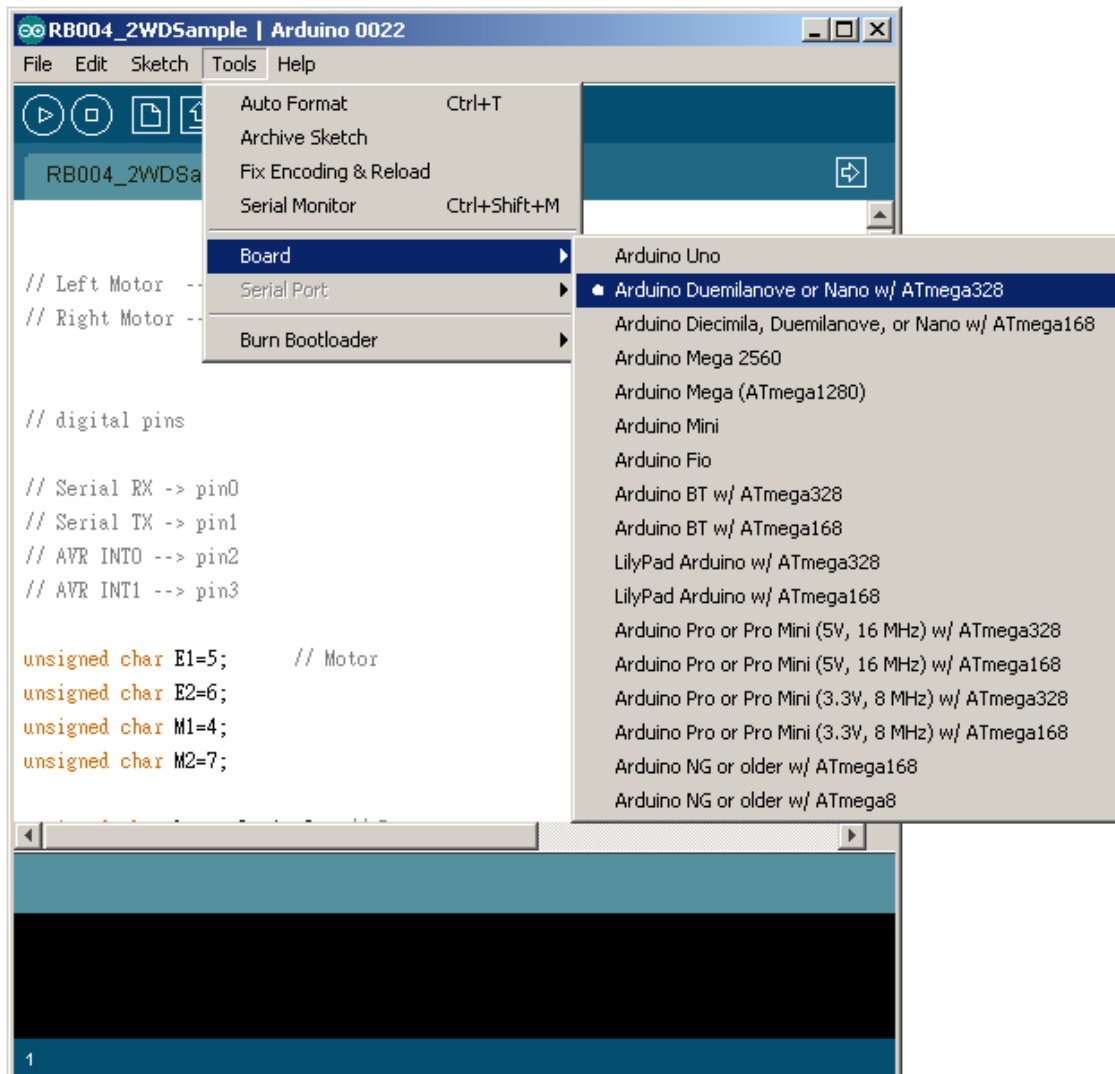
Next, click File > Serial Port > and then choose one of the serial ports listed. Ports COM1 and COM2 are usually already reserved by your computer, so try COM3 or above.

Finally upload the program to the board by pressing the [icon] icon. This will compile the sketch and upload it into your Arduino control board. If uploading is successful your Arduino IDE should look like this:


```
// Left Motor  --> M1+
// Right Motor --> M2-


// digital pins

// Serial RX -> pin0
// Serial TX -> pin1
// AVR INT0 --> pin2
// AVR INT1 --> pin3

unsigned char E1=5;        // Motor
unsigned char E2=6;
unsigned char M1=4;
unsigned char M2=7;
```

Done uploading.

