Mr.General

Manual NO.RS002
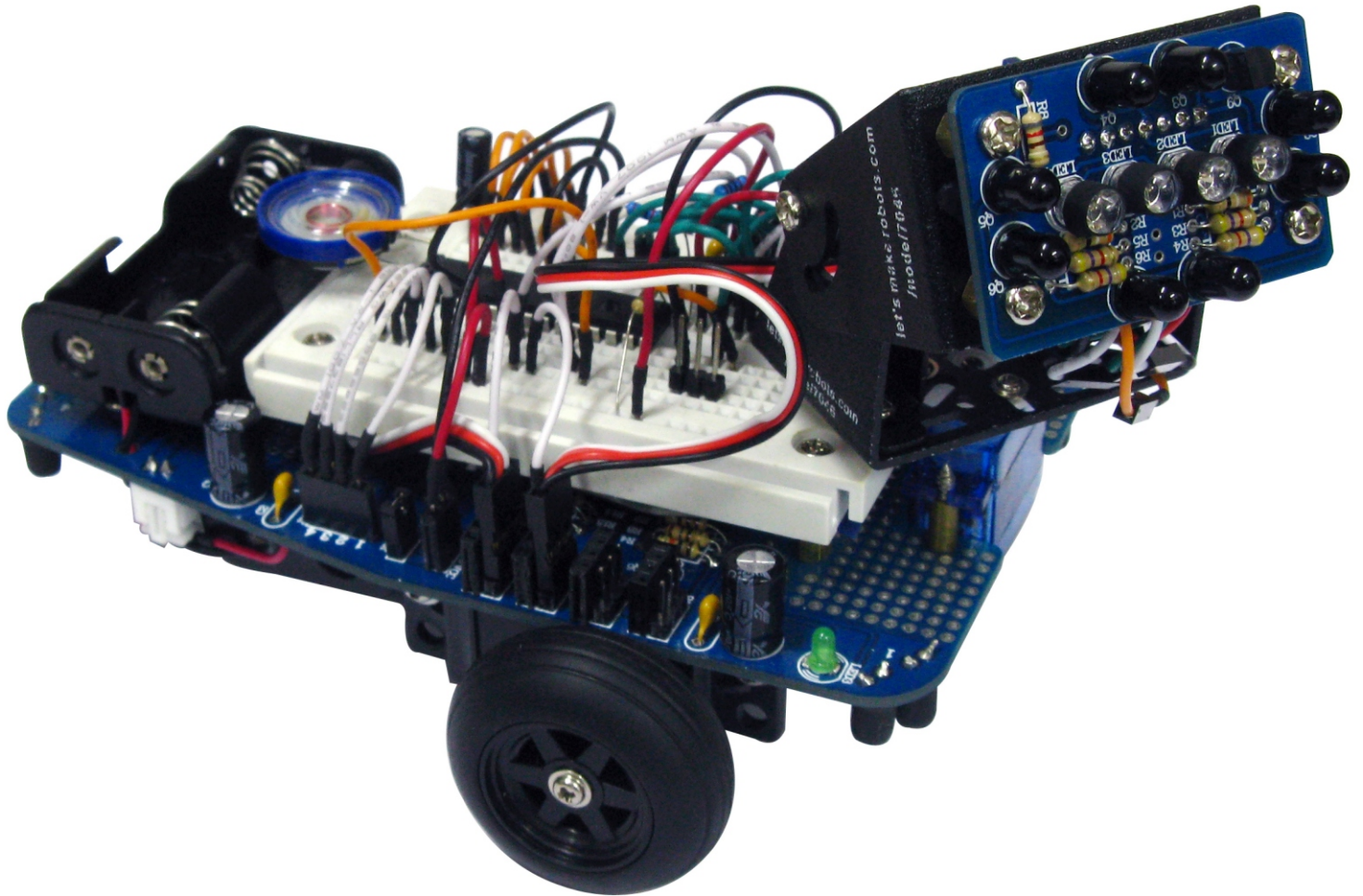
Manufacturer:
DAGU Hi-Tech Electronic Co.,LTD
WWW.AREXX.COM.CN

European Importer:
AREXX Engineering
ZWOLLE, HOLLAND

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Contents

PRODUCT DESCRIPTION:
Mr.General is a general purpose robotic platform designed for students and hobbyist alike.

PRODUCT FEATURES:
1. Abundant sensors and custom servos make this robot easy to program and fun to use.
2. The breadboard simplifies experimentation and allows other processors to be used.
3. The prototype area on the PCB allows custom circuits to be added.
4. Built in recharge circuit allows batteries to be easily recharged overnight.

*Build it now! Realize your dream! Create your next masterpiece!*

⚠ Warnings:

- No return is possible after having opened the bags with components and pieces.
- Prior to the assembly read the manual thoroughly.
- Be careful when using tools.
- Keep this kit away from young children during construction and operation. (They might get hurt by the tools or swallow small components).
- Observe the correct polarity of the battery.
- Keep dry. When the Mr.general gets wet DO NOT USE.Remove batteries immediately.
- Let the robot dry completely before re-using.
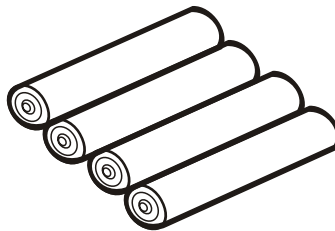- If it is not used for a long time, remove the battery.

Necessary Tools:
Before you start assembling we suggest you first read the manual thoroughly.
Please follow the assbembling instructions precisely to avoid problems.
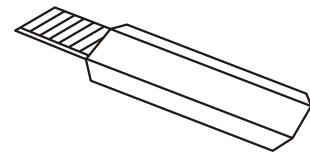Incorrect assembly will result in poor operation

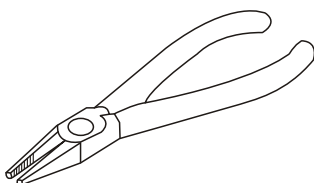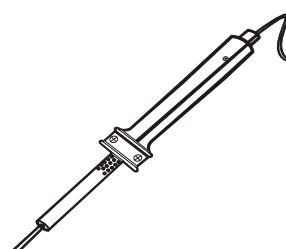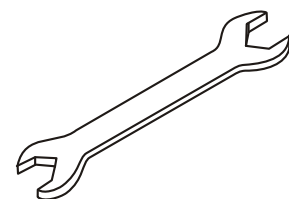Before you start you will require the following tools:
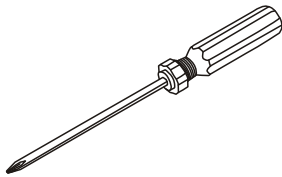
Phillips screwdriver (supplied)   AA NiMh batteries   Sharp Knife
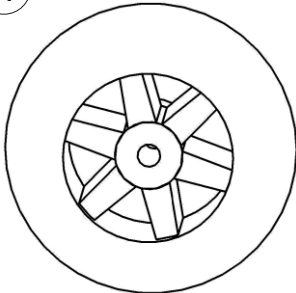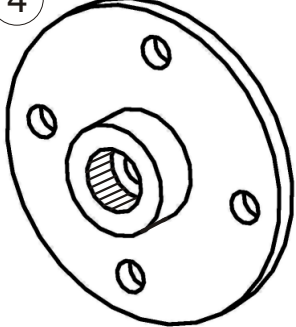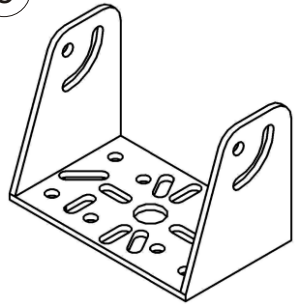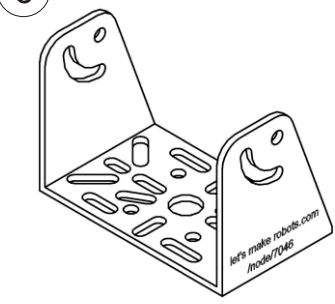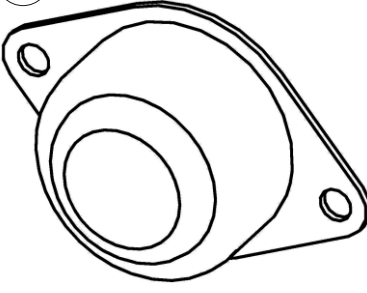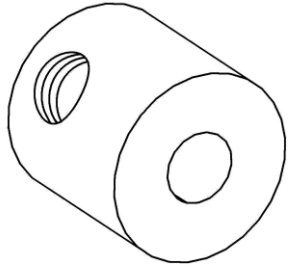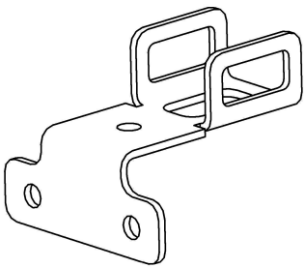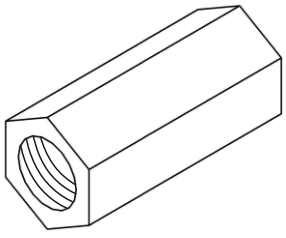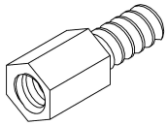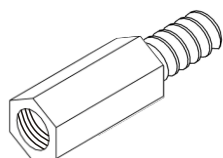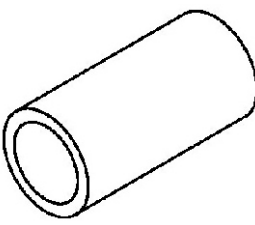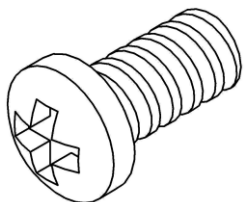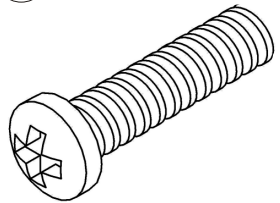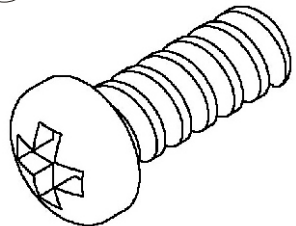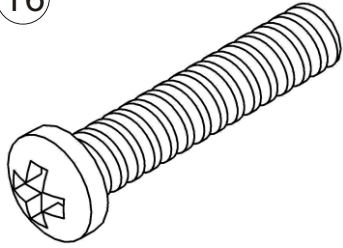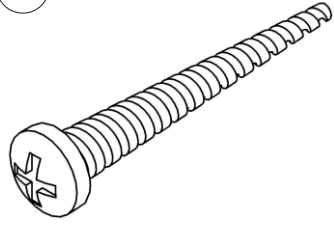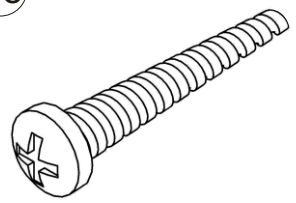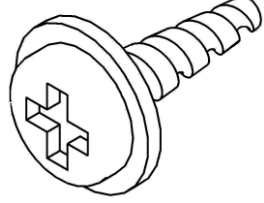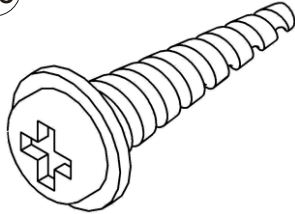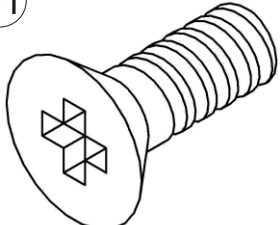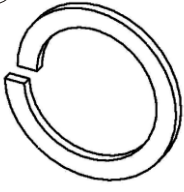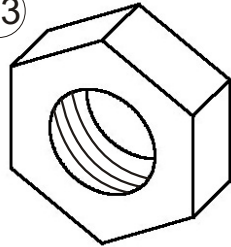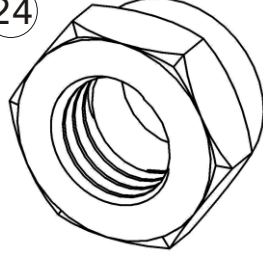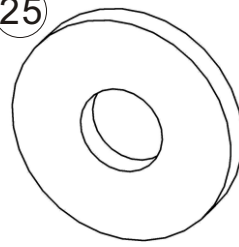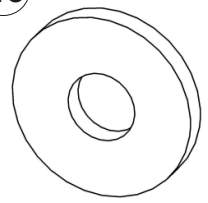
Longnose plier   Soldering Iron   Hex wrench (supplied)
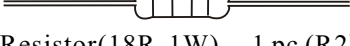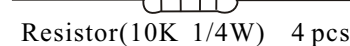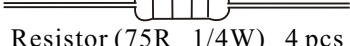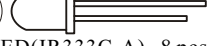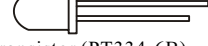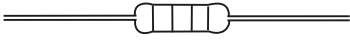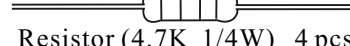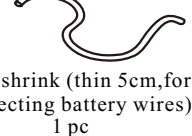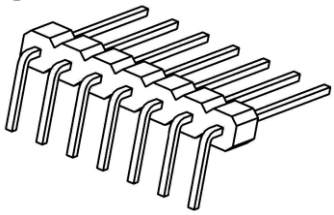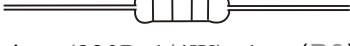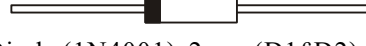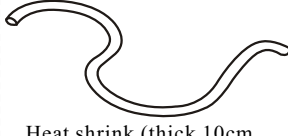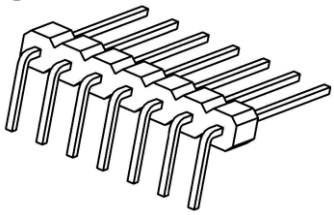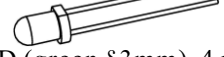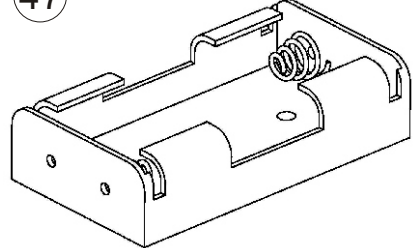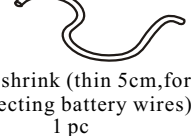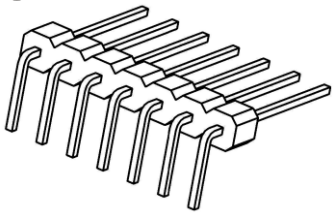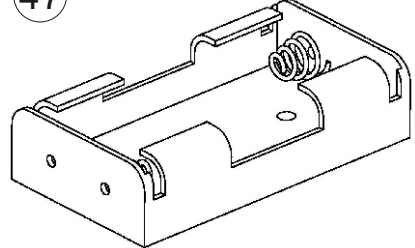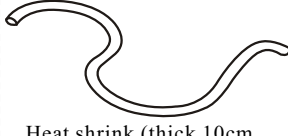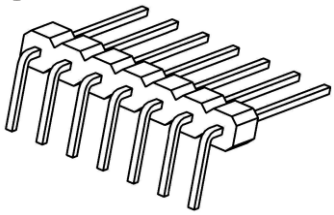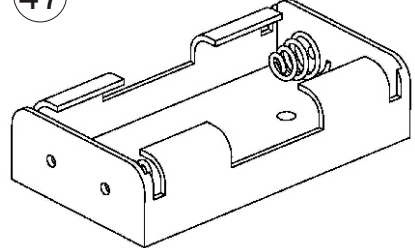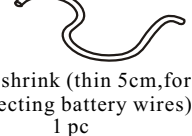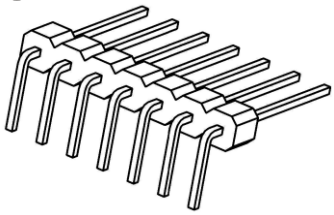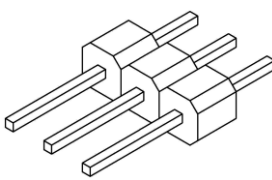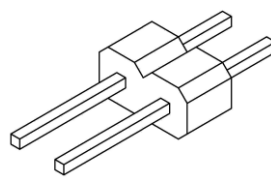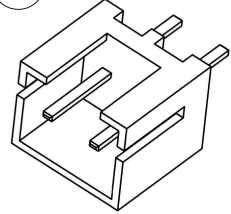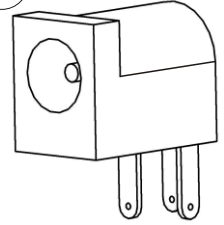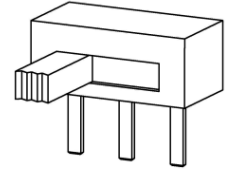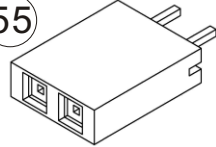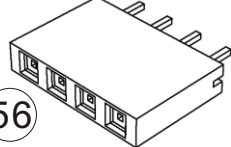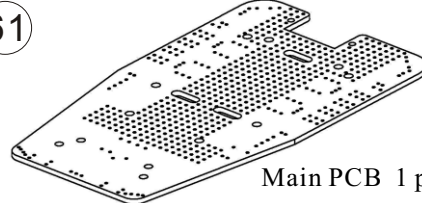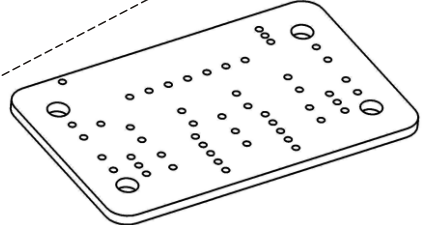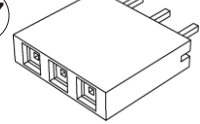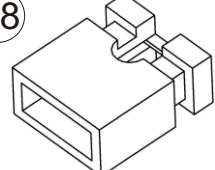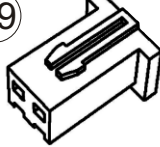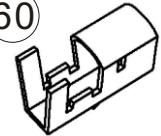
Components list 1 (Hardware and plastic parts)

