FiveBOT
Robotic Platform Solution

FB002 Mecanum 4WD Robotic Platform

User Manual

Fivebro International Corp.

User Manual V1.0

Table of Contents

Version History

(mm/dd/yyyy)
v1.0 – 05/18/2011 – Author: AJ, sample code v1.0

1. FB002 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.
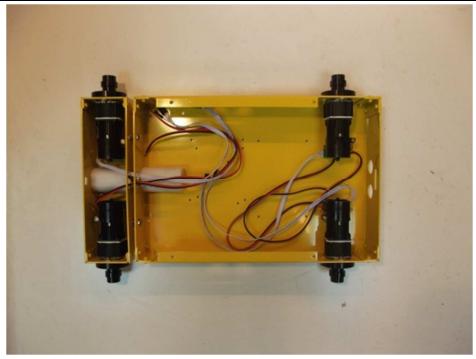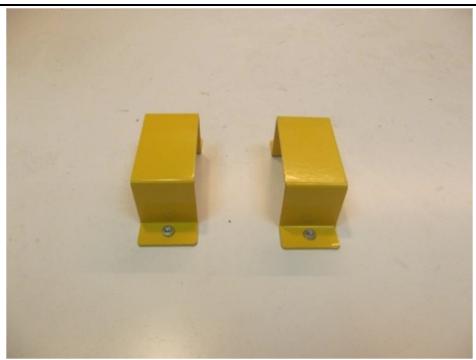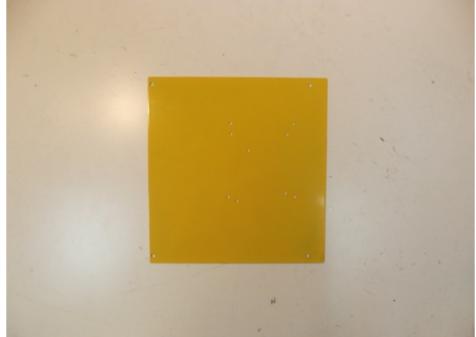
The FiveBOT002 is designed for robotic research and development. The FiveBOT002 can be used as a transporter, a remote monitoring device and a Navigation/Patrol robot.

The maximum load capacity of the FiveBOT002 is 20kg.
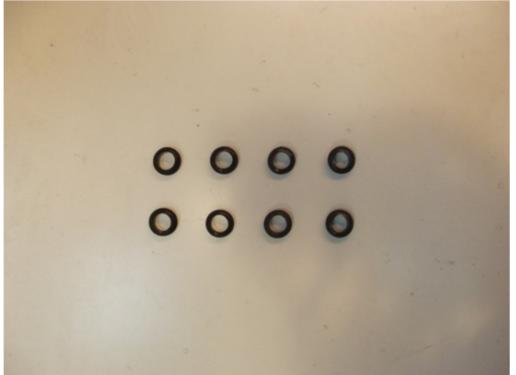
The FB002 comes with 4 mecanum wheels controlled by 4 DC motors, allowing clockwise/anti-clockwise rotation as well as sideways movement. The robotic platform's 3 ultrasonic sensors allow the robotic platform to detect objects or avoid obstacles.

The FiveBOT002 robotic platform's maximum load capacity is 20kg. This load can be placed on top of the platform.

2. FB002 Mecanum 4WD Parts List

ID	Part Number	Part Name	QTY	Accessories	Check
FB002 Mecanum 4WD Parts List					
1	12053	Chassis Body	1		
2	12056	Front Sonar Mounting Bracket	1		
3	12060	Battery Mounting Bracket	2		
4	12061	Chassis Cover Plate	1		

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5	14087	100mm Al Mecanum Wheel ,Left	2		
6	14092	100mm Al Mecanum Wheel, Right	2		
7	18005	Wheel Hub Assembly	4		
8	16002	DC Motor	4	Pre-installed	

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9	12016	Ultrasonic Rubber Grommet	8		
10	95002	Hex Screwdrivers	1	2 pieces set	
11	12040	Power switch charging socket	1	One main power switch, one charge socket, one power switch	

FB002 Electronic Components
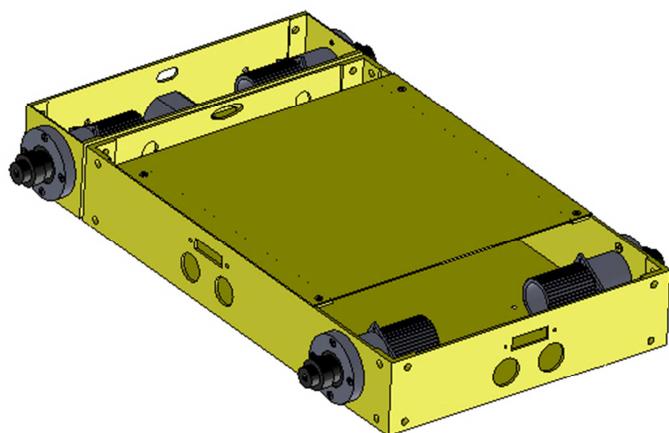
ID	Part Number	Part Name	QTY	Accessories	Check
1	22002	Arduino Board, Atmega328	1		
2	22006	Arduino Expansion V1.2	1		
3	20012	Ultrasonic Sensor Module	3	Cable, Screws	
4	71001	Motor Encoder Cable	4		
5	71005	Arduino USB Cable	1		
6	80011	Ultrasonic Cable & Screws	3		
7	71006	Jumper Cable	3		
8	80005	Controller Screws Bag	1		
9	80017	Battery Mounting Bracket Screws	1		

FB002 Mecanum 4WD Chassis Construction
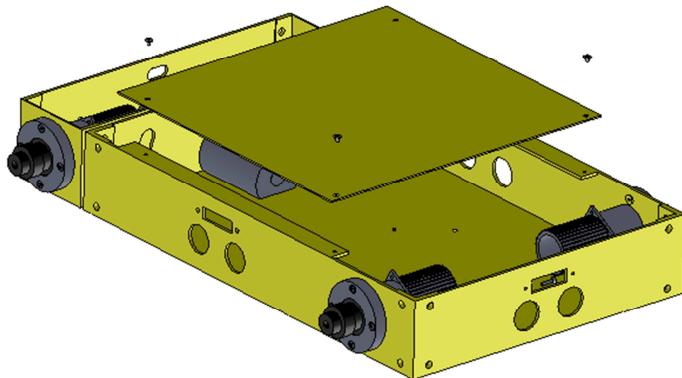
Welcome to your new FB002 Mecanum 4WD Robotic Platform! Please take a moment to remove all of chassis parts from the box and check all of parts against the parts list before commencing assembly.

