

# Duct Bot

Wednesday, April 14 2004 @ 02:17 PM EDT



In this article I will show you how I built a small bot to travel through my ductwork.

See this Article in more detail in the [July issue in Servo Magazine](#)

I purchased one of those mold test kits from my local home center. After following the instructions for testing furnace and ductwork it indicated that I had a serious mold problem.

This project is not meant to give you step by step instructions but is more of a guide to help you in similar endeavors.

I decided to build a small bot with mini remote camera to check out the duct work.

The main restriction is that the bot had to fit into a 4x10 hole normally used for a vent.

I had been working on a small bot 7" x 7" x 2 1/2". This would make a great bot for the duct crawler. I made the main base out of 1/8" expanded PVC and 1/4" expanded PVC. I used small gear motors and the Ares Robot Controller.

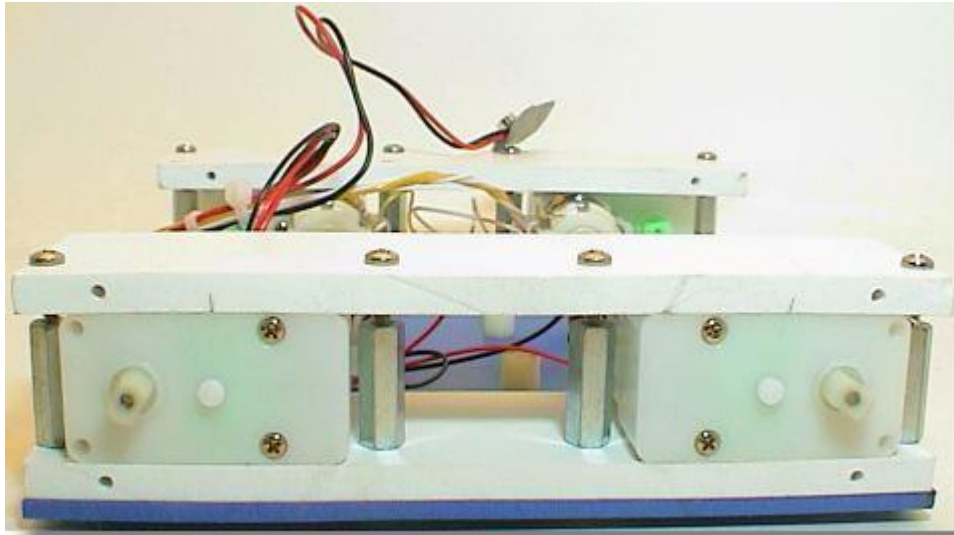
The heart of the main base for this bot is the motor assembly.



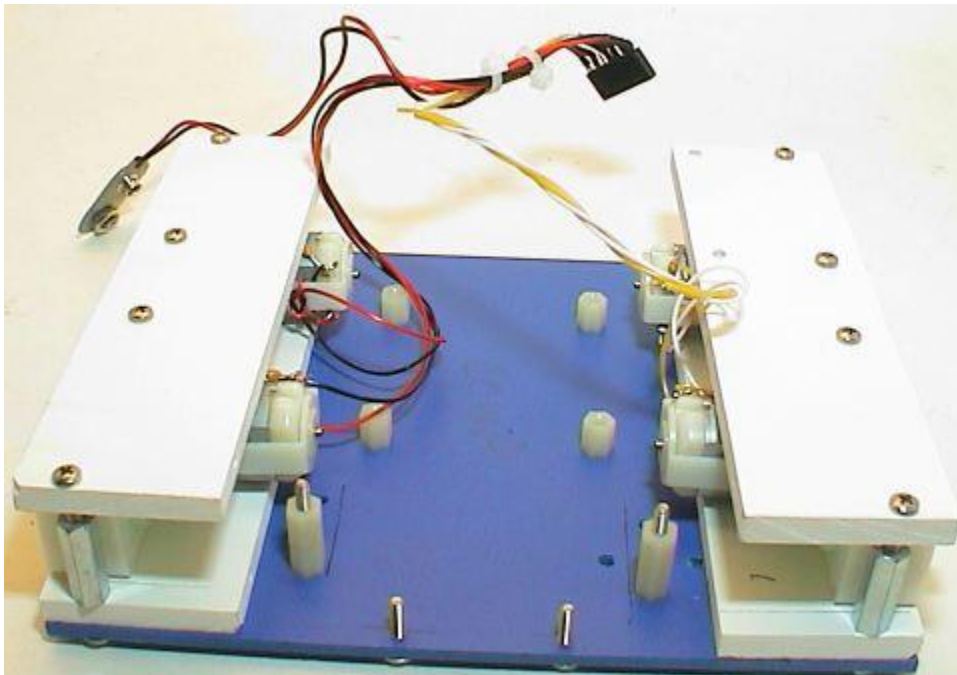
The motor assembly is very simple its just 2 pieces of 5-1/2" x 1-1/2" x 1/4" expanded PVC with 2 of the gear motors sandwiched in. I used double stick carpet tape to hold the gear motors in place then used 3/4" standoffs and #4 machine screws to hold it all in place.

