

Mini Bots

Manual:RS014



Mini Hexapod



Mini Biped

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Product Description

Thank you for buying our MiniBots kit. Designed specifically for beginners and younger students this kit will teach all the basic skills needed for making and programming robots.

Product Features

- Arduino compatibility with plug-in USB interface for easy programming.
- Infra-red compound eye for detecting objects and tracking motion.
- 4x miniature servos for complex walking motions.
- Universal TV remote supplied for remote control.
- 2 programmable LEDs and a speaker give you feedback from the robot.

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



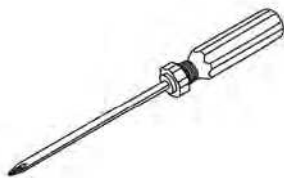
Warnings:

- No return is possible after having opened the bags with components and pieces.
- Prior to 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.
- Insert batteries correctly to prevent damage to the electrical components.
- Keep dry. If the robot gets wet DO NOT USE! Remove batteries immediately. Let the robot dry completely before re-installing the batteries.
- Remove batteries if the robot is not being used for a long time.

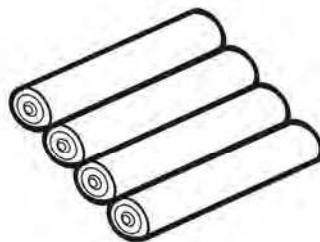
Necessary Tools:

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

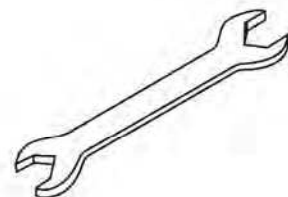
Before you start you will require the following tools:



Phillips screwdriver
(included)



4*NiMh AAA
rechargeable
batteries

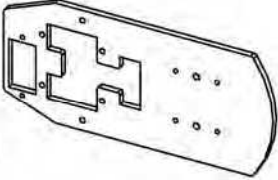
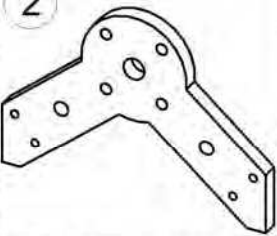

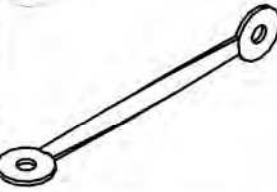
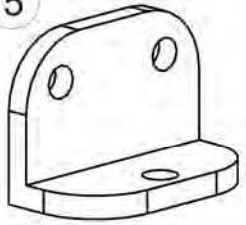
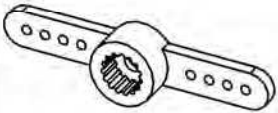
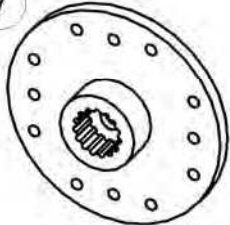
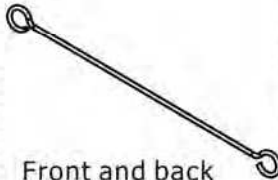
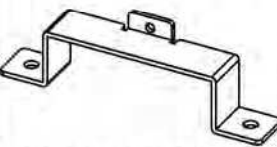
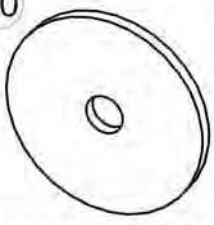
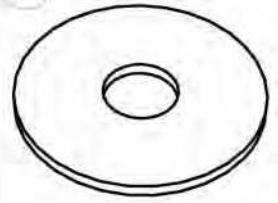
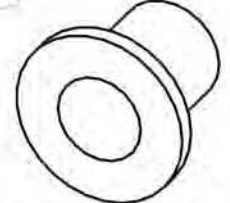

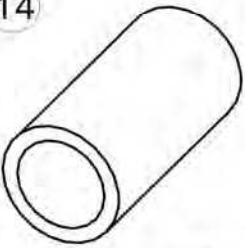
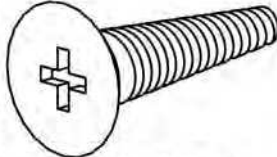
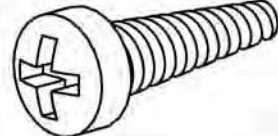
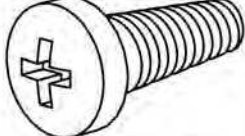
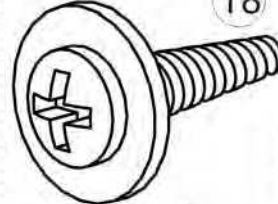
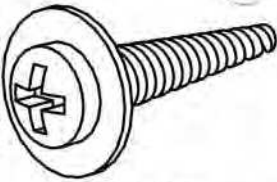
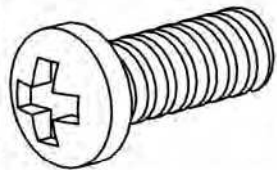

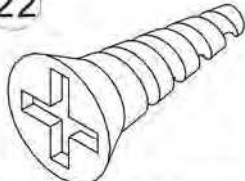
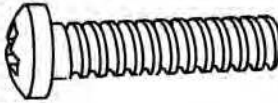
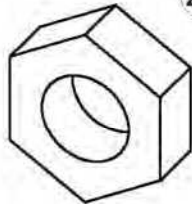
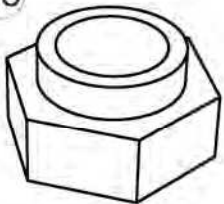
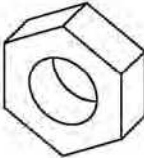


Hex spanner
(included)

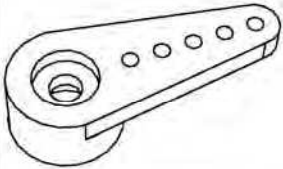
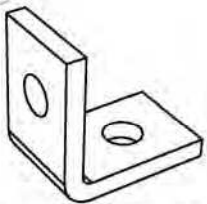
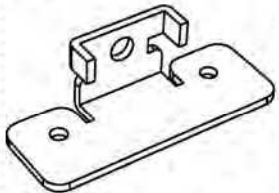
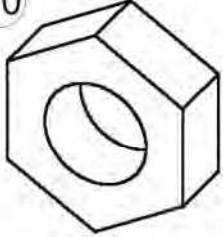
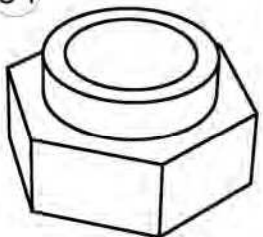
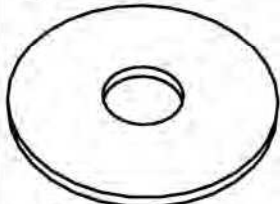
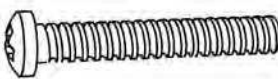
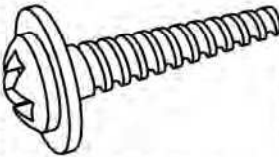
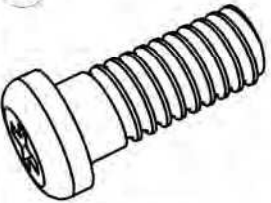
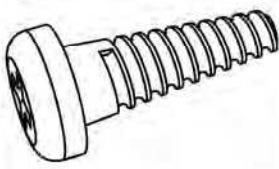


Do not use alkaline batteries!
NiMh or NiCd batteries only!

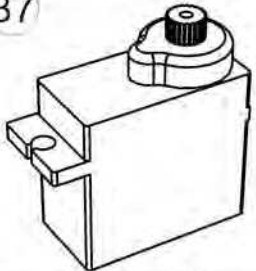
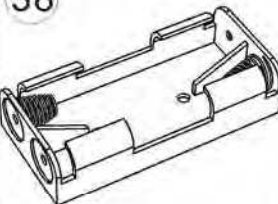
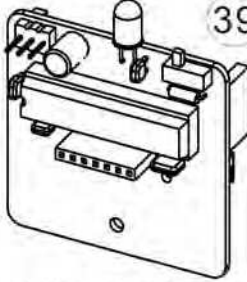
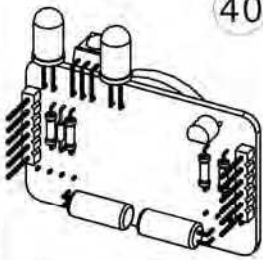
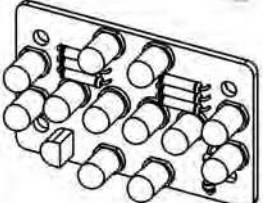
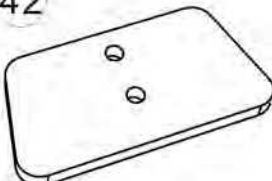
Hexapod parts :

<p>1</p>  <p>Chassis 1PC</p>	<p>2</p>  <p>Middle leg mount 1PC</p>	<p>3</p>  <p>Front and back legs 4PCS</p>	<p>4</p>  <p>Middle legs 2PCS</p>	<p>5</p>  <p>Neck joint 1PC</p>
<p>6</p>  <p>Servo horn-1 1PC</p>	<p>7</p>  <p>Servo horn-2 5PCS</p>	<p>8</p>  <p>Front and back leg wire linkage 2PCS</p>	<p>9</p>  <p>Servo mounting bracket 1PC</p>	<p>10</p>  <p>Large metal washer 2PCS</p>
<p>11</p>  <p>M3 washer 8PCS</p>	<p>12</p>  <p>Flanged metal spacer 4PCS</p>	<p>13</p>  <p>M3 Spring washer 2PCS</p>	<p>14</p>  <p>L10 spacer 2PCS</p>	<p>15</p>  <p>Screw M2.6*8 Pan head self-tapping 4PCS</p>
<p>16</p>  <p>Screw M2*6 self-tapping 8PCS</p>	<p>17</p>  <p>Screw M2.6*6 self-tapping 7PCS</p>	<p>18</p>  <p>Screw M2*6 self-tapping with flange 12PCS</p>	<p>19</p>  <p>Screw M2.3*8 self-tapping with flange 7PCS</p>	<p>20</p>  <p>Screw M3*8 7PCS</p>
<p>21</p>  <p>Screw M3*25 2PCS</p>	<p>22</p>  <p>Screw M3*6 counter sunk self-tapping 2PCS</p>	<p>23</p>  <p>Screw M2*8 1PC</p>	<p>24</p>  <p>M3 nut 6PCS</p>	<p>25</p>  <p>Nylon nut 9PCS</p>
<p>26</p>  <p>M2 nut 1PC</p>				

Mini biped parts :

<p>27</p>  <p>Servo horn 4PCS</p>	<p>28</p>  <p>Metal mounting with angle 2PCS</p>	<p>29</p>  <p>Joint-part 2PCS</p>	<p>30</p>  <p>M2 nut 2PCS</p>	<p>31</p>  <p>Nylon nut 1PC</p>
<p>32</p>  <p>Large metal washer 1PC</p>	<p>33</p>  <p>Screw M3*20 1PC</p>	<p>34</p>  <p>Screw M2.3*10 self-tapping with flange 4PCS</p>	<p>35</p>  <p>Screw M2*5 10PCS</p>	<p>36</p>  <p>Screw M2*5 self-tapping 8PCS</p>

Sharing Components list :

<p>37</p>  <p>Stepper servo(share) 4PCS</p>	<p>38</p>  <p>Battery box(share) 2PCS</p>	<p>39</p>  <p>Processor board (share) 1PC</p>	<p>40</p>  <p>Backpack(share) 1PC</p>	<p>41</p>  <p>Compound eye(share) 1PC</p>
<p>42</p>  <p>Silicon feet 6PCS</p>				

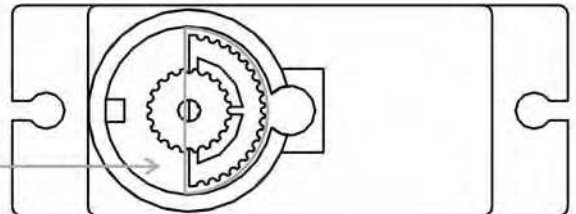
Hexapod Mechanical Assembly Instructions:



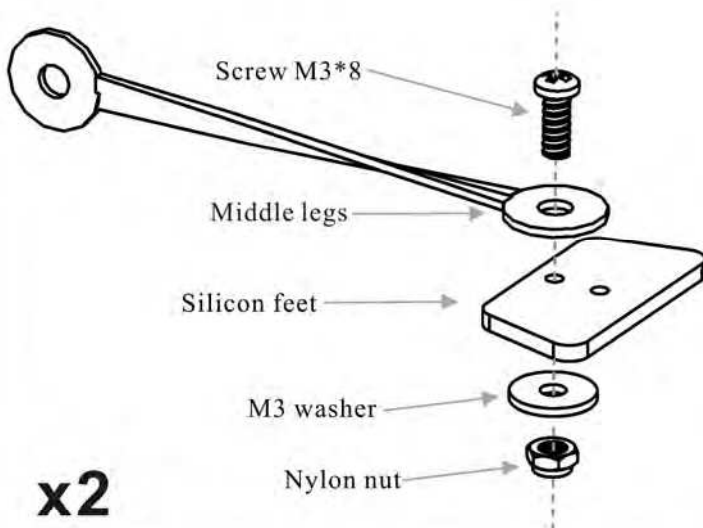
ATTENTION!

All servos need to be centered prior to construction.