Binary sketch size: 5314 bytes (of a 14336 byte maximum)

If communication with the control board fails, please try selecting a different serial port. If you still cannot succeed in connecting, please refer to the troubleshooting section of the Arduino website at:

http://arduino.cc/en/Guide/Troubleshooting

Button Press Tutorials

The controller has 7 build-in buttons, labelled S1-S7. Buttons S1-S5 use analog input, S6, S7 use digital input.

To enable S6 and S7, apply all three of the "button enable jumpers" (shown on the pinout diagram, page 23). S6 uses Digital Pin2, S7 uses Digital Pin3. Once these enable jumpers have been applied, Pin 2 and 3 will be occupied by the push buttons.

// Sample code 1: One-button LED switch
//Code function: Press button S6, LED turns on, press it again, LED turns off.

```
int ledPin = 13;
int key_s6 = 2;
int val=0;

void setup()
{
    pinMode(ledPin, OUTPUT);     // Set Pin13 to output mode
    pinMode(key_s6, INPUT);      // Set Pin12 to output mode
}
void loop()
{
    if(digitalRead(key_s6)==0)  {
        while(!digitalRead(key_s6));
        val++;
    }

    if(val==1)  {
    digitalWrite(ledPin, HIGH);   //
    }

    if(val==2)  {
        val=0;
        digitalWrite(ledPin, LOW);    //
    }
}
```

// Sample code 2: Two-button LED switch
//Code function: Press button S6, turn on LED, Press button S7, turn off LED.


```
int ledPin = 13;
int key_s6 = 2;
int key_s7 = 3;

void setup() {
   pinMode(ledPin, OUTPUT);
   pinMode(key_s6, INPUT);
   pinMode(key_s7, INPUT);
}
void loop()
{
  if(digitalRead(key_s6)==0)
    {
       digitalWrite(ledPin, HIGH);
    }

  if(digitalRead(key_s7)==0)
    {
       digitalWrite(ledPin, LOW);
    }
}
```

Dual DC Motor Speed Control

Hardware Setting

Connect four motor wires to Motor Terminal. And apply power through motor power terminal.

Pin Allocation

"PWM Mode"	
Pin	**Function**
Digital 4	Motor 1 Direction control
Digital 5	Motor 1 PWM control
Digital 6	Motor 2 PWM control
Digital 7	Motor 2 Direction control

"PLL Mode"	
Pin	**Function**
Digital 4	Motor 1 Enable control
Digital 5	Motor 1 Direction control
Digital 6	Motor 2 Direction control
Digital 7	Motor 2 Enable control

PWM Control Mode

The PWM DC motor control is implemented by manipulating two digital IO pins and two PWM pins. As illustrated in the

diagram above, Pin 4,7 are motor direction control pins, Pin 5,6 are motor speed control pins.