Makes sure your motors have suppression capacitors installed.

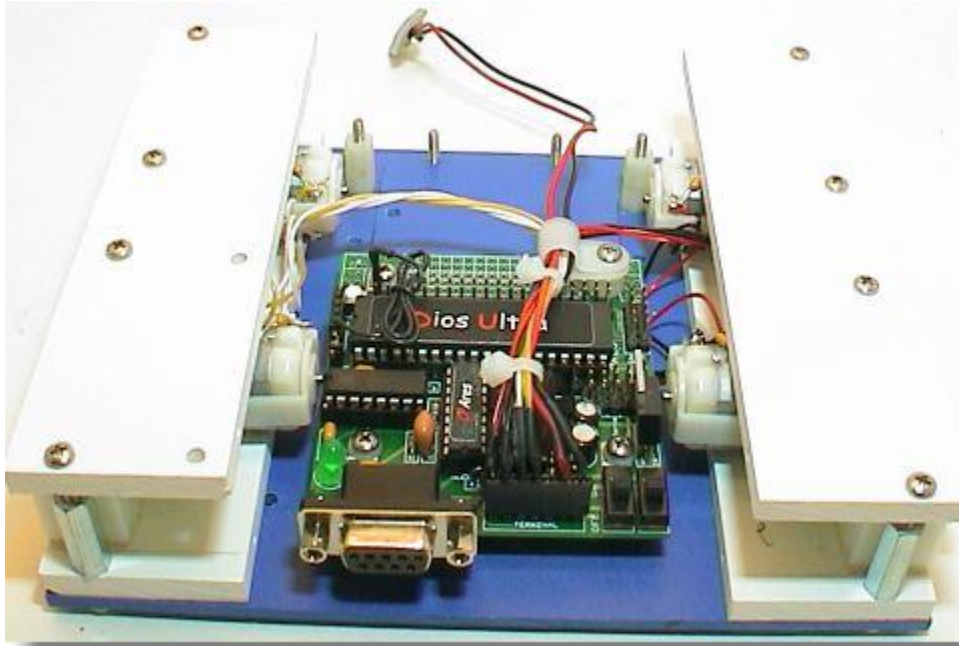
The motor assembly is mounted on the 5-1/2" x 6-1/2" x 1/8" expanded PVC base.