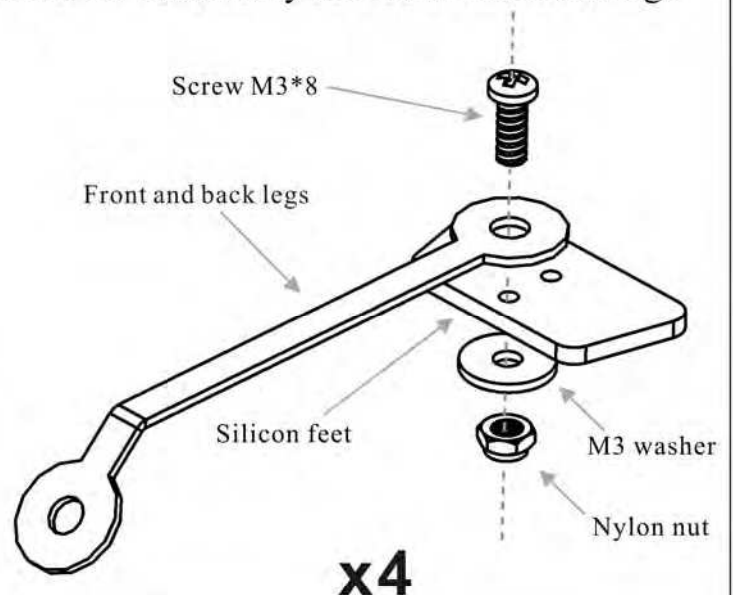
Look through the clear servo case and turn servo by hand until it looks like this.



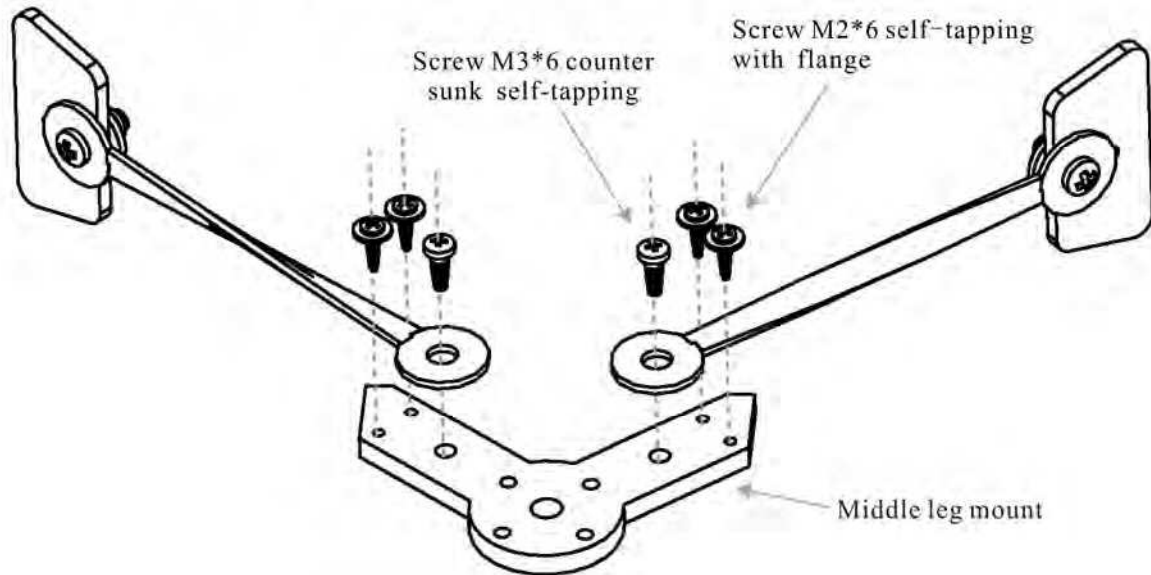
STEP 1: Assembly the middle legs



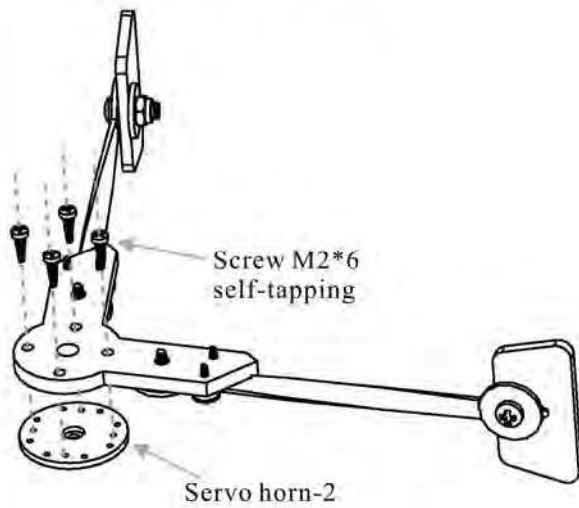
STEP 2: Assembly the front and back legs



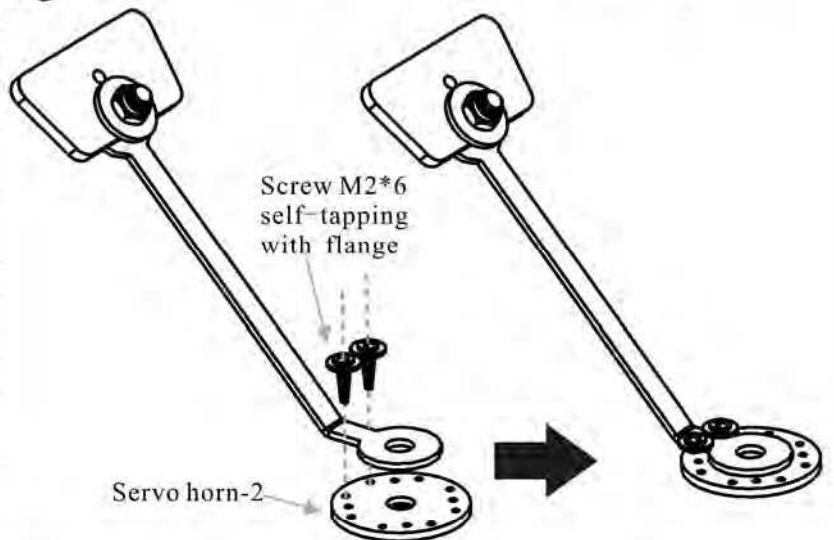
STEP 3: Attach the middle legs to the middle leg mount



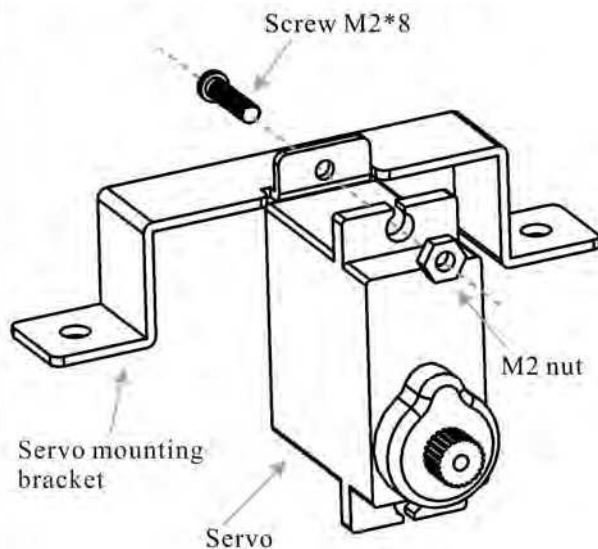
STEP 4: Install servo horn-2



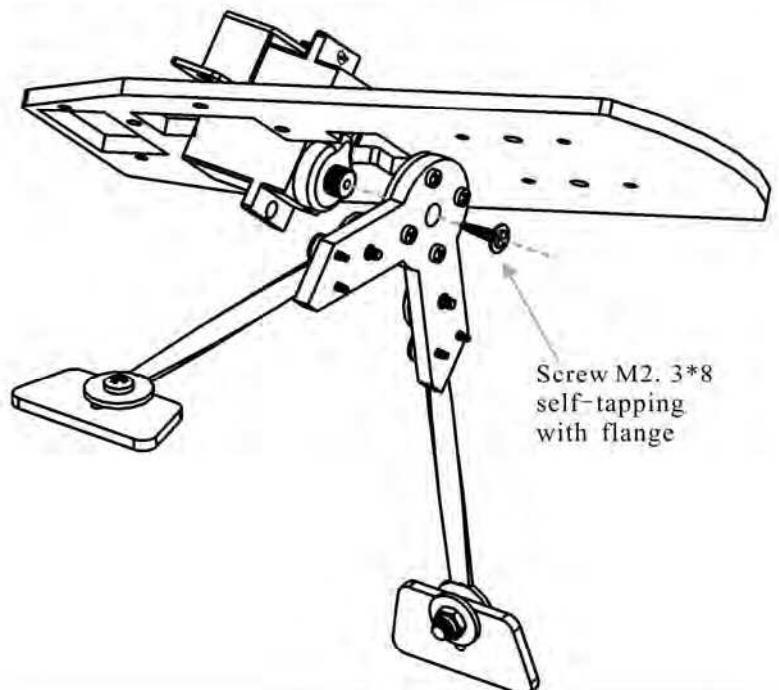
STEP 5: Install servo horn-2 on the front and back legs



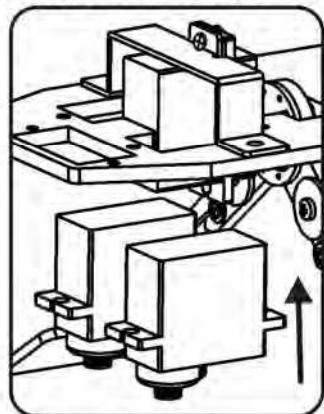
STEP 6: Mount the middle leg servo on the servo mounting bracket



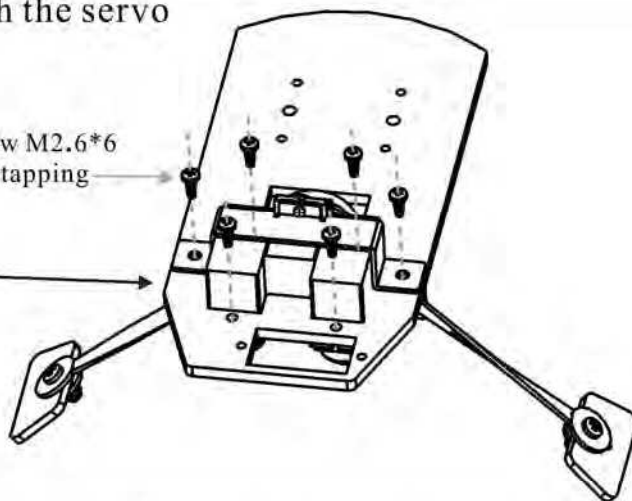
STEP 7: Fit the middle legs on the servo and lock in place with screw as shown.



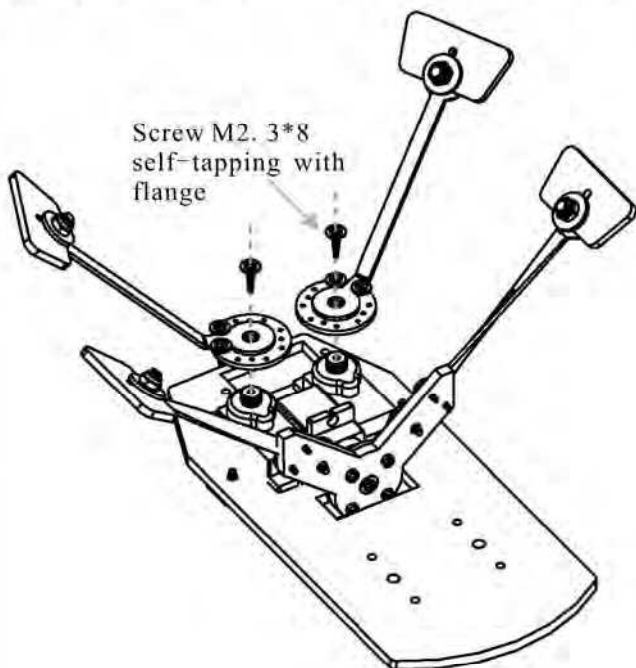
STEP 8: Install left and right leg servos. Attach the servo mounting bracket to the chassis as shown.



Screw M2.6*6 self-tapping

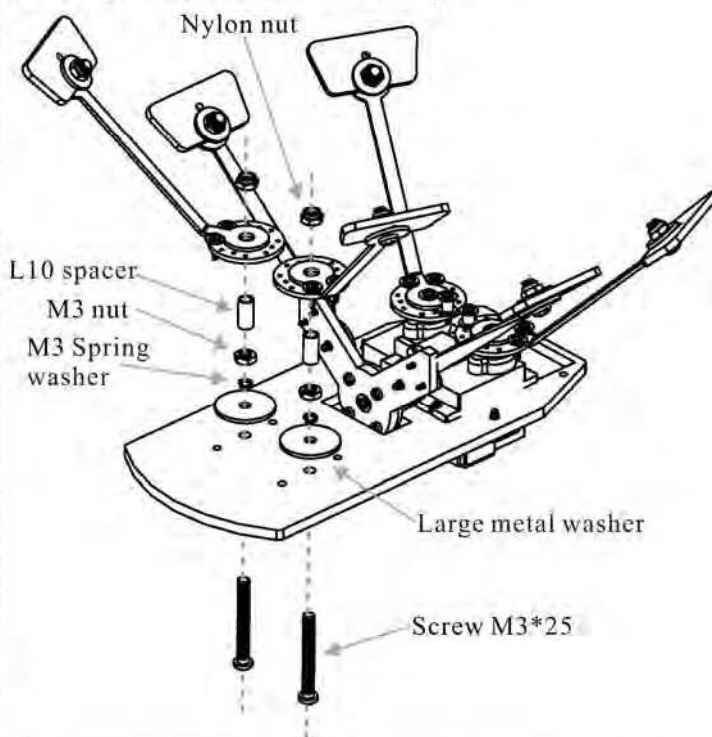


STEP 9: Mount the front legs so they are slightly forward with the servo centered.



