FiveBOT

Robotic Platform Solution

FiveBOT003 Omni 3 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, sample code v1.0
v1.1 – 03/07/2011 - Authors: AJ, KL, EC sample code v1.0
v1.2 – 03/16/2011 – Author: AJ, Updated: New components.

1. FB003 Robotic Platform Overview

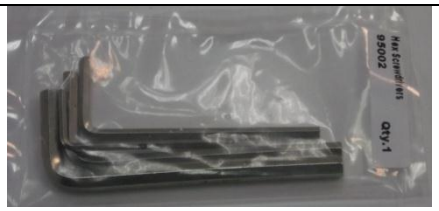
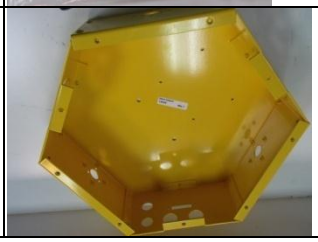
This manual will explain how to assemble and configure your FiveBOT robot. Please take your time to carefully read through this manual.

The FiveBOT003 Omni-3 wheel robotic platform robotic platform is designed for researchers and students working on robotic development. FiveBOT003 Omni-3 wheel robotic platform has vast advantages over a conventional robot designs as it has better mobility in congested environments. It is capable of easily performing tasks in environments congested with static and dynamic obstacles and narrow aisles.

FiveBOT003 Omni-3 Wheel robotic platform comes with 3 Omni-directional wheels controlled by 3 DC motors, allowing rotation and movement in any direction simultaneously. The robotic platform's 3 Ultrasonic Sensors allow the FB003 to avoid obstacles in 360 degrees.

The FiveBOT003 robotic platform's maximum load capacity is 15kg. This load can be placed on top of the platform.

2. FB003 Omni 3WD Parts List

FB3003 Omni 3WD Part List					
ID	Part Number	Part Name	QTY	Accessories	Check
1	12003	Battery Mounting Plate	1		
2	95002	Hex Screwdrivers	1	4 piece set	
3	16002	DC Motors	3	With encoders and cables	
4	14056	Omni Wheels	3		
5	12040	Power Switch Charging Socket	1	One Main Power switch, One Power switch	
6	12025	Omni Chassis	1		

7	80009	Wheel Hub Screws Bag	1			
8	80014	M4 * 8 Hex Socket Head Cap Screw	6			
9	12016	Ultrasonic Rubber Grommet	6			
10	18005	Wheel Hub Assembly	3			
11	12030	Second Layer Mounting Plate	1			

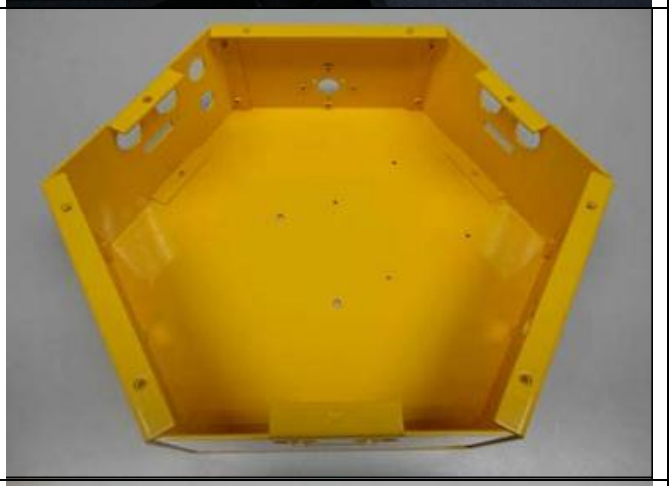
3. FB003 Omni 3WD Electronic Components

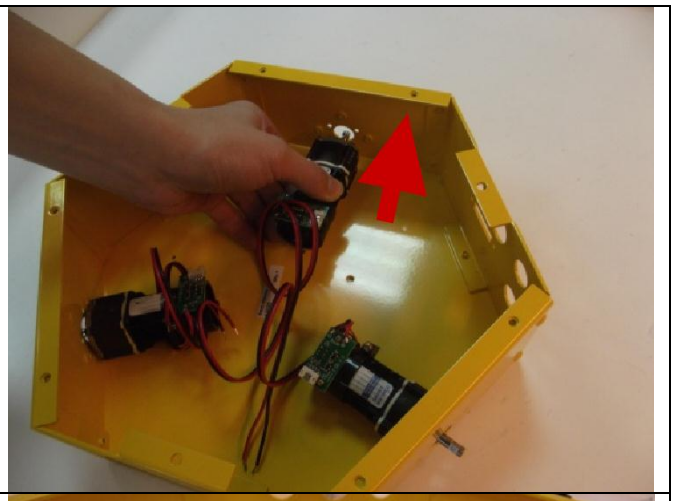
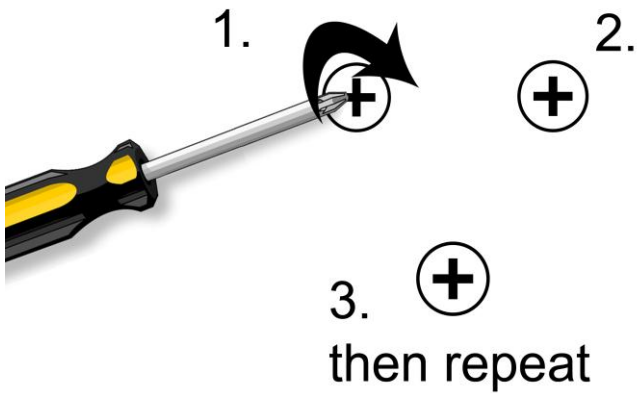
ID	Part Number	Part Name	QTY	Accessories	Check
1	22002	Arduino Board, Atmega328	1	Screws	
2	22004	Arduino Expansion V1.1	1		
3	20012	Dual Ultrasonic Sensor Module	3	Cable, Screws	
4	76001	NI-MH Battery 12V 1800mAh	1		
5	76002	NI-MH Battery Charger, 500mA	1		
6	71001	Motor Encoder Cable	3		
7	71005	Arduino USB Cable	1		
8	71006	Jumper Cable	2		
9	80011	Ultrasonic Cable & Screws	3		
10	80008	Controller Screws Bag	1		

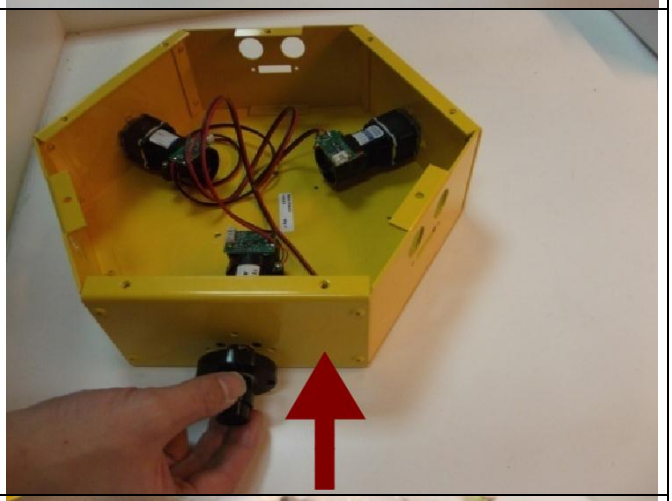
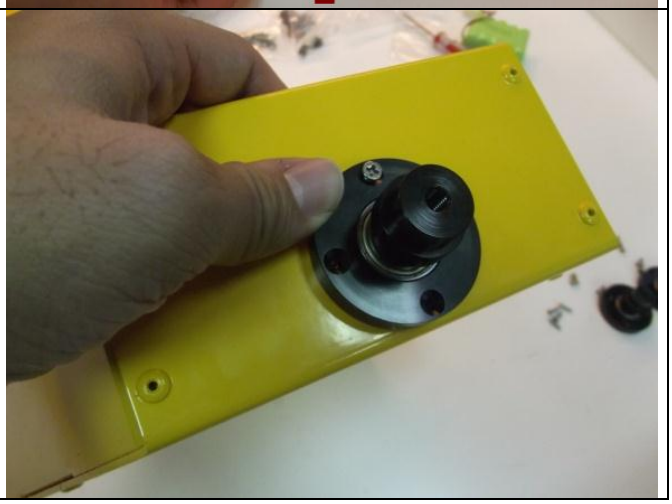
4. FB003 Omni 3WD Chassis Construction