1 Wheels
2 pcs

2 Modified servo
2 pcs

3 Miniature servo
2pcs

4 Servo horn
2 pcs

5 Sensor mounting **bracket 1**
1 pc

6 Sensor mounting **bracket 2**
1 pc

7 Ball caster
1 pc

8 Spacer (L10, Inner Diameter 3, Middle M3 Thread)
4 pcs

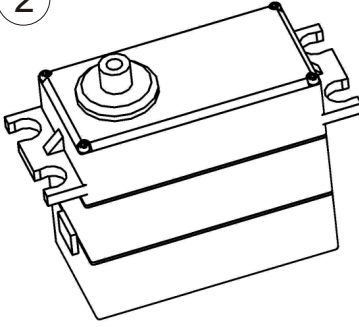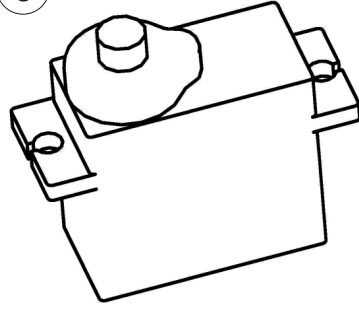**9** Servo mounting bracket 1 pc

10 Hex spacer (female to female L10) 4 pcs

11 Hex spacer (female to male L6) 6 pcs

Hex spacer (female to male L10) 2 pcs

12 Round spacer (Inner 3, outer 4, L8)
2 pcs

13 Screw M3*6
12 pcs

14 Screw M3*12
1 pc

15 Screw M3*8
4 pcs

16 Screw M3*20
4 pcs

17 Self-tapping screw 2.6*18
2 pcs

18 Self-tapping screw 2.6*16 2 pcs

19 Self-tapping screw pan head 2.0*6 7 pcs

20 Self-tapping screw pan head 2.3*10 1 pc

21 Flat head screw M3*6
4 pcs

㉒	㉓	㉔	㉕	㉖
M3 spring washer 4 pcs	M3 Nut 10 pcs	M3 Nylon nut 5 pcs	M3 Flat washer 4 pcs	Nylon washer 8 pcs

Components list 2 (Electronic parts):

■ .Black marks indicate the parts should be used on Main PCB
■ .PCB.Gray marks indicate the parts should be used on COMPOUND EYE

㉗ Resistor(390R 1/4W) 1 pc)'R(	㉘ Resistor (180R 1/4W) 5 pcs (R3,R8,R10,R12,R14)	㊲ Electrolyze Capacitor (470¦/16 V) 3 pcs (C1,C3,C5)	㊳ 10uf capacitor 1pc
㉙ Resistor(18R 1W) 1 pc (R2)	㉚ Resistor(10K 1/4W) 4 pcs (R4,R5,R6,R7)	㊴ Capacitor (0.22¦) 3 pcs (C2,C4,C6)	㊵ Transistor (BC547TO92B) 4 pcs (Q5,Q6,Q7,Q8)	㊶ Transistor (PN100 TO92B) 1 pc (Q9)
㉛ Resistor (75R 1/4W) 4 pcs (R9,R11,R13,R15)	㉜ Resistor(2.2K 1/4W) 4 pcs (R16,R17,R18,R19)		
㉝ Resistor (39R 1/4W) 2 pcs (R1,R2)	㉞ Resistor (4.7K 1/4W) 4 pcs (R3,R4,R5,R6)	㊷ IR LED(IR333C-A) 8 pcs (IR1,IR2,IR3,IR4)(LED1 ,LED2,LED3,LED4)	㊸ Photo Transistor (PT334-6B) 12 pcs (Q1,Q2,Q3,Q4)(Q1£Q2£ Q3£Q4£Q5£Q6£Q7£Q8)
㉟ Resistor(820R 1/4W) 1 pc (R8)	㊱ Diode (1N4001) 2 pcs (D1£D2)		

㊹ LED (green §3mm) 4 pcs (LED3,LED4,LED5,LED6)	㊼ Battery box 2 pcs	㊽ Heat shrink (thin 5cm,for connecting battery wires) 1 pc Heat shrink (thick 10cm, for covering the IR sensors) 1 pc	㊾ 7 Pin right-angle male header 1 pc (J1)
㊺ LED (orange §3mm) 1 pc (LED1)			
㊻ LED (red §3mm) 1 pc (LED2)			

㊿ 3 Pin male header 8 pcs (J2,J4,J6,J8,J11,J13, J15,J17)	51 2 Pin male header 2 pcs (J9,J18)	52 2 Pin socket 1 pc (BT)	53 DC connector (DC-002) 1 pc (POWER)	54 Switch (SK-12F01P) 1 pc (S1)

55 2 Pin female header 2 pcs (J21,J22)	56 4 Pin female header 2 pcs (J19,J20)	61 Main PCB 1 pc	62
57 3 Pin female header 8 pcs (J1,J3,J5,J7, J10,J12,J14,J16)	58 Header jumper 2 pcs	59 2 Pin female socekt 1pc 60 Crimp connector 2pcs	Compound-eye PCB (48mm*30mm) 1 pc
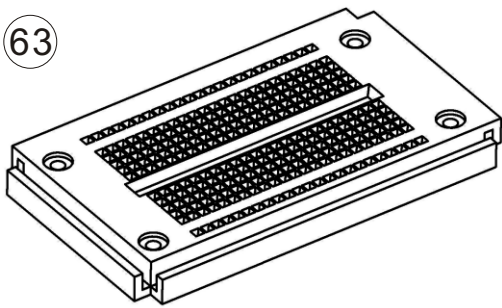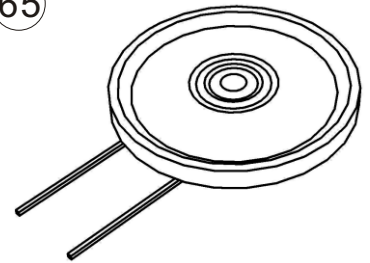
Compound eye assembly instructions

1. Install the resistors and 7 pin header first.
2. Install the 4 IR LEDs (clear colour) in the center. Note one side is flat.
3. Install the PN100 transistor.
4. Install the 8 IR phototransistors (black colour). Note one side is flat.

Note: All LEDs and photo transistors should sit flat on the PCB. Pay careful attention to the printed layout on the PCB as it shows the correct orientation of all components.
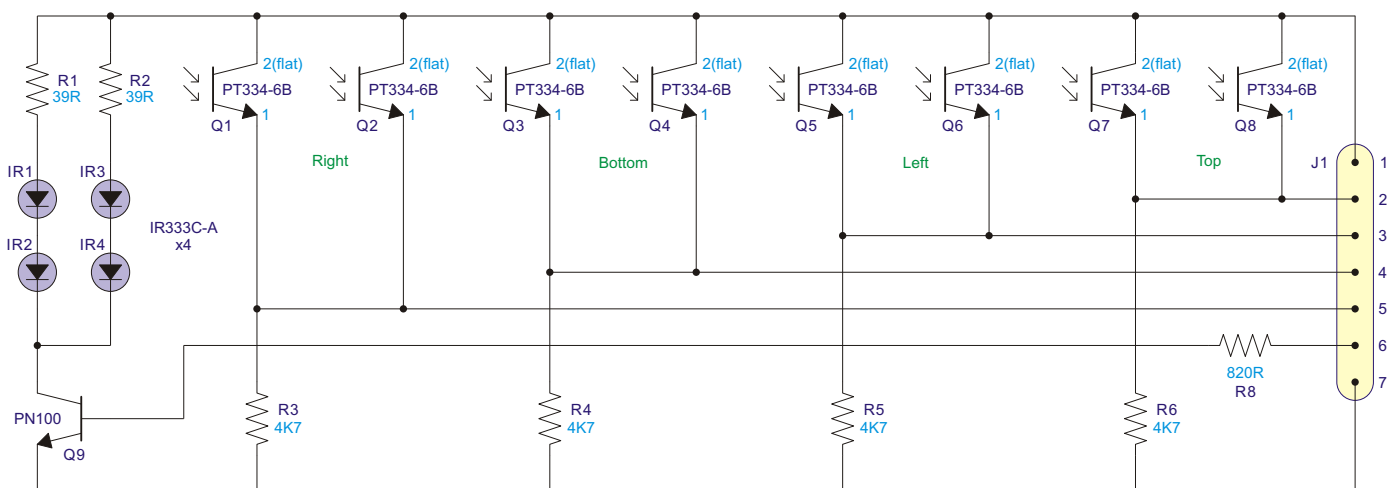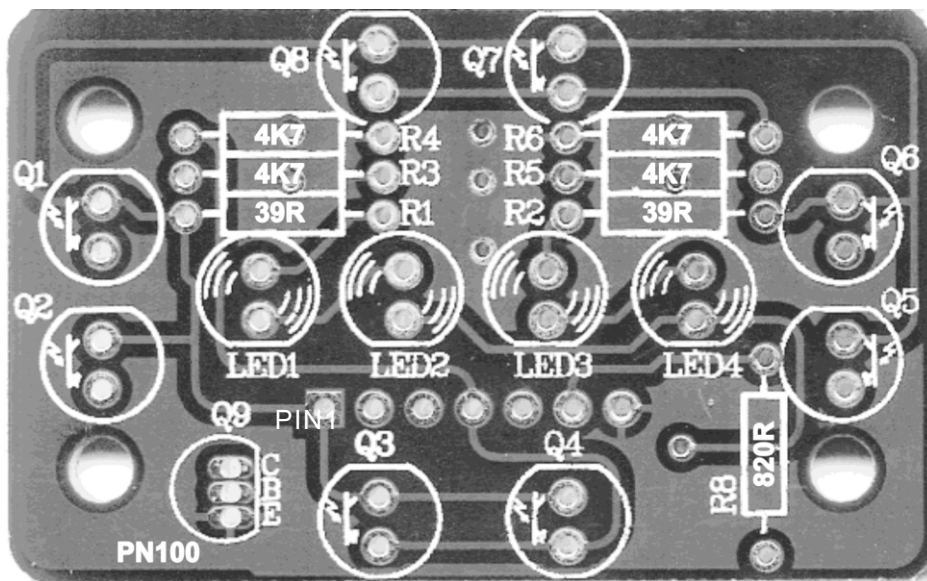
Main PCB assembly instructions

To assemble Mr. General's PCB, start by inserting components on the top side. Note that the component designation, polarity and value is printed on the PCB to simplify construction.