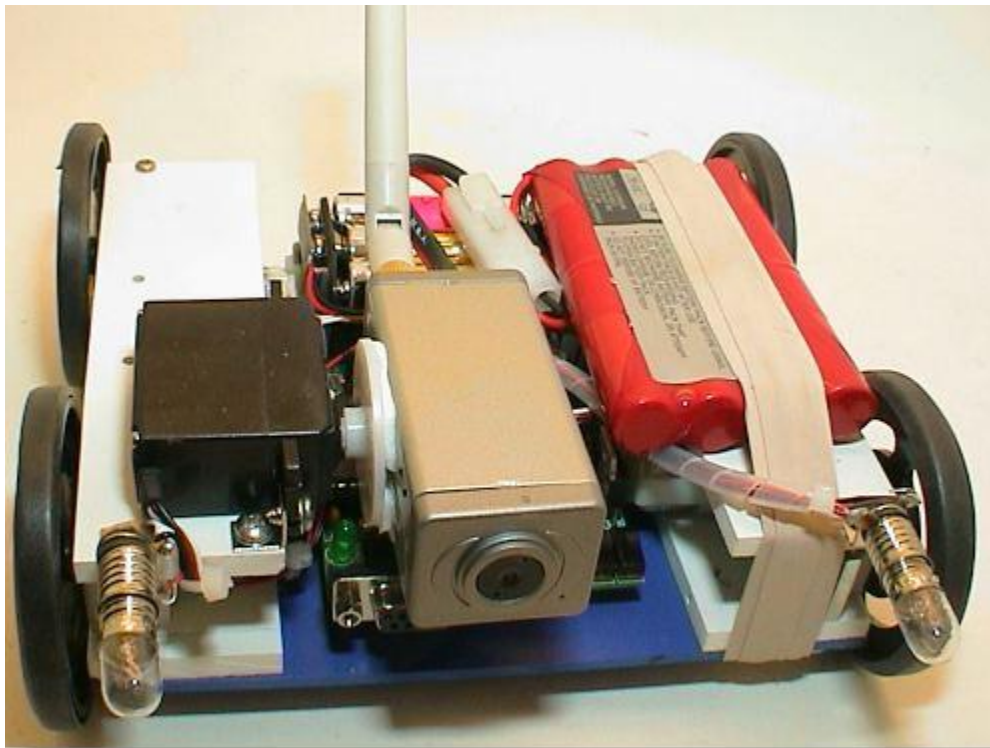
The two motors in each assembly are connected together in parallel. This will give you a drive train on each side of the bot. This will let you use differential steering to control your bot.



I used small 1/4" standoffs for mounting the Ares Board and a female header to connect the motors and power. The Ares board supports dual and single power modes. On this bot I used a single power source to power both the logic and motors.



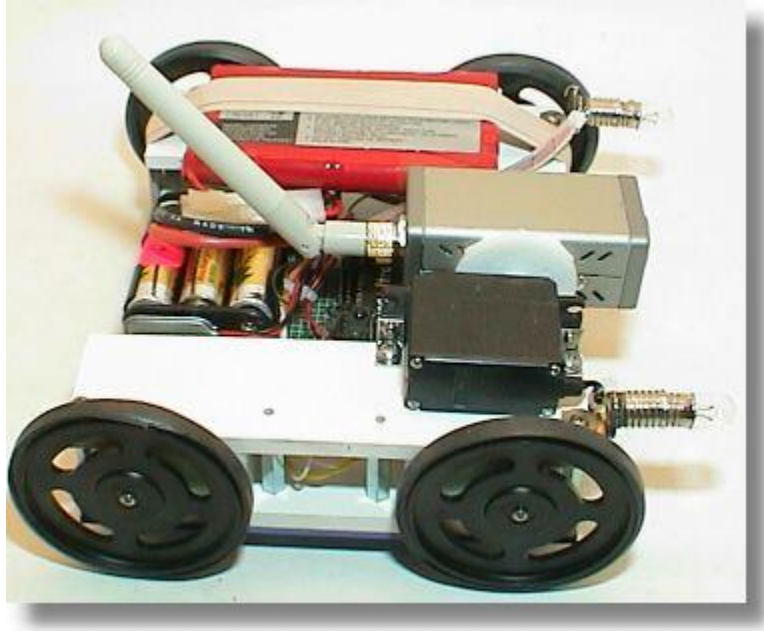
Some longer machine screws and standoffs were used to keep the 6 cell battery holder in place.