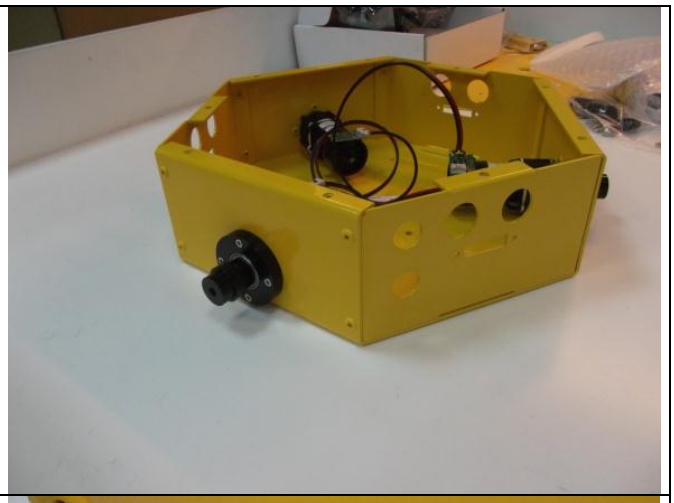
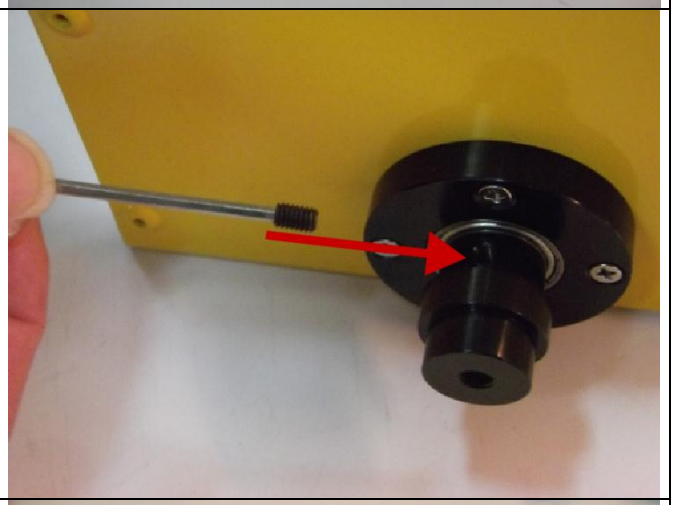
Welcome to your new FiveBOT004 2 Wheel Drive Robotic Platform! Please take a moment to remove all of chassis parts from the box and check all of parts against the parts list before commencing assembly.

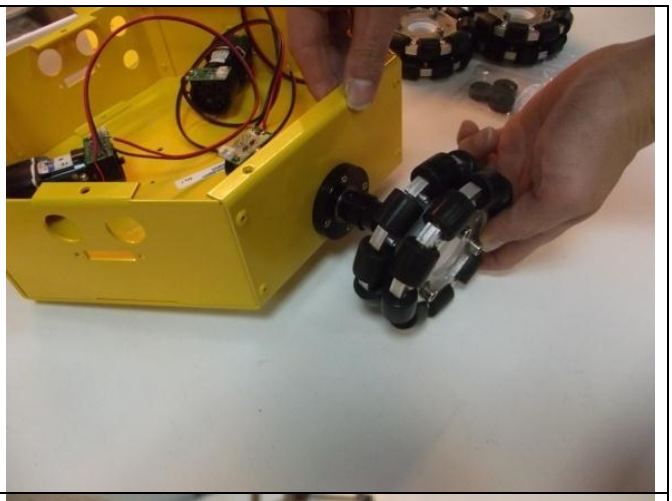
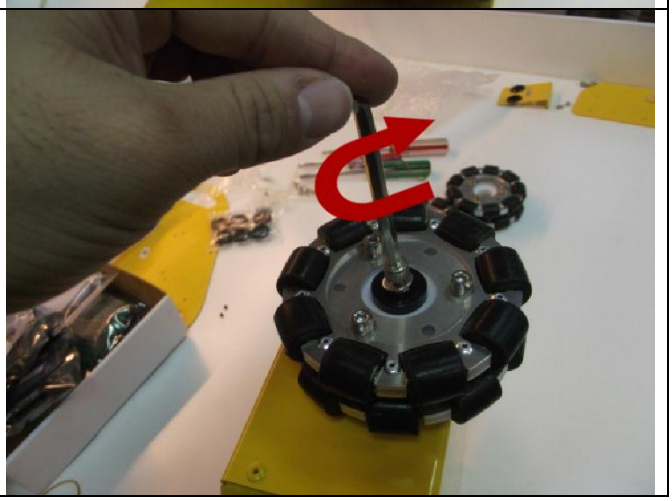
Please note: A Phillips screwdriver is required for assembly and is not included.

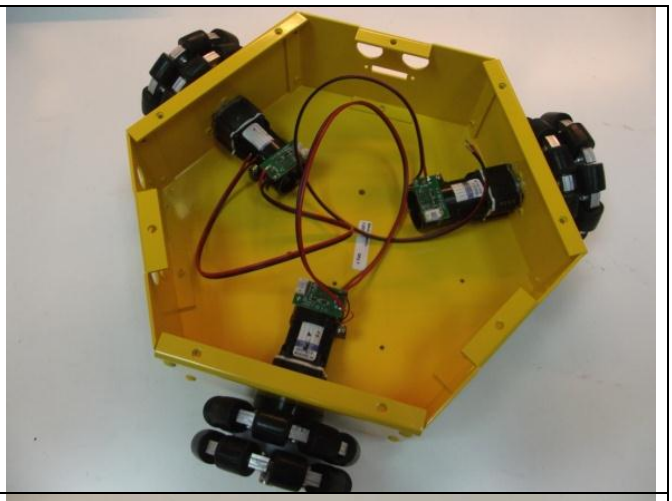
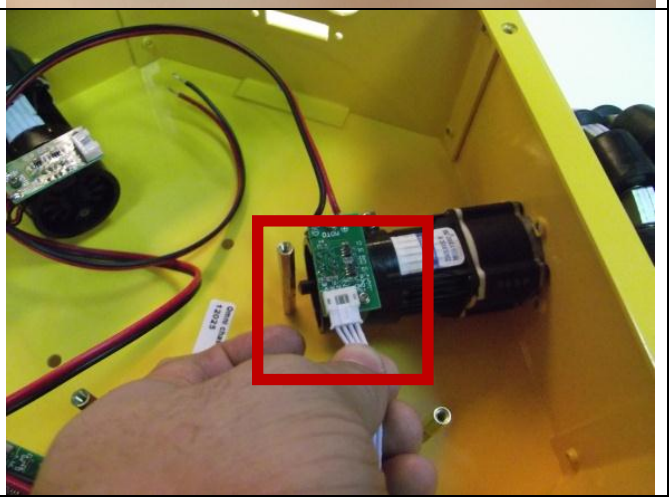
Step 1. Check all parts and tools.	
Step 2. Take out the Omni chassis (Part No:12025)	
Step 3. Take out the three DC Motors (Part No:16002) and the small black screws from the wheel hub screws bag (Part No:80009). These black screws have a phillips (cross-shaped) head.	