Insert the resistors and diodes first. Take care to orientate the diodes correctly as they are polarised.

Insert the transistors and 6 indicator LEDs. Check they are inserted correctly and be careful not to apply too much heat! These components are easily damaged from excessive heat.

Now insert the capacitors. The electrolytic capacitors are polarised and usually have a negative symbol printed on one side. Note the + and - symbols printed on the PCB.

The power switch and headers can now be soldered on the PCB.

Note:
J8 and J9 are 2 pin male headers with jumpers. These are used to isolate +V on each side, allowing different voltages to be used.

J21, J22 are 2 pin female header for connecting power to / from the individual voltage rails.
J2, J4, J6, J8, J11, J13, J15, J17 are **male** headers used for plugging in servos or sensors.
J1, J3, J5, J7, J10, J12, J14, J16 are **female** headers used for connecting wires from the servos and sensors to the breadboard.

J19, J20 are **4 pin female headers** used to connect the IR sensors and LEDs to the breadboard.

Now turn the PCB over.
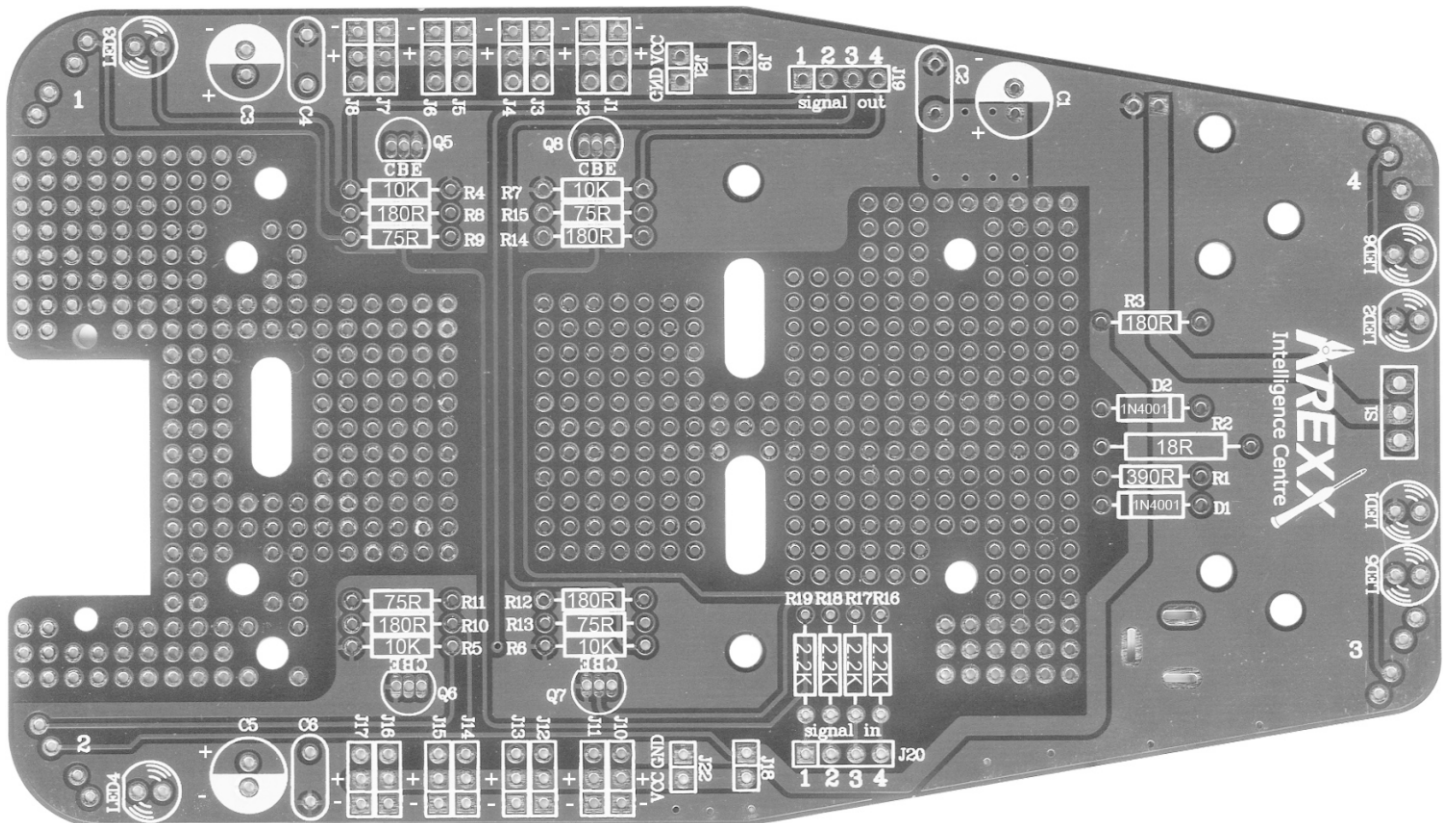
You now need to decide do you want your IR sensors to look outward or downward. If you have your sensors facing outward then Mr. General can use them to avoid running into objects. If you have them facing downward then they can be used to prevent Mr. General from falling over edges or to detect black lines on the ground.

Edge detection
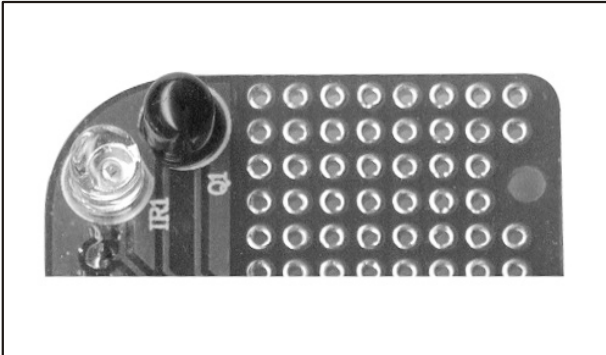
Object detection
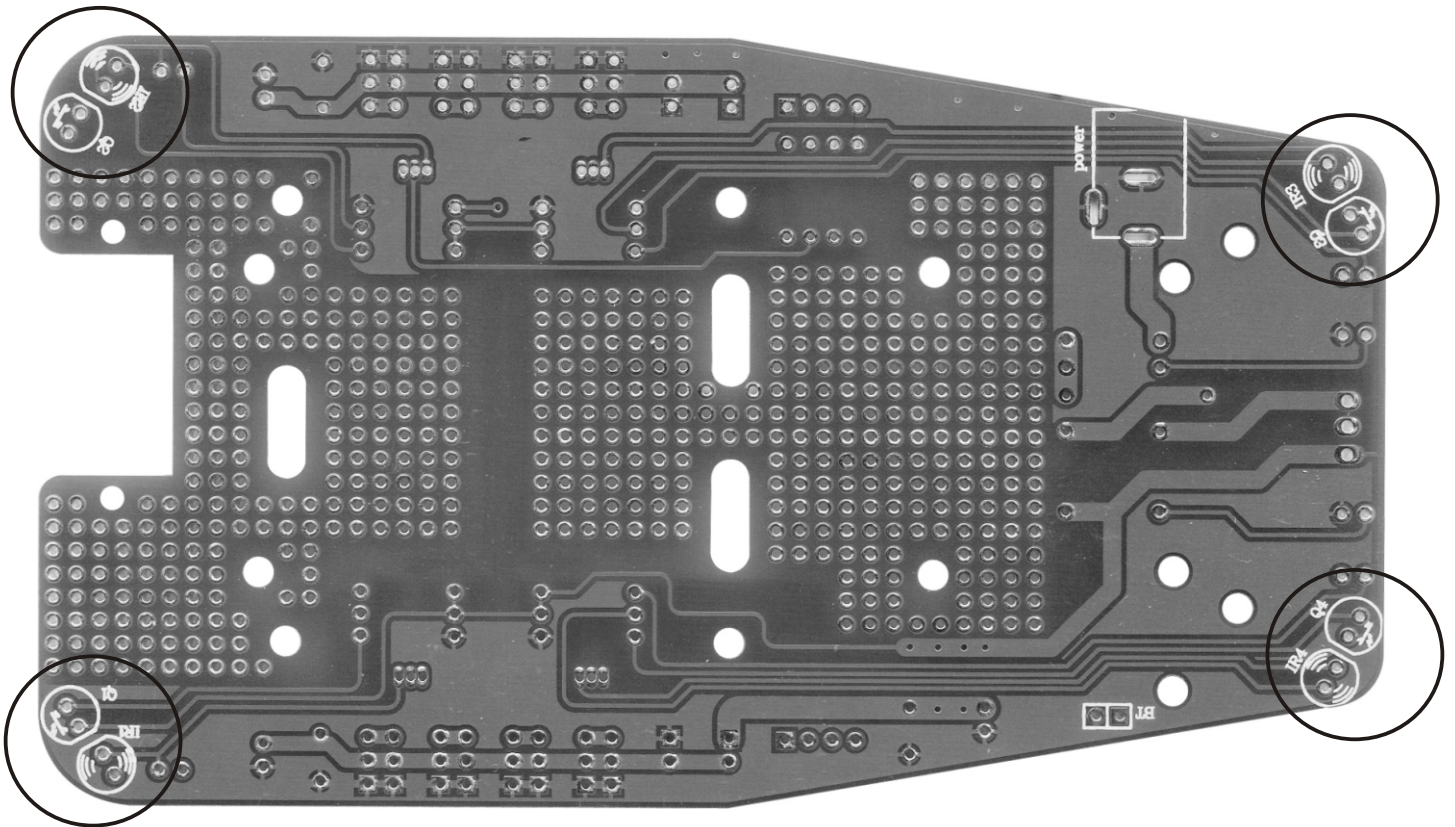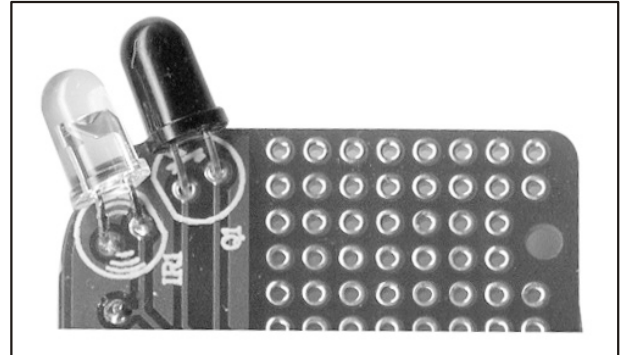
Mount your IR LEDs (clear) and phototransistors (black) to suit. Be careful to insert them the correct way around otherwise they will not work and may be damaged. Be careful not to apply too much heat as this can damage them.

Now finish the PCB by soldering in your battery connector and recharge socket(9V DC).

Mechanical assembly instructions

Screw M3*20

Soldered PCB

Nylon washer

Spacer

M3 Nylon nut

STEP1: Mount the spacer

M3 spring washer

Screw M3*6
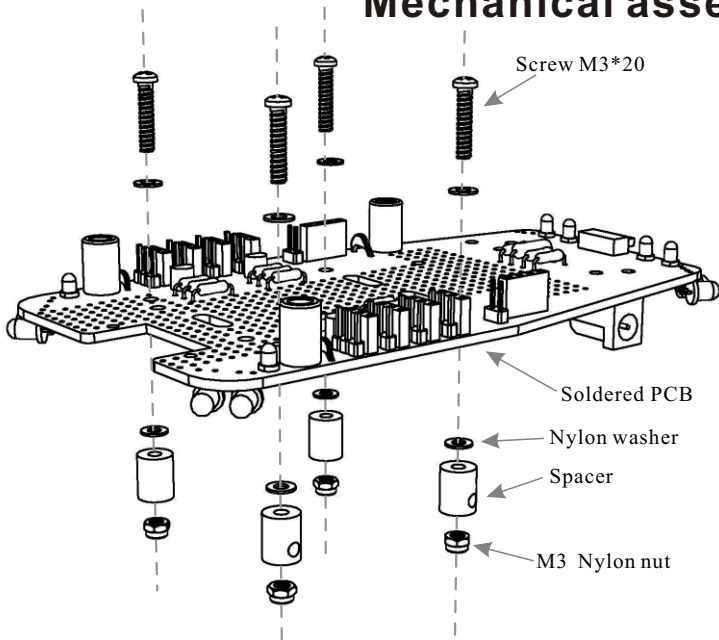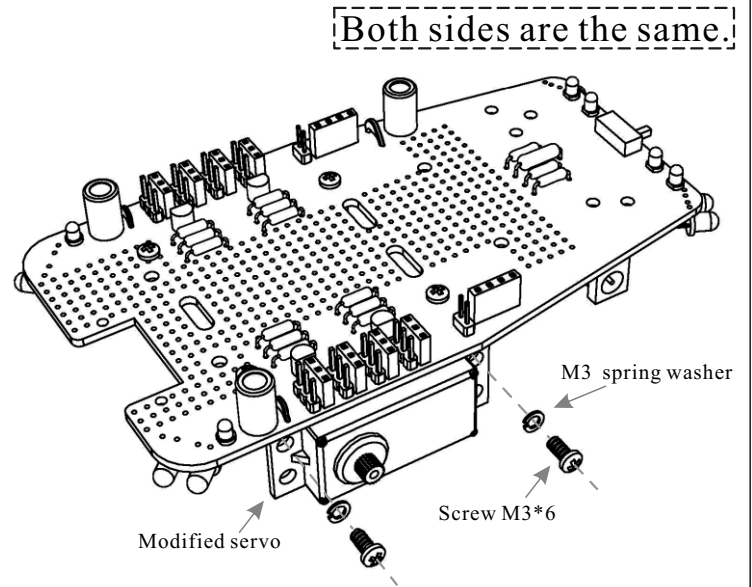
Modified servo

STEP2: Mount modified servos (Both sides)

Both sides are the same.

