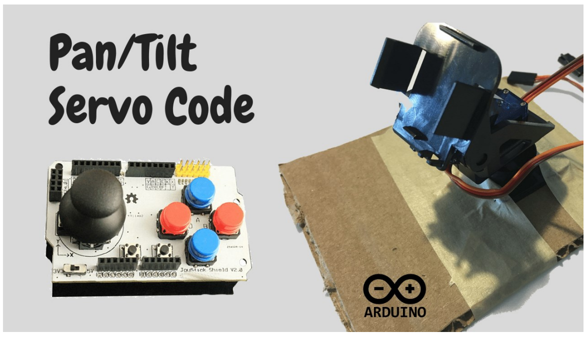

The Complete Guide to Program Pan-Tilt Servos

Last Updated: 01/28/2020

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In my last tutorial, I showed you how to build the pan-tilt servo assembly. So, if you haven't already built yours, I recommend checking that out first. This tutorial will show you how to program pan-tilt servos using buttons and potentiometers. The goal is to have (wired) manual control in all directions (pan: left/right and tilt: up/down).

The first thing we'll do is create our circuit. There are three options to control the pan-tilt movement: potentiometers, buttons, or a joystick. The programming methodology will be similar to all of these examples.

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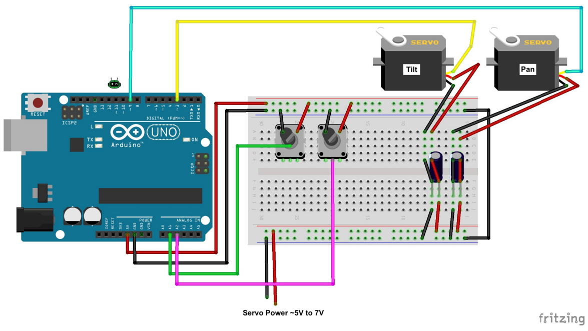
Which controller is right for me?

When deciding on which circuit to build, I recommend thinking about how the user will use this system. *Would it be easier for the user to push a button, rotate a dial, or jog a joystick?*

Without further delay, let's get started!

Pan-Tilt Wiring Diagram using Potentiometers

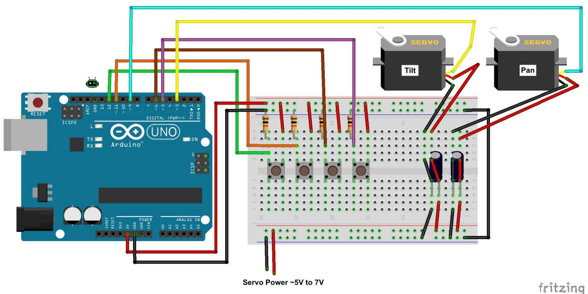
The first wiring diagram uses two potentiometers: one for pan and one for tilt.



You'll notice a couple of capacitors (bottom right corner) connected to the servos. The servos are powered by a separate source. The capacitors are there to reduce the amount of noise on this line. Furthermore, the servo connections will stay the same throughout this guide.

Pan-Tilt Wiring Diagram using Buttons

Also, you may opt to control the movements using four buttons. When the user presses and holds a button, the servo will move accordingly. When the user releases the button, the servo will stop in its current position. Here's a diagram for pan-tilt using buttons:



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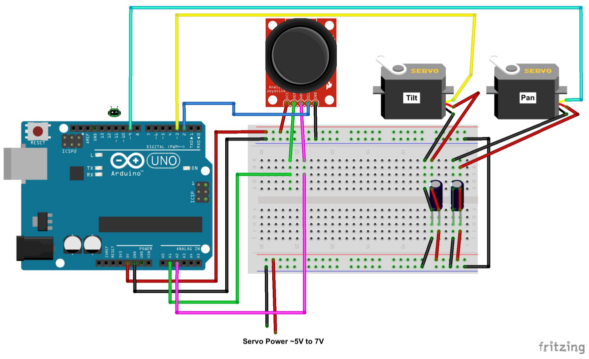
We will assign functionality to the buttons in the code, so this can be configured however you like. This is just a starting point for getting it wired up!

Pan-Tilt Wiring Diagram using a Joystick

Lastly, we can program pan-tilt servos using a joystick. If you want a user experience similar to a video game controller, this is the option I'd pick.



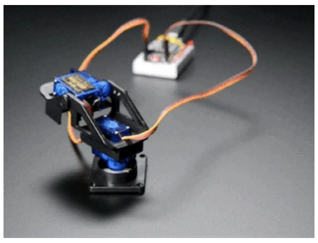
There are also Joystick Shields that you can get for Arduino. They include both a joystick and a set of four buttons. This would be another great option! (And would combine the programming logic from the joystick and button sections.)