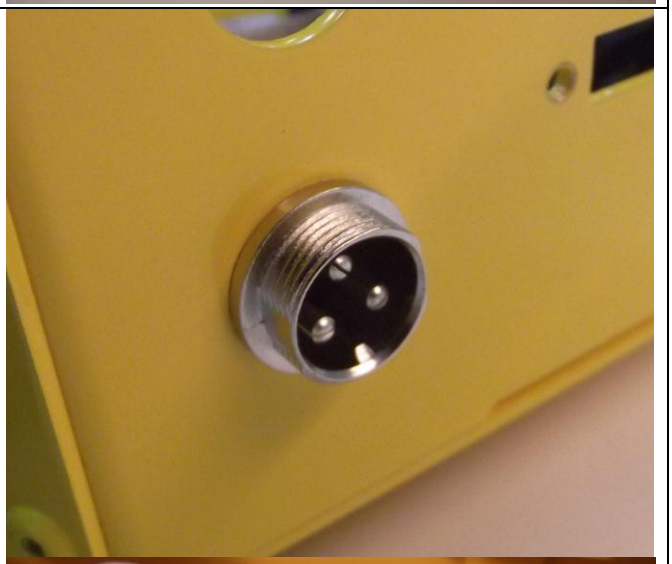
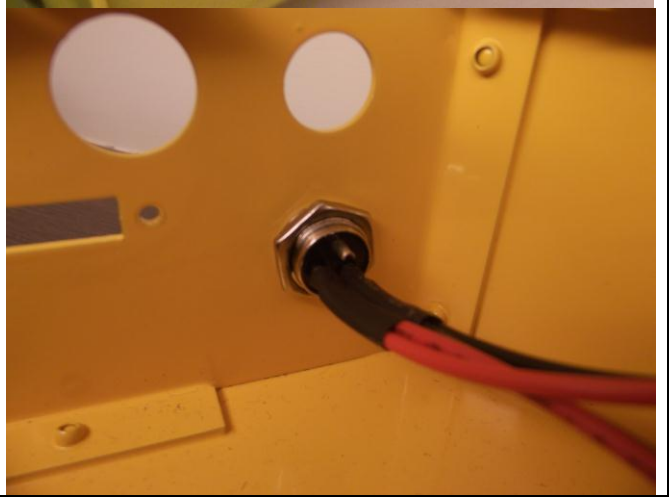
Step 4.Place the DC Motors into the holes in the Omni chassis as shown. Please ensure that the DC motors are placed in the correct orientation with the green encoder boards facing upwards (as shown to the right).	
Step 5. Use each of the screws from Step 3 to secure the DC motors into the Omni Chassis. Please be sure to tighten each screw a little, one at a time as shown in the diagram using a Phillips screwdriver. Please double check to ensure the DC motor is secured flush to the inside wall of the chassis. If it is not, you need to tighten these screws the whole way.	 

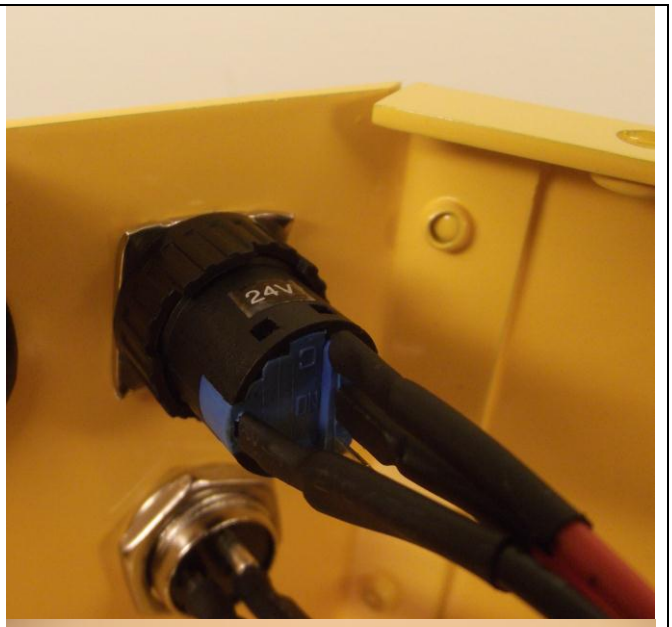
Step 6. Take out the couplers from the wheel hub assembly bag (Part No: 18005). Also take out the silver Phillips-head screws from the wheel hub screws bag (Part No: 80009).	
Step 7. Place one of the couplers onto one of the DC Motor shafts as shown.	
Step 8. Place four of the silver screws from step 6 into one the coupler as shown. Secure the screws using a Phillips screwdriver.	

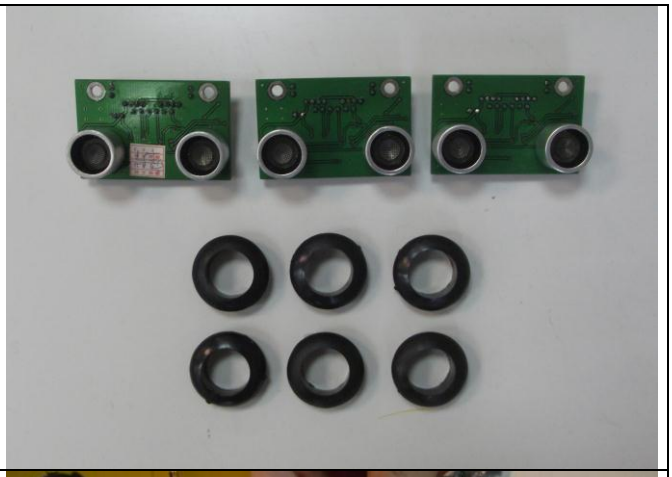
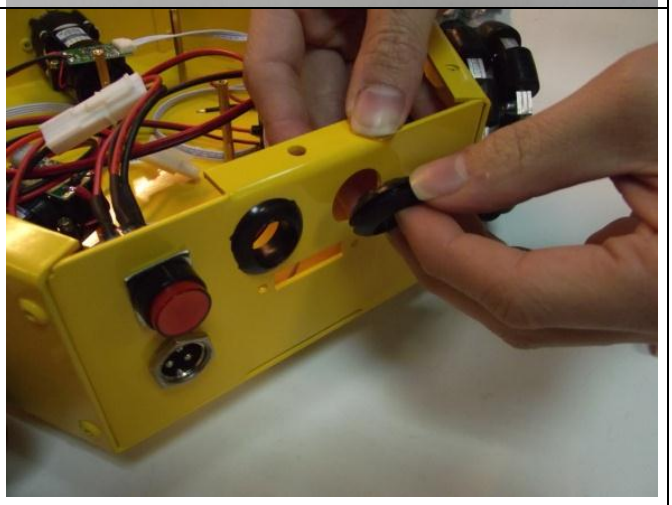
Step 9. Repeat step 8 for the two remaining couplers.	
Step 10. Take out the small hexagonal black screws from the wheel hub screws bag (Part No: 80009). Use the smallest sized hexagonal screwdriver (pictured) to secure these screws onto the couplers.	
Step 11. Take out the three Omni Wheels (Part No:14056). Also take out the large hexagonal screws and wheel hubs from the wheel hub assembly bag (Part No:80009).	

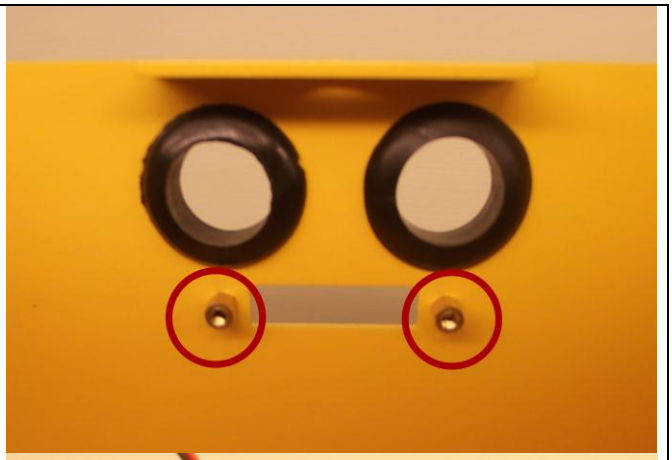
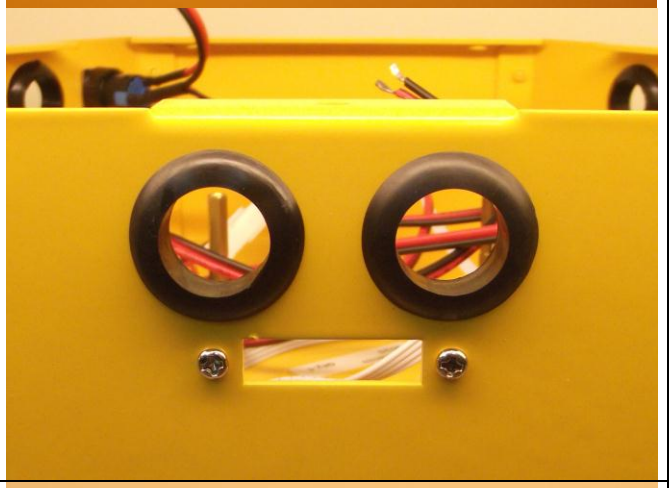
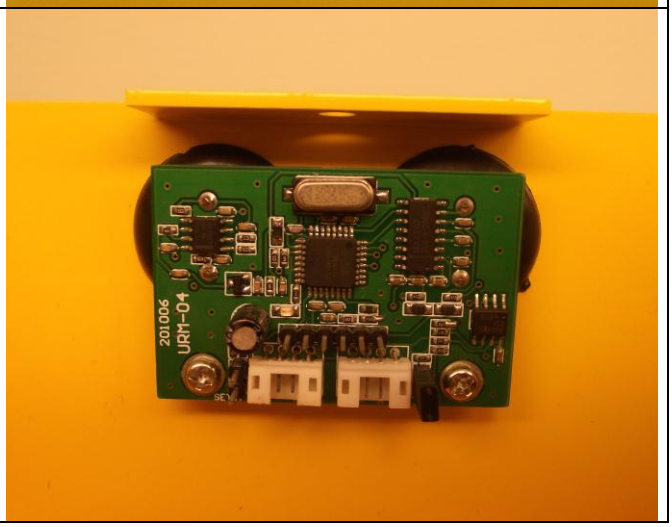
Step 12. Place one of the Omni wheels onto the couplers as shown.	
Step 13. Place a wheel hub onto the Omni wheel as shown.	
Step 14. Take out one of the large hexagonal screws from the wheel hub assembly bag (Part No:80009) and use the largest hexagonal screwdriver to secure them on as shown. Please ensure the two washers included are also screwed on.	