The camera was mounted directly to the round horn connected to a servo mounted on top of one of the motor assemblies. The servo is controlled by the Ares board and allows me to move the camera up or down. By spinning the bot I can view just about any angle.

For lighting I attached two 6 volt bulbs directly to the switched Vin of the Ares board. These bulbs were mounted on two holders I purchased from Radio Shack.

I powered the camera with a separate 9.6 volt rechargeable battery.



The wheels are small servo type wheels which are made just for these gear motors.

The Ares board has a provision for a small IR module. This makes hookup pretty simple. For complete directions on hooking components to the Ares board check out the Ares manual.

This program is used to control the bot. You must use the bot controller shown below. I does calls to the IRread function and determines the state of the 4 switches. The only down side is that you must have a delay of 25 ms between transmitted commands or the Vishay IR module will shut down.

### **Bot Program**

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```
func main()  
  pause 1  
  dim cmd  
  dim camerapos  
  dim botpower  
  
  print "reset"  
  
  CPinit()  
  CPMotorReset(0)  
  
  botpower = 190  
  gosub setpower  
  
  camerapos = 7500  
  CPAres_setservo(3, camerapos)  
  
  CPMotorDampvalue(0,100)
```

```

loop:

    cmd = IRread(0,10000)

    if IRdevice = 0 then
        goto loop
    endif

'print IRcmd," ",IRdevice
    branch IRdevice,loop,dosw1,dosw2,dosw3,dosw4
    goto loop

dosw1:
    branch IRcmd,sw1cmd0,sw1cmd1,sw1cmd2

sw1cmd0:
    CPMotor2stop(0)
    goto loop

sw1cmd1:
    CPMotor2fwd(0)
    goto loop

sw1cmd2:
    CPMotor2rev(0)
    goto loop

dosw2:
    branch IRcmd,sw2cmd0,sw2cmd1,sw2cmd2

sw2cmd0:
    CPMotor1stop(0)
    goto loop

sw2cmd1:
    CPMotor1fwd(0)
    goto loop

sw2cmd2:
    CPMotor1rev(0)
    goto loop

dosw3:
    branch IRcmd,sw3cmd0,sw3cmd1,sw3cmd2

sw3cmd0:
    goto loop

sw3cmd2:
    botpower=botpower - 10
    print botpower
    if botpower < 140 then
        botpower = 140
    endif
    gosub setpower
    goto loop

```

```

sw3cmd1:
  botpower=botpower + 10
  print botpower
  if botpower > 255 then
    botpower = 255
  endif
  gosub setpower
  goto loop

dosw4:
  branch IRcmd,sw4cmd0,sw4cmd1,sw4cmd2

sw4cmd0:
  goto loop

sw4cmd1:
  camerapos=camerapos - 100
  print camerapos
  if camerapos < 7000 then
    camerapos = 7000
  endif
  CPares_setservo(3,camerapos)
  goto loop

sw4cmd2:
  camerapos=camerapos + 100
  'print camerapos
  if camerapos > 11000 then
    camerapos = 11000
  endif
  CPares_setservo(3,camerapos)
  goto loop

setpower:
  CPMotor1speed(0,botpower) 'Right Motor
  CPMotor2speed(0,botpower) ' Left Motor
  return