Please note: A Phillips screwdriver is required for assembly and is not included.
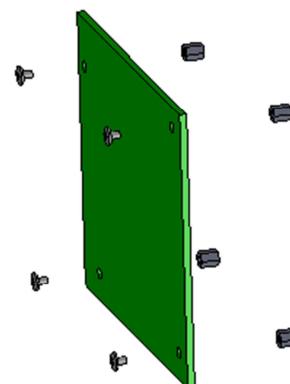
Step 1 –Take out the chassis body from the packaging. The chassis body has the DC motors and their couplers pre-installed.	
Step 2 – Take off the chassis cover plate by undoing the screws with a Phillips screwdriver.	
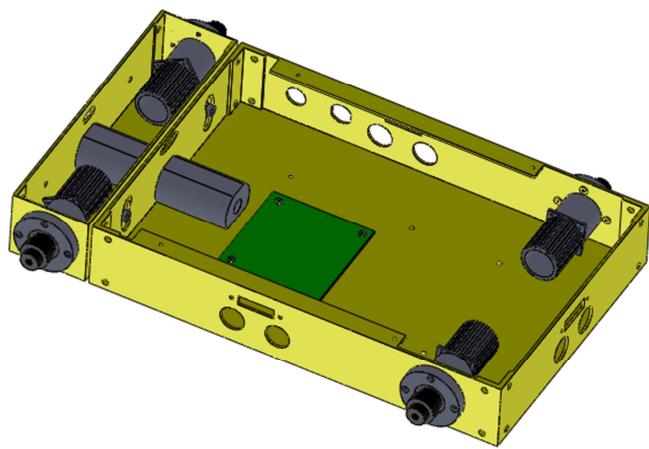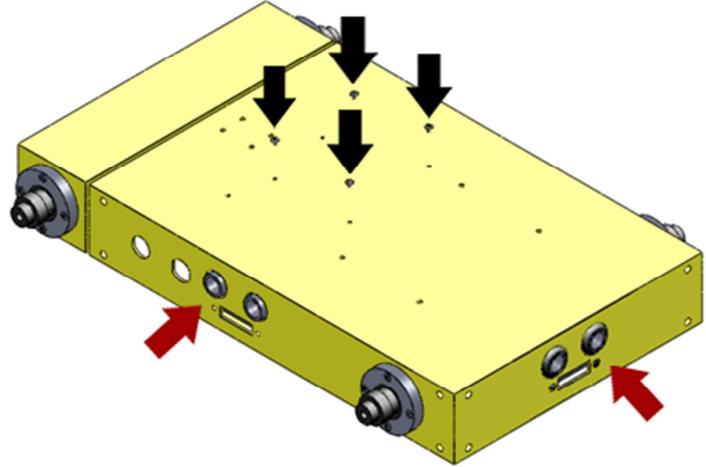
Step 3 – Take out the Arduino motherboard (part #22002) and attach 4 screws and 4 spacers as illustrated.	
Step 4 – install the motherboard into the chassis as shown. You will need to install 4 more screws into the opposite side of the chassis, as indicated by the black arrows. **Next, Install 6 rubber grommets as indicated by the red arrows.**	
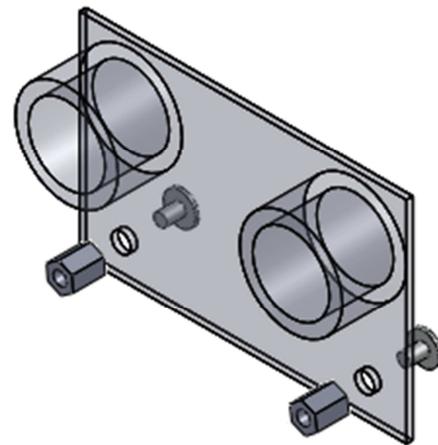
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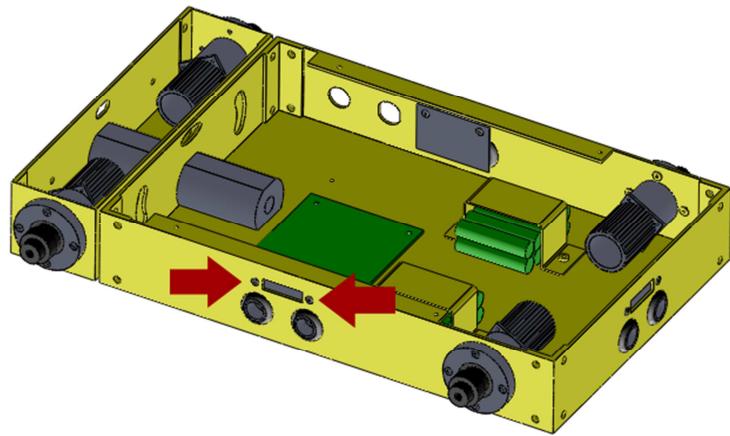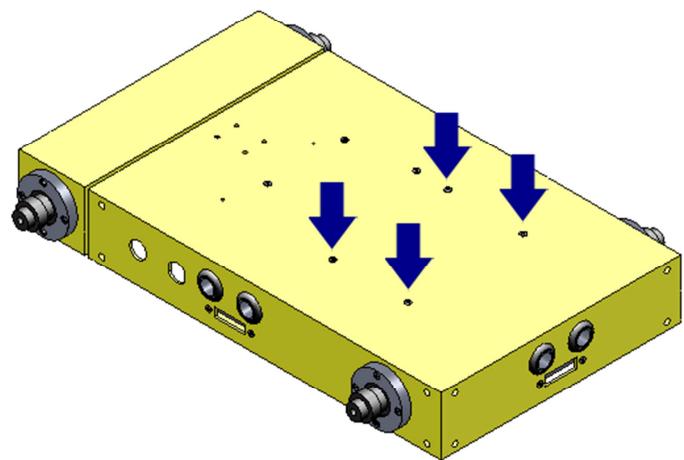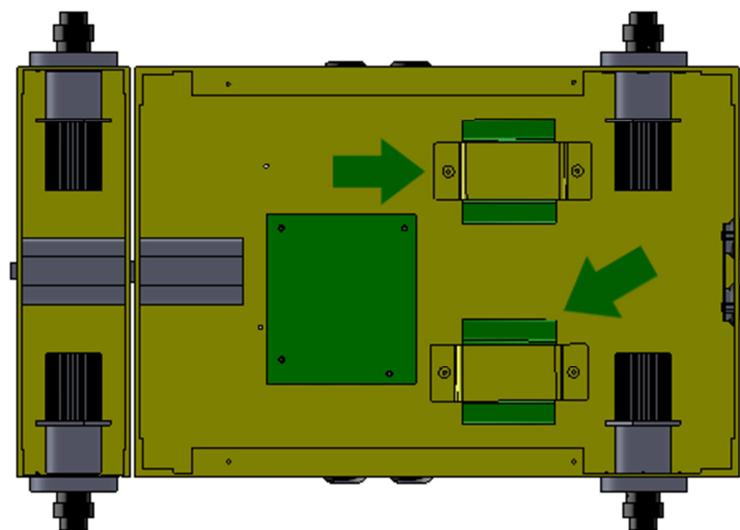
Step 5 – Install 2 spacers and 2 screws onto each of the ultrasonic sensors.	
Step 6 – Now place the ultrasonic sensors into the rubber grommets and secure the screws as shown by the red arrows.	
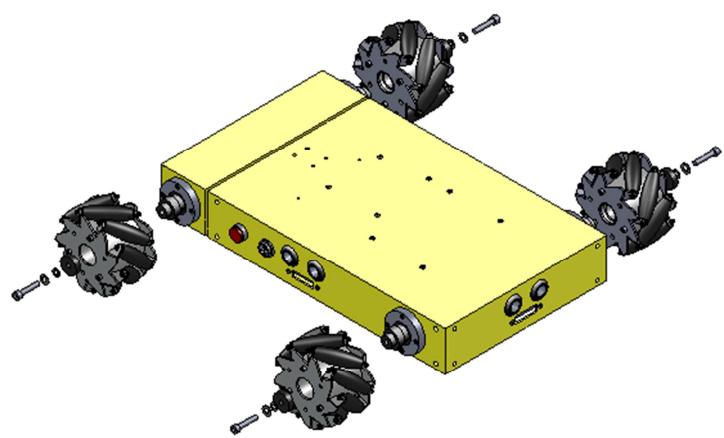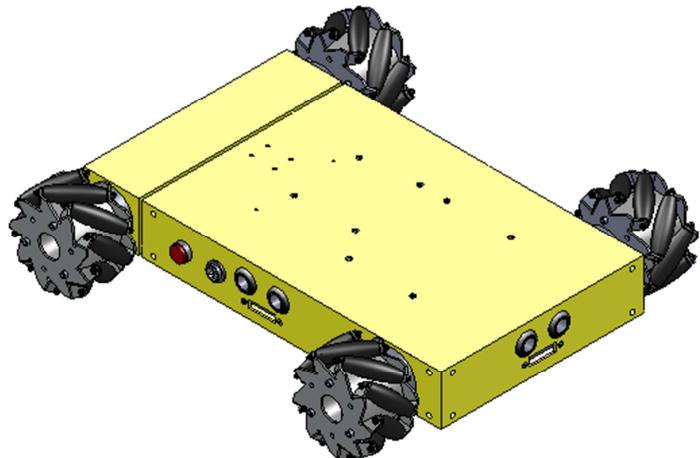
Step 7 – Install the batteries and battery mounting plates and screw them into the opposite side using the Battery Mounting Bracket Screws (part #80117). These screws are indicated with blue arrows.