// Sample code: Standard PWM DC control

```
#define LED 13        //pin for the LED labelled "L"

//motor control pins
unsigned char E1=6;
unsigned char E2=5;
unsigned char M1=4;
unsigned char M2=7;

int incomingByte = 0; // for incoming serial data


void setup() {
      Serial.begin(9600);
}

void advance() //advance
{
      analogWrite(E1,100);
      digitalWrite(M1,HIGH);
      analogWrite(E2,100);
      digitalWrite(M2,HIGH);
      return;
}
void back_off () //Move backward
{
      analogWrite (E1,100);
      digitalWrite(M1,LOW);
      analogWrite (E2,100);
      digitalWrite(M2,LOW);
}
```

```
void stop() //stop
{
        analogWrite(E1,0);
        digitalWrite(M1,HIGH);
        analogWrite(E2,0);
        digitalWrite(M2,HIGH);
        return;
}


void loop() {

        if (Serial.available() > 0) {

           // read the incoming byte:
           incomingByte = Serial.read();

           // say what you got:
           Serial.print("I received: ");
           Serial.println(incomingByte, DEC);

           if (incomingByte == 119) {  // press "w"
             advance();
             delay(1000);
             stop();
           }

           if (incomingByte == 115) { //press "s"
             back_off();
             delay(1000);
             stop();
           }
        }
}
```
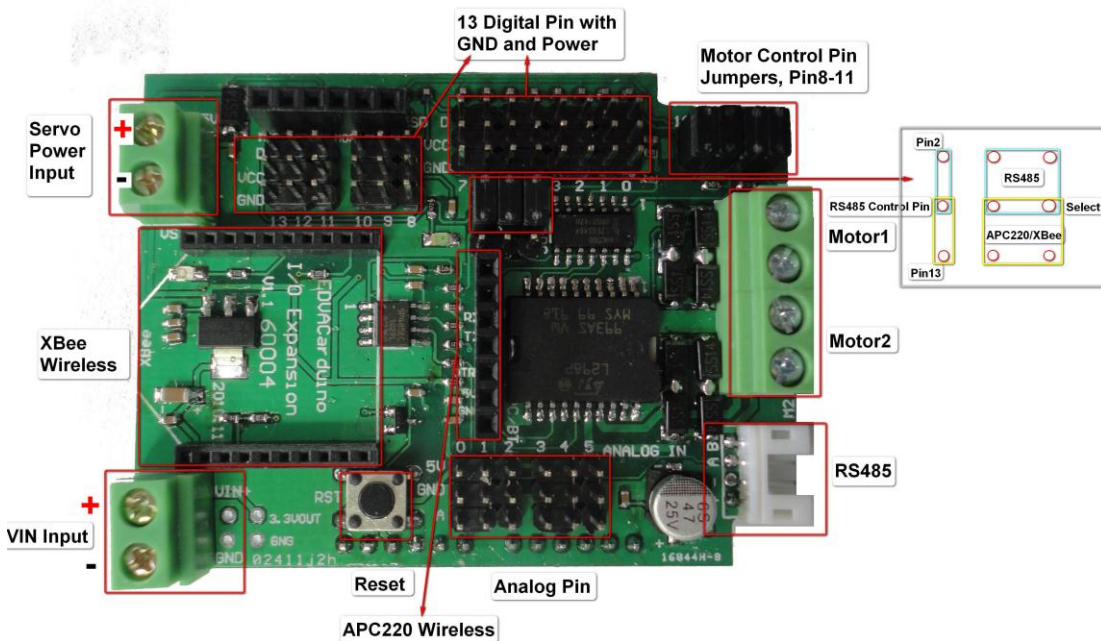
IO Expansion Board

To support RS485 interface or drive 4 motors, IO Expansion Board is available.

13 Digital Pin with GND and Power

Motor Control Pin Jumpers, Pin8-11

Servo Power Input

XBee Wireless

VIN Input

Reset

Analog Pin

APC220 Wireless

Pin2

RS485

RS485 Control Pin

Select

APC220/XBee

Pin13

Motor1

Motor2

RS485

Arduino IO Expansion Board, V1.1
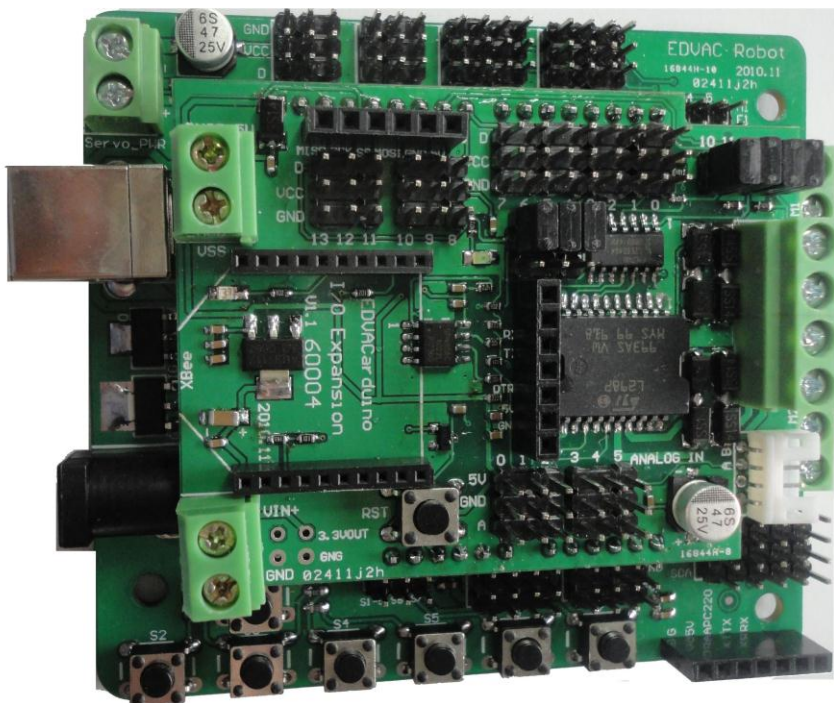
Arduino control board combined with IO expansion board

7. Limited Warranty

FIVEBRO ONE YEAR LIMITED WARRANTY

Fivebros warranty obligations for this FiveBOT (this "Product") are limited to the terms set forth below.