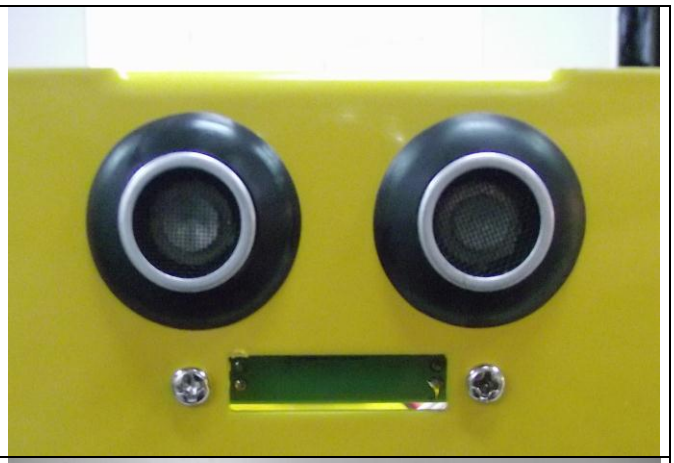
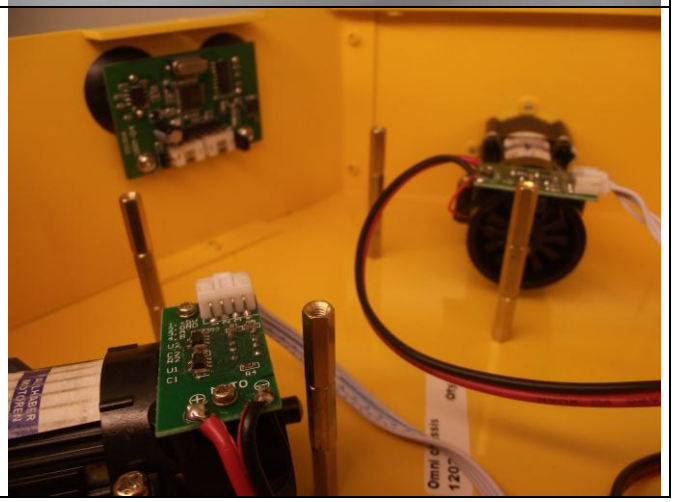
Step 15. Repeat steps 12 to 14 for the remaining Omni wheels.	
Step 16. Next please take out the motor encoder cable (Part No: 71001).	
Step 17. Plug each of the motor encoder cables into the motor encoders as shown.	

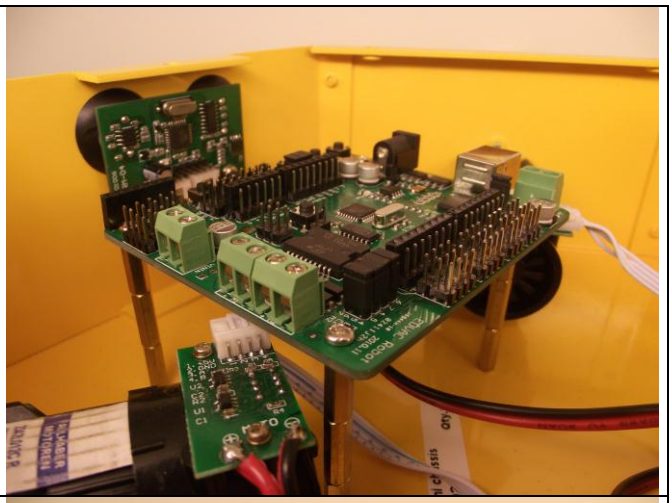
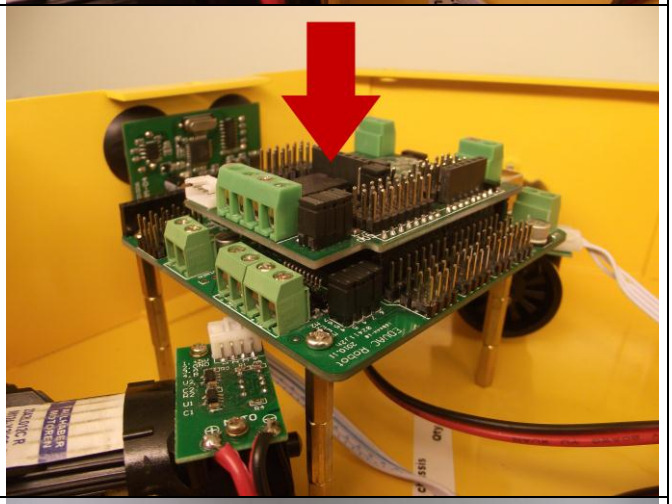
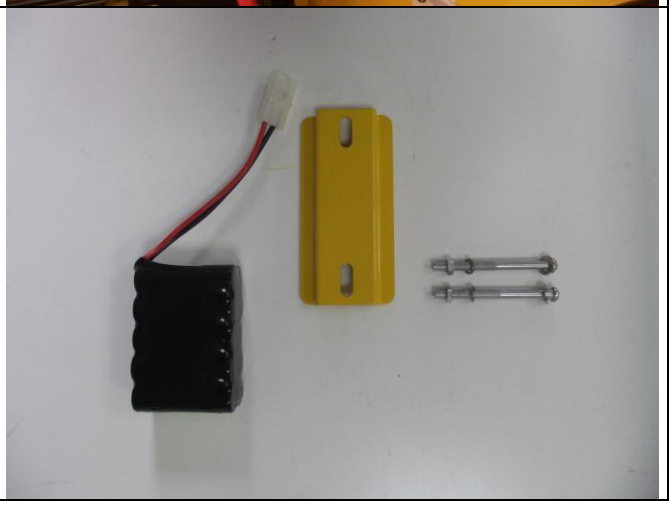
Step 18. Next, take out the power switch and charging socket (Part No: 12040).	
Step 19. Set up the charging socket as shown in the following two images.	 

Step 20. Install the power switch as shown in the following two images.	 
Step 21. Connect the charging socket and power switch by joining the smallest set of white plugs (pictured).	

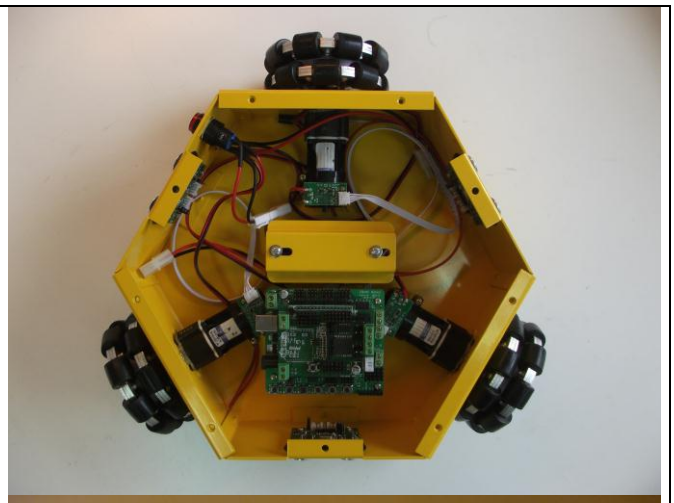
Step 22. Take out the following parts: Ultrasonic rubber grommet (Part No: 12016) Dual Ultrasonic Sensor Module (Part No: 20012)	
Step 23. Place all 6 of the ultrasonic rubber grommets (Part No: 12016) into the holes around the chassis.	