Step 8 – Install the wheels using the Wheel Hub Assembly parts (part #18005).	
Step 9 - Your FB002 4WD chassis construction is now complete!	
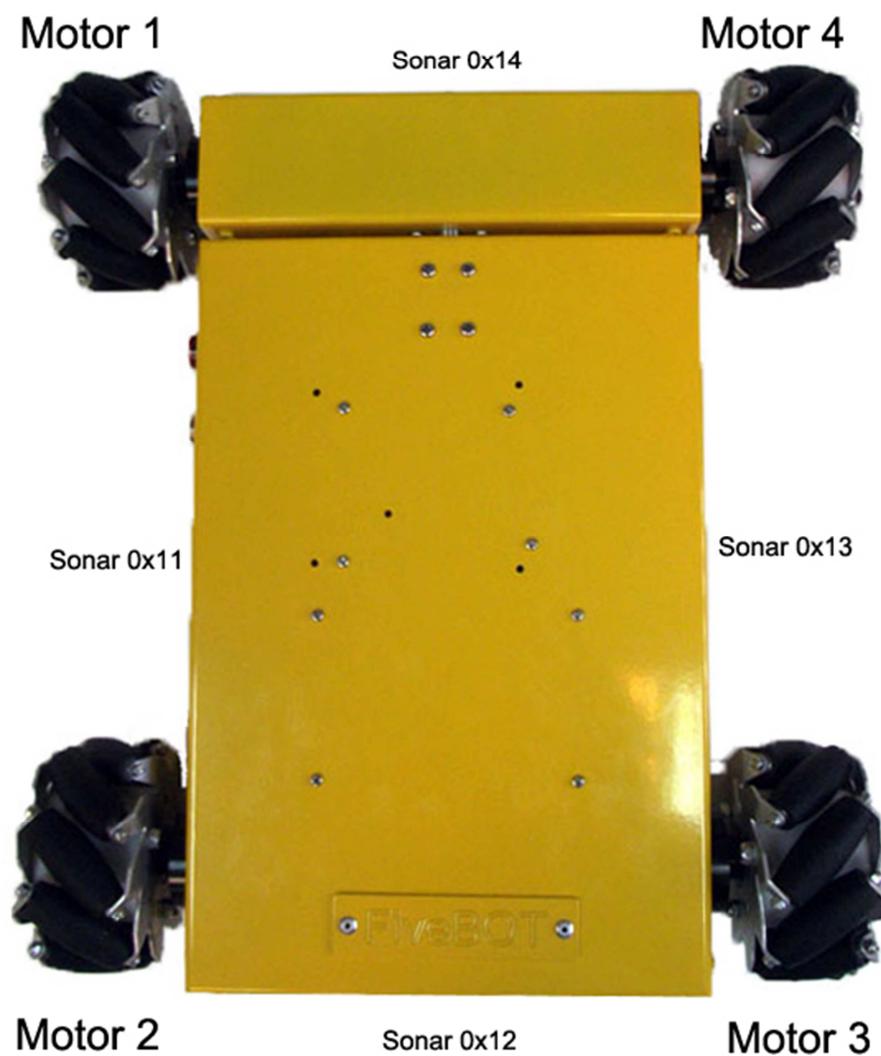
Sample Wiring Installation
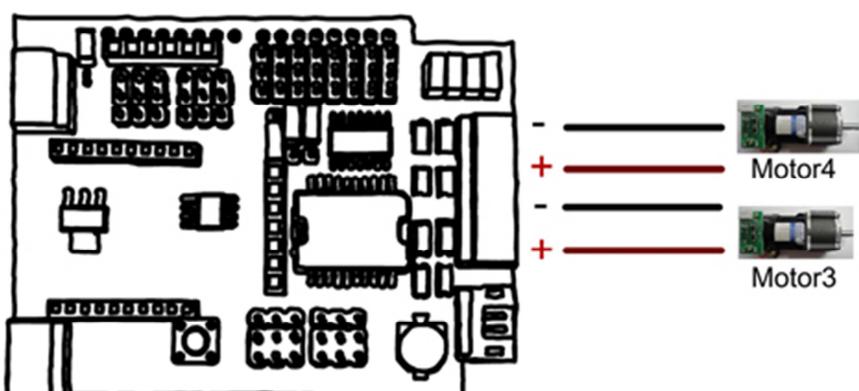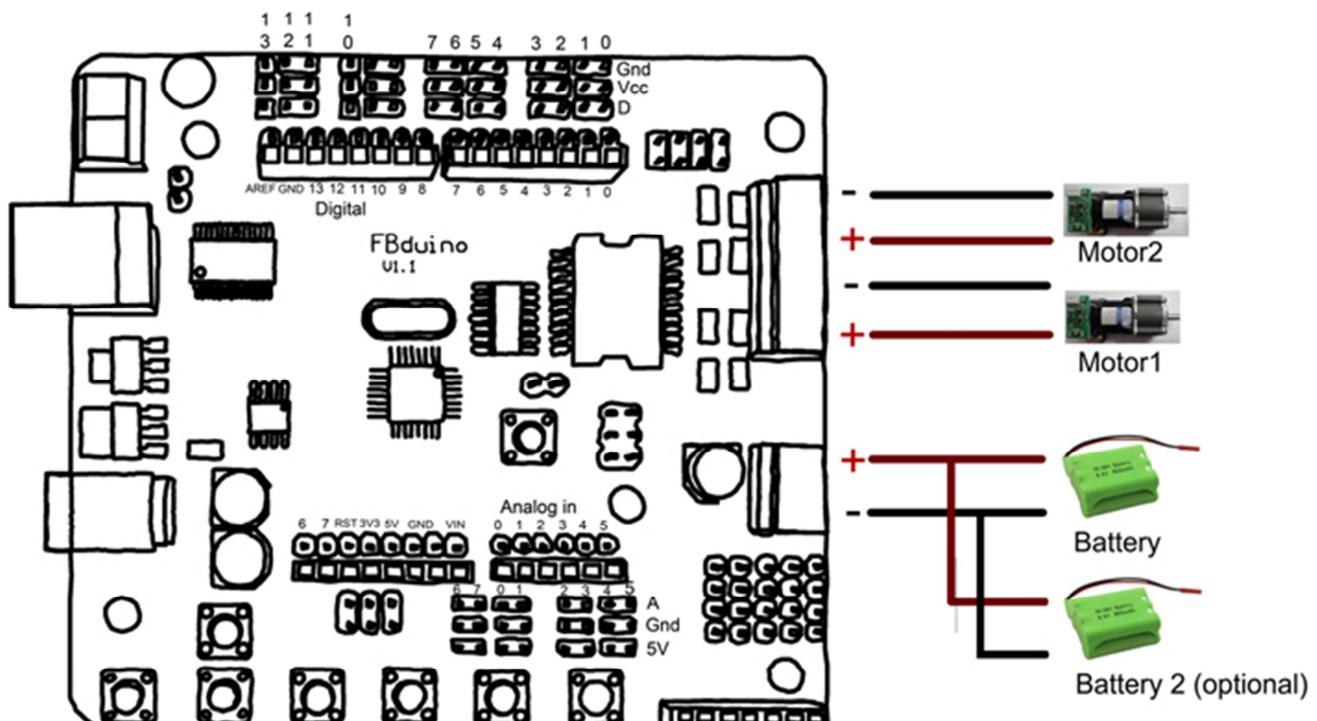
The FB002 sample code assumes that the motors and ultrasonic sensors are positioned as shown. The ultrasonic sensors are pre-addressed and their addresses are written on each of the boards.