Go ahead and pick one (or all) of these options, wire up the circuit(s), and then come back to this article to learn how to program it.

Program Pan-Tilt Servos using Arduino

In this guide, I will show you how to program pan-tilt servos using potentiometers, buttons, and a joystick. Realistically, once you have one control pattern written, the others are very easy to develop. We will be using the Arduino IDE for our code development.

Code for Pan-Tilt Servos controlled by Potentiometers



First, import the Servo library for this project. Next, create some constant global variables to store the potentiometer pins. Then, initialize the Serial Monitor within the method.

If these concepts are foreign to you, please check out my article on Four Steps to Writing Any Arduino Program. I'll be following these guidelines loosely, so some prior Arduino programming experience is expected.

Next, you'll want to read the value of the first potentiometer using `analogRead(pin)` and store that into a variable. This will be reading from 0-1023 because we have a 10-bit ADC on the Arduino. We'll need to map this value to the range of our servo (in degrees). Most hobby servos are 0-180 degrees of rotation. Therefore, we can use the mapped value to command our servo into a position.

`tiltVal = map(tiltVal, 0, 1023, 0, 180); //map reading from 0-1023 to 0-180`

If your servo has a different range of rotation, be sure to map your potentiometer reading to match this spec!

Then, repeat this process for the second potentiometer. When you're done, you can command your servo into position by using the `myservo.write(pos)` method. For example, if our tilt servo is named "tilt", we can tell the servo to move to the mapped position using the following code:

`tilt.write(tiltVal);`

Finally, give the servo enough time to get into position. I recommend adding in at least a 15-millisecond delay. You can test out this number to see what works best for your application. I've used up to 50-millisecond delays in some projects!

Code for Pan-Tilt Servos controlled by Buttons

Now, we're going to look at programming pan-tilt servos using four buttons.

We want to use the buttons as momentary switches. That means, when the button is pressed, the servo will move. When the button is released, the servo will stop. We'll use four buttons to move the servos in four distinct directions: up, down, left, right.

First, we'll import the Servo library and define our buttons as globals. Then, we'll define a few auxiliary variables for button debouncing. These include button state, last button state, debounce delay, and last debounce time.

Here's what it should look like:

```
#include <Servo.h>
/*
 * Pan Tilt Servos
 * Written by Liz Miller
 * for Learn Robotics (www.learnrobotics.org)
 * Version 1.1
 * 9-19-18
 * ---
 * The Software is provided "AS IS" and "WITH ALL FAULTS,"
 * without warranty of any kind, including without limitation
 * the warranties of merchantability, fitness for a particular
 * purpose and non-infringement.
 */

//buttons
const int bButton = 6; //left CCW (pan)
const int wButton = 5; //right CW (pan)
const int rButton = 12; //up (tilt)
const int lButton = 11; //down (tilt)

const int tiltPin = 3; //tilt servo on pin 3
const int panPin = 9; //pan servo on pin 9

//servos
Servo tilt;
Servo pan;

//button states
int bState = 0;
int wState = 0;
int rState = 0;
int lState = 0;

//debouncing buttons
int bLBS = LOW; //blue button last state (init)
int wLBS = LOW; //white button last state (init)
int rLBS = LOW; //red button last state (init)
int lLBS = LOW; //black button last state (init)
unsigned long lastDebounceTime = 0;
unsigned long debounceDelay = 50;

//helpers
int z,y,posT, posP; //pan, tilt pos (bits) & mapped positions (deg)
int deg = 180; //servo rotation in degrees

void setup(){
  //... fill out
}

void loop(){
  //... fill out
}
```

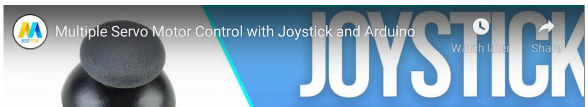
pan-tilt-part-1.ino hosted with ❤ by GitHub   view raw

The Logic for Button Control

Next, we'll set up the buttons using `pinMode()`, initialize the servos, and start the Serial Monitor. I recommend creating a new method to store all the code for button control. We'll use principles from debouncing to check if the button has been pressed.

If so, we'll increment our servo position (in bits), then set a variable for the servo position (in degrees). I used a multiplier so that I could control how many bits per degree. That way if you want to fine-tune the movement, all you have to do is decrease the multiplier.

Because we have multiple directions, I used two buttons for +/- tilt (up & down) and two buttons for +/- pan (left & right). We'll check the button state for the direction we want to move in and verify that we're less than the degree limit. There's no point in commanding the servos past their limits!