Screw M2. 3*8 self-tapping with flange

STEP 10: Mount the back legs as shown. Make sure the legs can turn easily.



Nylon nut

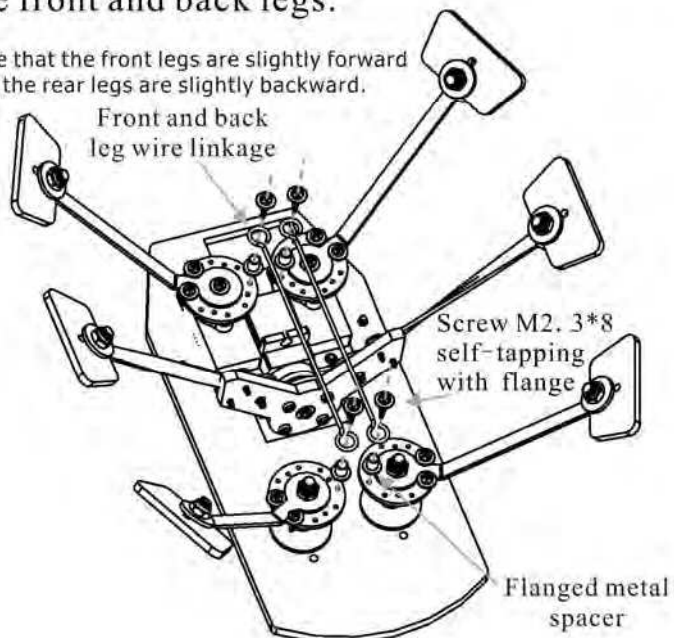
L10 spacer
M3 nut
M3 Spring washer

Large metal washer

Screw M3*25

STEP 11: Install the wire linkages between the front and back legs.

Note that the front legs are slightly forward and the rear legs are slightly backward.

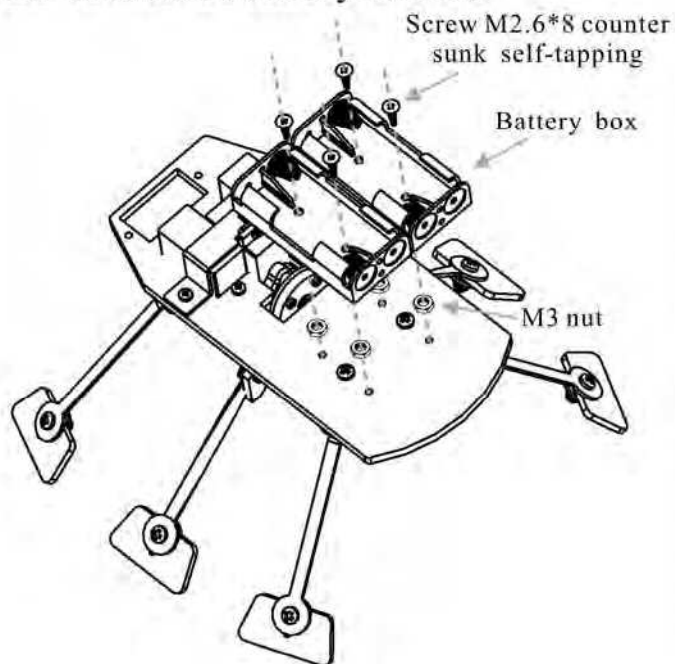


Front and back leg wire linkage

Screw M2. 3*8 self-tapping with flange

Flanged metal spacer

STEP 12: Mount battery holders

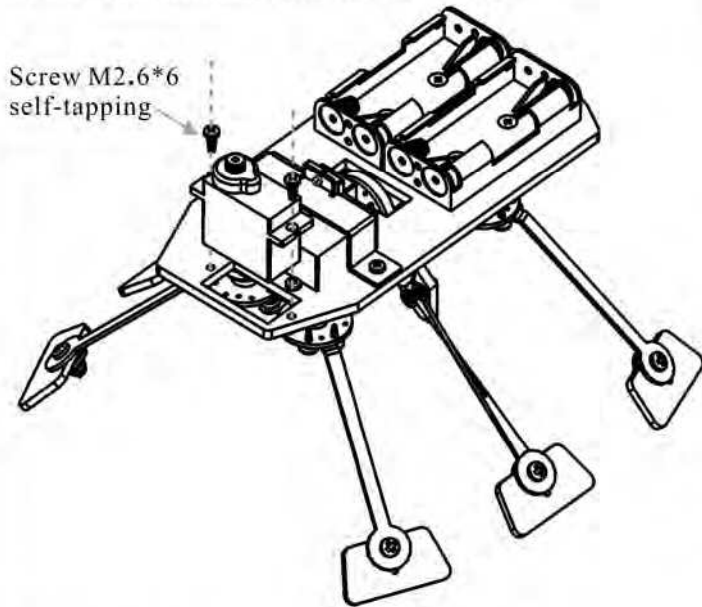


Screw M2.6*8 counter sunk self-tapping

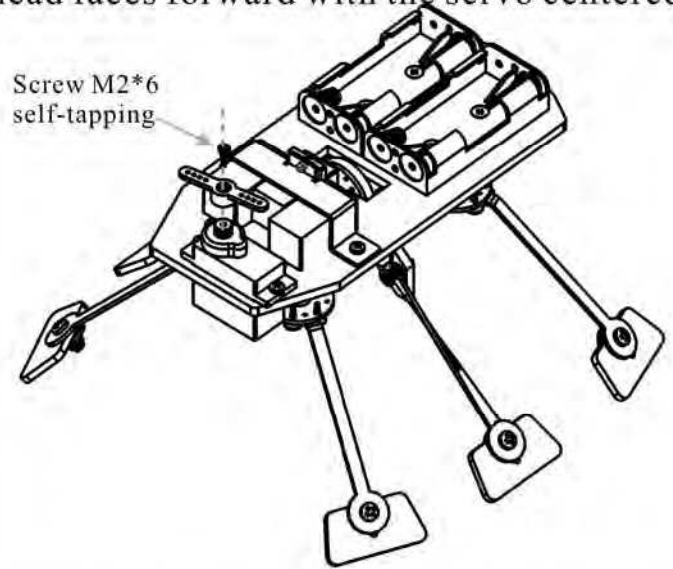
Battery box

M3 nut

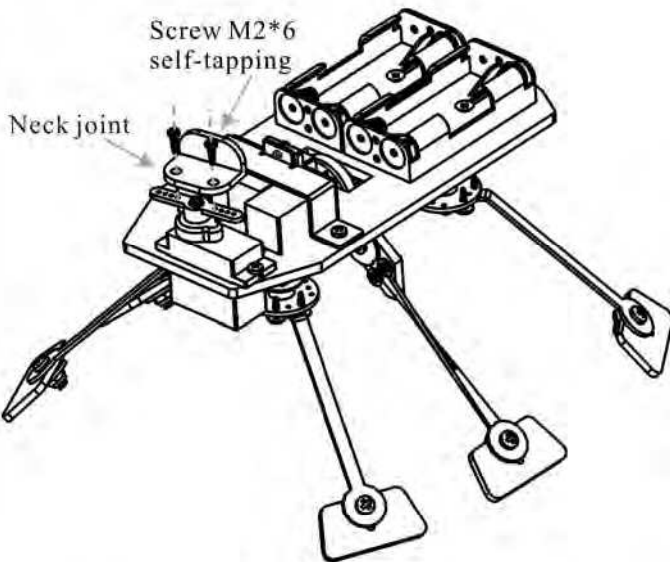
STEP 13: Mount the neck servo



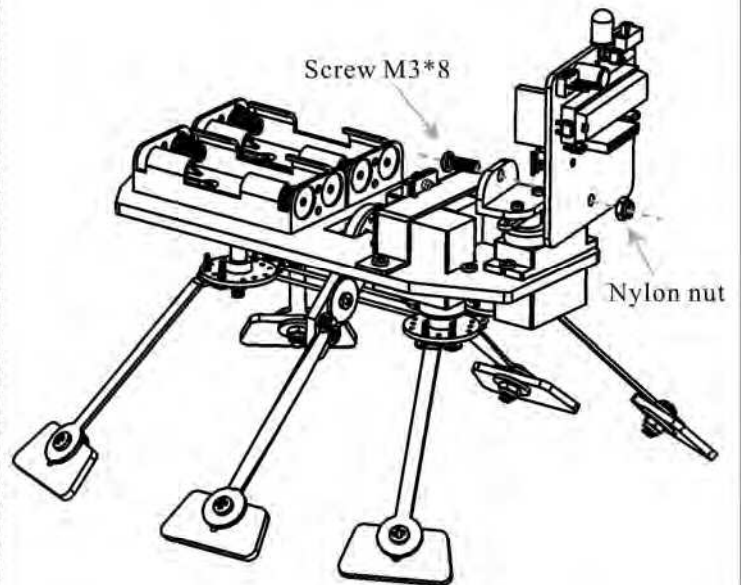
STEP 14: Install servo horn-1 so that the head faces forward with the servo centered.



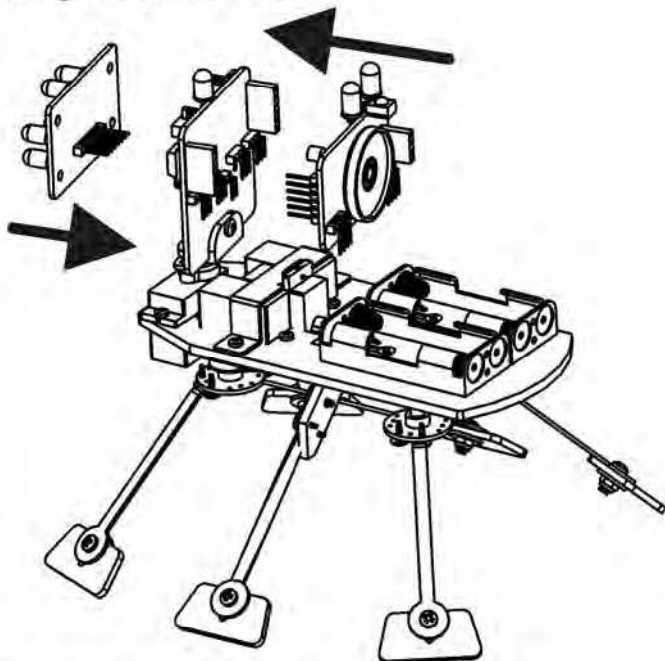
STEP 15: Mount the neck joint on the servo horn



STEP 16: Mount the main board



STEP 17: Plug the back pack and eye into the processor board.

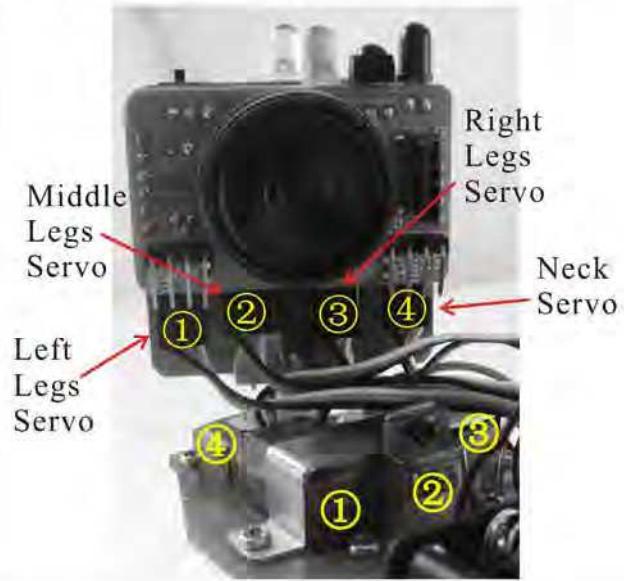


STEP 18: Turn the robot over and pay careful attention to the labelling of the power and servo connectors.

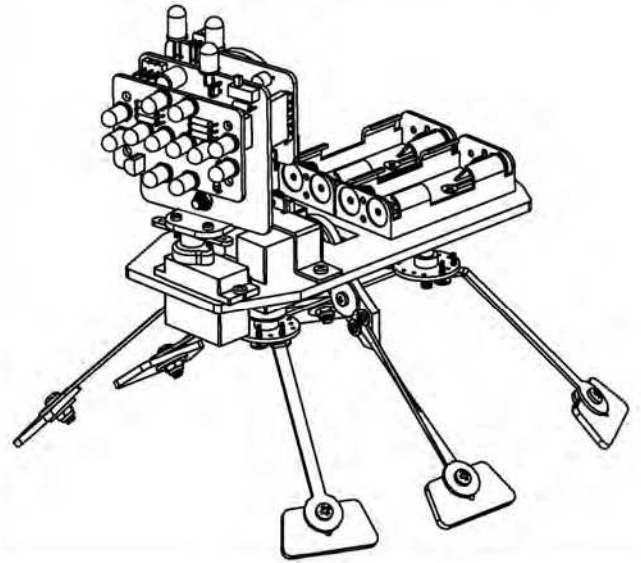
Connect the power first making sure to connect the red wire to the +.