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Wiring instructions for sample code

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 FB002 Mecanum Wheel Robotic Platform

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Quiet PWM mode

You may optionally wish to increase the PWM frequency of the Arduino board which will help the motors to operate more quietly. For this you need to modify the sample code slightly and add 3 jumper wires;

Uncomment the following two lines of code from the Setup() section of the sample code:
>   //   TCCR1B=TCCR1B&0xf8|0x01;   // Pin9,Pin10 PWM 31250Hz
>   //   TCCR2B=TCCR2B&0xf8|0x01;   // Pin3,Pin11 PWM 31250Hz
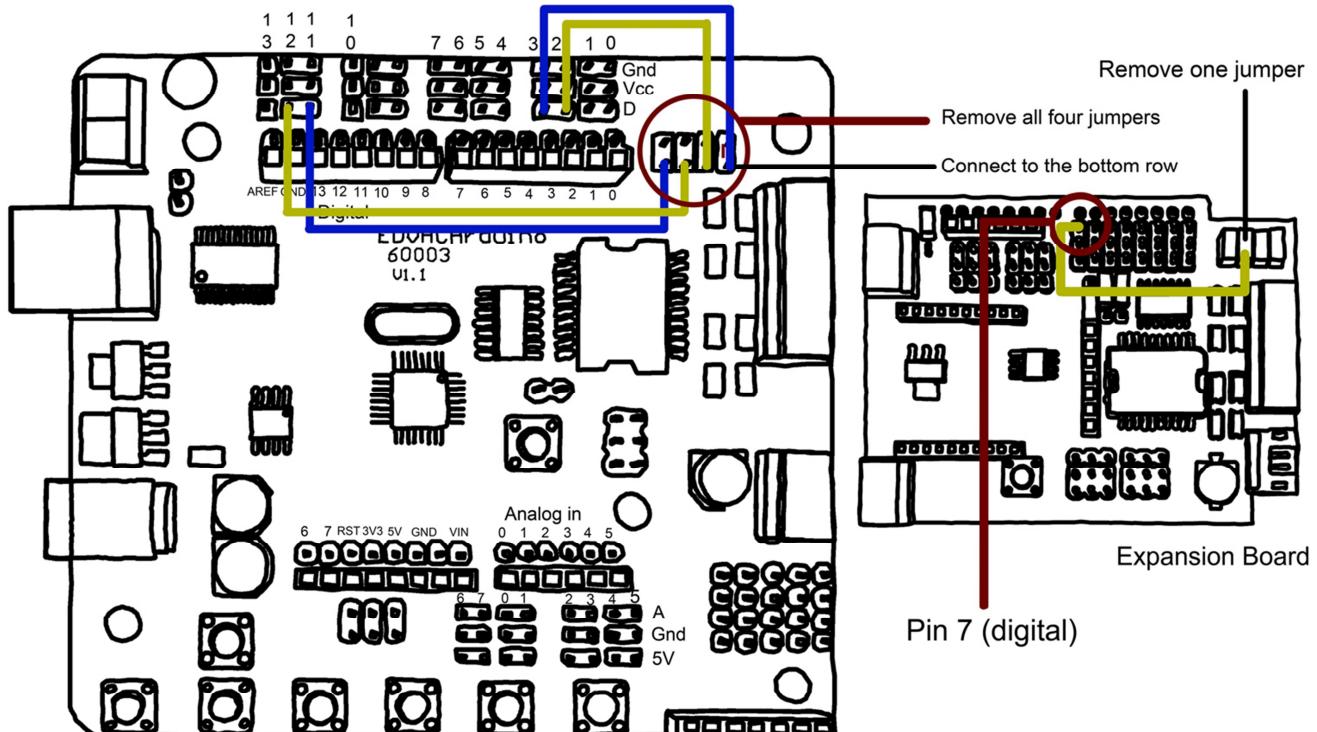
Then locate the section of the code segment labeled "Motor control pins" and modify the code according to the table.

