About Bolo-Bot:

The Current project of The Robotics Club of Yahoo is a little robot I call Bolo-Bot. It can run around a room and play hide and go seek. It is quite simple, and I compare it to an analog or BEAM style robot, as it has no embedded microprocessor. But it is not a BEAM in true spirit of the BEAM philosophy. Total cost should not exceed $20 U.S. funds.

The body is a bowl, and a piece of plywood cut around the top of the bowl to be used as a base. For this robot the lid of the bowl you pick could even be used, as it is not a very heavy robot. You'll also need two small size motors, you could use any 3-9 volt motors. The small dc motors that Radio Shack carries can even be used, although I would not use them unless I really had to! You'll also need two small caster wheels or two of the small plastic feet used on the bottom of chairs to keep them from marking up the floor. Also needed of course are two wheels for the motors...

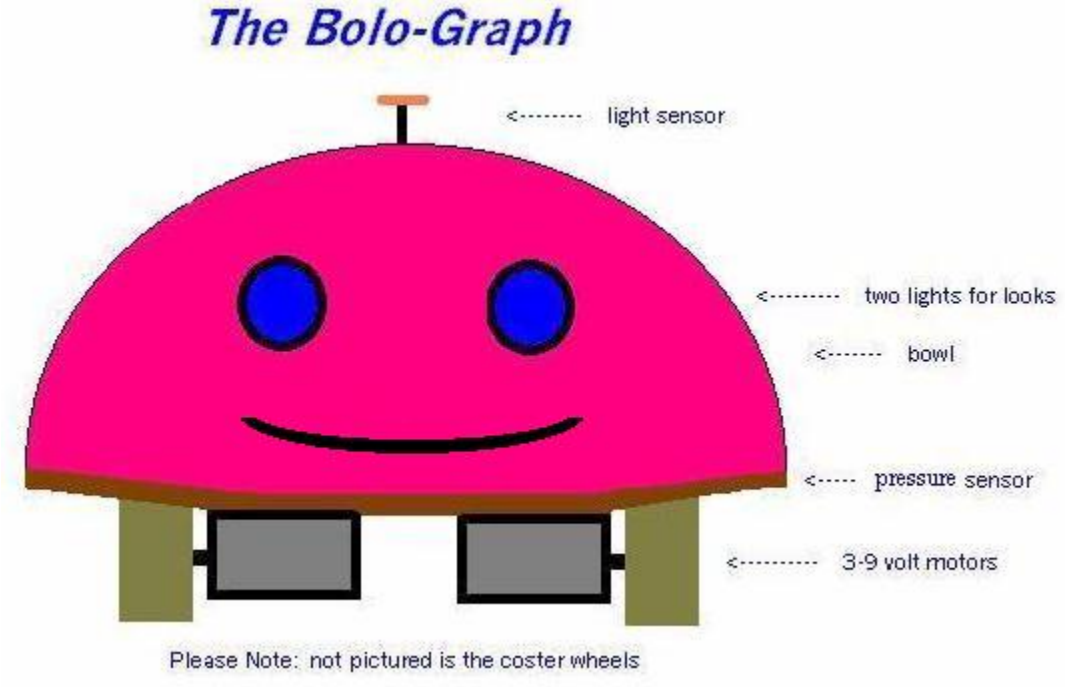
You'll hot glue or super glue the motors to the middle of the base. You'll then need to add the wheels to your motors. For my Bolo-Bot I used a large sized wooden doweling rod and cut it to make 2 wheels. If you have a problem with traction using wheels like this, try rubber bands or gluing some felt or rubber to the wheels. On my Bolo-Bot I cut two square indents into the base so my wheels would not stick out past the overall size of the body.

Also another option is to forgo the building of a body like this and buy a cheap-wired remote controlled toy car! The kind that goes forward and turns in reverse is really all that is needed. I picked two up in a set for $10 at Wal-Mart and suggest to you that you go with a remote controlled car! I doubt total cost of the robot should go over $20, even if you get most of the parts at Radio Shack. However, I recommend that if this is your very first robot that you breadboard all the circuits using a solder less breadboard. This will allow you to make changes if you wire something incorrectly. You'll need the medium sized breadboard from Radio Shack to house all of the circuits that make up Bolo-Bot. Cost of this breadboard is about $11 and it's small enough for most robots to carry. The cost of a breadboard is not figured into the $20 or less cost of Bolo-Bot. You can also use this breadboard for any other electronic projects, so getting a breadboard is worth the investment.

I will finish describing how to build Bolo-Bot as if you are going to build the body with two dc motors. If you go with the remote controlled car all that really changes is the other drive motor. You simply ignore the other motor!