STEP 19: Connect the servos to the appropriate socket making sure the white wire connects to the "S" and the black wire to the "-".



Your hexapod is complete. Now install 4x AAA NiMh batteries and program your robot.



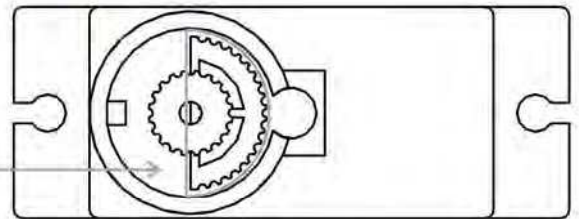
Biped Mechanical Assembly Instructions:



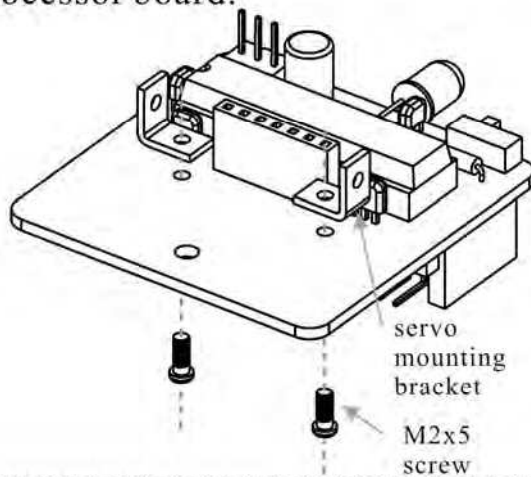
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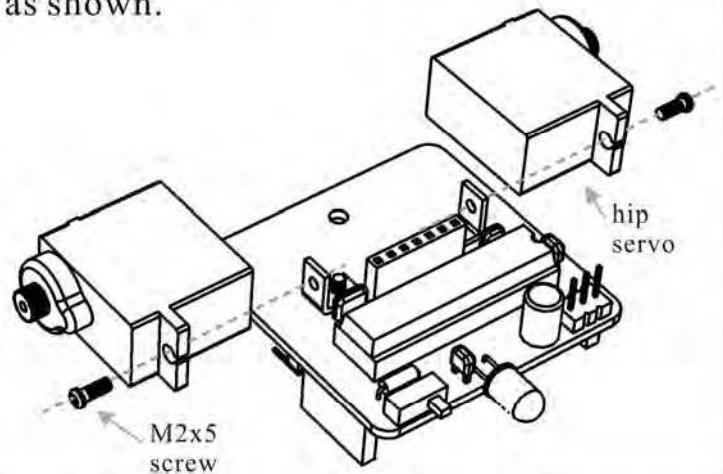
Look through the clear servo case and turn servo by hand until it looks like this.



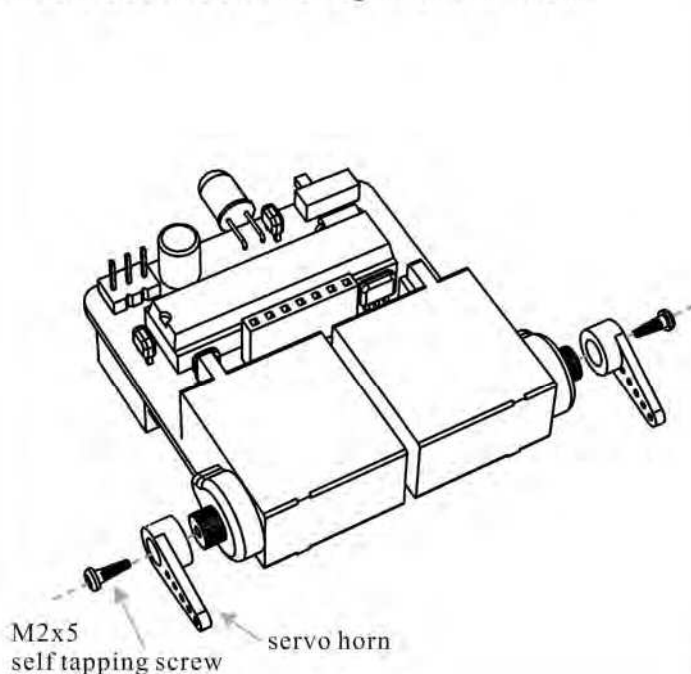
STEP 1: Attach two servo mounting brackets to the processor board.



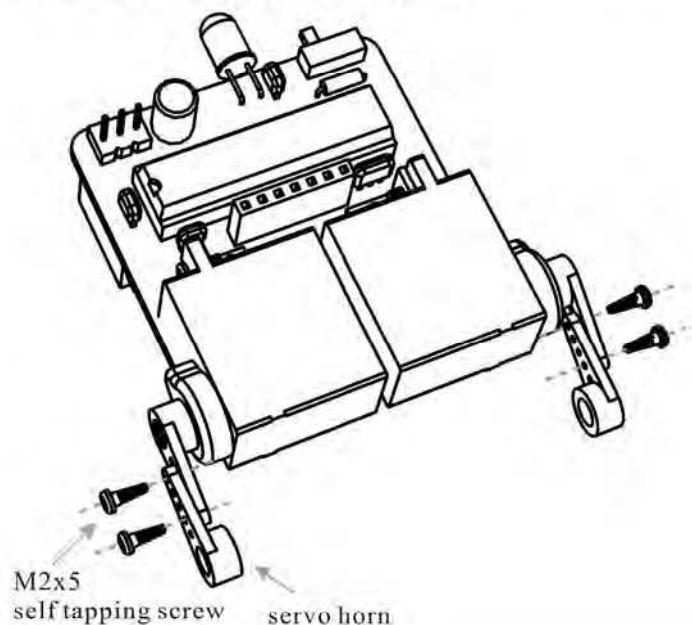
STEP 2: Mount the left and right hip servos as shown.



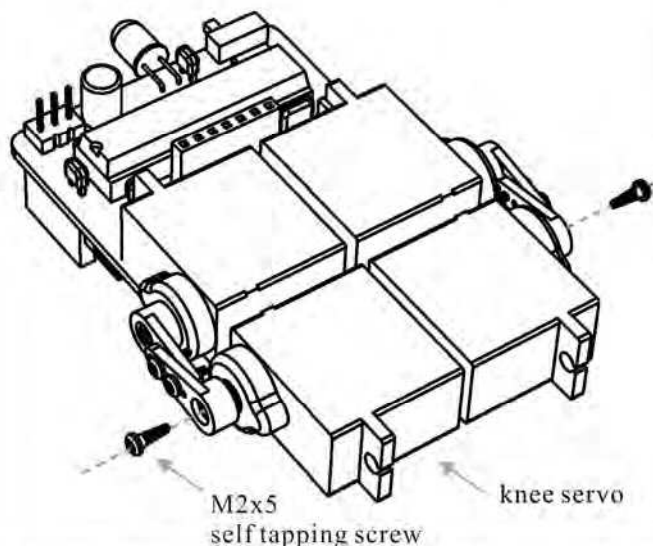
STEP 3: Attach the hip servo horns.



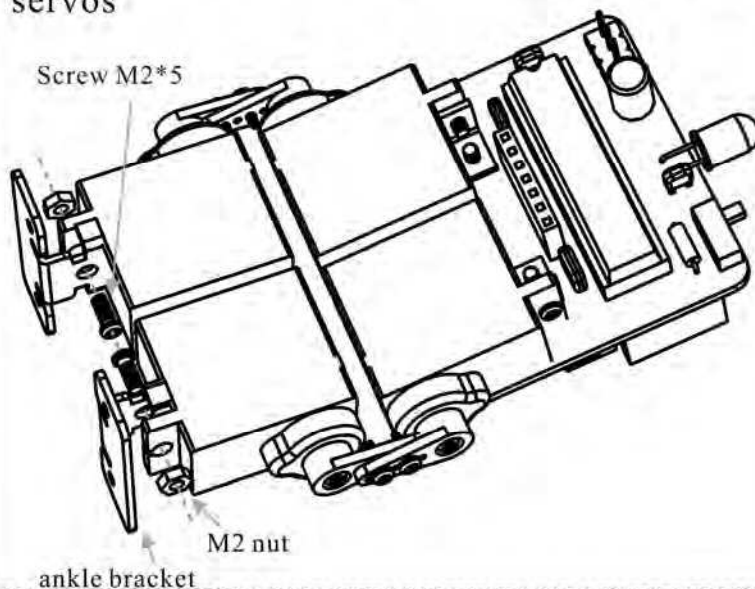
STEP 4: Now join the knee servo horns to the hip servo horns as shown.



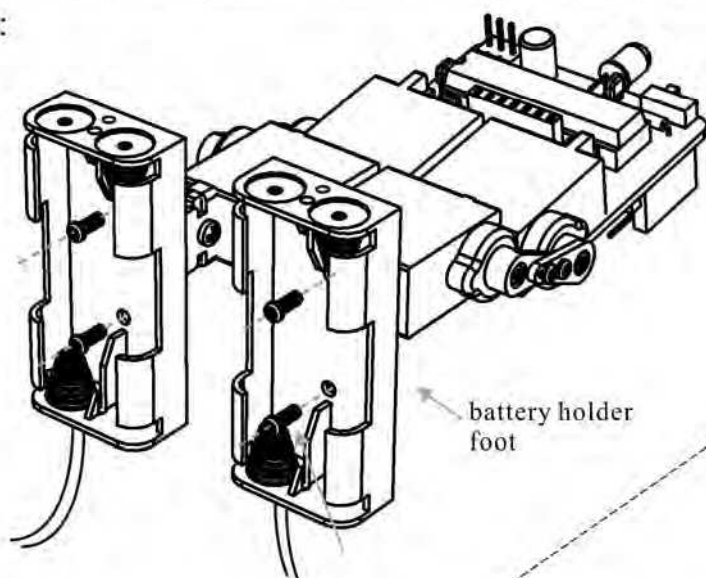
STEP 5: Mount the knee servos as shown



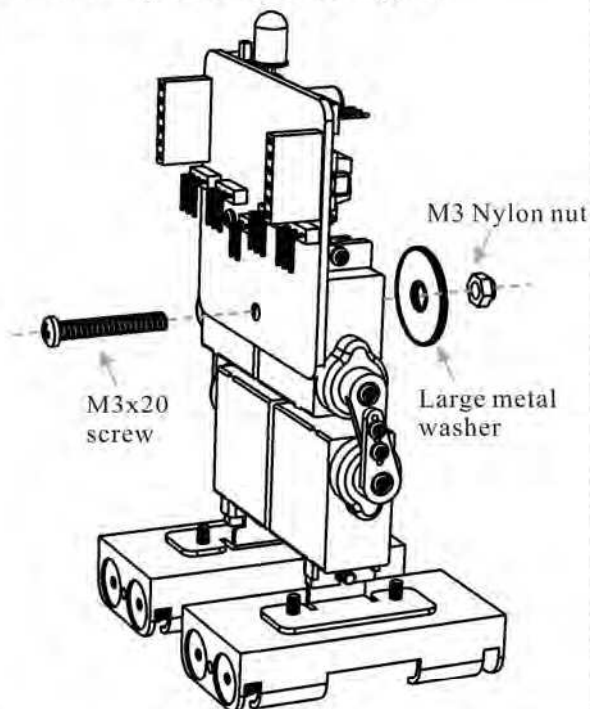
STEP 6: Attach the ankle brackets to the knee servos



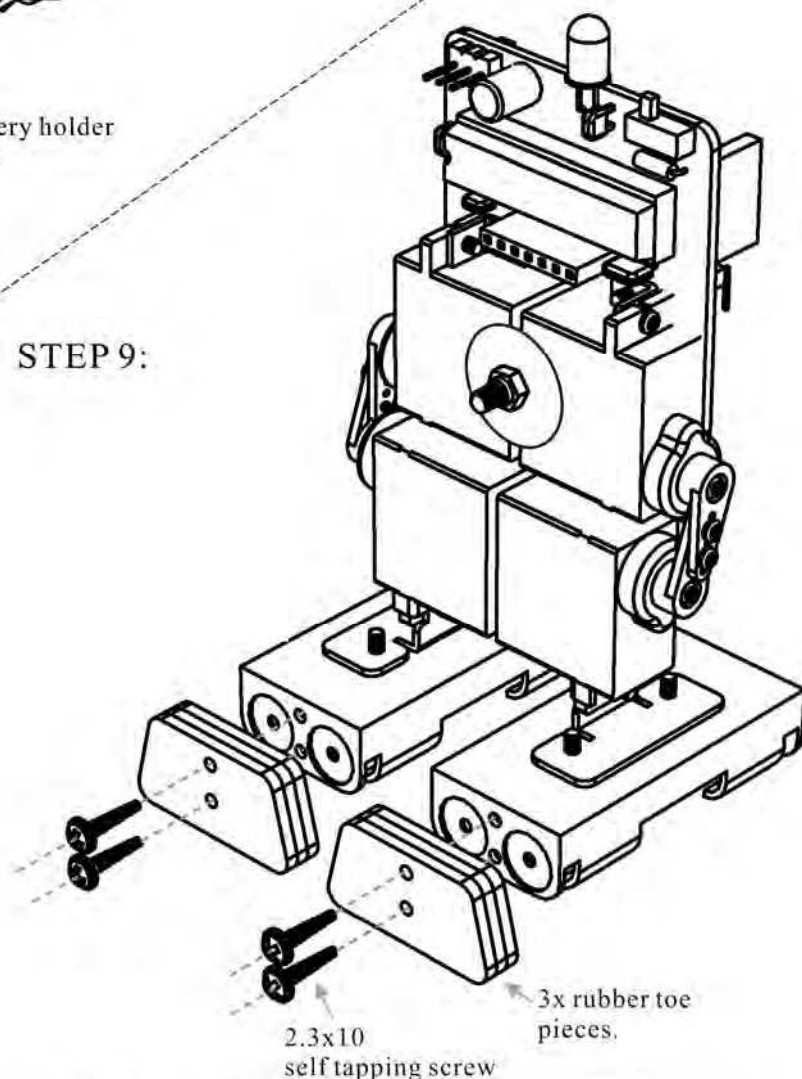
STEP 7:



STEP 8: Insert the 20x3mm screw through the processor board and between the hip servos. Tighten the nut firmly but not too tight.