Original code	Replace with
#define M1 4	#define M1 2
#define E1 5	#define E1 3
#define E2 6	#define E2 11
#define M2 7	#define M2 12
#define M4 11	#define M4 7

After that, you will need to add three jumper wires according to the following diagram:

Sample Wiring Diagram for FB002 with PWM modification

6. Arduino control board information

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 FB002 sample code can be found within this user guide, on the accompanying CD and also under the support section of the Fivebro International website – www.fivebro.com.tw.

Introduction
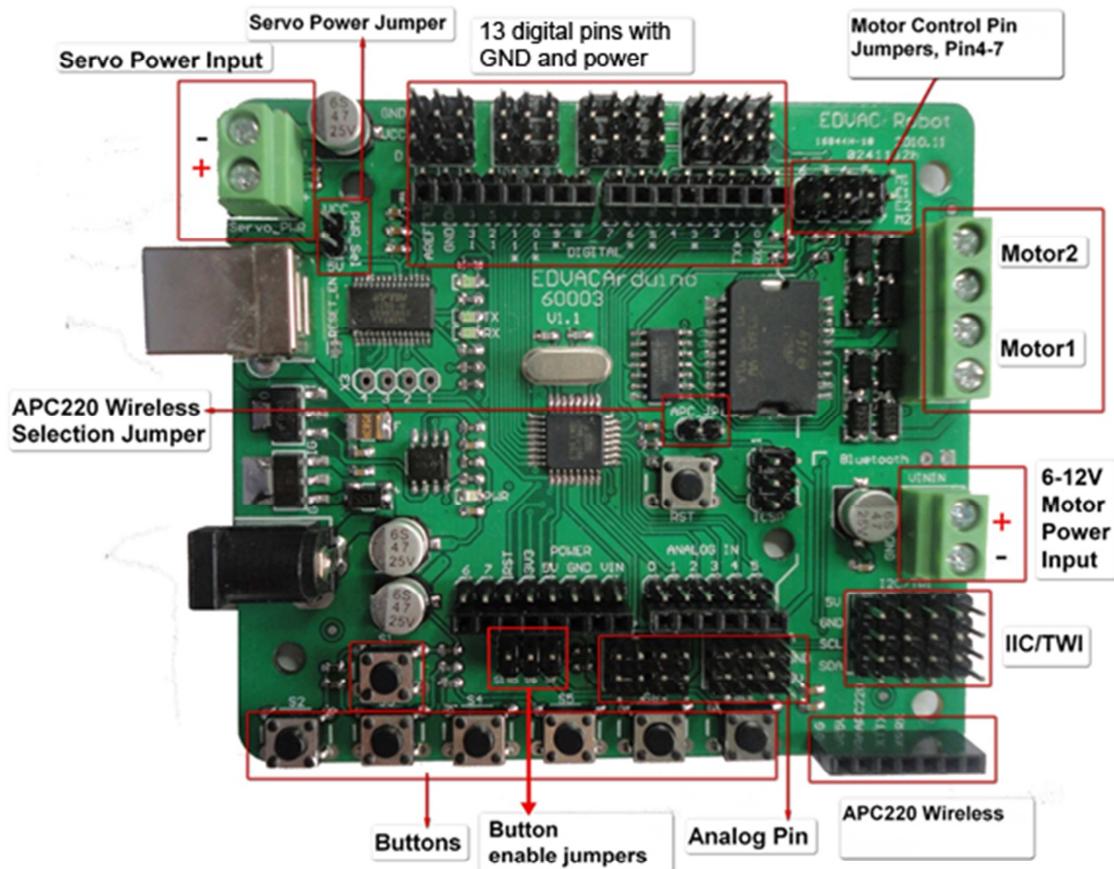
The FB002's Arduino control board is a specially modified Arduino board designed especially for robotics applications. Built from the Arduino open source platform, it is supported by thousands of open source codes and can be easily expanded with most Arduino Shields. The integrated 2 way DC motor driver 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

Arduino Board V1.1, Atmega328P

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, use power from the 6-12V Motor Power Input (shown on page 15).

