simpleWalker: 4-legged 2-servo walking robot

by edwindertien on February 20, 2009

Table of Contents

intro: simpleWalker: 4-legged 2-servo walking robot ................................................................. 2
step 1: Get the materials .................................................................................................................. 2
step 2: make the parts ...................................................................................................................... 3
step 3: mount the RC servo's .......................................................................................................... 3
step 4: assemble the legs ................................................................................................................ 4
step 5: Add the electronics and battery .......................................................................................... 4
step 6: Upload the program ............................................................................................................ 5
step 7: now turn it on and let it go.... ............................................................................................. 6

Video .............................................................................................................................................. 6

Related Instructables ..................................................................................................................... 6
Advertisements ............................................................................................................................... 6
Customized Instructable T-shirts .................................................................................................... 6
Comments ...................................................................................................................................... 7

http://www.instructables.com/id/simpleWalker_4_legged_2_servo_walking_robot/
intro: simpleWalker: 4-legged 2-servo walking robot
Arduino (cheapduino) controlled walking robot, made with two RC servo's and 1 A4 of sheet material

step 1: Get the materials
materials needed:
1 sheet of birch plywood (4mm) of 21 x 29.7 cm (A4) (this can be any material, really. You can also use scrap bits, and cut the individual parts from them)
2 RC servo's (standard size) with mounting materials
8 screws m2 x 8 including nuts
8 screws m3 x 12 including nuts
2 screws m3 x 10
1 battery container with clip, wires
4 niMh batteries (preferably rechargeable...since servo's use quite a bit of power)
1 arduino or compatible microcontroller board (cheapduino)
step 2: make the parts
The parts can be cut or sawed out of one sheet of 4mm thick material, such as polycarbonate glass or wood. In this example I used 4mm birch plywood, which has been cut using a laser-cutter in a Fablab. The pdf with parts can be obtained from the page about the simpleWalker on my blog. For the polycarbonate version on the blog I have used a band saw instead of a laser cutter.

step 3: mount the RC servo's
The servo's can be mounted using 4 screws each. Using wood, self-tapping screws will suffice. Otherwise use nuts and bolts.
**step 4: assemble the legs**

Mount the servo-plates on the leg-plates using m2 screws. You might need to enlarge the drilled holes a little bit. The m2 screws don’t need to take much force, they’re mainly used as placeholders. The central m3 screw that bolts the leg to the servo shaft will take the load.

Don’t tighten the central m3 screws yet. First you need to discover the servo’s center-position in software. After centering the servo’s (in arduino code with a servo range of [0-180] it means writing the value ‘80’ to the servo) you can mount the legs at a straight angle.

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**step 5: Add the electronics and battery**

Battery holder and the microcontroller board are mounted with double-sided sticky tape. (the one with foam-core). The microcontroller board that’s been used is a breadboard version of an arduino-inspired design which I dubbed the ‘cheapduino’ since parts+pcb will cost < 15$. You can use any microcontroller board you like (A normal Arduino or Arduino nano or mini will do fine). You can also try to build the cheapduino design on breadboard, as described on the cheapduino wiki.

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http://www.instructables.com/id/simpleWalker_4_legged_2_servo_walking_robot/
step 6: Upload the program
The arduino program is very straightforward. I used an RS232 dongle made on breadboard to upload the program. Again the schematic, bootloader sources etc. can be found on the wiki. The arduino sketch:

```cpp
#include <Servo.h>
Servo frontservo, backservo;
char forward[] = {60,100,100,100,100,60,60,60};
void setup()
{
  frontservo.attach(9);
  backservo.attach(10);
}
void loop()
{
  for(int n=0;n<4;n++)
  {
    frontservo.write(forward[2*n]);
    backservo.write(forward[(2*n)+1]);
    delay(300);
  }
}
```

http://www.instructables.com/id/simpleWalker_4_legged_2_servo_walking_robot/
step 7: now turn in on and let it go....
See the robot in action on youtube:

all the resources used in this instructable can be found on my blog on http://retrointerfacing.com

Related Instructables
overslacked says:
Hi Andy, I'm curious, why did you decide to add a microprocessor? You seem to describe your little guy here as a BEAM device, but it doesn't seem (to me, at least) very common to introduce a microprocessor at this level of complexity.

edwindentien says:
You are right. You could take out the electronics of the RC servo's and put in a BEAM bi-core. In 'the old days' of Tilden's beam robotics (when there were chunky 6502 or 68HC board around) a system with only two analog IC's and a couple of capacitors was a great improvement. Now a microcontroller is just as easy (one atmel IC costing less than two dollar) and offers a great deal of flexibility in terms of adding sensors etc..

Kiteman says:
That's nice - are there any plans for sensors or steering?

andy says:
I believe steering is a function of timings with this morphology. Specifically (as far as i understand) the rear legs are normally (optimally?) a half phase (180 degrees or "anti phase") from the from legs - when the front leg is rotating in one direction the rear legs are rotating in the opposite direction. There are ways (given this configuration) to turn left and right, reverse, go forwards and "stomp" (where the robot is moving its legs but such motion doesn't cause it to move forwards) without any further physical alterations. Forward, stomp and reverse are a function of the phase. Steering is related to the amplitude of the signal sent for any given step forwards; a long left step and a short right results in a slight turn, over a number of steps this becomes an arc to the right.
Hope this is useful,
Drew

p.s. "stomping" may appear useless but it can be very useful; for example your robot detects that moving its legs is harder than normal it could summarize that it has become stuck or bogged down. Imagine its traveling through a pile of leaves and is walking into and through the pile rather than over it, stomping could get it atop the otherwise untraversable pile of leaves.

Kiteman says:
I know how it steers, but this project lacks steering (either by remote control or as a consequence of sensed obstacles), which is why I asked.

andy says:
Sorry, my mistake, Drew

andy says:
Also, I'm currently experimenting with getting a beam robot walker to achieve static postures, so it would be able to posture for charging for example, or in order to get a better look around, would this be better as two Instructables (how to make the walker, how to get it to posture) or one with it all together?
Thanks,
Drew

Kiteman says:
Since the walker would have a fairly unique geometry to be able to pose upright, I would put it all in one - there's nothing wrong with a lot of steps in an 'ible.

andy says:
On the contrary its a fairly standard BEAM layout, the real trick is in circuit design. There needs to be one or two modifications to more standard designs but these can easily be added on to an existing robot. I suppose a "built from scratch" approach would be more accessible and generally more clear, so I think i should still have one larger 'ible, as you advise.
Thanks for your input,
Drew

AndyGadget says:
I love the leg movement. I was trying to remember where I'd seen it before and it's the same as lizards I'd seen scuttling up and across walls in France and Greece.