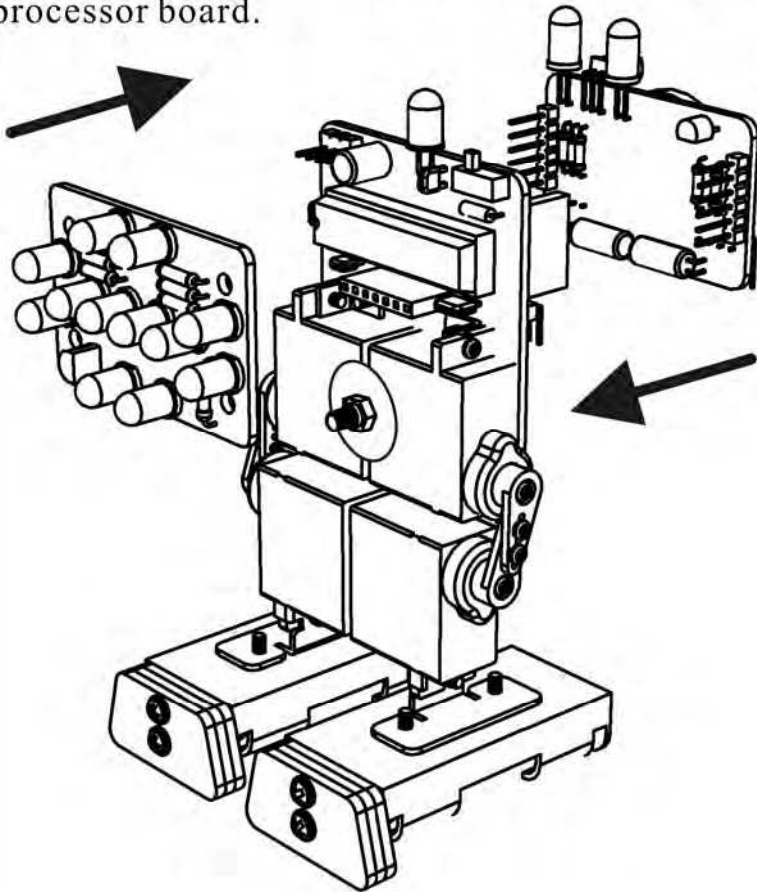


STEP 9:



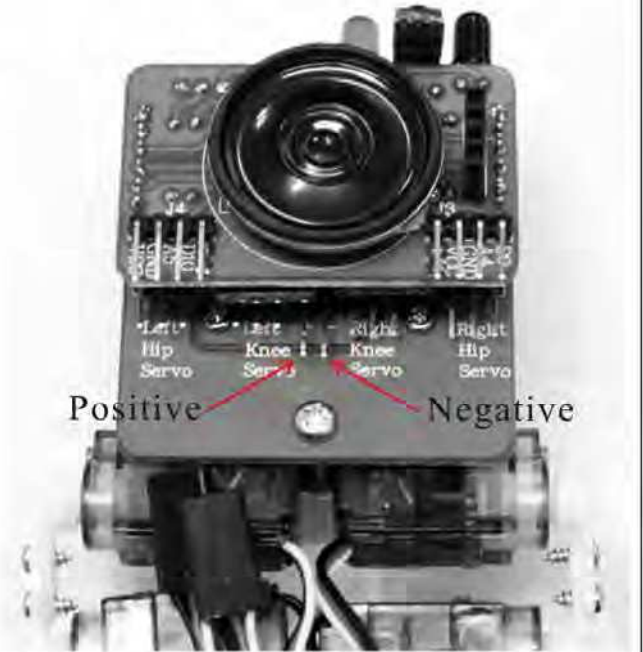
Align the toe pieces and make two toes. Screw the toes to the feet as shown. Tighten screws just enough to hold the toes firmly in place

STEP 10: Plug the back pack and eye into the processor board.

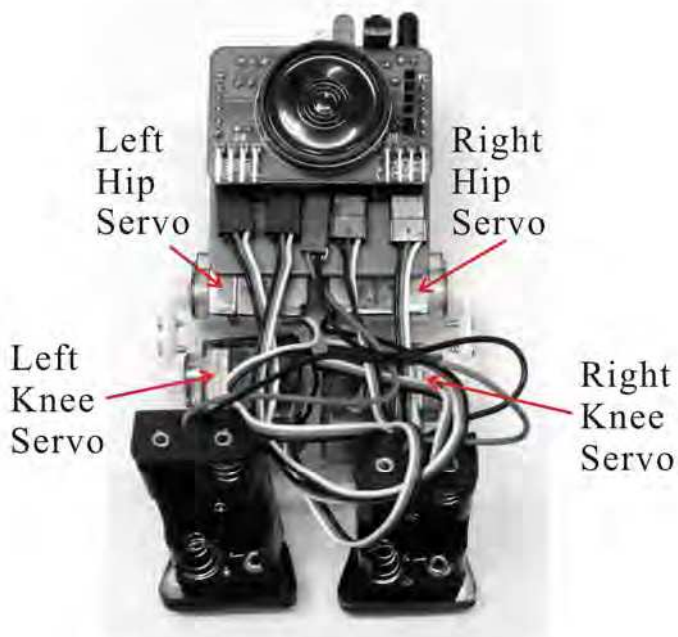


STEP 11: Turn the robot over and pay carefull attention to the labelling of the power and servo connectors.

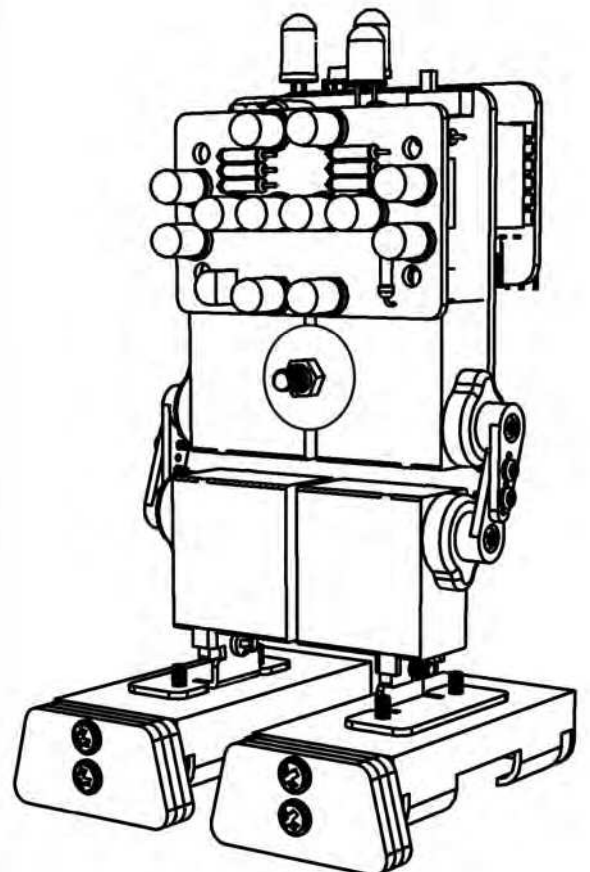
Connect the power first making sure to connect the red wire to the +.



STEP 12: Connect the servos to the appropriate socket making sure the white wire connects to the "S" and the black wire to the "-".



Your Biped is complete!
Install 4x NiMh AAA batteries
and program your robot.



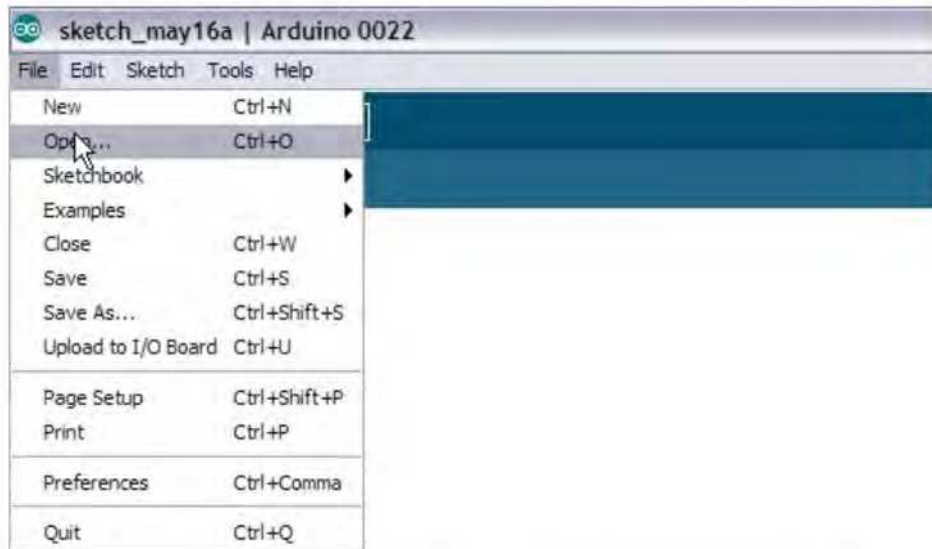
Installing the Arduino IDE:

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

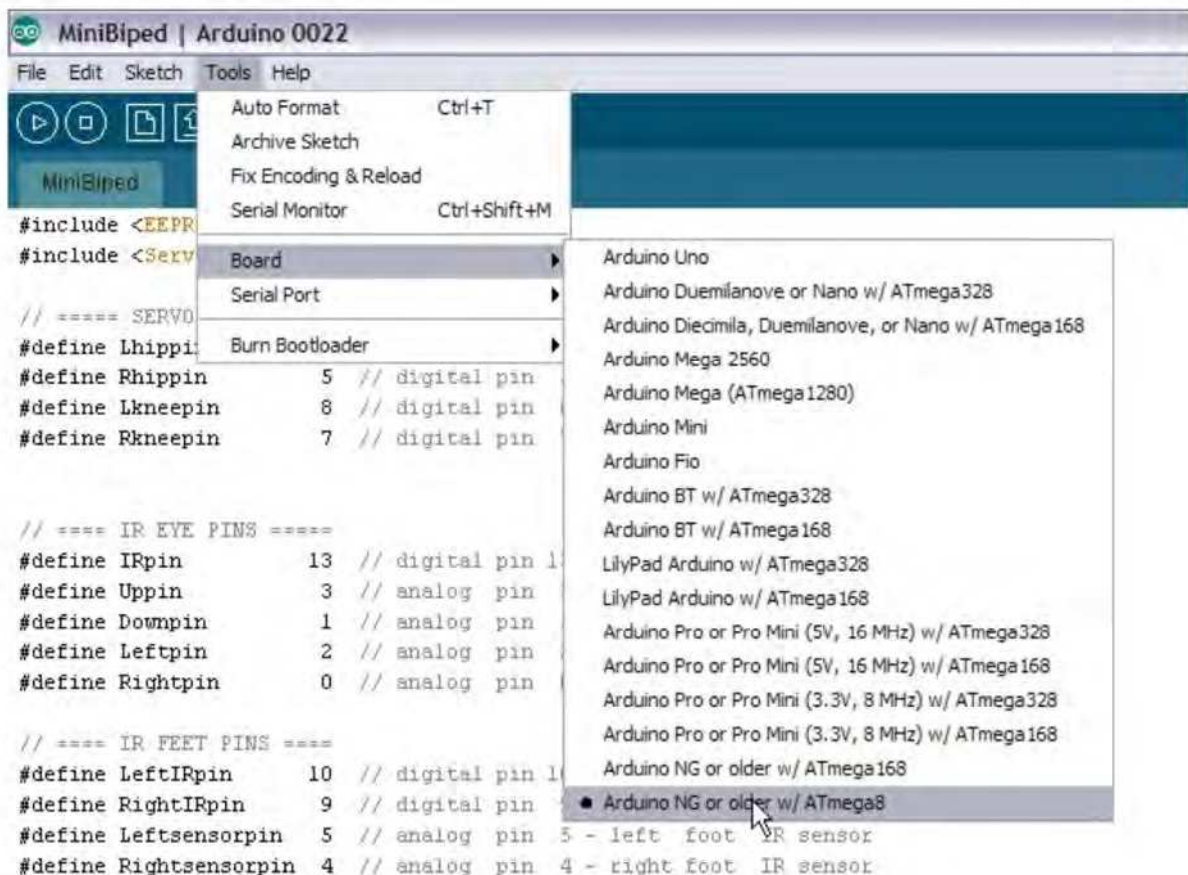
The latest version can be downloaded from: <http://arduino.cc/en/Main/Software>
Choose your operating system (Windows, Mac, Linux) and follow the installation instructions.

Uploading the sample programs:

Two sample programs are provided on CD with this kit, MiniBiped.pde and MiniHexapod.pde. Open the program matching the robot you have constructed.