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:
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: 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
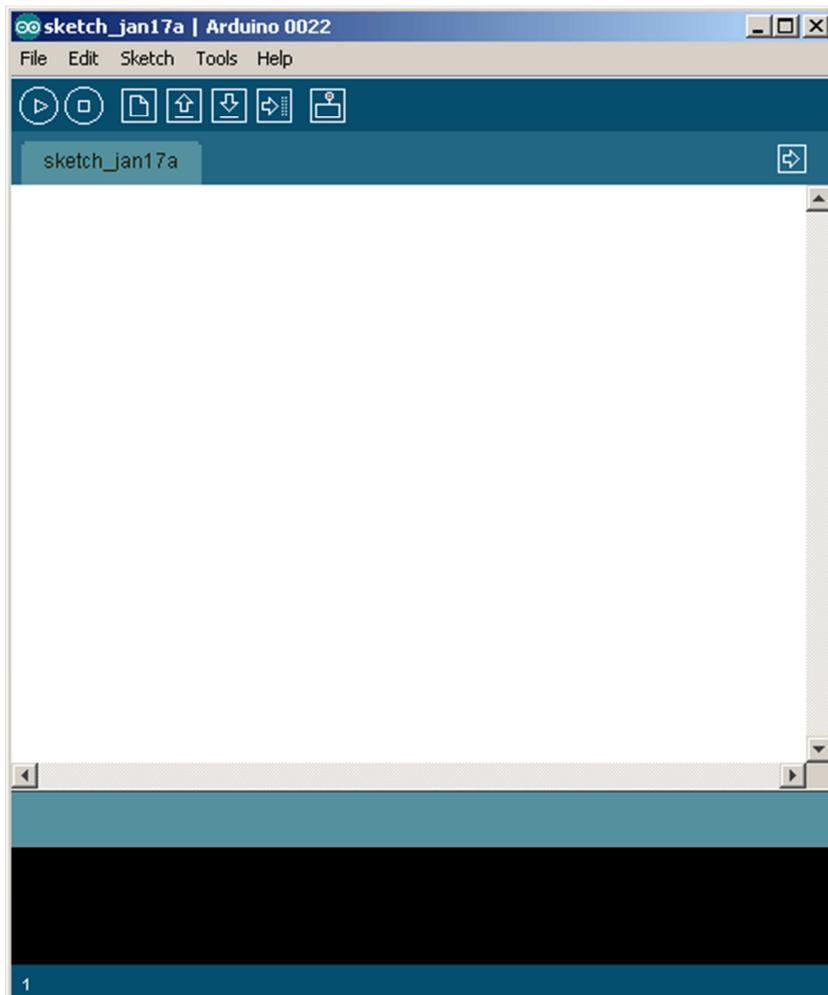
For this section you will need:

- Arduino IDE (Integrated Development Environment) software
- The FB002 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 FB002 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:
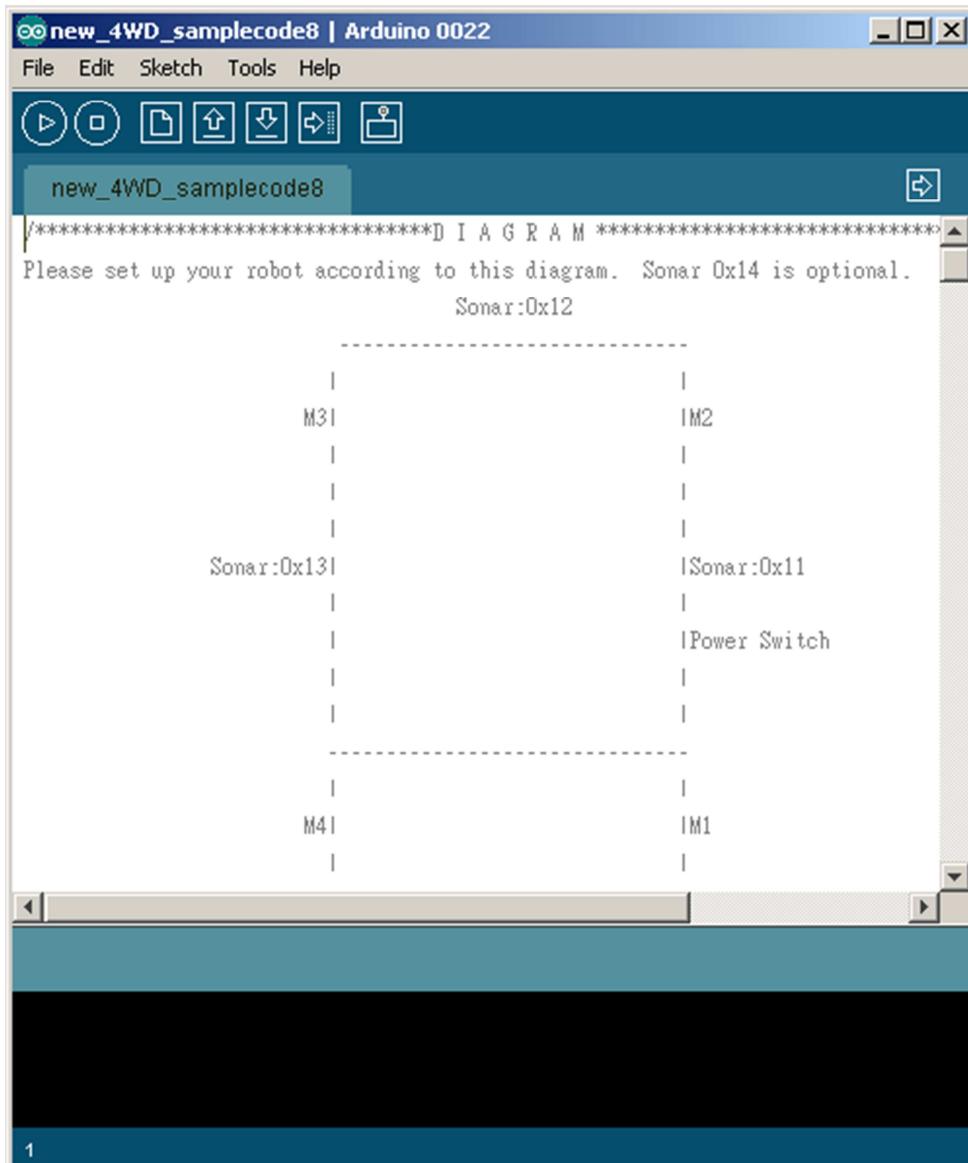
The next step is to simply connect the Arduino control board to your computer using the USB cable supplied (part #71005).
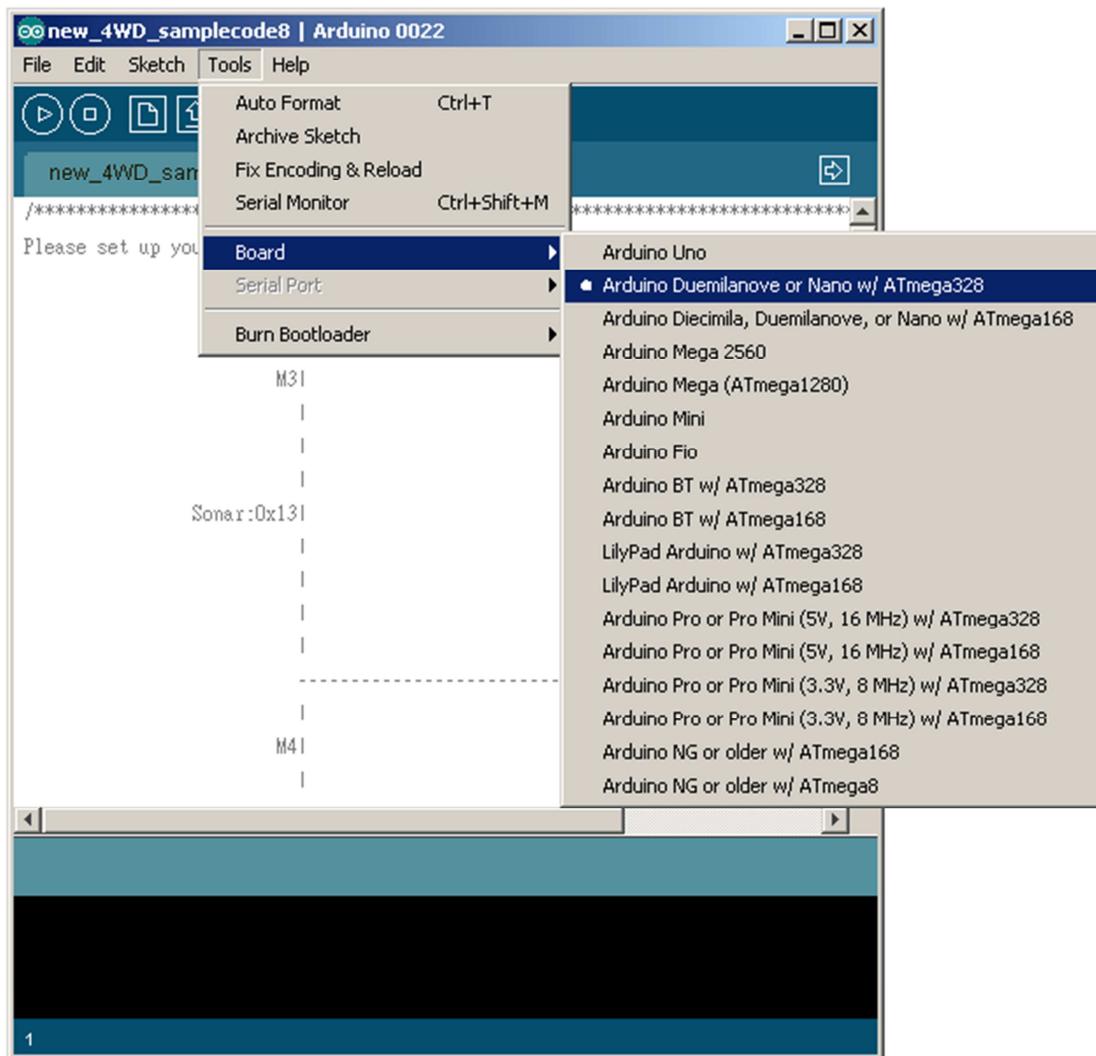
Please note: The Arduino expansion board cannot be plugged in while uploading any programs.