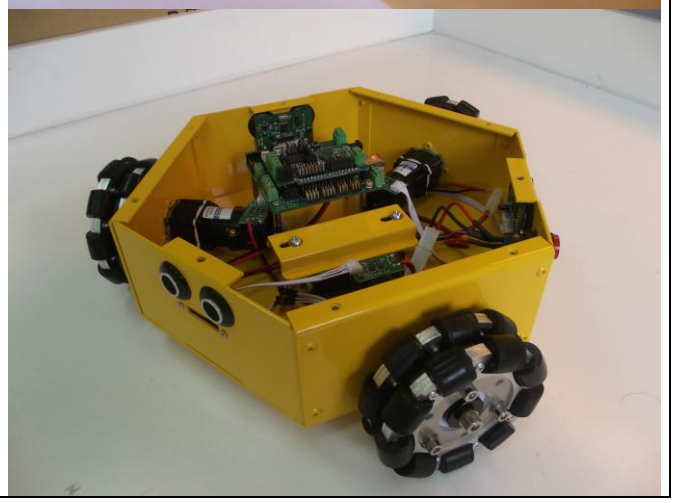
Step 24. Take out the small bronze colored spacers from the packet labeled Ultrasonic Cable & Screws (Part No: 80011) and fasten them to the inside of the chassis as shown. Use the small silver Phillips screws contained within the same bag and screw them in from the outside of the chassis (pictured).	 
Step 25. Take out the Dual Ultrasonic Sensor Module (Part No: 20012) and place it into the rubber grommets. Secure the sensor module using the silver screws from the Ultrasonic Cable & Screws Bag (Part No: 80011).	

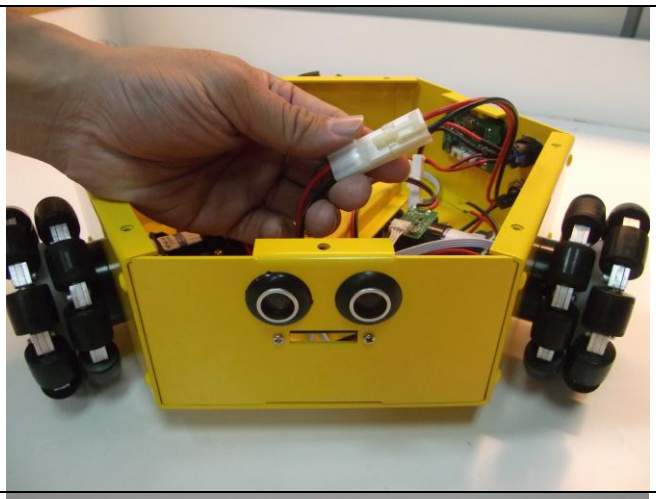
	
Step 26. Take out the Arduino Board (Part No: 22002) and the Controller Screws Bag (Part No: 80008).	
Step 27. Fasten the bronze colored pillars onto the chassis using the small screws contained the same bag.	

Step 28. Next, secure the Arduino board onto the pillars using the screws contained within the Controller Screws Bag (Part No: 80008).	
Step 29. Finally, plug the Arduino Expansion V1.1 (Part No:22004) into the Arduino board.	
Step 30. Please take out the 12V Battery (Part No. 76001) , the Battery Mounting Plate (Part No. 12003) and its accompanying screws.	

Step 31. Place the battery beneath the mounting plate and screw it into the chassis as shown to the right. You will need to use a screwdriver and a spanner at the same time to secure these screws.

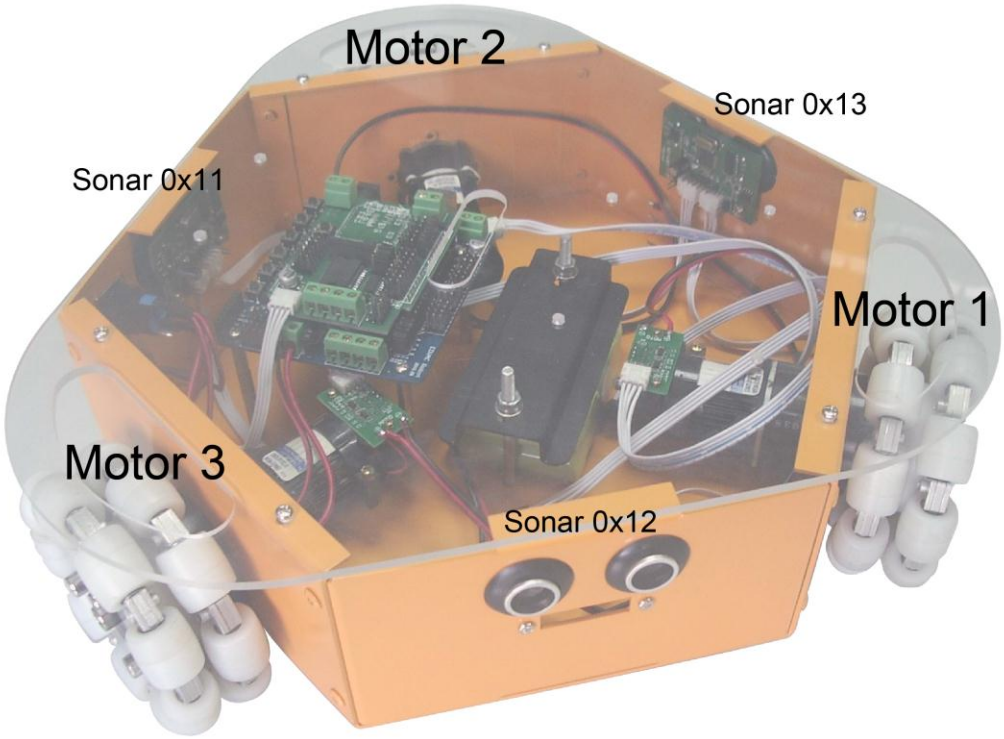




Step 32. Connect the charging socket to the battery by connecting the large white plug as shown.	
Step 33. Install the chassis cover. Your chassis building is now complete!. Please read the following section for instructions on how to connect the remaining wires in the chassis.	