Wheels

Self-tapping screw 2.6*18
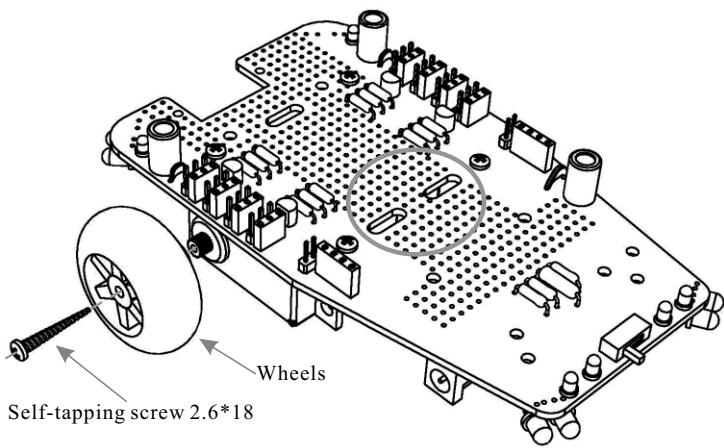
Do not have screw too tight or the wheels will not turn easily!

STEP3: Mount the front wheels (Both sides)

Hex spacer
(female to female L10)

Screw M3*6
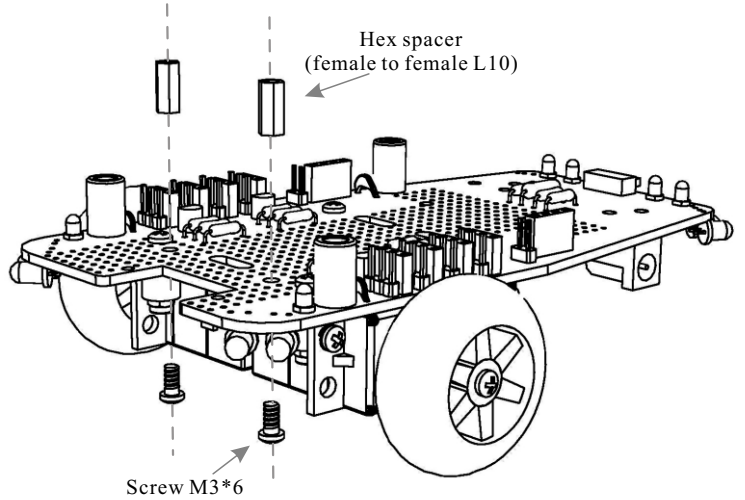
STEP4: Fit the front breadboard spacers.

Flat head screw M3*6

Battery box

Hex spacer
(female to female L10)
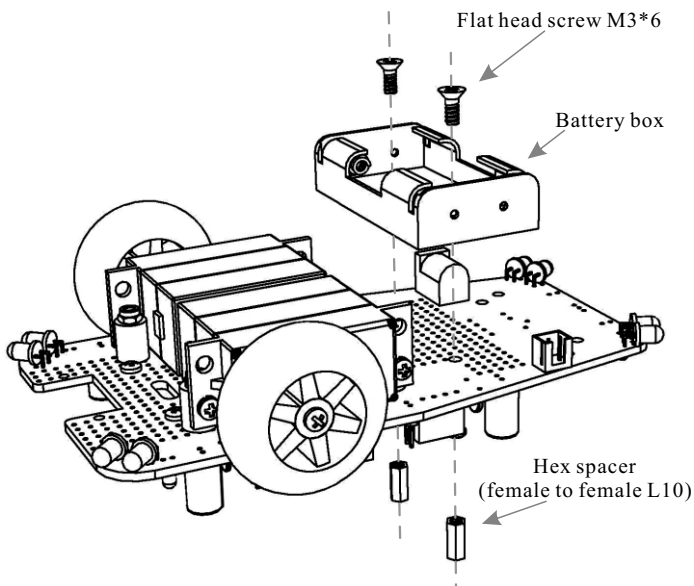
STEP5:Mount the battery on the bottom.

Hex spacer
(female to male L6)

M3 Nut
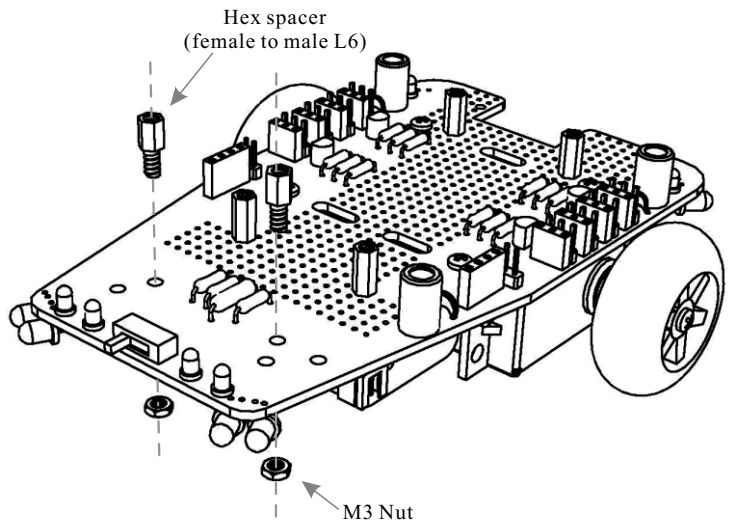
STEP6: Mount the male-female hex spacer

STEP7: Mount the ball caster.

M3 Nut

Ball caster

Hex spacer
(female to male L10)

Screw M3*6
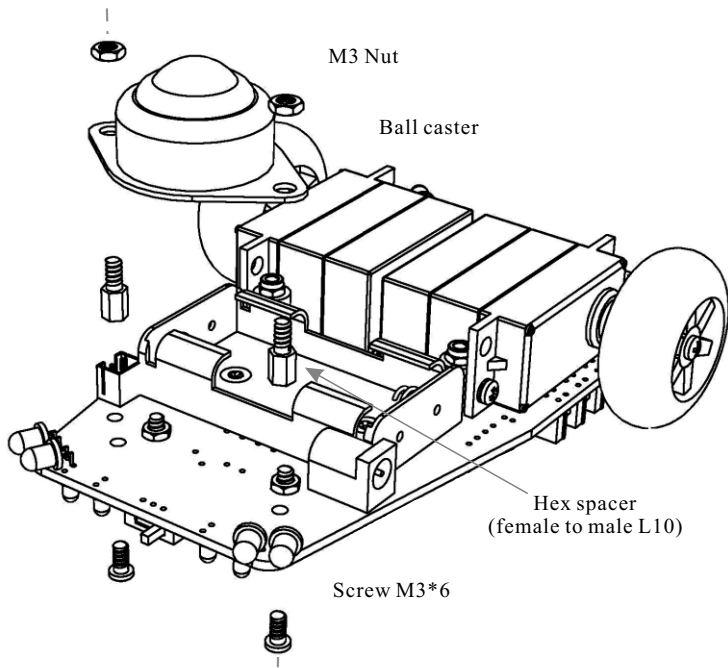
STEP8: Mount the top battery box

Flat head screw M3*6

Battery box

STEP9:

⬛ Red   ⬛ Black

Battery box

Battery box

Heat shrink(thin)

Put small piece of
heatshrink over
solderjoint.
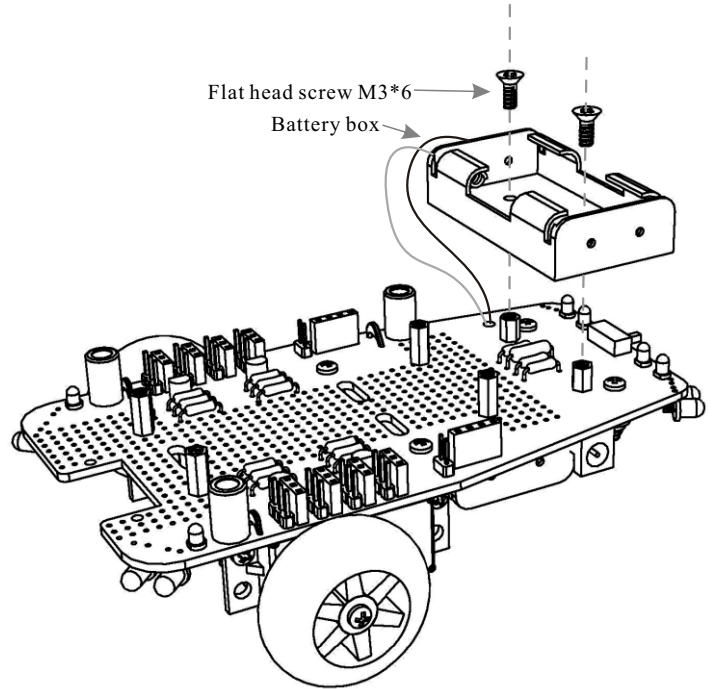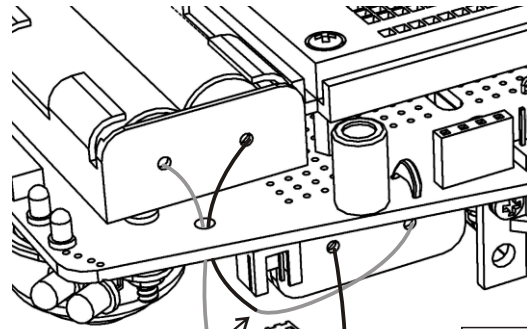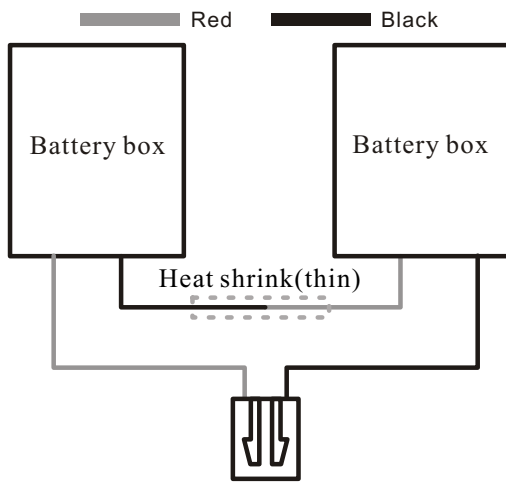
Trim battery wires
and solder con-
nections.
Take care to con-
nect blackand red
wires as shown.
Reverse polarity
will damage the
circuitry.
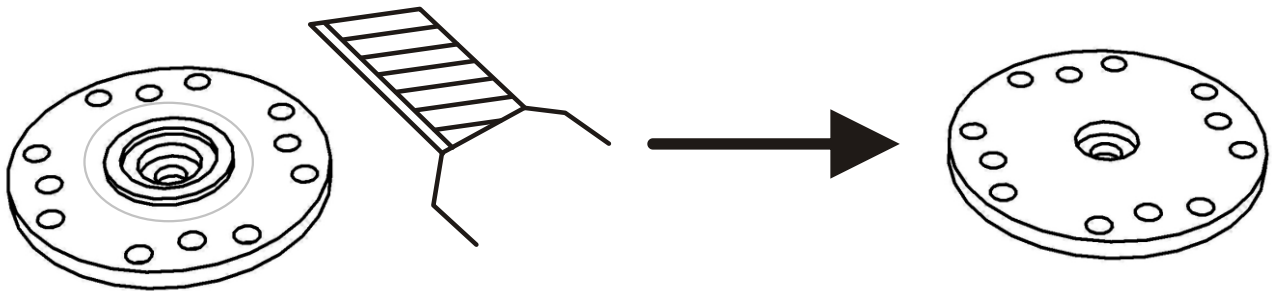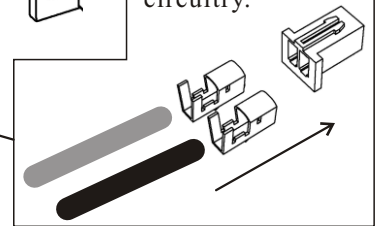
STEP10: Before mount please trim the surface of the servo horn with knife.

STEP11: Rotate the servo with its servo horn, adjust the servo gear to the middle position.

Parallel
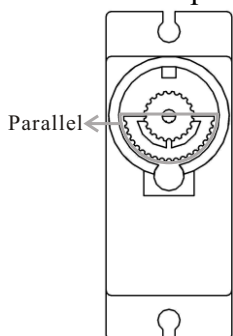
STEP12: Mount sensor bracket 2 as shown

Self-tapping screw pan head 2.0*6

Miniature
servo

Servo horn

Note that the
two brackets
have different
hole patterns

Sensor mounting **bracket 2**
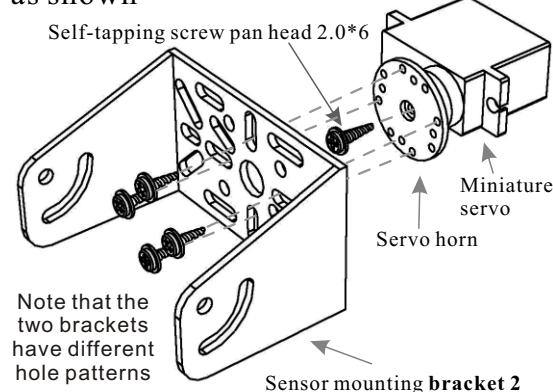
STEP13: Mount the servo mounting bracket

Sservo mounting
bracket

Screw M3*6

M3 Nut
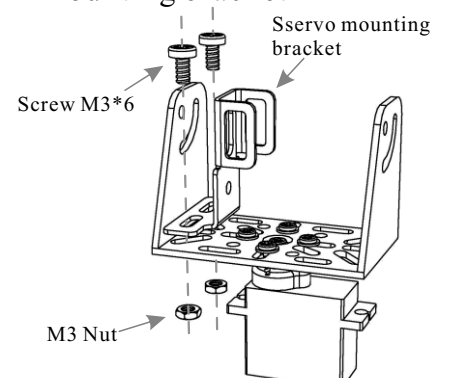
STEP 14: Mount sensor bracket 1 and miniature servo

Sensor mounting **bracket 1**

Self-tapping screw pan head 2.0*6

Servo horn

Miniature servo

STEP 15: complete pan / tilt assembly

M3 Flat washer*2

M3 Flat washer*2

Screw M3*12

M3 Nylon nut

Self-tapping screw pan head 2.3*10

The nylon nut and screw should be loose so that the bracket can move freely

STEP16: Mount pan / tilt assembly on the main PCB

Pass servo cables through holes in the board

Round spacer (Inner 3, outer 4, L8)

Self-tapping screw 2.6*14
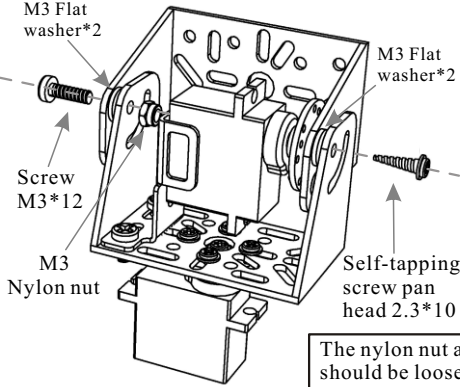
STEP17:Mount the breadboard.