Using your Arduino IDE software, click File > Open > and then point the browser to the location where you have downloaded the FB002 sample code.

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

```
new_4WD_samplecode8 | Arduino 0022                                    _ □ X
File   Edit   Sketch   Tools   Help

  ▷  □   □  ⇧  ⇩  ⇥  □

  new_4WD_samplecode8                                                    ⇨

/********************************D I A G R A M ********************************
Please set up your robot according to this diagram.  Sonar 0x14 is optional.
                              Sonar:0x12
               -------------------------------
               |                             |
           M3|                             |M2
               |                             |
               |                             |
               |                             |
   Sonar:0x13|                             |Sonar:0x11
               |                             |
               |                             |Power Switch
               |                             |
               |                             |
               -------------------------------
               |                             |
           M4|                             |M1
               |                             |

  1
```
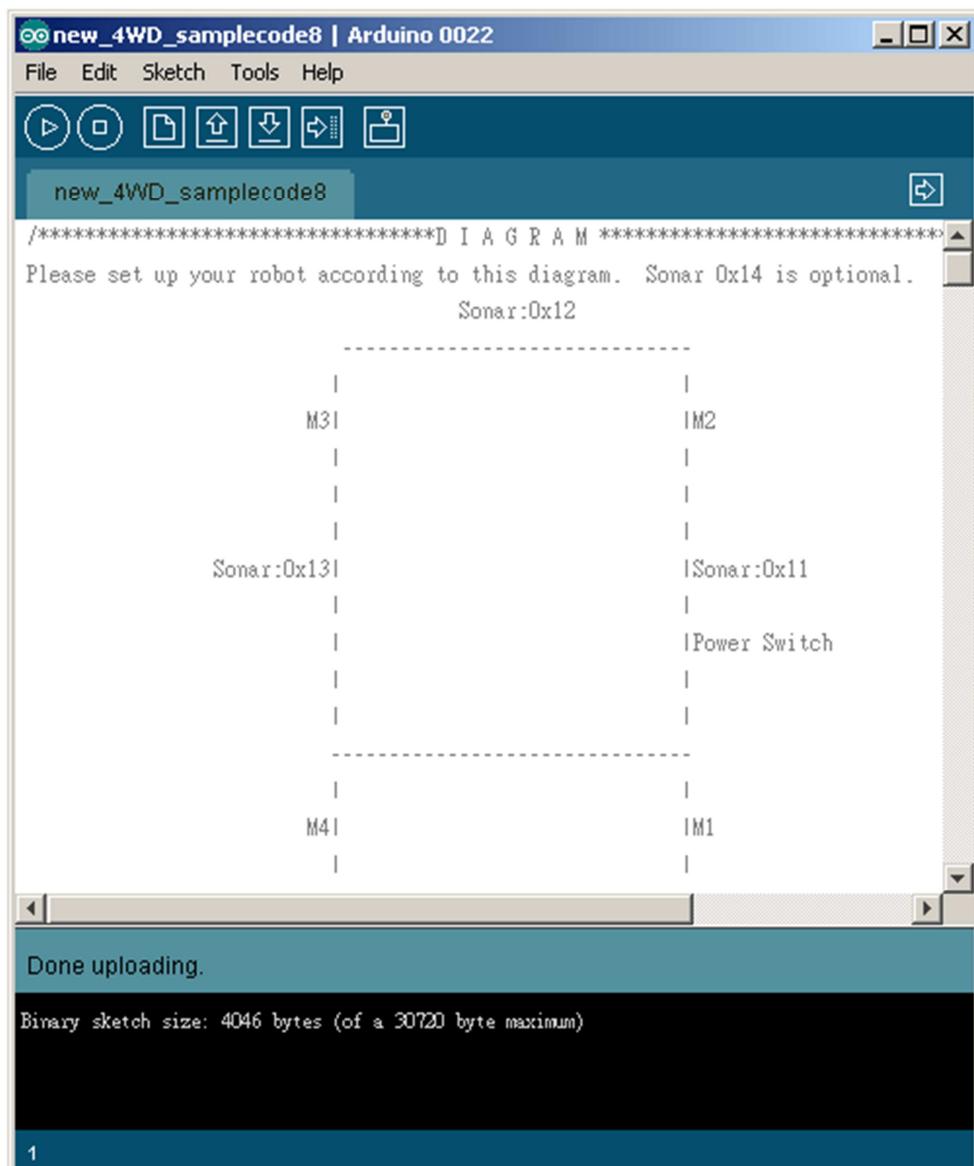
Now click Tools > Board > then select "Arduino Diecimila, Duemilanove, or Nano w/ ATMega328".