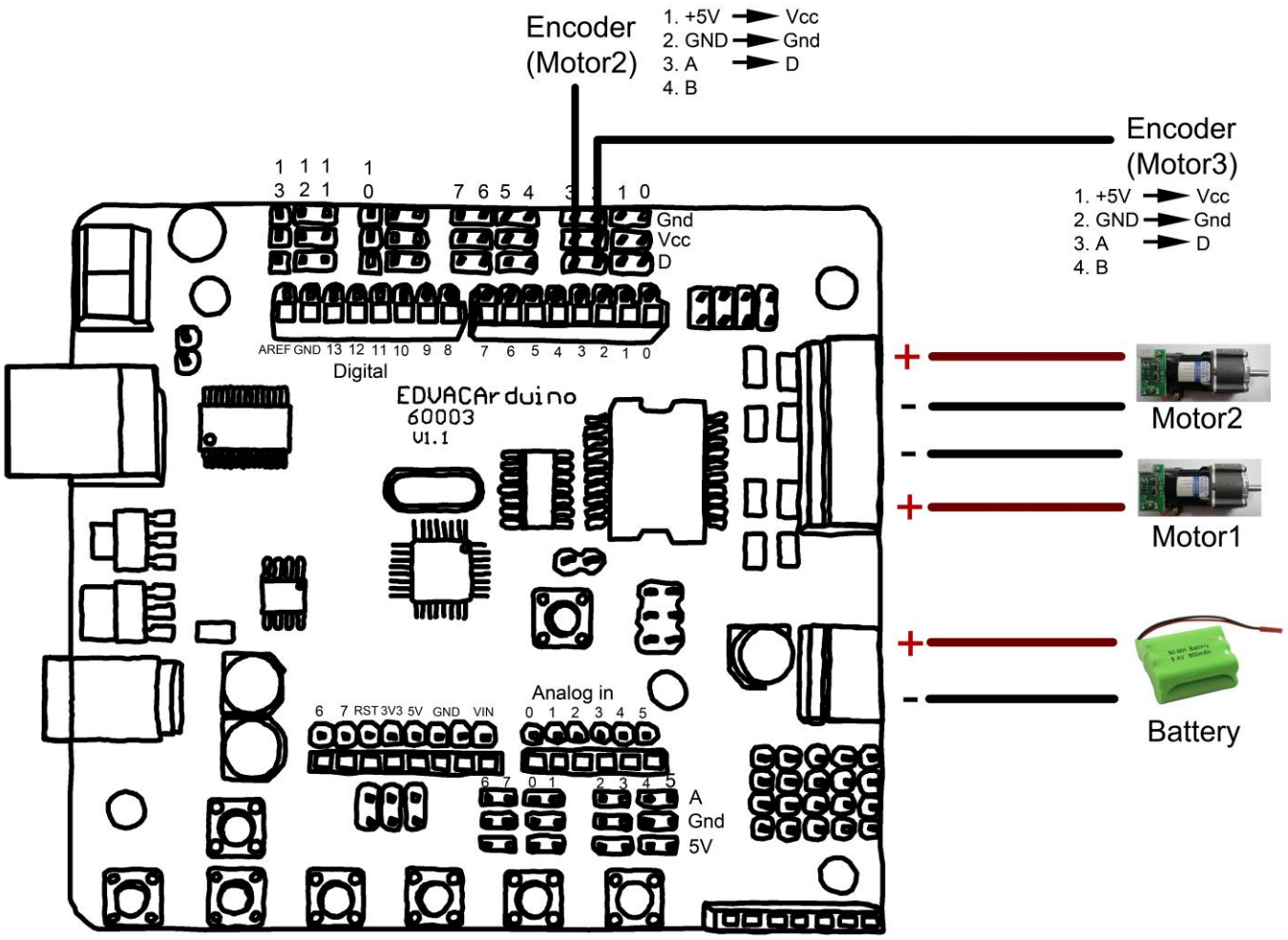
5. Sample Wiring Installation

Subsequent assembly instructions will make references to this figure.

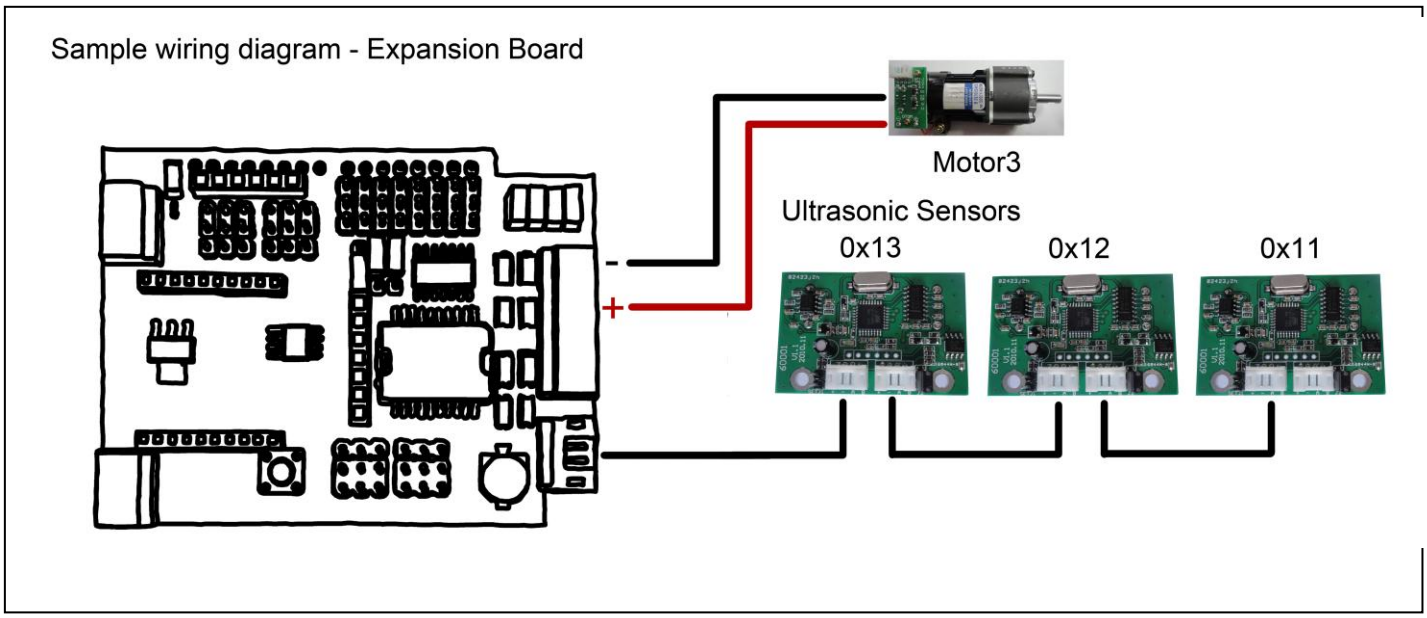


The diagram below illustrates an example of how to connect the Arduino control board to the sensors, motors and battery. Please pay particular attention to the battery connections. Wiring these incorrectly will cause damage to the controller.

Sample Wiring Diagram for FB003 Omni 3 Wheel Drive Robotic Platform



Please see the following page for expansion board connections.



6. Arduino Control Board & Sample Code

A. Please read this section carefully before applying power to the Arduino control board.
B. The control board is not designed for military or medical purposes and therefore cannot be used for these applications.
C. The FB004 2WD sample code can be found on this user guide, on the accompanying CD and also under the support section of the Fivebro International website – www.fivebro.com.tw.