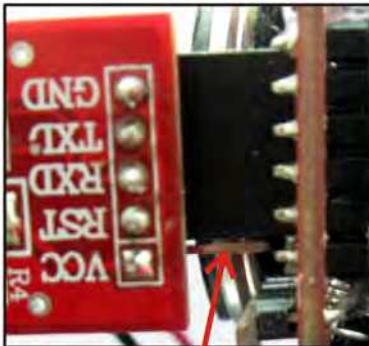


Go to the Tools menu at the top of the screen and select your board type as "Arduino NG or older w/ ATmega8"

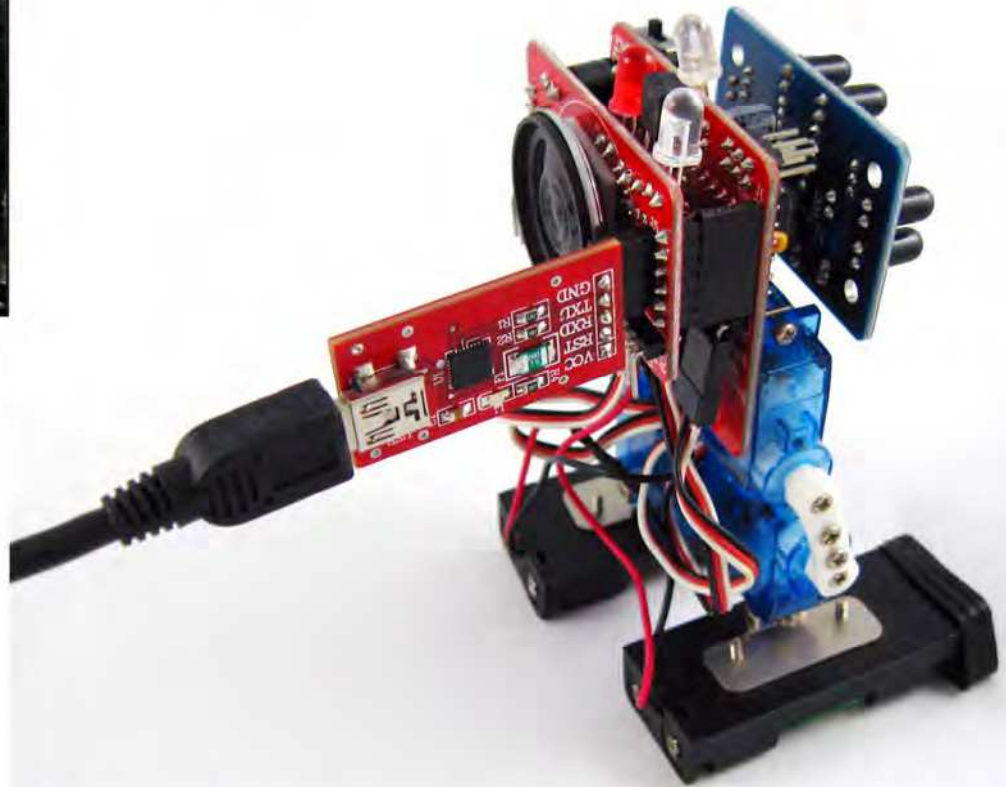


Plug your interface into the back of the robot as shown with the GND pin to the top. The VCC pin is not used and remains outside of the robots programming socket as shown in the photo below.

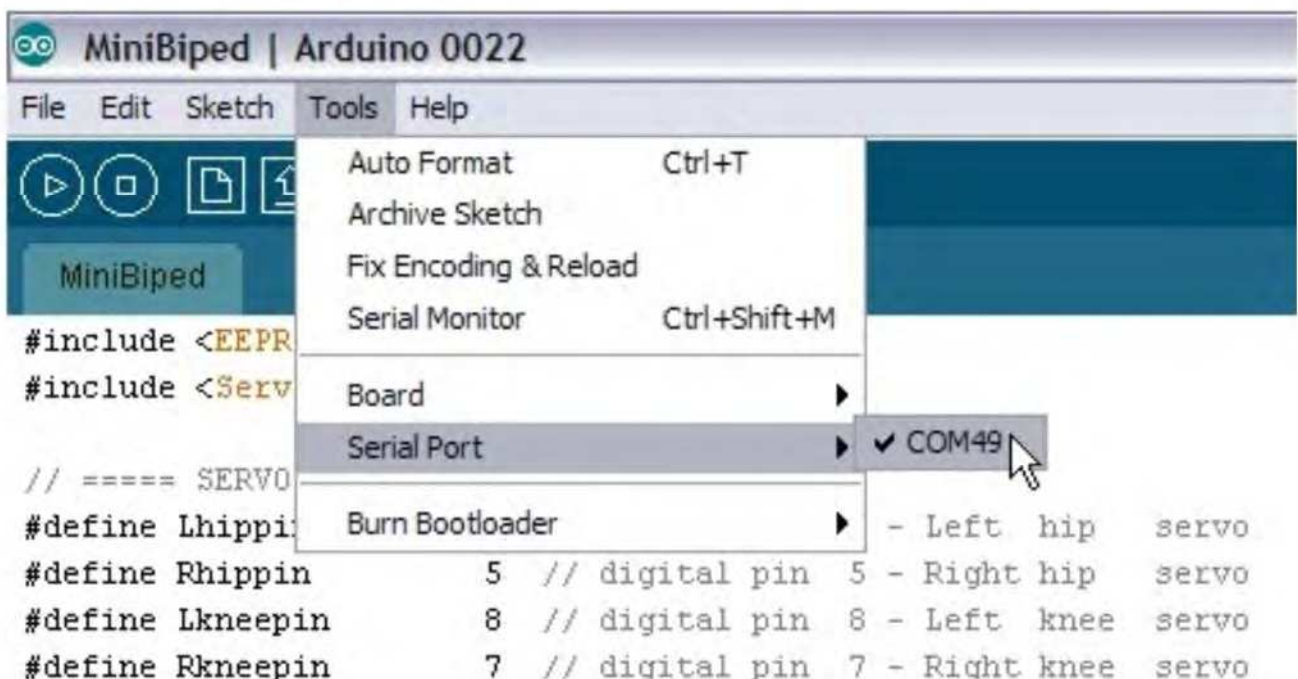
Make sure your robot has good batteries and his power switch is on prior to uploading the program. When you first turn the robot on it's white LED should flash briefly. This will also occur when the program uploads.



VCC pin not used!



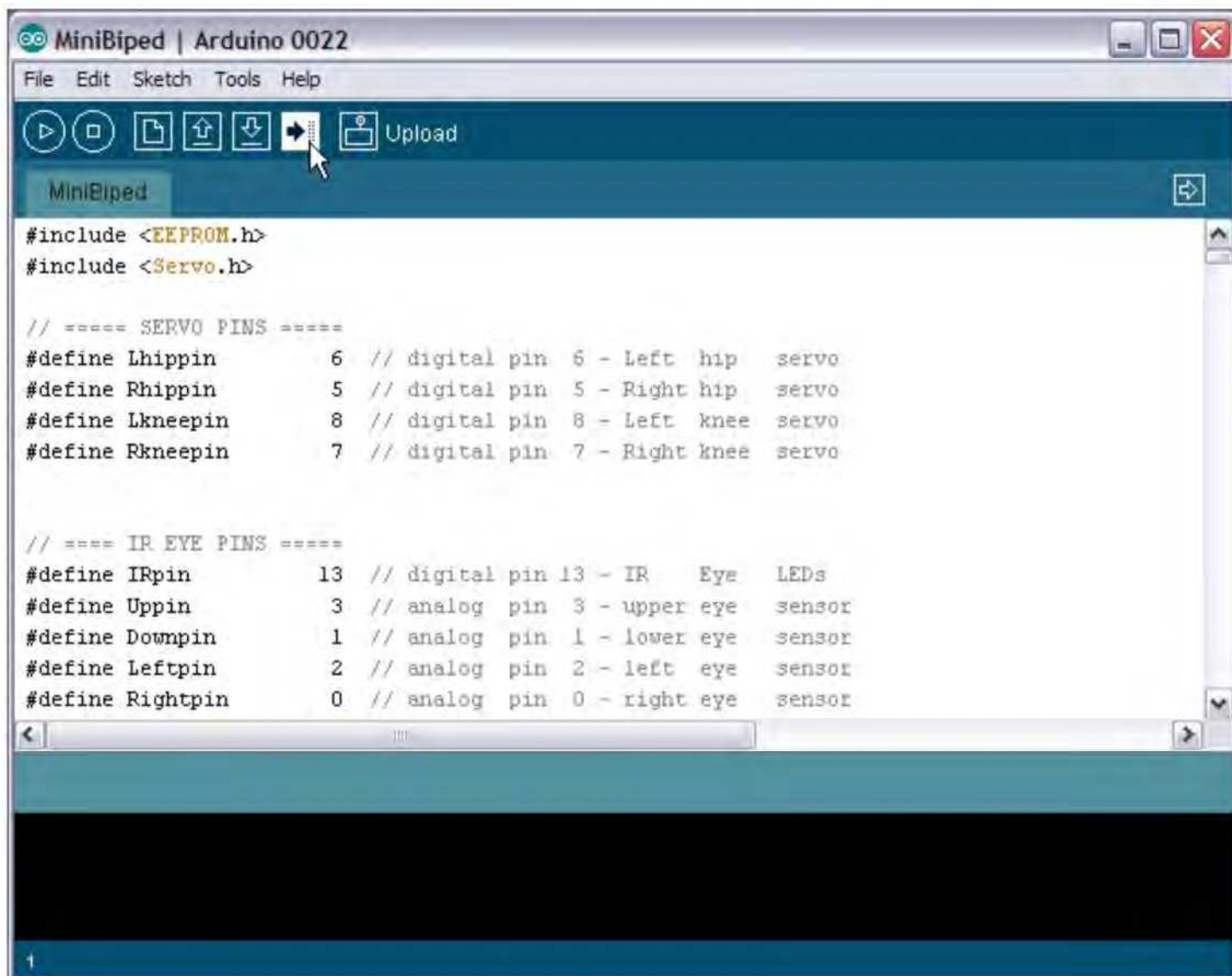
Now select your serial port. Your USB/Serial interface will appear as a virtual serial port. If you cannot find this port then you may need to install the drivers for the USB interface. See the USB installation guide on page 20.



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 white LED should flash briefly 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. 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.

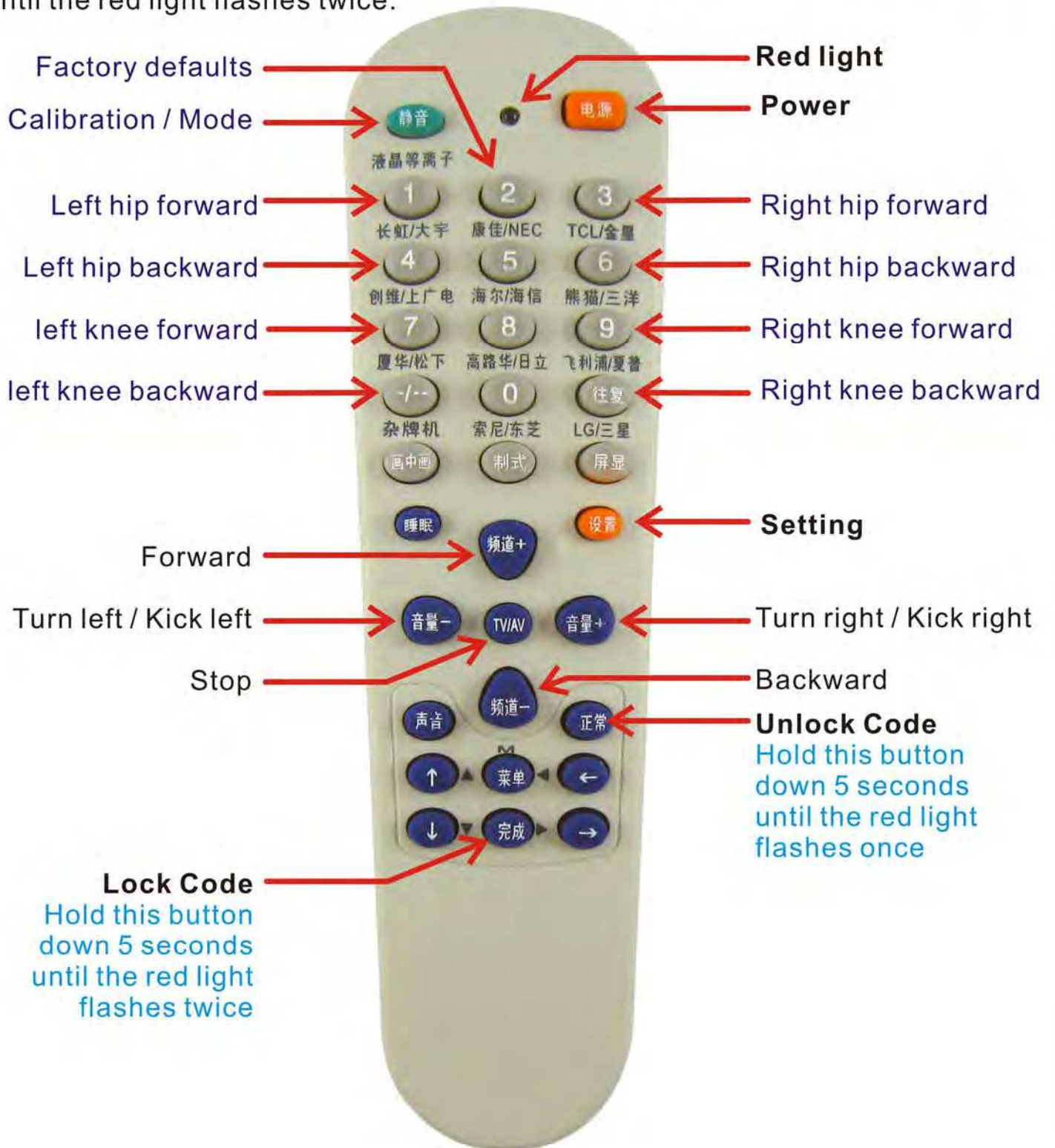
The robot should start by playing a short tune. It will be in autonomous mode but you can also control the robot manually with the remote control.