endfunc

include \lib\DiosCPMotor.lib
include \lib\DiosIR.lib

include \lib\DiosCPAres.lib

```

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## Controller

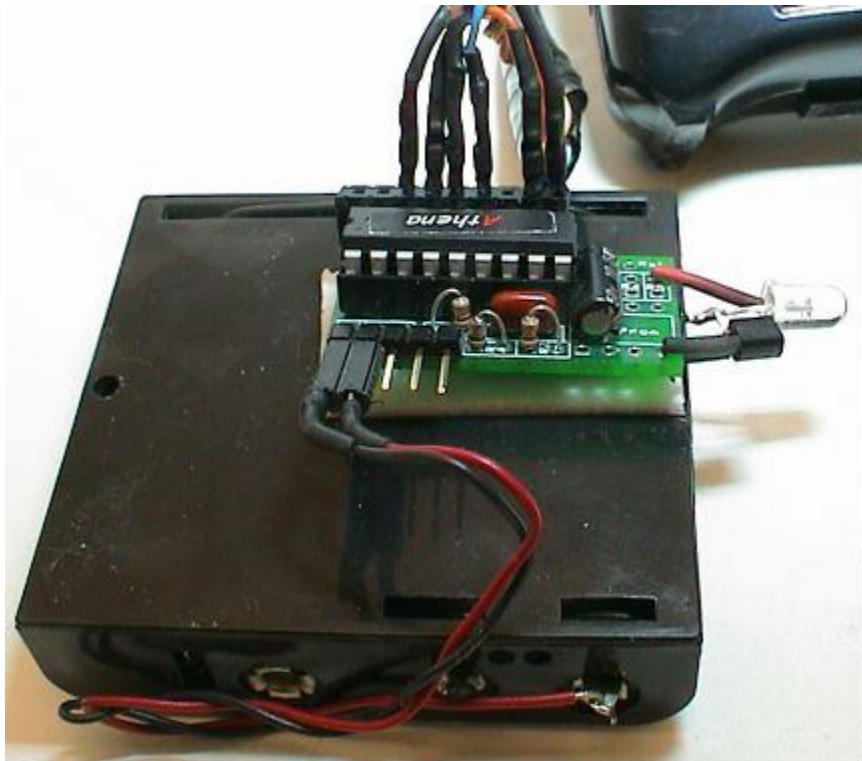
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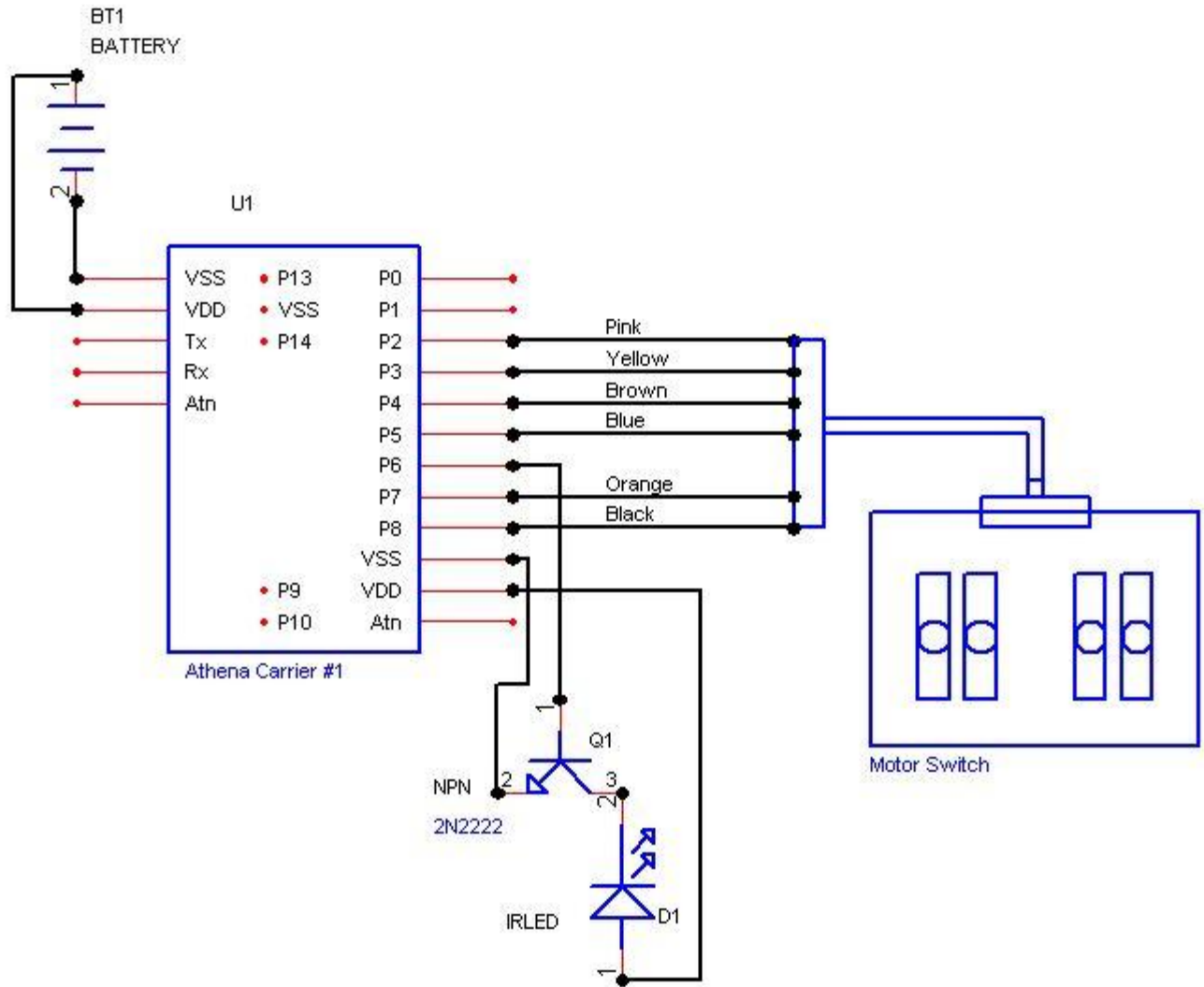
Originally I used a remote TV control but for this second bot I decided to completely redesign the remote control.

I decided to use one of the [motor switches](#). These switches have 4, 3 state switches. I used to the Athena controller to create a interface to the switch and to send the IR data.



I used the Carrier 1 board for the IR transmitter with a couple of headers. The board is mounted on the 4 cell battery holder. If the bot gets out of range you can simply poke a 1/4" small hole in the duct and insert the LED to regain control.





I used one a [TPN2222](#) transistor to drive the IR LED. If you use some other transistor you may need to place a 1k-10k resistor between the IO port 6 and the base of the transistor.

This Athena program is used to monitor the 4 switches on the motor switch. Every 25ms a code is sent to the duct bot with instructions on which motor or servo to control. You can even change the speed of the bot.

### Controller Program