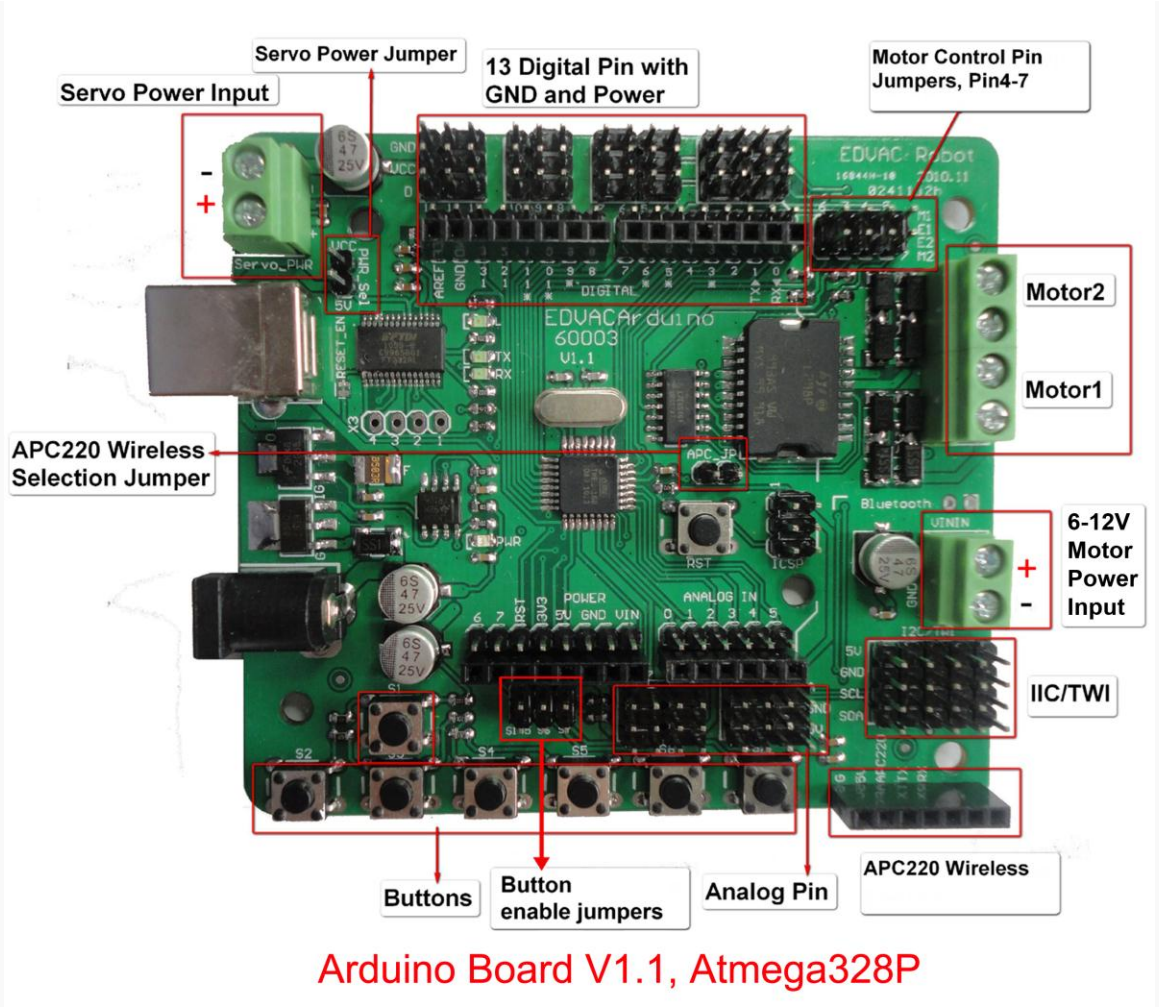
Introduction

The FB003'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

- Atmega328P 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



The picture above shows all of the I/O lines and Connectors on the controller, 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 draw 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 23).

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 23).

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

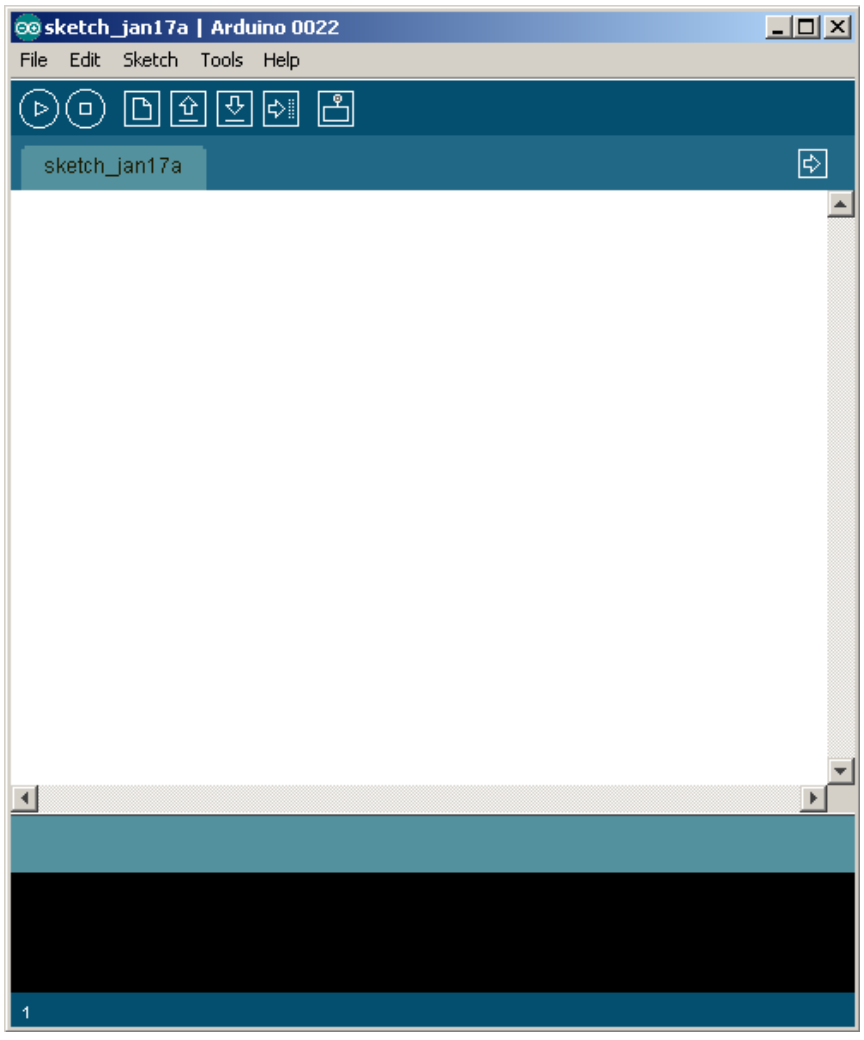
For this section you will need:

- 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:

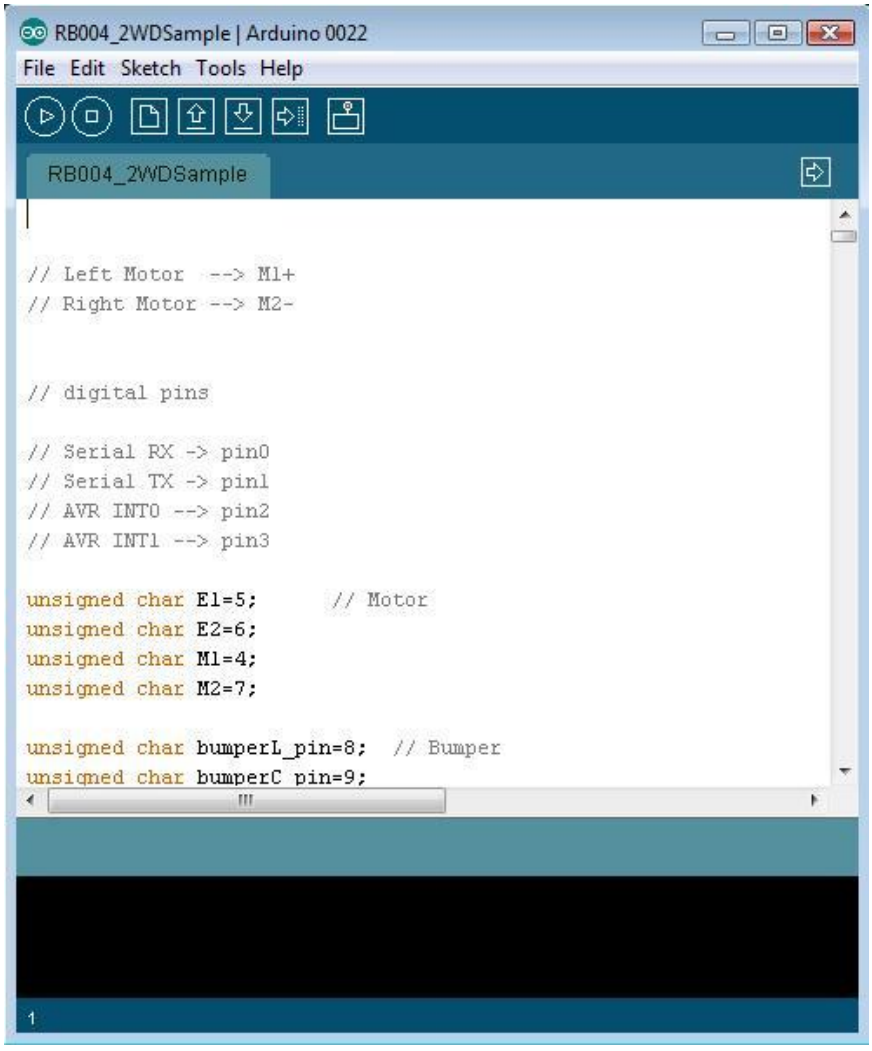


The next step is to simply connect the Arduino control board to your computer using the USB cable supplied (part #71005).