Note: Before mounting your breadboard, plug in your servos as shown on page 14 and tidy up your servo cables. This will give your robot a neater appearance.

Screw M3*8

Breadbord
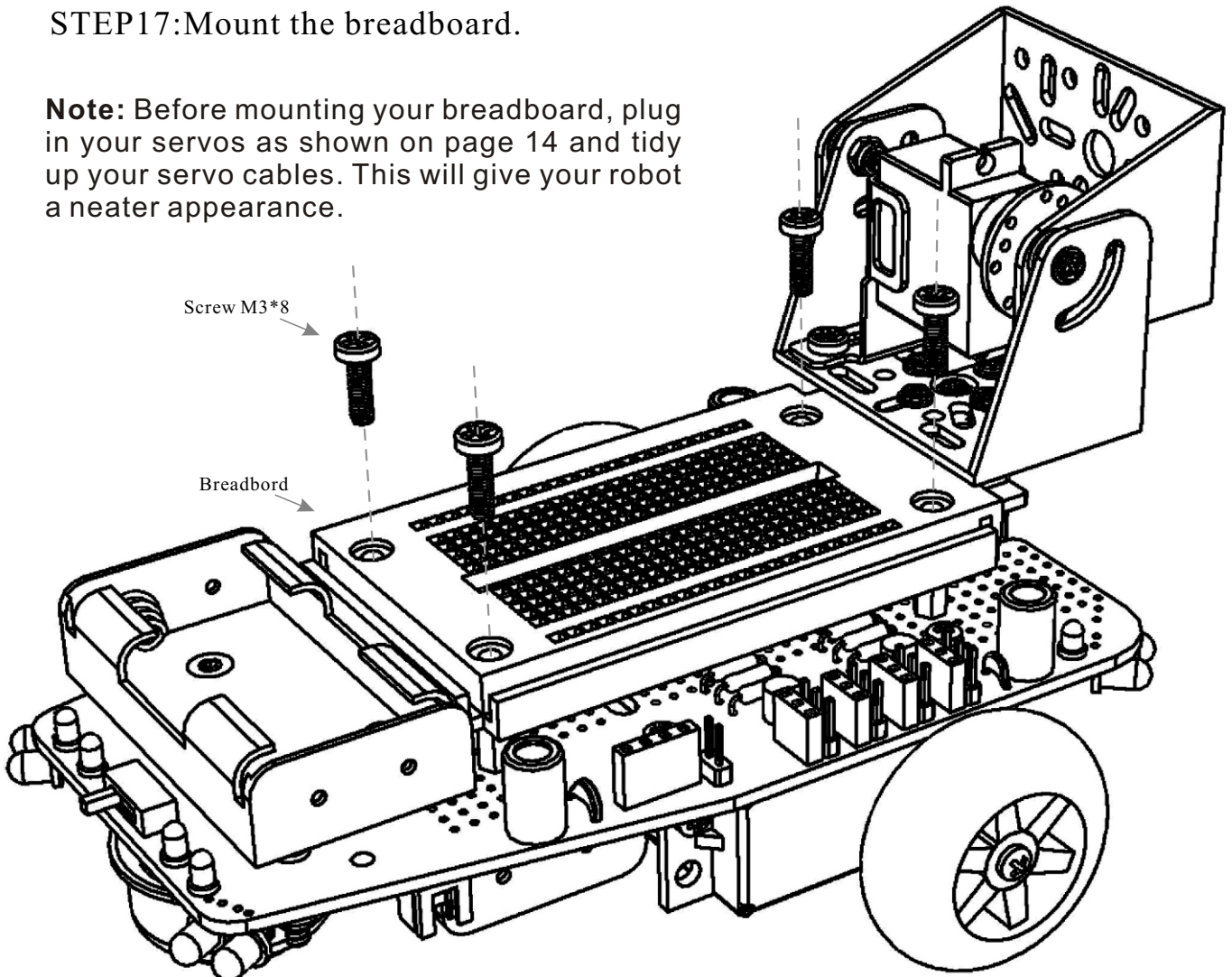
STEP18:Mount the sensor PCB.

The four screws should be fixed with four nuts.

M3 Nut

Hex spacer
(female to male L6)

Screw M3*6
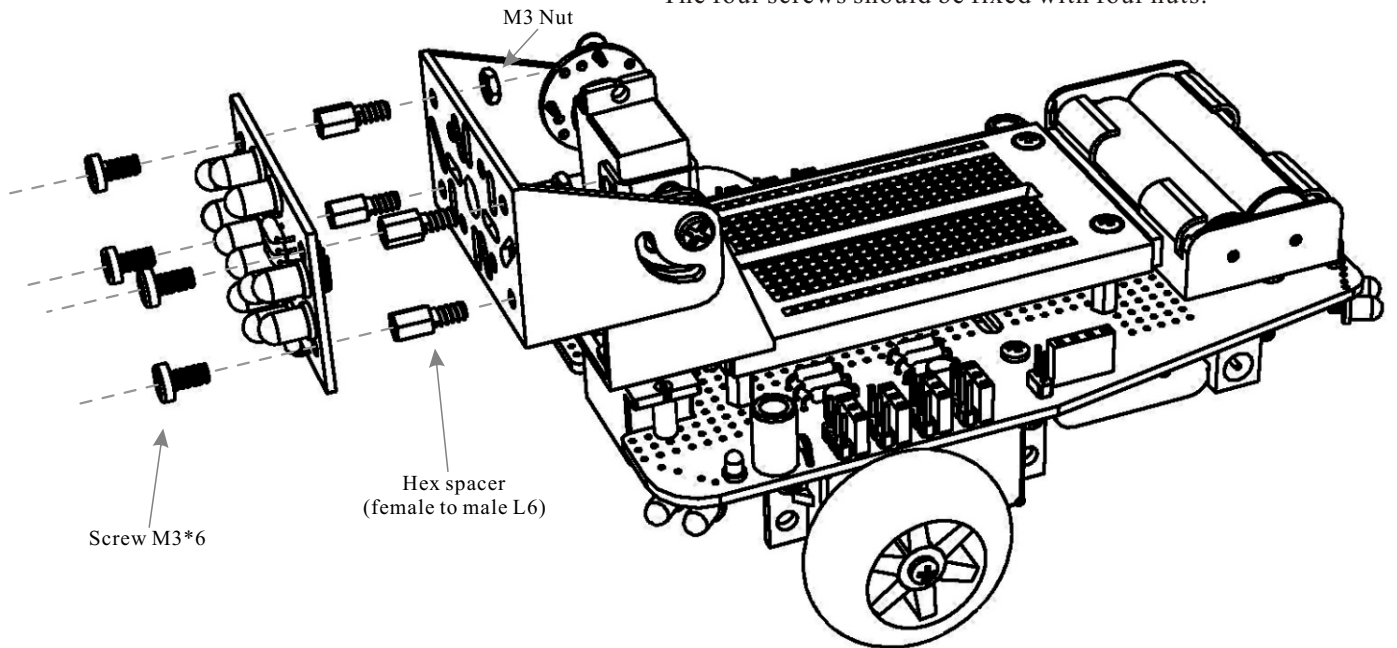
Install 4x AA NiMh batteries. These batteries can be recharged overnight using the on board charging circuit and a 9V DC power supply.

When the switch is turned on LED2 (red) will light up.

When 9VDC is connected to the recharge socket LED1 (yellow) will light up.

When the switch is in the OFF position and 9VDC is applied to the recharge socket then the batteries will trickle charge at an average rate of approximately 170mA.
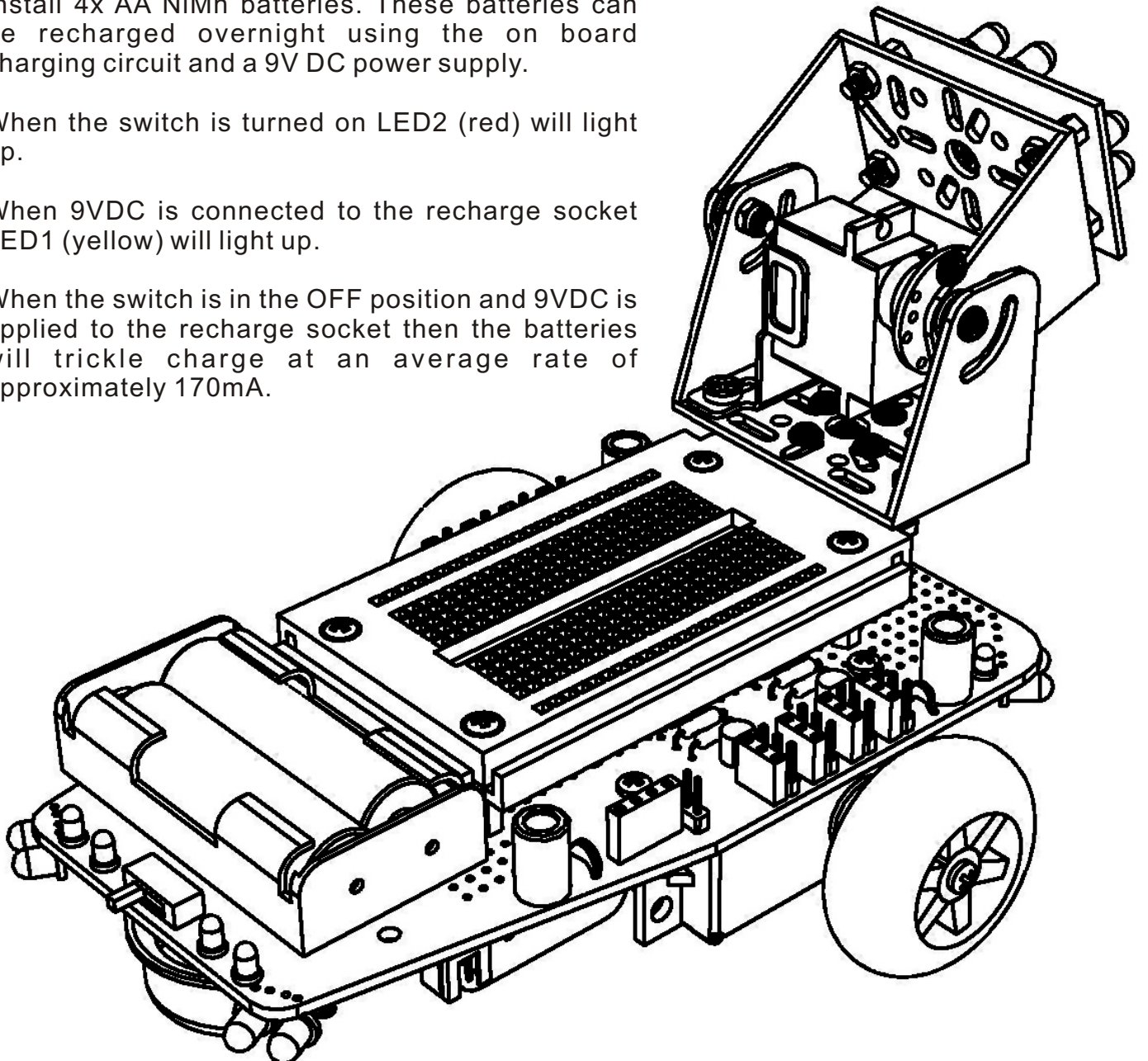
Wiring instructions

The following page shows both the wiring diagram and schematics for Mr. General. Before you begin wiring the breadboard please study the diagram carefully and note the following.

Although the motors and IR sensors of this robot are designed to work between 4.5V and 5.5V you may at some stage wish to experiment with 3.3V devices. For this reason the PCB is capable of supporting 2 different voltages. These voltages will be referred to as **Vcc1** (4.8V) and **Vcc2** (optional 3.3V).

The wiring diagram in this manual only uses **Vcc1** which is connected to the positive terminal of the batteries and has a nominal voltage of 4.8V when using NiMh rechargeable batteries. Note that all **Vcc1** connections are made with red wires.

The Ground (**Gnd**) connections on this robot are all connected to the negative terminal of the battery and are common to **Vcc1** and **Vcc2**. Ground connections are all made with black wires.

Your wire pack may not have the exact colours shown in this manual but all wire packs will have red and black as well 3 other colours. Your wire pack will include female to female as well as male to male jumper wires. Your wires come in 3 lengths for male to male (4cm, 8cm & 12cm) and 2 lengths for female to female (4cm and 8cm).

Step 1: Remove the jumpers on J18 and J21 to prevent power accidentally being applied while the breadboard is being wired up.

Step 2: Place the processor, ceramic resonator, 10K resistor and 100nF capacitor on the breadboard as shown. Connect the red and black power wires as shown. Incorrect placement of the power wires can damage your processor!

Step 3: Connect your ceramic resonator using short wires only. Now connect your corner sensors and servo signal wires as shown.

Step 4: Plug in your servos. Pay careful attention to the plug orientation. The middle wire is always red. The wire closest to the breadboard is the signal wire and should be either white or orange. The outer most wire is ground and should be black or brown.