Motor control is very simple, when you turn the robot on both motors spin. If the navigation sensors encounter something Bolo-Bot uses a DPDT relay to reverse one motor, while the other continues forward. And so with the DPTP relay Bolo-Bot spins for a second and heads in a new direction. Bolo-Bot also uses a light sensor to detect when he is under something, thus hid. When Bolo-Bot does not see light he uses a SPDT relay to cut power to both motors, thus stopping "*the little fireball*" from moving and he will wait for you to find him and bring him back into the light. Then the game begins again.

The circuits are laid out so you can build them one at a time to see how they work. The circuits should be built on a breadboard. Once you understand the circuits and see that they work you can combine them on a medium sized breadboard and simply attach it to the inside of Bolo-Bot. For my Bolo-Bot I used two 9 volts for power. One for circuit power and one for motor power. You could use AA's if you choose to. However, 9 volts are smaller and the bowl I picked was not very big.



Bolo-Bot parts list:

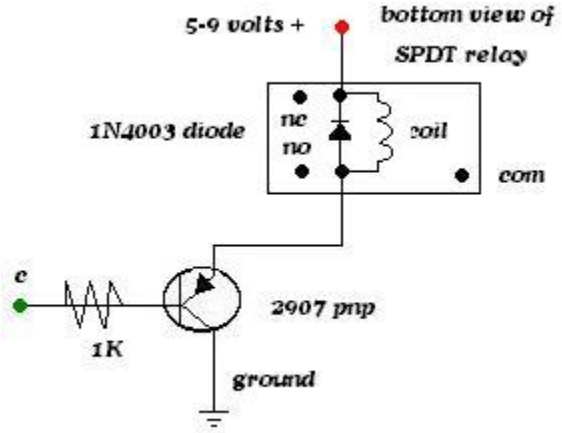
SENSORS
1 LM339 IC
2 10K pots
2 330 ohm resistors
2 N.O. contact switches or pressure sensor, see fig.3
1 Cds photo sensor or similar

TIMER
1 555 timer IC
1 1M pot
1 10K resistor
1 .01 mf cap. or similar
1 10 mf cap. or similar

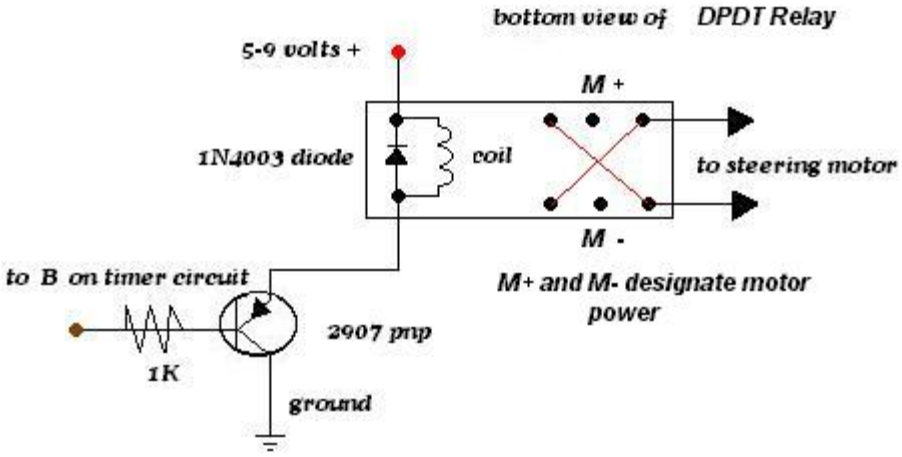
MOTOR CONTROLS
2 1K resistors
2 2907 PnP transistors
2 1N4003 diode or similar
1 DPDT 5-9 volt relay
1 SPDT 5-9 volt relay

MISC.
1 Cheap remote controlled car
or
2 3-9 volt motors
1 small sized plastic bowl
plywood for base
large wooden dowel
bread board

I want to point out that I have drawn out the relay circuits so as to illustrate the placement of relays to make it easy to identify how you connect them up. The relays are drawn so you can see how to wire them up with the pins facing you. Some may wonder why I use PnP 2907 over chooses such as the more popular NpN 2N2222. I have found that for Bolo-Bot the 2907 transistor works and the 2N2222 does not. The reason is the 2N2222 needs a positive voltage to activate it and the 2907 needs a negative signal to activate it. The sensor circuit using the LM339 sends out a negative signal, so this is why the 2N2222 transistor is not used.