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.

Using the Remote Control:

The Mini Bots kit includes a Universal TV remote control that can be used to manually control the robot. Because it is a universal remote you must set it to the correct mode so the robot can understand it.

1. Press the orange **Setting** button, *hold it down* and then press the top orange **Power** button. The red light on the remote will light up.
2. Enter the code: **322**. The red light on the remote will turn off and the robot will now understand commands from the remote.
3. Hold down the **Lock Code** button at the bottom of the remote for 5 seconds until the red light flashes twice.



Operating the Biped with the remote control:

When you first turn the robot on the white LED should flash briefly. The robot will not start for about 10 seconds to give you time to put it down. A short tune is then played to let you know the robot is ready and the white LED will come on to show it is in normal operation mode.

When the robot is standing still it will look for an object to track. When an object comes within range the robot will start beeping and the white LED will flash. If an object gets too close then the robot will automatically kick at it. Pressing left or right while the robot is stopped will make the left or right foot kick even if there is no object in range.

Pressing forward or backward will start the robot walking. You do not have to hold the buttons down. Press left or right to make the robot turn. Press stop to make the robot stop.

If the robot does not turn very well then it may need to have the servos calibrated so that both feet are flat on the ground when the robot stands still. If the rubber toes get dirty or the robot is not walking on a smooth flat surface then this can also affect how it walks and turns.



Biped calibration:

When you first turn your robot on it's legs may not be straight. This is because the servos need to be calibrated. When you press the green "calibration" button the robot should stop moving, the white LED will turn off and the red LED should come on to show the robot is in calibration mode.

You can now adjust the servos until the legs are straight. If you want the robot to detect and kick the soccer ball then adjust the hip or knee servos so that the robot is looking downward slightly.

The servos should be adjusted so that the robot's weight is spread evenly on both feet otherwise it may turn to one side when walking forward and backwards. Pressing the "factory defaults" button will reset the servo positions to the factory settings.

Once you have the robots legs set correctly press the green calibration button again. This will save your settings in the robots EEPROM, the red LED will turn off and the robot will go back to it's normal operating mode.

Operating the Mini Hexapod by remote:

When you first turn the hexapod on the white LED should flash briefly. The hexapod will not start for about 10 seconds to give you time to put it down. A short tune is then played to let you know the robot is ready and the white LED will begin to flash rapidly to show it is in autonomous mode.

When the robot is standing still it will look for an object to track. When an object comes within range the robot will start beeping and approach the object. If an object gets too close then the robot will back away from it. If you move your hand

slowly in front of the robot then it will follow your hand.

Pressing the green mode button will toggle the robot between autonomous and manual mode. In manual mode the white LED stops flashing and the robot is controlled with the arrow buttons on the remote.

If the robot does not walk properly then you may need to adjust the servo horns. To check the position of the horns, put the robot in manual mode and press stop. This will return the servos to their center positions. Looking at the robot from underneath the legs should be in this position.



USB drivers installation guide:

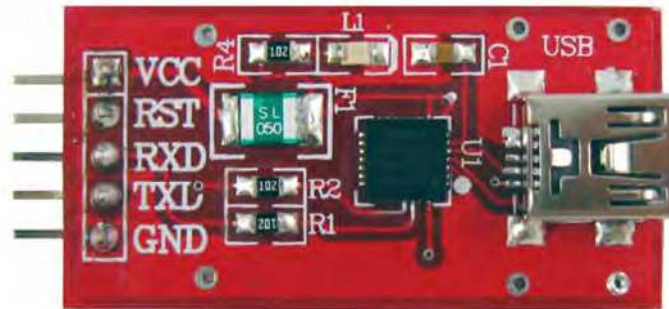
The USB interface uses the CP2102 USB to serial interface IC. Depending on your operating system, you may need to install drivers for this interface to be recognized and function correctly.

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

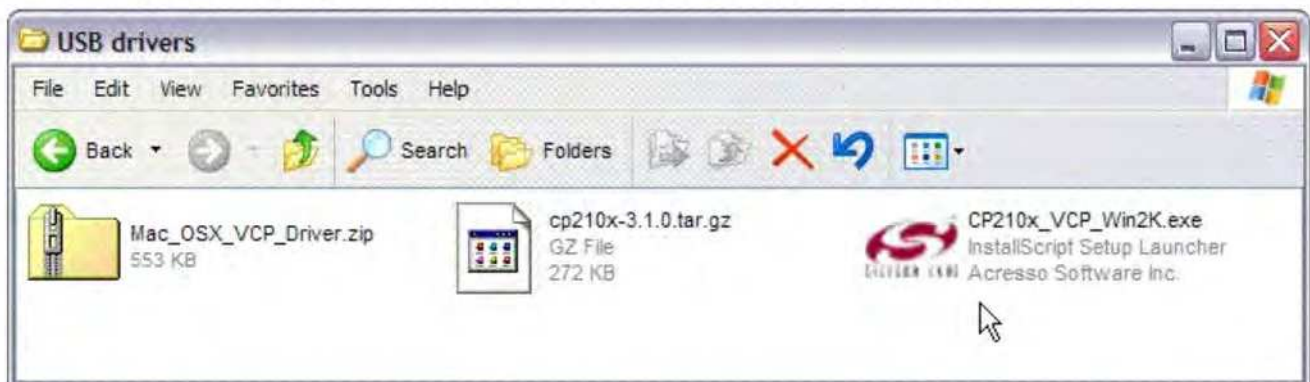
For the latest drivers and installation instructions go to:

<http://www.silabs.com/products/mcu/Pages/USBtoUARTBridgeVCPDrivers.aspx>

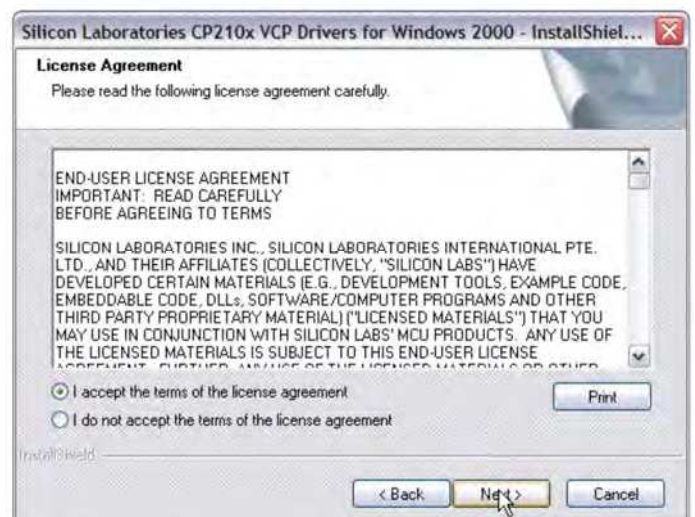
These instructions apply to Windows XP machines and are intended as a guide only.



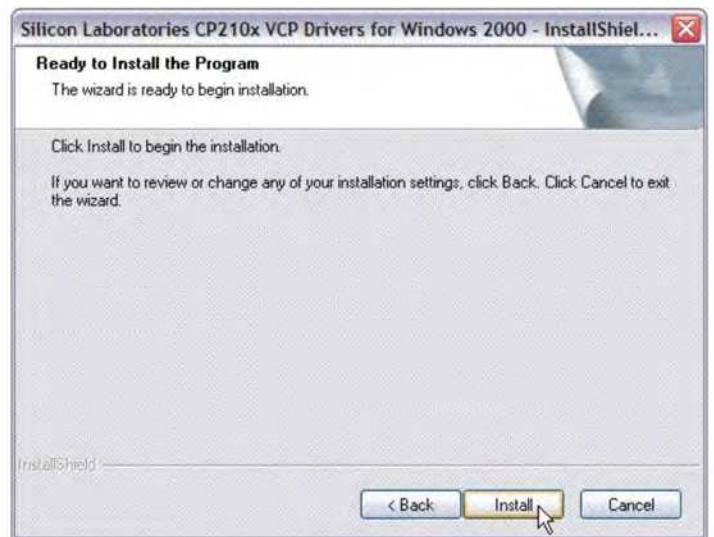
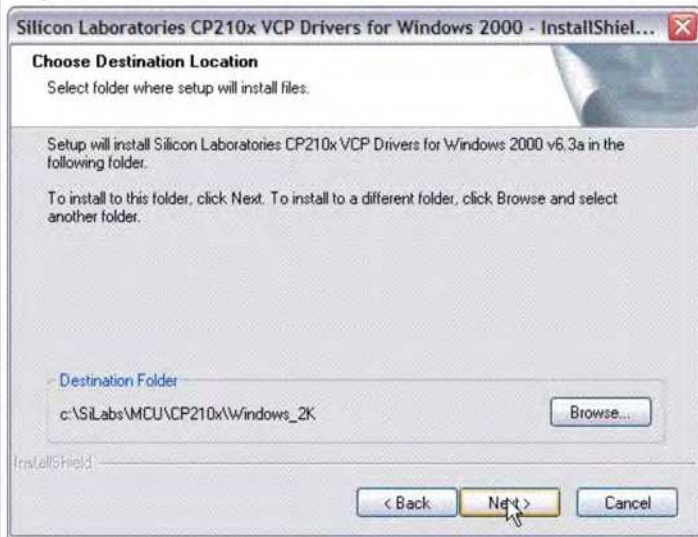
Step 1: Run the installation file in the MiniBots USB drivers folder.



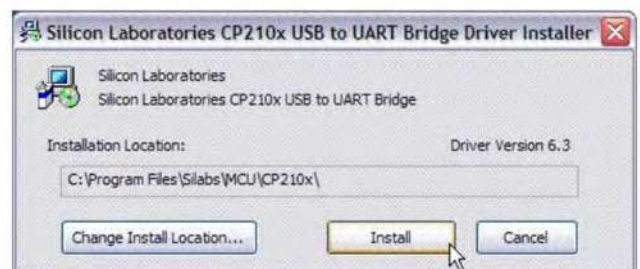
Step 2: Follow the installation instructions. Click on the "accept agreement" button to continue.



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.



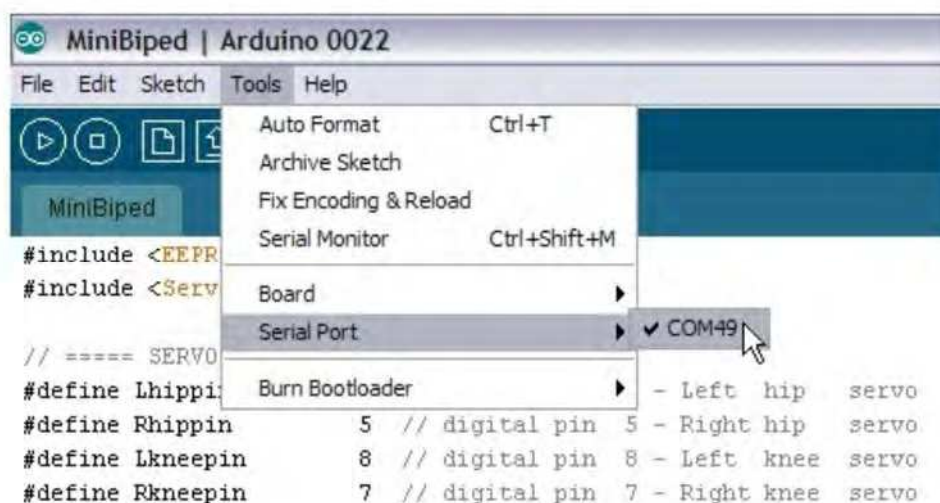
Step 7: The wizard should be searching for a Silicon Labs CP210x USB to UART Bridge.



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.



Programming Methods:

The processor board comes with the Arduino bootloader pre-loaded. Using the USB-TTL serial interface and cable, the Arduino Environment is the quickest and easiest way to program your robot. The Arduino Environment can be downloaded from here:

<http://arduino.cc/en/Main/Software>

More experienced programmers may wish to program the robot in "C" using free software such as WinAVR. Removing the eye exposes a standard ISP socket allowing the Atmega8 to be programmed with commonly available programmers. WinAVR can be downloaded from here:

<http://winavr.sourceforge.net/>

Additional sensors:

On the back of the robot are two spare sockets. Each socket has power plus one 10bit analog input and one digital I/O. These could be used to add IR sensors on the feet.

Removing the IR compound eye gives you a seven pin female header with power, one digital I/O pin and 4x 10bit analog inputs.

The analog inputs can be changed to digital I/O pins if required and all I/O pins have internal pullup resistors that are software selectable.