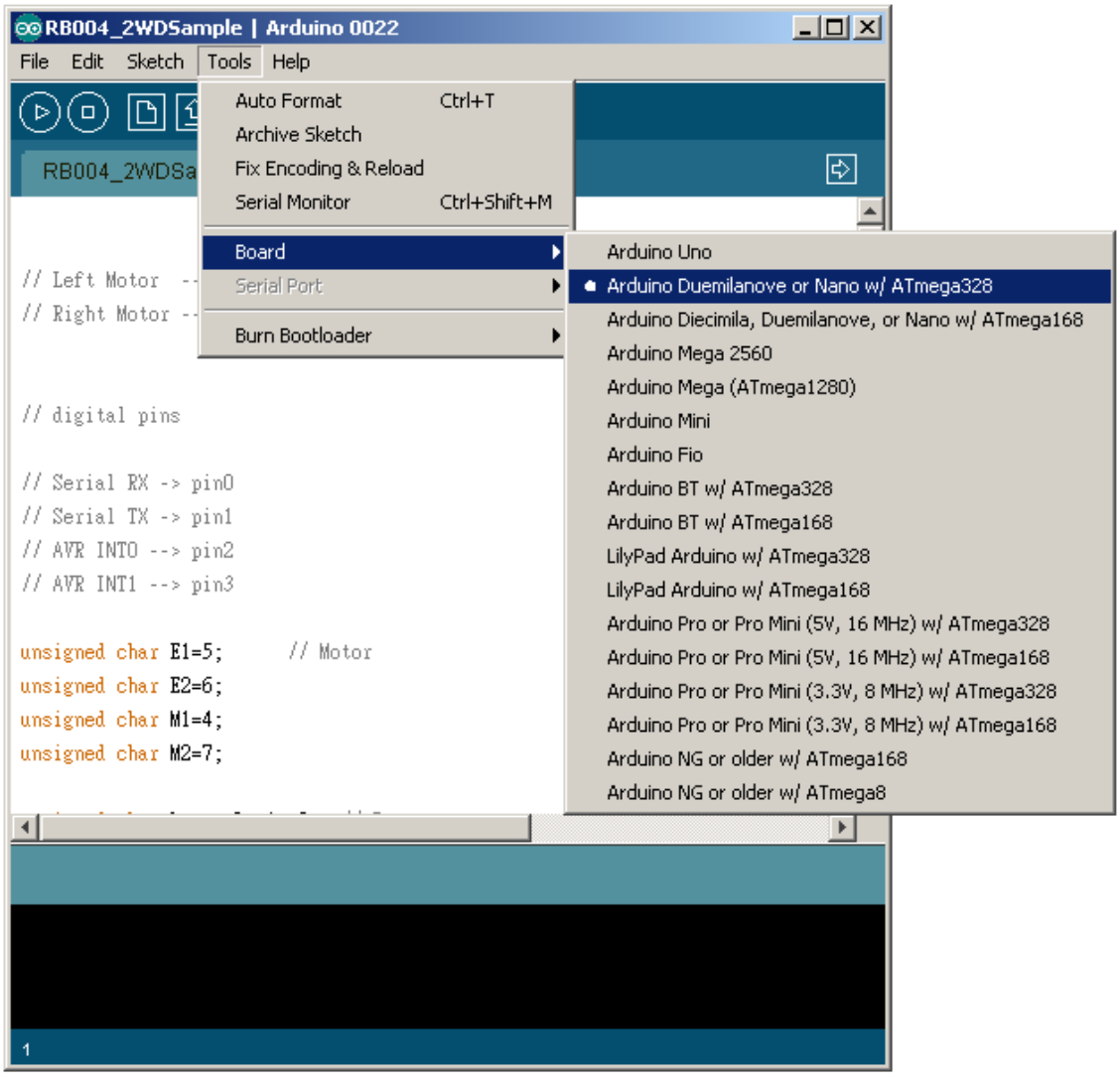
Please note: The Arduino expansion board cannot be plugged in while uploading any programs.

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. This will compile the sketch and upload it into your Arduino control board. If uploading is successful your Arduino IDE should look like this:

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 layout 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

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.

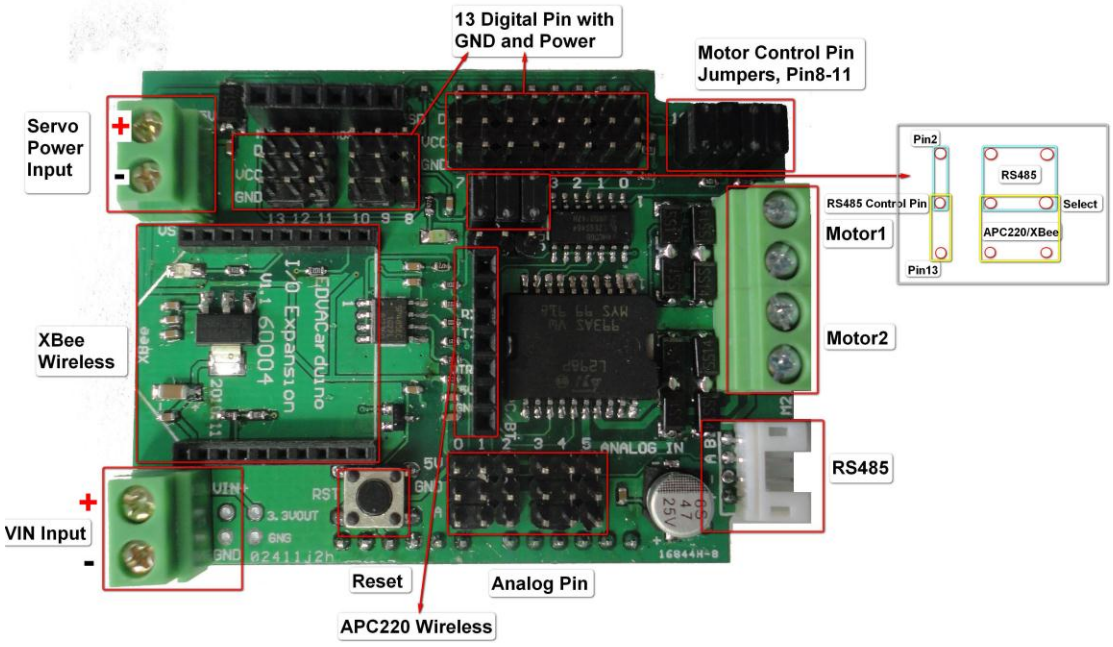
// Sample code3: Standard PWM DC control

```
#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);
```

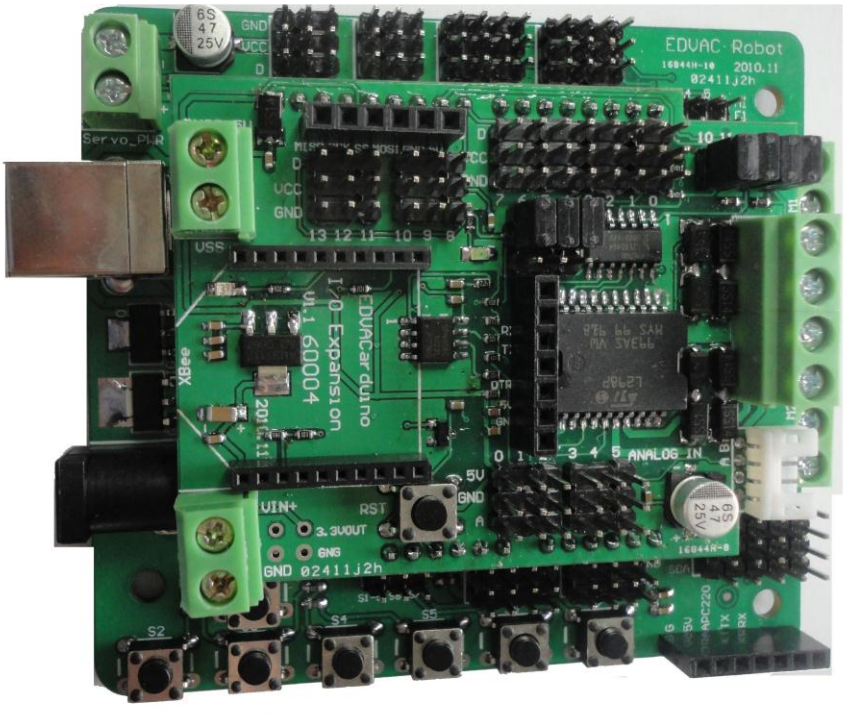
```
}

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.



Arduino IO Expansion Board, V1.1



Arduino main controller board combine with expansion board

6. 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.

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Fivebro International Crop.
1105 Room, 11F, No. 206, Song Jiang Rd.,
Taipei City 10467, Taiwan, R.O.C.
Email: sales@fivebro.com.tw
Web: www.fivebro.com.tw

Customer service line: +886 2 2562 8445
Customer online support: http://www.fivebro.com.tw/supprot/support.html

We recommend that you retain our address for future reference.
Product and colors may vary.
Printed in Taiwan.
This product is not suitable for children under 3 years

This user manual should be kept as it contains important information.