Step 5: Plug in your speaker and the 10uF electrolytic capacitor. The capacitor is polarized and must be inserted with the negative terminal to the ground.

Step 6: Connect two small wires from pins 2 & 3 of the processor to the positions shown in the diagram next to the 100nF capacitor. These are your serial transmit and receive signals used by the USB interface to program your processor.

Note in the diagram that two other wires also connect to pins 2 & 3 of the processor. These are circled in the diagram and must be temporarily disconnected when loading a program.

Step 7: To connect the compound eye to the breadboard you must join 8cm male to male and 8cm female to female wires together. This gives you the necessary length as well as the right configuration (male to female).

Plug the female ends into the compound eye first and then thread the wires through the pan / tilt assembly as shown before connecting them to the breadboard.

The eye should be able to pan / tilt freely without pulling the wires from the breadboard.

Step 8: Re-install the jumper on J18 to connect power to the breadboard.
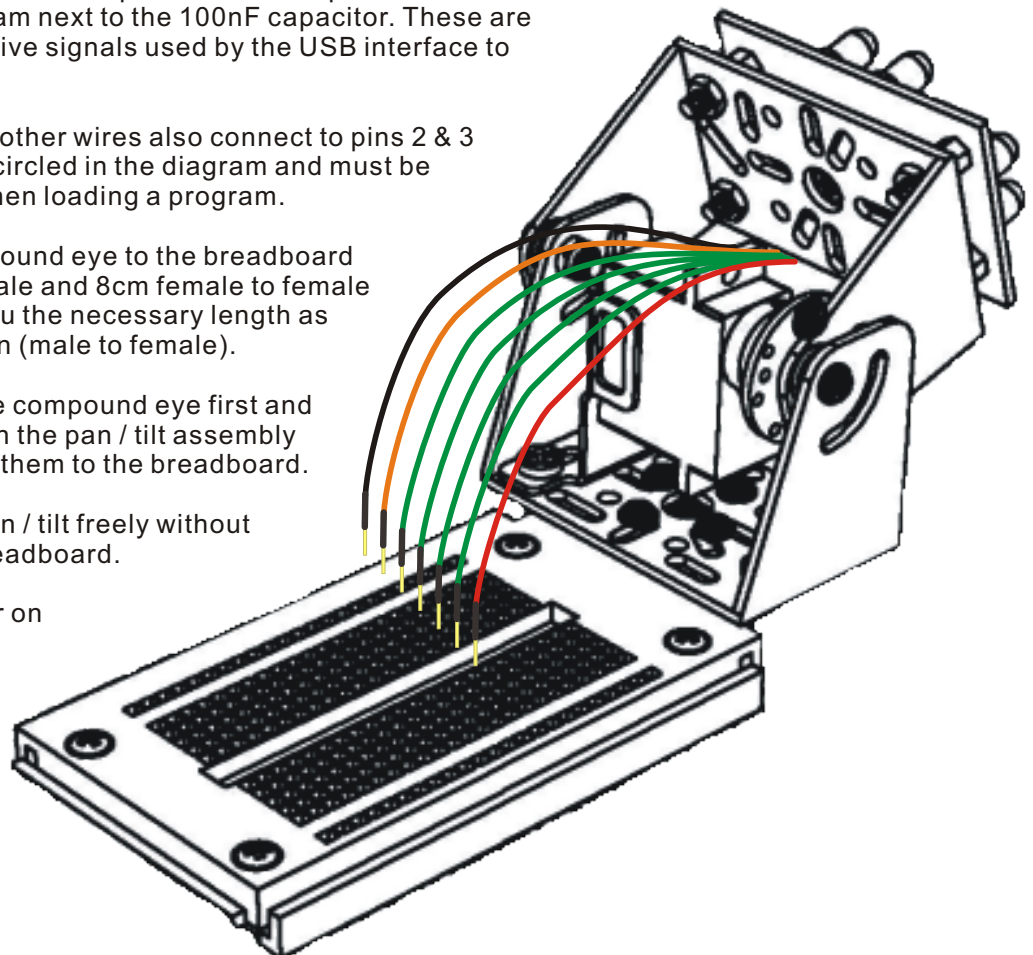
Infrared compound eye
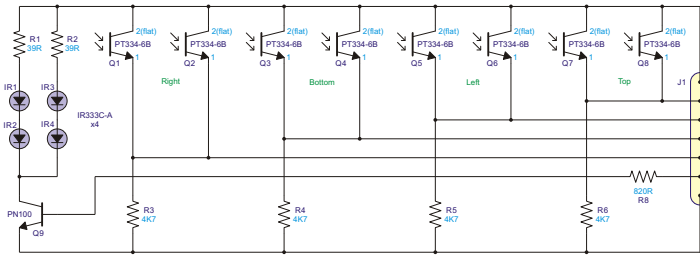
R1 39R, R2 39R
PT334-6B Q1-Q8, 2(flat)
IR1 IR2 IR3 IR4, IR333C-A x4
Right, Bottom, Left, Top
PN100 Q9
R3 4K7, R4 4K7, R5 4K7, R6 4K7
R8 820R
J1 1-7

Infrared object detection corner 2

R10 180R, R11 100R, Q2 PT334-6B 2(flat) +4.8V
IR2 IR333C-A, LED4
R5 10K
BC547 Q6
R18 2K2
J19-2, J20-2, Gnd

Infrared object detection corner 1

R8 180R, R9 100R, Q1 PT334-6B 2(flat) +4.8V
IR1 IR333C-A, LED3
R4 10K
BC547 Q5
R19 2K2
J19-1, J20-1, Gnd
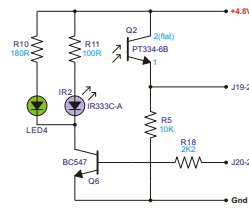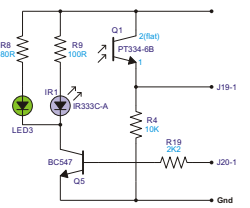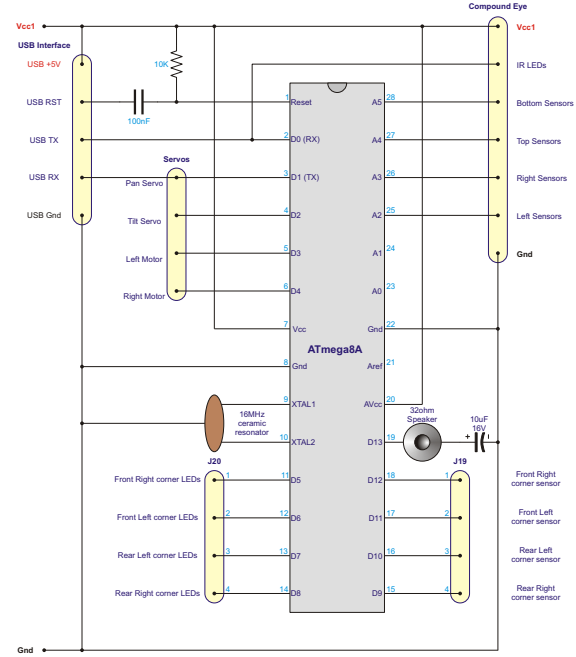
1. Vcc
2. Top
3. Left
4. Bottom
5. Right
6. IR LEDs
7. Gnd

LED1 LED2 LED3 LED4
1 2 3 4 5 6 7

Bread Board Schematic

Vcc1, Vcc1
USB Interface
USB +5V
USB RST
USB TX
USB RX
USB Gnd
10K
100nF
Reset
D0 (RX)
D1 (TX)

Servos
Pan Servo
Tilt Servo
Left Motor
Right Motor

ATmega8A
Compound Eye
Vcc1
IR LEDs
Bottom Sensors
Top Sensors
Right Sensors
Left Sensors
Gnd

16MHz ceramic resonator
XTAL1, XTAL2
32ohm Speaker
10uF 16V
J20, J19
AVcc, Aref, Gnd

Front Right corner LEDs
Front Left corner LEDs
Rear Left corner LEDs
Rear Right corner LEDs
D5 D6 D7 D8
D12 D11 D10 D9

Front Right corner sensor
Front Left corner sensor
Rear Left corner sensor
Rear Right corner sensor

Gnd

Power configuration

Recharge, On
R2 18R 1W
R3 180R
J18, J9
J22 Vcc1, J21 Vcc2
+4.8V
4.8V NiMh
1N4001
1N4001
R1 390R
LED 1 Recharge
LED 2 Power
9V DC
C1 470uF, C2 0.22uF
C6 0.22uF, C5 470uF 16V, C4 0.22uF, C3 470uF 16V
J10 J11 J12 J13 J14 J15 J16 J17
J1 J2 J3 J4 J5 J6 J7 J8
Gnd

Robot body

USB interface
10K resistor
100nF capacitor
DISCONNECT BEFORE PROGRAMMING

Pan Servo J17
Gnd Vcc1 Control
Tilt Servo J15
Gnd Vcc1 Control
Left Motor J13
Gnd Vcc1 Control
Right Motor J11
Gnd Vcc1 Control

J8 J7 Control Vcc2 Gnd
J6 J5 Control Vcc2 Gnd
J4 J3 Control Vcc2 Gnd
J2 J1 Control Vcc2 Gnd

Gnd Vcc2 J21
Vcc1 Gnd J22

Short J18 to connect Vcc1 to +4.8V
Vcc1 J18 +4.8V
Short J9 to connect Vcc2 to +4.8V
+4.8V J9 Vcc2

ATmega8A
16MHz ceramic resonator
32ohm Speaker
10uF electrolytic capacitor

1 2 3 4 J20
1 2 3 4 J19

Recharge Socket
9VDC

AA NiMh Batteries

Recharge LED
On/Off Switch
Power LED

IR333C-A PT334-6B 2(flat)
3, 4
1, 2

Infrared object detection corner 3

R12 180R, R13 100R, Q3 PT334-6B 2(flat) +4.8V
IR3 IR333C-A, LED5
R6 10K
BC547 Q7
R17 2K2
J19-3, J20-3, Gnd

Infrared object detection corner 4

R14 180R, R15 100R, Q4 PT334-6B 2(flat) +4.8V
IR4 IR333C-A, LED6
R7 10K
BC547 Q8
R16 2K2
J19-4, J20-4, Gnd

Installing the Arduino IDE:

Before you can program your robot you must install the Arduino IDE on your computer. Version 0022 is supplied on the CD.

The latest version can be downloaded from: http://arduino.cc/en/Main/Software Choose your operating system (Windows, Mac, Linux) and follow the installation instructions.

Uploading the sample program:

Two sample programs are provided on CD with this kit. Choose the sample program that matches the configuration of your corner sensors.
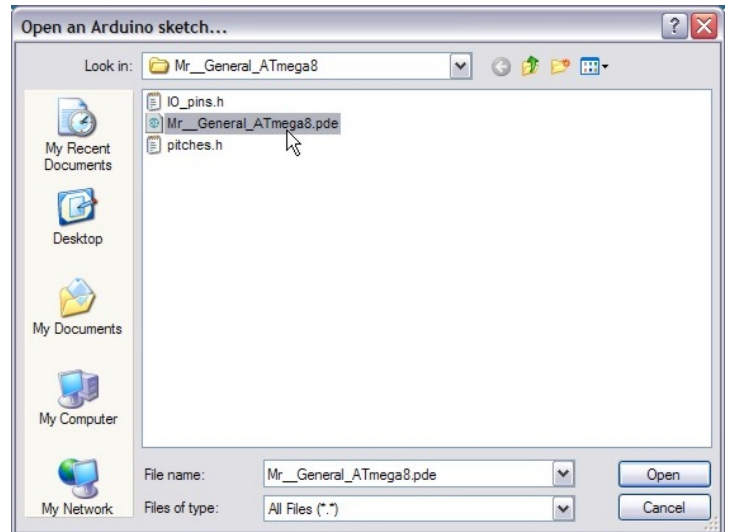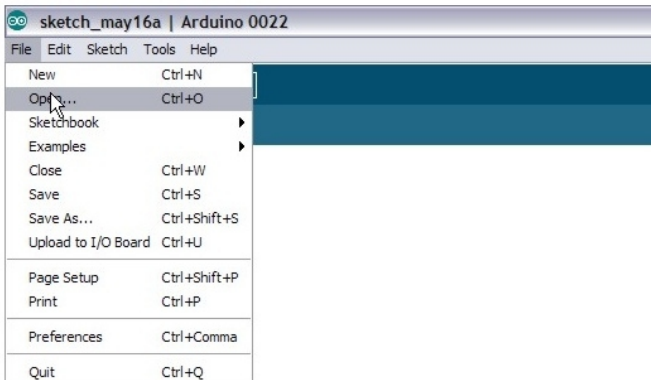
Go to the Tools menu at the top of the screen and select your board type as "Arduino NG or older w/ ATmega8"
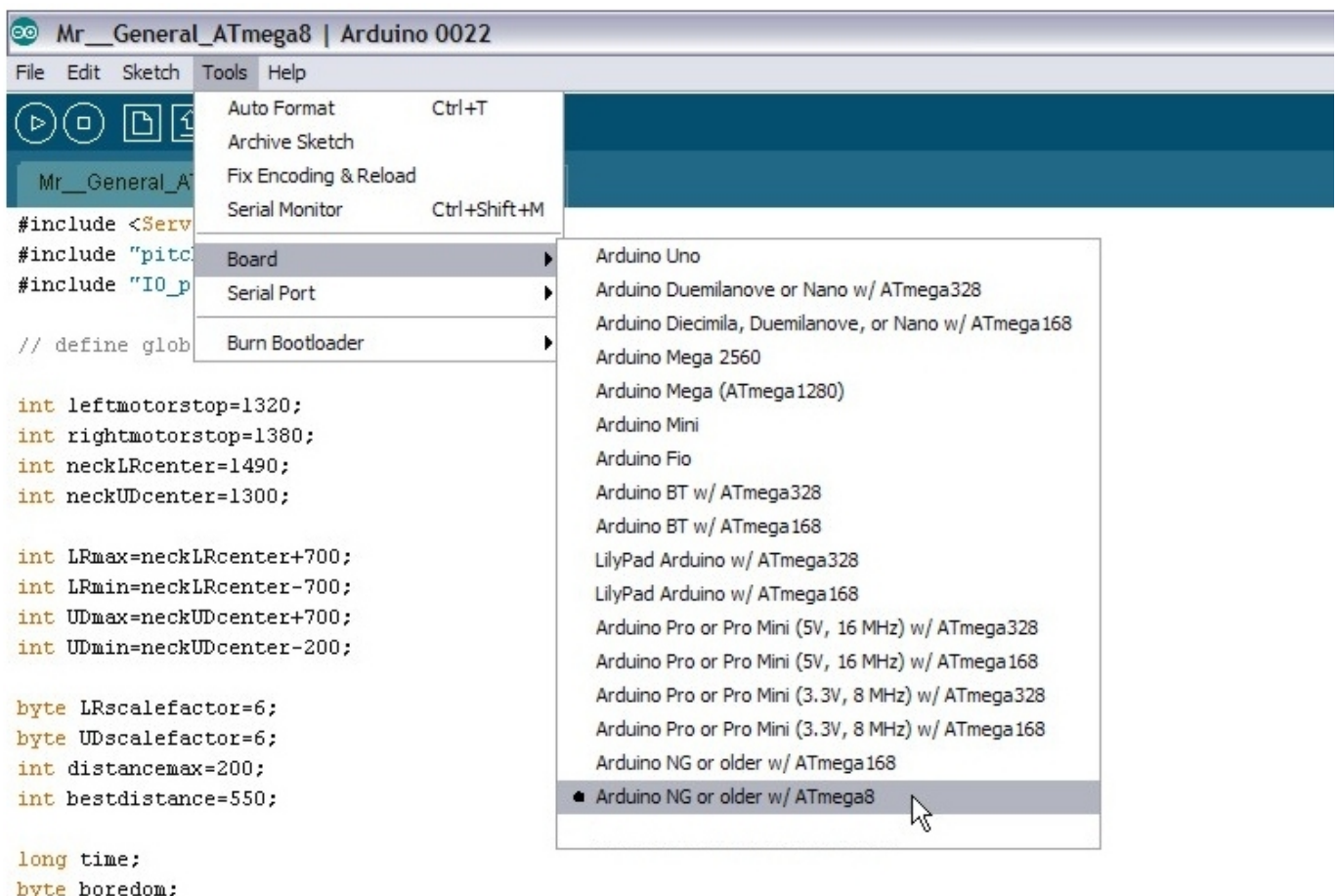
Plug your interface into the bread board as shown with the Vcc pin near the head. Make sure your robot has good batteries and the power switch is on prior to uploading the program.