Specifications:

Power:	4.8V - 4x 1.2V NiMh AAA batteries (5.5V maximum).
Servo Torque:	1.2Kg/cm at 4.8V.
Processor:	ATmega8A (2.7V - 5.5V)
Speed:	16MHz (4.5V - 5.5V)
Main board:	Arduino compatible (NG or older).
IR receiver:	38KHz
IR protocol:	SIRC
USB interface:	CP2102

Trouble Shooting:

The first thing you should check, regardless of what problem you have is the batteries in the remote control and in the robot. Flat batteries in the robot is the most common source of trouble.

You should be using good quality NiMh or NiCd rechargeable batteries for the robot. These batteries provide a fairly stable voltage of 4.8V during operation and can provide the higher currents necessary for proper operation when all servos are working at once.

Standard alkaline batteries are better suited for the remote control which only draws a very small amount of current.

Problems uploading the program: Go to the "Tools" menu of the Arduino IDE and check that your USB serial interface has been selected. A tick will appear next to it's com port number. Also check that the correct board has been selected "Arduino NG or older w/ ATmega8"

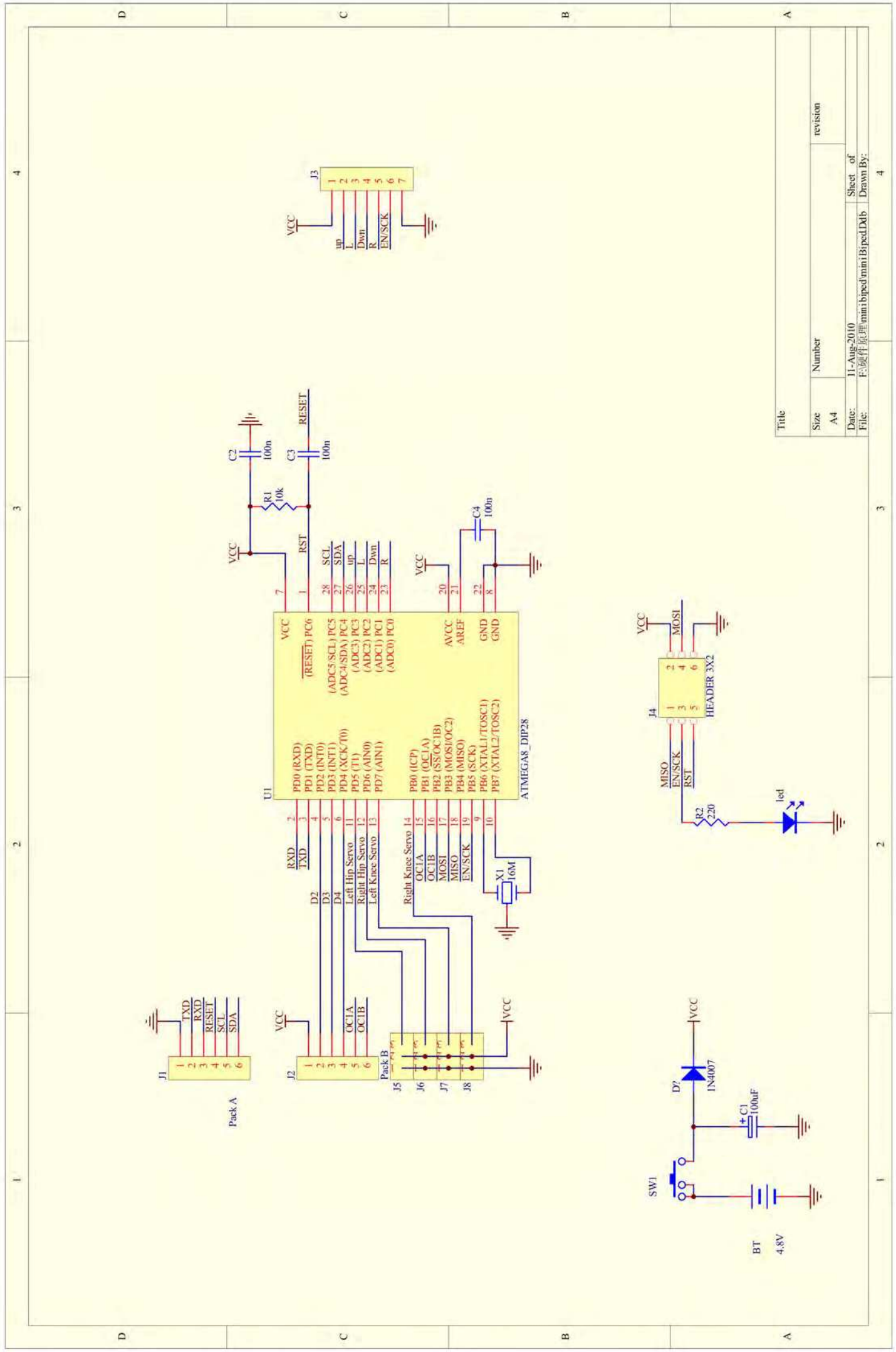
Make sure that the robot is turned on before the upload begins. Do not press the buttons on the TV remote until after the upload is complete as the IR receiver will disrupt communications between your computer and the robot.

The robot does not walk properly: Check that your servos have been plugged into the main board correctly. If a servo cable is plugged in the wrong way around then the servo will not function. If a servo cable is plugged into the wrong location then the robot will function but will not walk properly.

If the robot still does not walk well then the servos may need adjustment. Small adjustments can be made with the software by changing the servo's center position but large adjustments are best done by adjusting the position of the servo horn on the servo.

To adjust the servo horn position, turn on the robot and put the robot in manual mode. Press the stop button so the robot is standing still. Leave the power on so the servos can maintain their position. Remove the screw holding the servo horn in place and adjust the servo horn so that the legs are in the correct position. Reinstall the screw holding the servo horn in place.

The robot does not follow my hand: Check that the robot is in autonomous mode, the white LED should be on or flashing. Does the sound from the speaker change pitch as you move your hand in front of the eye? Check that the eye is plugged in correctly. The eye will not work in bright sunlight. The eye works best indoors and at night.



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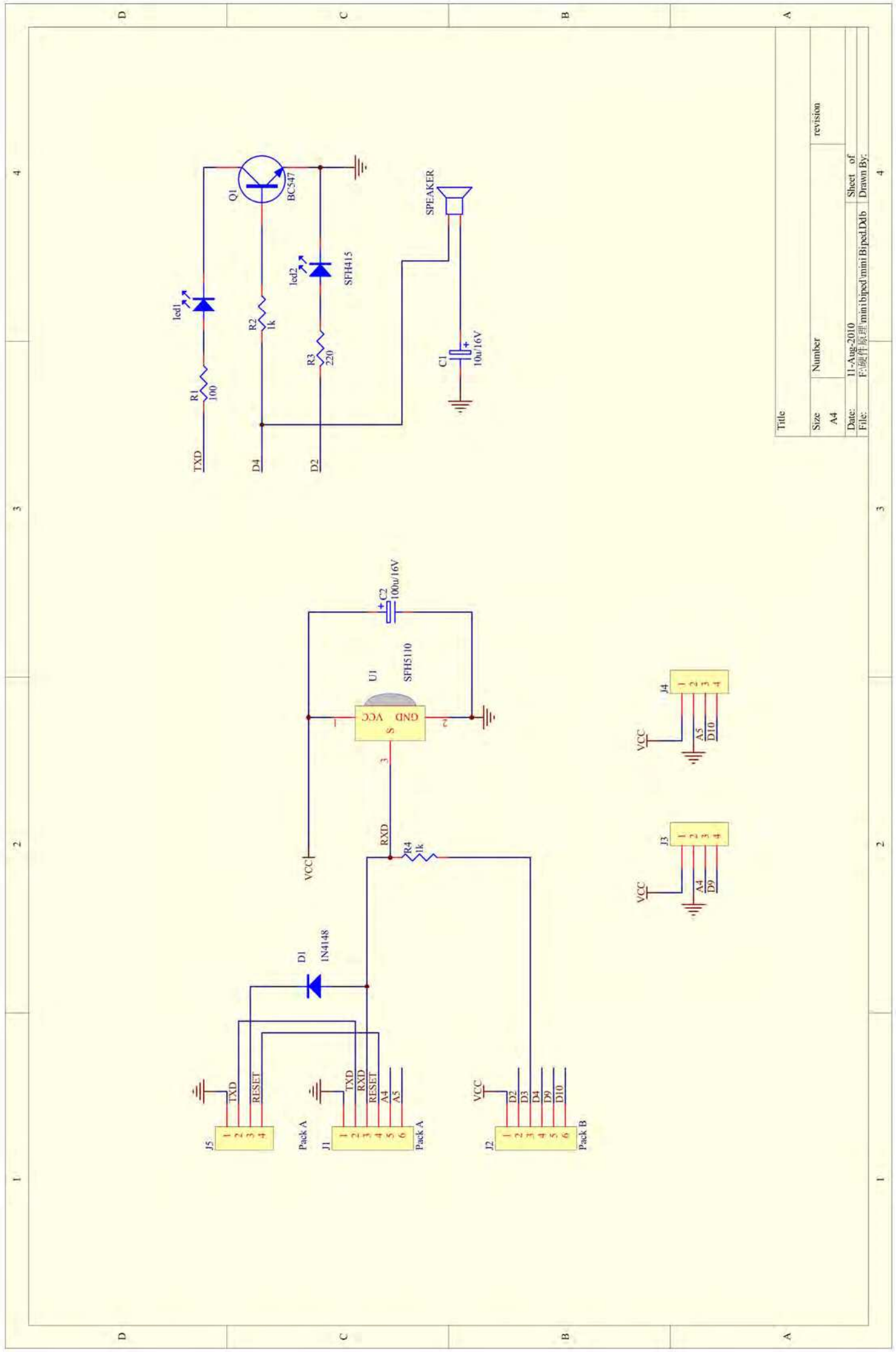
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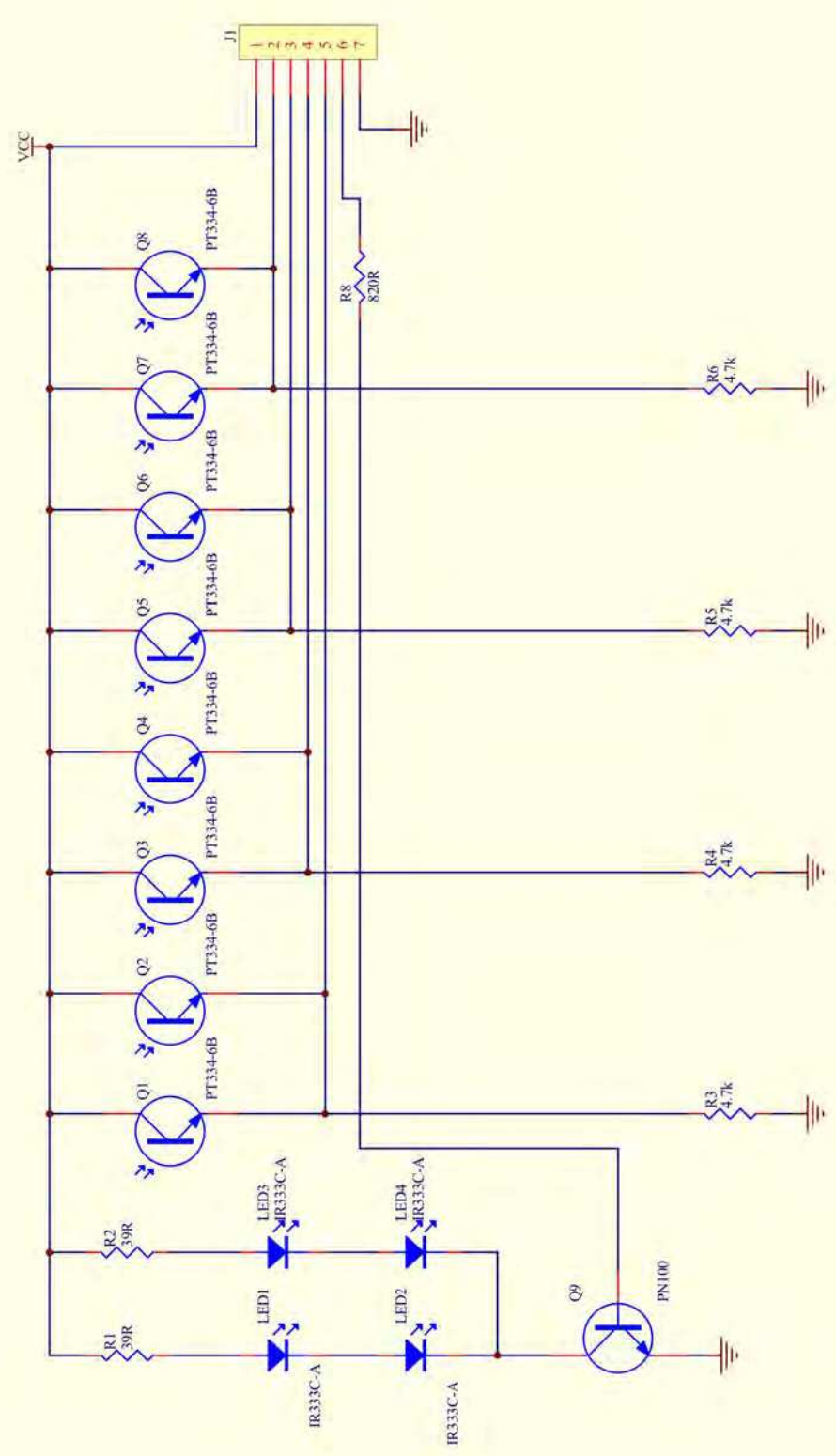
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