Fivebro International Corp. ("Fivebro") warrants to the original end-user purchaser that this Product will be free from defects in materials and workmanship under normal use for a period of 180 days from the date of retail purchase (the "Warranty Period").

This warranty is extended only to the original end-user purchaser of a new product that was not sold "as is".

If a defect arises:

(1) you may within 1 year from the date of retail purchase (or such other period specified by the return policies of the place of purchase) return this Product to the place of purchase, together with the original proof of purchase and either the original box or the UPC code label from the box, and this Product will be replaced or, in the event that a replacement for this Product is not available at the place of purchase, either a refund of the purchase price for this Product or an store credit of equivalent retail value will be provided; or

(2) you may after the day that is 30 days from the date of retail purchase (or such other period specified by the return policies of the place of purchase) and within the Warranty Period contact Fivebro Customer Support to arrange for the replacement of this Product. In the event that a replacement for this Product is not available this Product will be replaced by Fivebro with a product of equivalent or greater retail value.

A purchase receipt or other proof of the date of retail purchase is required in order to claim the benefit of this warranty.

If this Product is replaced, the replacement product becomes your property and the replaced Product becomes Fivebros property. If the place of purchase refunds the purchase price of this Product or issues a store credit of equivalent retail value, this Product must be returned to the place of purchase and becomes Fivebros property.

EXCLUSIONS AND LIMITATIONS

This warranty covers the normal and intended use of this Product. This warranty does not apply: (a) to damage caused by accident, abuse, unreasonable use, improper handling and care or other external causes not arising out of defects in materials or workmanship; (b) to damage caused by power line surge, lightning or acts of God; (c) to damage caused by service performed by anyone who is not an authorized representative of Fivebro; (d) to any hardware, software or other add-on components installed by the end-user; (e) if this Product has been disassembled or modified in any way; (f) to faulty installation or set-up adjustments; (g) to consumable parts, such as batteries, unless damage has occurred due to a defect in materials or workmanship; (h) to cosmetic damage, including but not limited to scratches, dents or broken plastic, or normal wear and tear. Regardless of whether the camera is in use or not,exposure to extremely bright lights or objects can damage the CMOS camera sensor. This warranty specifically excludes any damage to the CMOS sensor resulting from exposure to extremely bright lights or objects, whether accidental or deliberate.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS AND YOU MIGHT ALSO HAVE OTHER RIGHTS THAT VARY FROM STATE TO STATE. FIVEBROS RESPONSIBITLITY FOR PRODUCT DEFECTS IS LIMITED TO THE REPLACEMENT OF THIS PRODUCT OR THE REFUND OF THE PURCHASE PRICE FOR THIS PRODUCT. ALL EXPRESS AND IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES AND CONDITIONS OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN TIME TO THE TERM OF THIS LIMITED WARRANTY. NO WARRANTIES, WHETHER EXPRESS OR IMPLIED, WILL APPLY AFTER THE EXPIRATION OF THE LIMITED WARRANTY PERIOD. If any term of this warranty is held to be illegal or unenforceable, the legality or enforceability of the remaining terms shall not be affected or impaired.

EXCEPT AS PROVIDED IN THIS WARRANTY AND TO THE EXTENT PERMITTED BY LAW, FIVEBRO IS NOT RESPONSIBLE FOR DIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES HOWSOEVER CAUSED RESULTING FROM BREACH OF WARRANTY OR CONDITION OR UNDER ANY OTHER LEGAL THEORY, INCLUDING BUT NOT LIMITED TO LOSS OF USE. THE FOREGOING LIMITATION SHALL NOT APPLY TO DEATH OR PERSONAL INJURY CLAIMS, OR ANY STATUTORY LIABILITY FOR INTENTIONAL AND GROSS NEGLIGENT ACTS AND/OR OMISSIONS.

SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, OR LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THESE LIMITATIONS MIGHT NOT APPLY TO YOU.

Valid only in R.O.C. and U.S.A.

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