Note that the pan servo and eye IR LEDs signal wires are temporarily disconnected for programming.
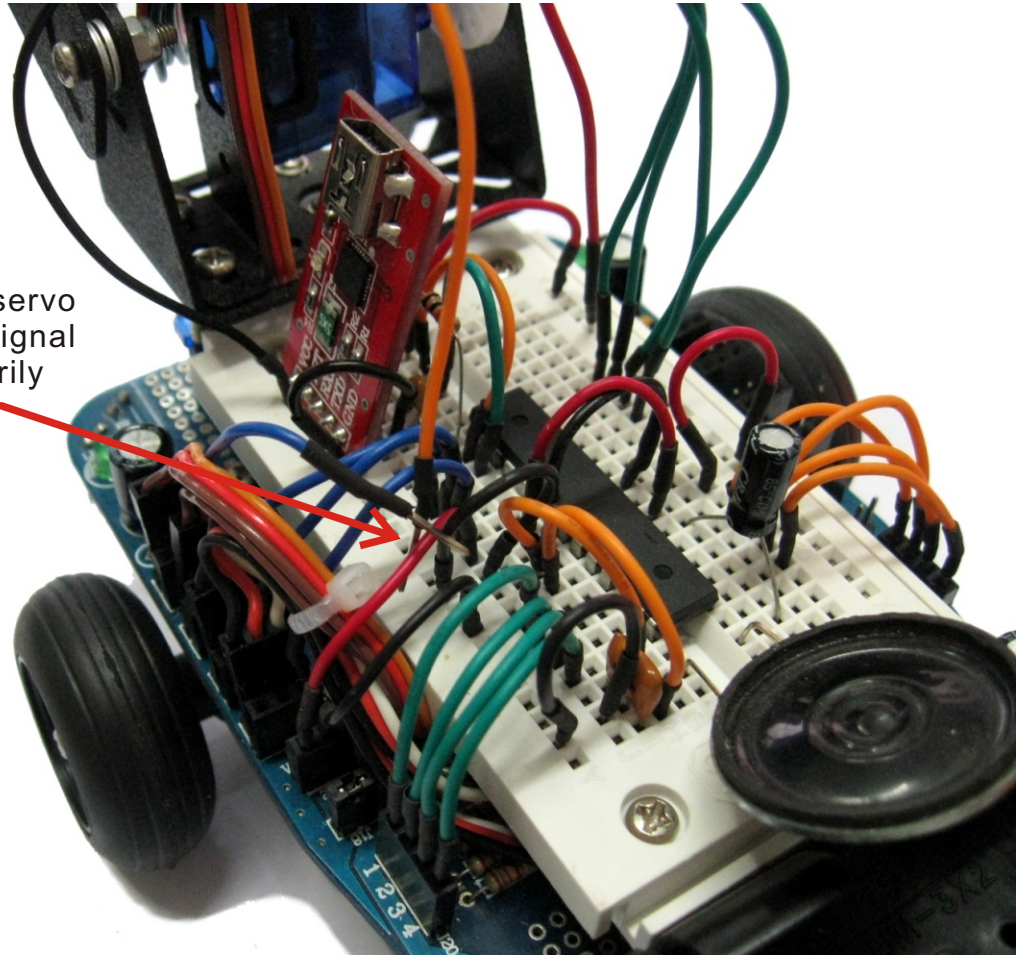
Now select your serial port. Your USB/Serial interface will appear as a virtual serial port. If you cannot find this port then you may need to install the drivers for the USB interface. See the USB installation guide on page 19.
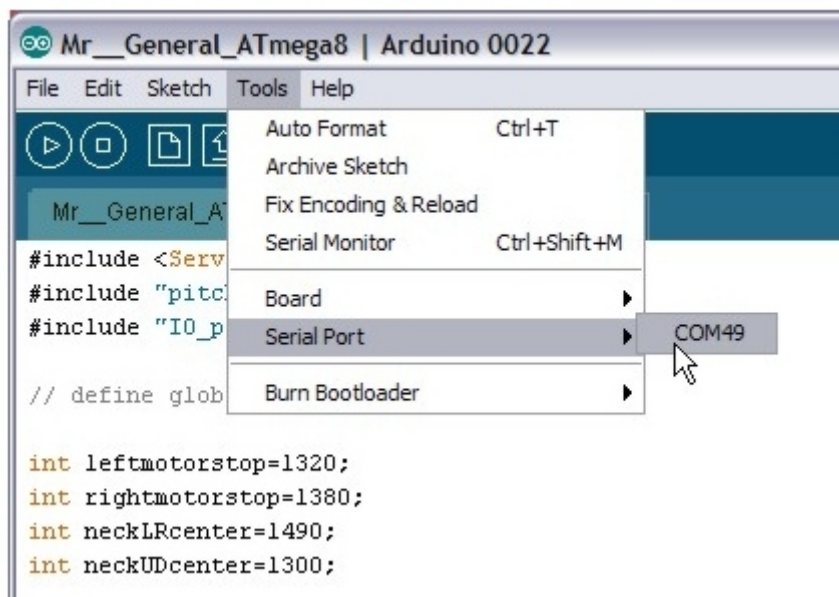
Now that your program is loaded and the board type and serial port have been selected you can Upload your program to the robot. Click on the Upload button.

The Arduino software will compile your program and then upload it to the robot. The speaker will buzz 3 times to indicate the upload has begun.

After about 7 seconds a message should appear indicating the download is complete.

Once the program has been uploaded to the robot the USB interface can be removed. Do not forget to reconnect the pan servo and eye IR LED signal wires.

The robot will not start immediately. This gives you time to place the robot on the ground. When ever the robot is turned on or reprogrammed it will wait about 5 seconds before it begins.

The robot should start by playing a short tune. Once the tune is finished move your hand in front of the robot slowly. The robot will follow your hand.

Do not be afraid to experiment with the program. If you make a mistake you can always re-install the original code from the CD or the internet.

Calibrating and Trouble Shooting

Calibration: When you turn your robot on you will probably find that the robot does not stay still while the tune is being played. You might also find that the head is not looking straight ahead. This is because no two servos are exactly the same and your software will need to be adjusted to suit your servos.

When you look at the beginning of the program you will see your variables being defined. The variables "leftmotorstop" and "rightmotorstop" must be adjusted until both motors are completely stopped when the robot is playing the tune. It is probably easiest to work on one motor at a time. Increase or decrease the value in small steps and then reload the program.

If your head needs major adjustment then you may need to mechanically adjust the head by reseating the servo horns on the pan and tilt servos. Minor adjustments can be done by adjusting the variables "neckLRcenter" and "neckUDcenter". Do this in the same manner as you adjusted the left and right servo motors until the head is looking straight ahead and slightly upward. If the head looks down too much and your floor is a light colour then the robot may become confused and stare at the floor thinking that it is an object to be followed.

The four corner sensors may also need calibration. Each corner sensor has a green LED that lights up when an object is detected. By adjusting the angle of the IR LED and photo-transistor you can adjust the sensitivity. If the IR LED and photo-transistor are too close together then you may get a false reading. Try to have the LED and photo-transistor parallel to each other for best range.

If you have configured your corner sensors for edge detection then depending on the colour of the floor they may be too sensitive. Try changing the angle so that they are pointing slightly away from the robot as this will also help detect the edge earlier.

Trouble Shooting:

Cannot upload the program:
Check that the USB interface is recognised by your computer.
Check that the correct serial port has been selected and that the board type is set to "Arduino NG or older w/ ATmega8".
Check that the USB interface is inserted correctly into the breadboard and it's power light is on.
Check that the batteries are not flat and that the robot is turned on.
Check that you have temporarily disconnected the pan servo and eye IR LEDs control wires as shown.
Check that all your wiring is correct and that no wires or components have come out of the breadboard.
Check that the USB cable is correctly plugged in and working correctly. If possible try another USB cable.

Head looks away from objects:
There are several different reasons why this may happen. In all cases the easiest solution is to simply swap the wires from the eye where they connect to the processor. If the robot looks down when it should look up then swap the up and down sensor wires. If the robot looks left when it should look right then swap the left and right sensor wires.

Robot appears dead!
Check that the batteries are fully charged and the power switch is on. Does the red LED (LED 2) light up?
Check that the jumper is on J18 and that power wires connect the breadboard to the PCB.
Check that the servo cables have been inserted the right way around.
Check that the power cable from the batteries is plugged into the PCB correctly.
Check your wiring. Make sure the processor and other components have been inserted correctly.
Reload the program.

Robot's head follows object but the body does not move correctly:
This often happens when one or more corner sensors tell the robot that an object or edge is present.
Check your corner sensor are not giving false readings. Re-align if necessary.
Check that your servo motor cables are plugged in correctly.
Check that the screws holding the wheels on are slightly loose.

Robot appears blind:
Check the wires from the eye have not pulled out. Pay careful attention to the power wires and IR LED signal wire.

Sound does not play correctly:
The original "Tone" library has a fault that prevents it working correctly on the ATmega8 processors. An updated version is included in the Arduino software on the CD. Delete the old "Tone" library and replace it with the new one.

Batteries do not charge:
Check that the yellow LED (LED 1) is on. If not then you do not have power connected to the robot or polarity is incorrect.
Check batteries: You must use **NiMh** or **NiCd** batteries only! Other battery types may be damaged if you try to charge them.
Check power supply: You must use a **9V DC** power supply with **positive going to the center pin** of the charging socket.

Note: The trickle charge circuit needs 16 hours to fully recharge 2400mAH batteries. The power switch must be in the off position for the batteries to charge.
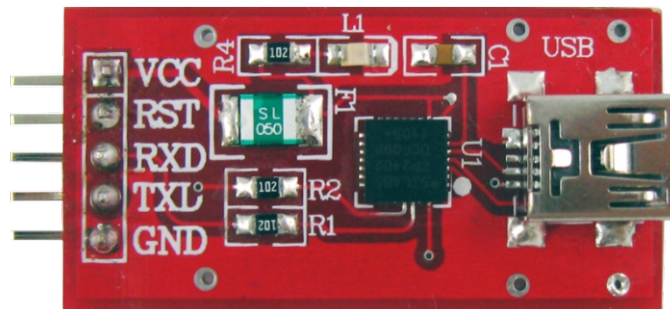
USB drivers installation guide:
The USB interface uses the CP2102 USB to serial interface IC. Depending on your operating system, you may need to install drivers for this interface to be recognized and function correctly.

The drivers supplied on the CD were the latest at the time these instructions were written.

For the latest drivers and installation instructions go to:
http://www.silabs.com/products/mcu/Pages/USBtoUARTBridgeVCPDrivers.aspx
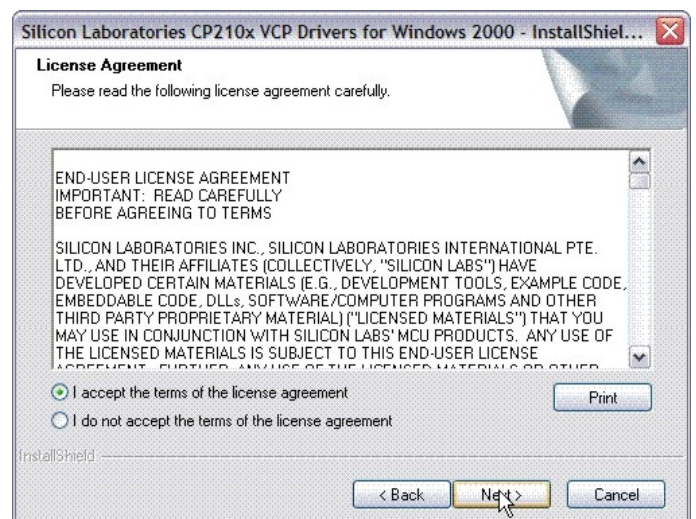
These instructions apply to Windows XP machines and are intended as a guide only. Future driver versions may install differently.