```
'motor switch controller for duct bot
  dim num,stat1,stat2,stat3,stat4
  clearall
  pullupon

  dim swno

loop:
  swno=1 : gosub check1
  swno=2 : gosub check2
  swno=3 : gosub check3
```

```
swno=4 : gosub check4
goto loop

check1:
  configio 4
  setio
  goto cont

check2:
  configio 5
  setio
  goto cont

check3:
  configio 7
  setio
  goto cont

check4:
  configio 8
  setio
  goto cont

cont:
  portbitget num,0,2
  portbitget num,1,3
  if num = 3 then
    num = 0
  endif

  configio 8
  irout num,swno
  pause 25
  return
```

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## Final Thoughts

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I was able to determine that I had no visible mold in my duct work or furnace.

When I did not locate any mold with the duct crawler I consulted an expert. I found out that many of the mold kits are a quite a racket. They show mold and expect you to send in the results (plus \$30) for an exact assessment. They advised me that if you cant see or smell a mold infestation chances are you don't have one.

### Some Short Videos (from bots perspective>

[Movie of bot on table top](#)

[Movie of bot falling down the main shaft of the furnace](#)

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### Related Products

[Ares Robot Board](#)

[Athena](#)  
[IR LED](#)  
[2N2222 Transistor](#)  
[Motor Switch](#)  
[4 Cell Battery Holder](#)  
[EZ232 Driver](#)

[0 comments](#)

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<http://kronosrobotics.com/gl/article.php?story=20040414141741894>