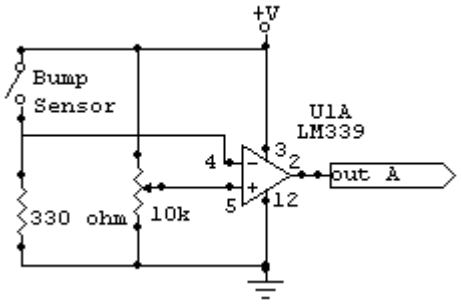
The First circuits are the motor controls. They are the drive circuit and the power circuit. The power circuit simply cuts power to both motors. You would connect the N.C. and the com pins on the SPDT between the motors and their battery. This circuit is connected to the light detector. When light hits the detector, the relay remains closed and so Bolo-Bot is able to run about. When there is no light present, the relay opens and the motors receive no power. You can test this circuit buy using a wire to briefly make a connection between the 1K resistor at location C and the ground. If the relay clicks on and off then your circuit has been built correctly!



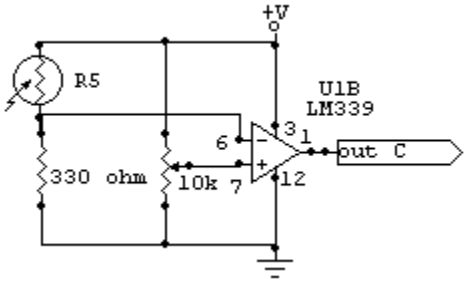
The next circuit is the DPDT motor driver. If you built the first one with out a problem you should have no problem with this one. Note: that N.C. and N.O. pins on the relay are crossed. This flip-flops the power so as to reverse the power to the drive motor. Again you can test this circuit the same way as the power circuit.

Now we come to the sensor circuits. It is broken up into two schematics but uses only one LM339 chip. I suggest building one then the other if you are new to robotics and electronics. You can add a low power LED between the out put pins 2 and 1 respectively of the LM339 and the positive power. Remember LED's have a positive and negative end so the longer lead of a LED indicate the positive side.

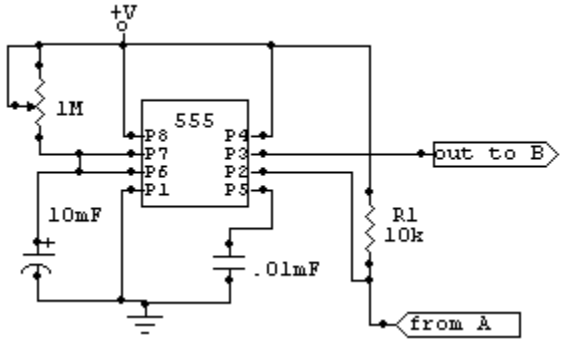
The circuit below is the navigation sensor. On my Bolo-Bot I used conductive foam to make a pressure sensor. You can get this from Radio Shack; it is what IC's come packed in. You cut it to the size you want, and then add aluminum foil to both sides and attach leads to both sides. The more this sensor is compressed the more power is lets through. The 10K pot controls what amount of pressure is needed to trigger the circuit. You could use momentary contact switches in parallel in place of the pressure sensor.



However, since Bolo-Bot is round, using this pressure sensor allows you to form the sensor around the robot and when he hits a wall he does not get stuck. Plus it is much easier to add a sensor ring around the whole body this way. If you want to use contact switches you could forgo this part of Bolo-Bot and connect the switches to the timer, point A on the time respectively. However, I suggest you built this circuit anyway because of the fact that you can use this same circuit to add IR sensors to Bolo-Bot in the future.



This is the light sensor. It sends a signal to the power circuit. Adjust the 10K pot so Bolo-Bot knows when he is hidden and when he is not. On the robot you will want to place the light sensor on the top of Bolo-Bot. You may want to put a tube around the sensor to limit its sensor range. You would want this if it runs under a table so it does not pick up ambient light, which would confuse the sensor.



This is the last circuit of Bolo-Bot. This is a timer that is triggered by the bump sensor. The bump sensor attaches at point A. When Bolo-Bot bumps into something the timer shuts off for a second or two then come back on. When this happens the DPDT relay reverses the drive motor until the timer comes back on. This allows Bolo-Bot enough time to turn around and head in a new direction. Timers are tricky! You may have to play with the 1M pot to get the right amount of time for your robot.

On my Bolo-Bot I drilled holes in the top so I could easily adjust the pots. I hope you will build and add to my little Bolo-Bot. I hope I have laid the plans out in an understandable way. If you do add to it send me an e-mail or post your new additions or changes to The Robotics Club on Yahoo.

This how-to guide was written by Justin R. Ratliff from The Robotics Club of Yahoo. (TRCY)