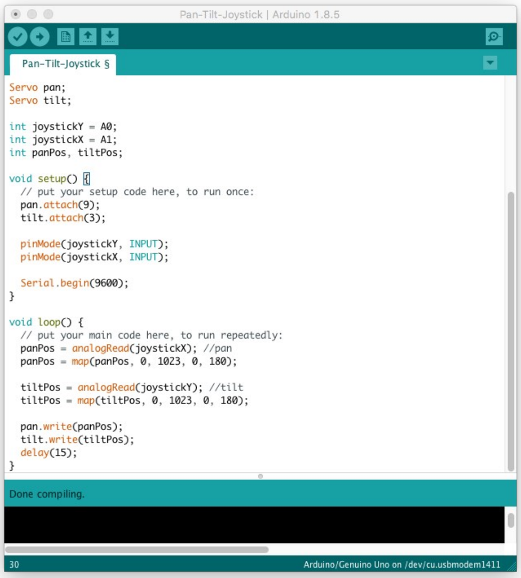


Once you have the calculations, you can command the servo to move into a position using the `write()` method. Again, you'll want to delay at least 15-milliseconds so that the servo has enough time to reach the position before it's triggered again. I created a "smoothTime" variable, which allows me to modify how much time I need to wait based on the bits per degree multiplier. You don't have to do this, but I've included it as an example of what you could do.

Finally, include the button control method in `loop()`, and test it out! With a little tweaking and timing, you should have pretty clean control over your pan-tilt mechanism.

Code for Pan-Tilt Servos controlled by a Joystick

Lastly, we can program pan-tilt servos using a joystick. The program for this is very similar to the code using the potentiometer. A joystick is essentially a two-axis potentiometer!


Pan-Tilt-Joystick | Arduino 1.8.5

Pan-Tilt-Joystick §

```
Servo pan;
Servo tilt;

int joystickY = A0;
int joystickX = A1;
int panPos, tiltPos;

void setup() {
  // put your setup code here, to run once:
  pan.attach(9);
  tilt.attach(3);

  pinMode(joystickY, INPUT);
  pinMode(joystickX, INPUT);

  Serial.begin(9600);
}

void loop() {
  // put your main code here, to run repeatedly:
  panPos = analogRead(joystickX); //pan
  panPos = map(panPos, 0, 1023, 0, 180);

  tiltPos = analogRead(joystickY); //tilt
  tiltPos = map(tiltPos, 0, 1023, 0, 180);

  pan.write(panPos);
  tilt.write(tiltPos);
  delay(15);
}
```

Done compiling.

30 Arduino/Genuino Uno on /dev/cu.usbmodem1411

First, create two variables to store the X and Y joystick analog pins. Then, attach the servos to the pins they're connected to on your Arduino.

Next, read the values from the X analog pin. Store that into a joystick position variable. This will be a 10-bit reading from the ADC. We'll map this from 0-1023 to 0-180 to convert bits to degrees. Repeat this step for the Y analog pin.

Then use the `write()` method to move the servo into the mapped joystick position. Your servos should start to move accordingly. Include at least a 15-millisecond delay to complete the move.

If you want to make the control more complex or intricate, this is a great starting point. You'll notice that when you move in both X and Y directions, that pan and tilt will move simultaneously. If you don't want this feature, then you'll have to write some code to prevent multi-axis movements.

Pan-Tilt Servo Control isn't too difficult

With a little planning, you can easily program pan-tilt servos to work with whatever inputs you desire. Whether it's a couple of potentiometers, buttons, or a joystick, the configuration is pretty much the same.

In future tutorials, I will show you how to create wireless control for your pan-tilt assembly. Until then, give these projects a try, and let me know if you have questions in the comments below!

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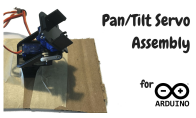
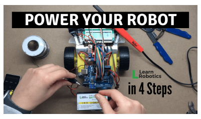


How to Assemble Pan/Tilt for Arduino Servos



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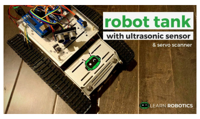

Make an Autonomous Robot Tank with HC-SR04 Sensor

Liz Miller

Liz is the Founder of Learn Robotics. She holds a **B.S. in Robotics Engineering** from WPI. Liz has a multitude of robotics experiences ranging from being a Robotics Researcher at **UPenn**, Instructor at **MIT**, and Automation Engineer for **United Technologies**. Liz writes technical tutorials and creates automation courses that anyone can follow. Her tips and tricks help engineers grow their careers. Liz has authored over 150 pieces of unique content on this site. **You can support her work here.** Learn more about Learn Robotics on our About Us page.

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   09/22/2018
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