Step 1: Run the installation file in the USB drivers folder.
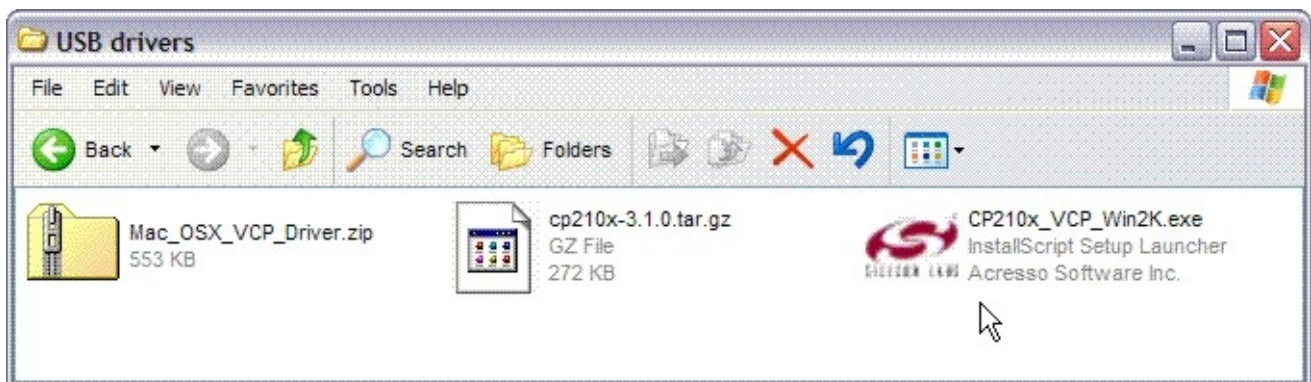
Step 2: Follow the installation instructions. Click on the "accept agreement" button to continue.
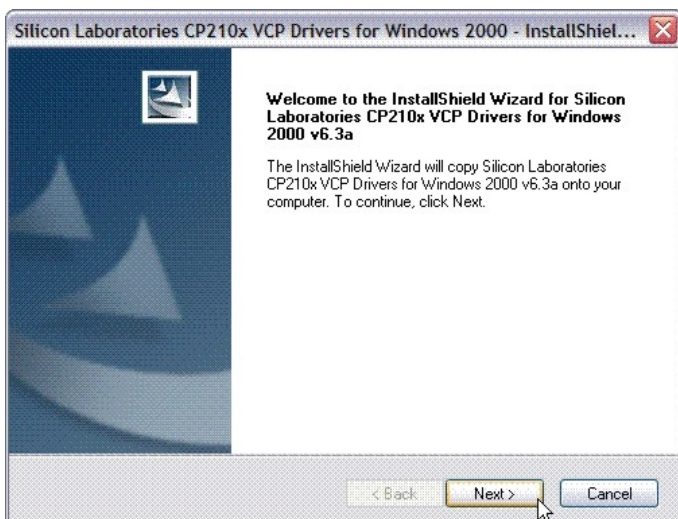
Step 3: Continue following instructions. You can change the installation folder if you wish.
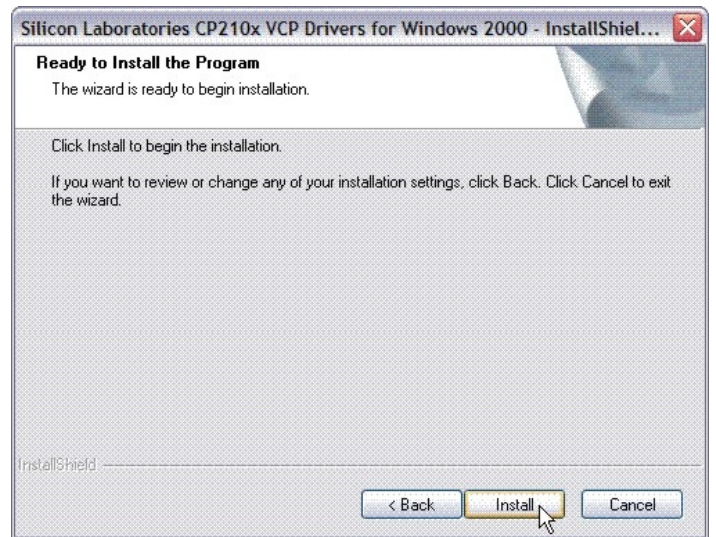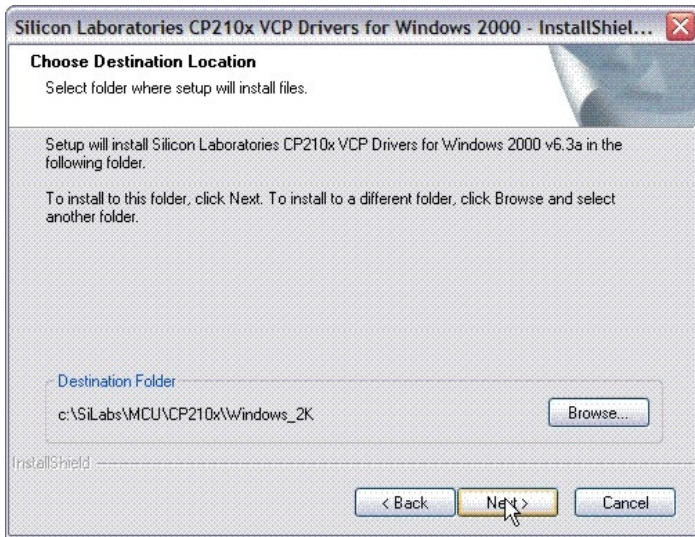
Step 4: You have now copied the drivers on your hard drive. Begin driver installation
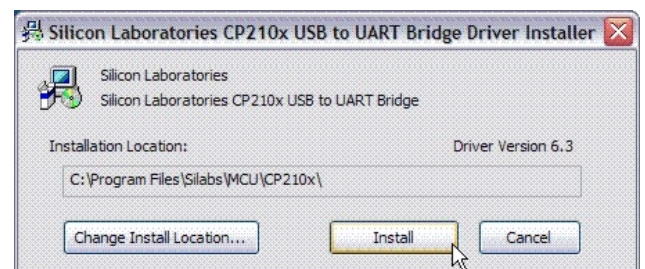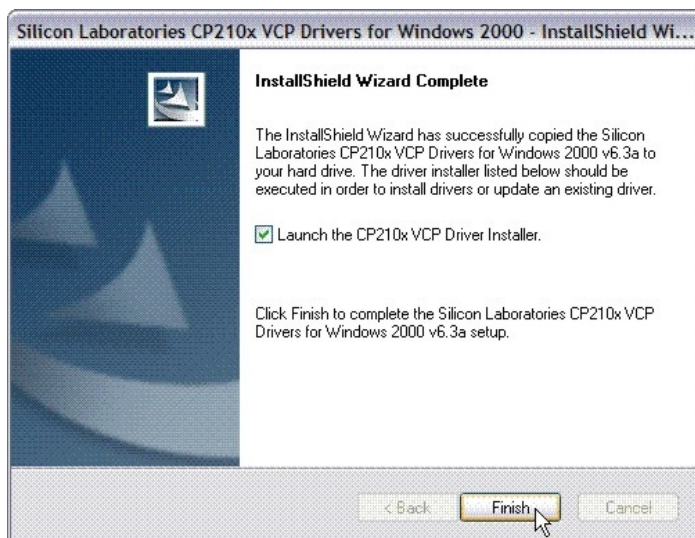
Step 5: Once the drivers are installed you must restart your computer.

Step 6: Once your computer has restarted, plug the USB interface into the computer.

Step 7: The wizard should be searching for a Silicon Labs CP210x USB to UART Bridge.

Step 8: Once the installation is finished you can close the wizard.

Step 9: When you run the Arduino IDE your USB interface should be recognized.

What's next?

Once you have your robot working well with the sample program then it is time for you to begin experimenting! Two spare pins are available for experimenting. These pins are Analog inputs A0 and A1. They can also be used as digital I/O pins D14 and D15.
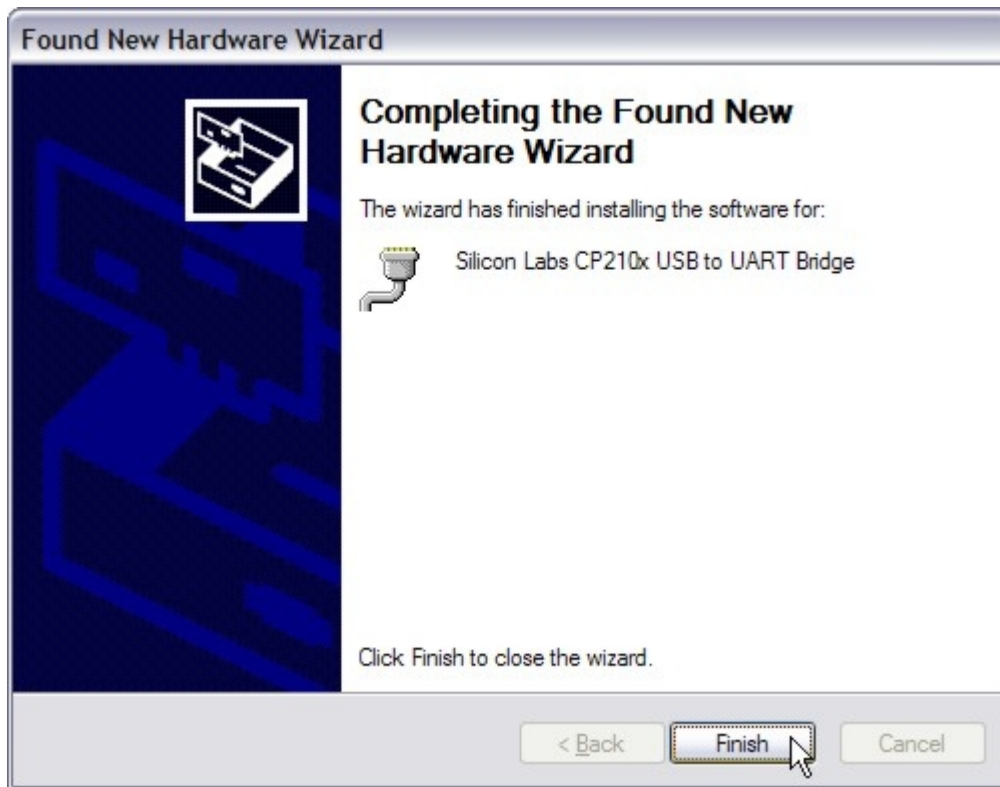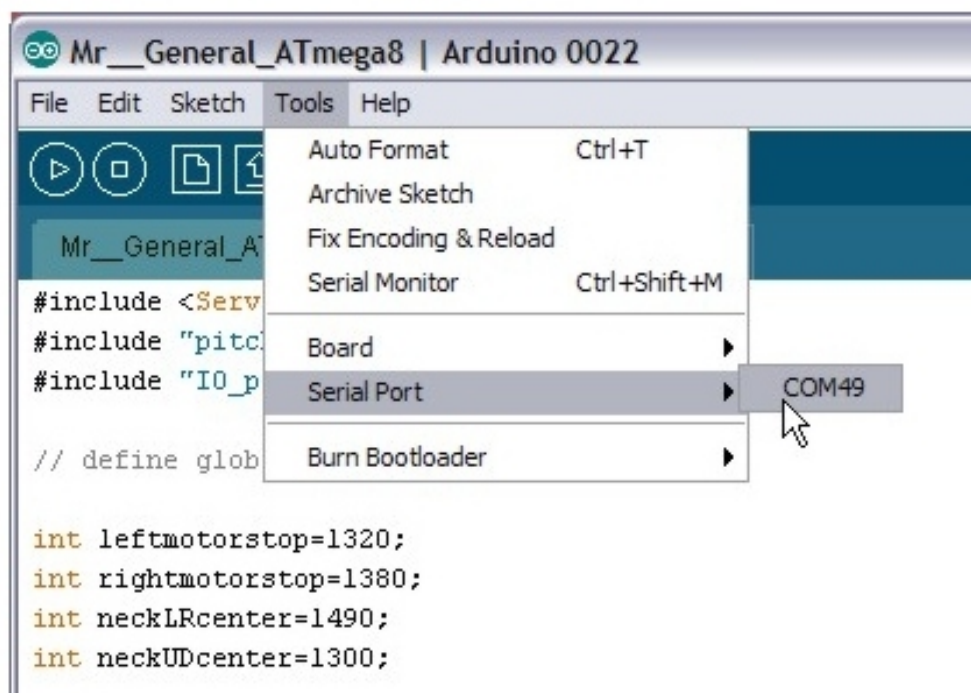
Software:
Experiment with the software and give your robot some personality. One way is to use a timer to measure how long the robot has sat without detecting anything. The more time the robot sits doing nothing the more bored it becomes.

Get the robot to make noises, look around or spin about to get your attention. If your robot becomes very bored then perhaps it will wander off using the eye to look for moving objects to play with. Maybe your robot will fall asleep and snore!

Hardware:
Mr. General is supplied with an ATmega8A processor. This chip can be easily upgraded to an ATmega168 or ATmega328 with the Arduino bootloader to increase memory.

If you use an Arduino Nano as your processor then you will have the advantage of an additional 2 analog inputs as the surface mount chips have extra pins.

The prototype area under the breadboard is an ideal location to add a 3.3V regulator for sensors such as accelerometers, compass modules etc.

Changes in temperature can affect the stop position of the left and right continuous rotation servos. Mounting a temperature sensor between the servos will allow your software to compensate for temperature.

Adding an IR receiver will allow the robot to be controlled with a TV remote control. Add a bluetooth module and control your robot with your computer or phone!

More experienced users may wish to add a speakjet chipset allowing the robot to talk.