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:

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```
new_4WD_samplecode8 | Arduino 0022
File  Edit  Sketch  Tools  Help

new_4WD_samplecode8

/********************************D I A G R A M ********************************
Please set up your robot according to this diagram.  Sonar 0x14 is optional.
                              Sonar:0x12
                     -----------------------------
                     |                           |
                 M3|                           |M2
                     |                           |
                     |                           |
                     |                           |
     Sonar:0x13|                           |Sonar:0x11
                     |                           |
                     |                           |Power Switch
                     |                           |
                     |                           |
                     -----------------------------
                     |                           |
                 M4|                           |M1
                     |                           |

Done uploading.

Binary sketch size: 4046 bytes (of a 30720 byte maximum)

1
```

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

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Button Press Tutorials

The controller has 7 built-in buttons, labelled S1-S7. Buttons S1-S5 use analog pin A7, S6 uses digital pin D2 and S7 uses digital pin D3.

To enable S6 and S7, apply the rightmost two of the "button enable jumpers" (shown on the layout diagram, page 15. Once these enable jumpers have been applied, digital pins 2 and 3 will be occupied by the push buttons.

```
// Sample code 1:  One-button LED switch
//Code function: Pressing button S6 turns LED on, pressing it again turns it 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
//Code function: Open Arduino IDE's serial monitor. Sending the character "w" will cause motors M1 and M2 to spin forward for 1 second. Sending the character "s" will cause the same motors to spin backward for 1 second.

```
#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);
```

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```
        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();
            }
        }
}
```
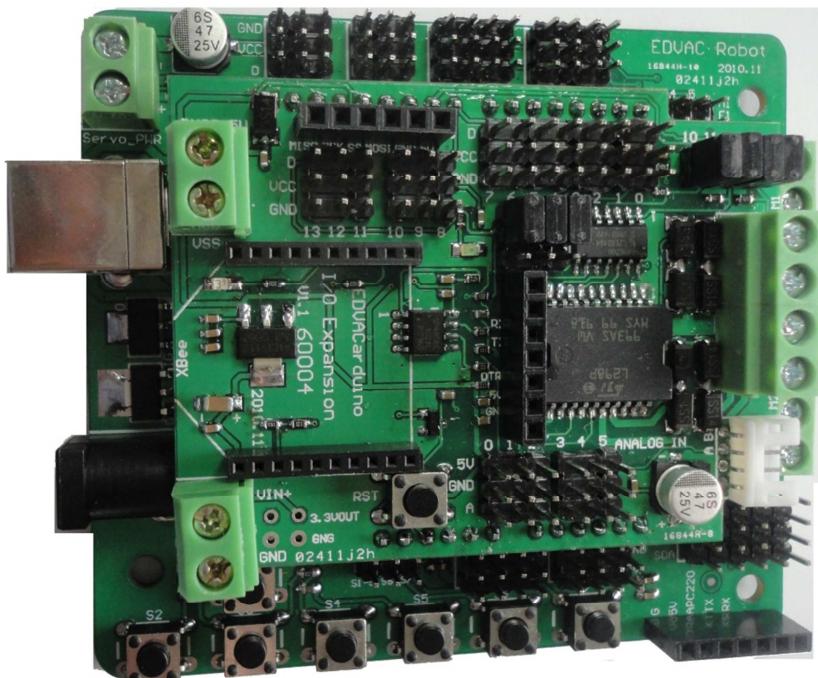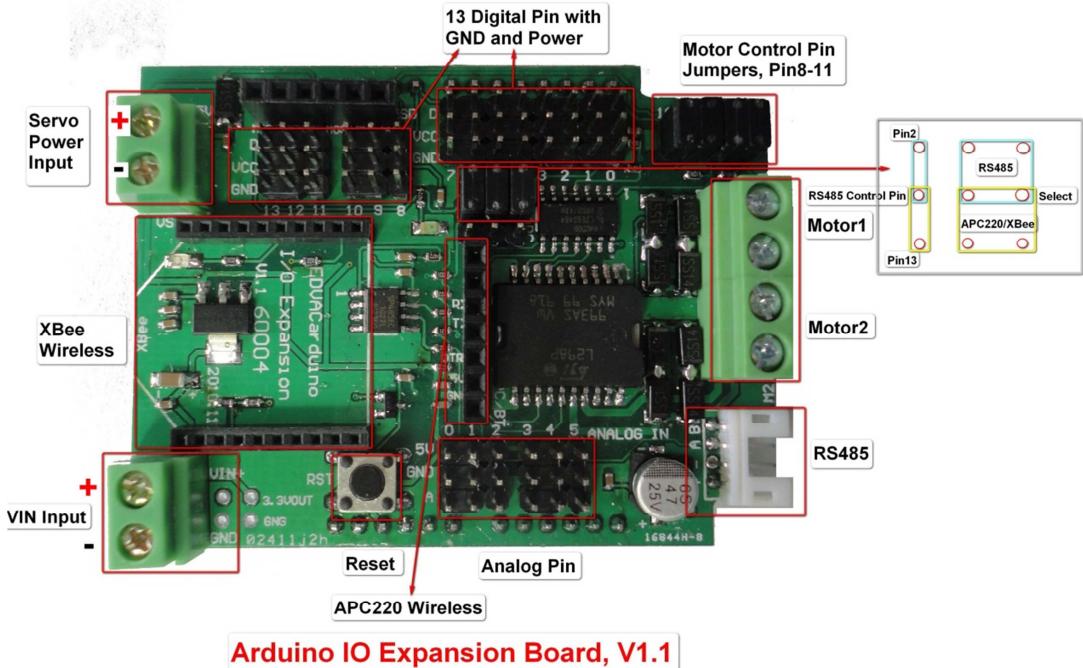
I/O Expansion Board

To support RS485 interface or drive 4 motors, I/O Expansion Board is available.

Arduino IO Expansion Board, V1.1

Above: Arduino main controller board combined with the expansion board

3. 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.

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