Object Controlled Laser

6.101 Final Project Proposal

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Overview

Sensors are used in a wide array of electronics systems. The goal of this project is to interface a distance measuring sensor with a circuit that will display the data in an interesting way. For this application, we have decided to ultrasound sensors to measure the location of an object. The data from the sensors will be used to control the position of a laser pointer. As we move the input object, the laser will follow the movement.

Circuit Design

The project will consist of two parts: The input stage and the output stage. The input stage will include two ultrasound sensors positioned 90 degrees from each other. The Ultrasound outputs a voltage that is proportional to how close an object is to the sensor's face. This voltage will be used as the input to the circuit that will control the motors.

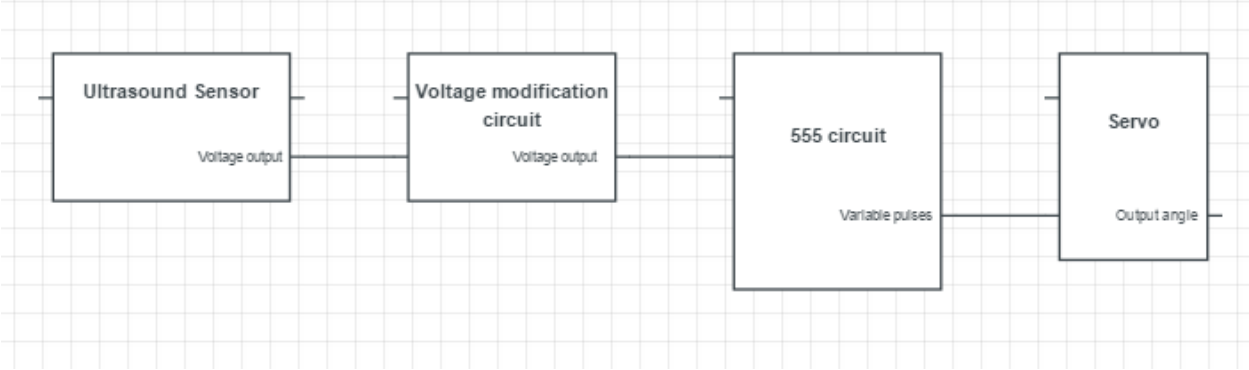
For this project, two Servo motors will be used to control the direction of the laser. Servo Motors are controlled with a series of pulses. The length of the pulses turns the servo to a specific angle. Ie. a pulse width of 2ms will the servo as far clockwise as it can while a pulse width of 0.5ms will turn the servo as far counter clockwise as it can go. Any angle in between can be created using a pulse with a width between 0.5ms and 2ms. By creating a circuit that can create variable output pulses with widths between 0.5ms and 2ms we can move the servo to any desired angle.

An astable 555 timer circuit will be used to create the variable pulse width circuit The output of the ultrasound will be used to control the threshold of the 555 timer. This variable threshold will allow us to create the different pulse widths. The output of the ultrasound will most likely require some modification before it is passed as the threshold of the 555 timer. This is because there is some voltage range that the 555 timer inputs to create the range of 0.5ms-2ms pulse width length, lets call that Vf (0.5ms), Vt (2ms). There is also some output voltage range that the ultrasound outputs, let's call those Vm (farthest from ultrasound) and Vl (closest to ultrasound). These ranges must match each other to get proper outputs. Ie Vf must match Vm and Vt must match Vl. Upon choosing the exact parts these ranges will become apparent.

The laser itself will be mounted on the stack of servos that are each 90 degrees from each other. Each Servo will control one axis of rotation for the laser. This implies that there will be two of the Servo controller circuit described above, one for each axis. The location of

the input object will be mapped in the X and Y axis, and the laser will move to match those coordinates.

Block Diagram



Power

The 555 timer circuit and the Servos will be powered with a 9V battery. The power source for the ultrasound sensors will be determined upon choosing the exact sensors. The laser also requires a power source. The power source details for the laser will be decided when the laser is chosen.

Testing and Demonstration

The setup for the demo will have the two ultrasound sensors set up 90 degrees from each other to create a plane. An object will be placed in this plane and the position will be measured by the sensors, sent to the 555 circuit and out to the servos to control the laser point. In the demo we will move the object around and watch the laser move to follow the objects position.

This demo can be divided into three distinct parts. The first is seeing the variable voltage output of the ultrasound on the oscilloscope. The second is the demo of the pulse-width modulation circuit. This portion of the demo will show, using a potentiometer, the variable length of pulses and should show that the circuit can span the full range of necessary pulse-widths for the Servo motors (0.5ms-2ms). The third portion is the completed system where the two previous parts are linked together with an interfacing circuit that matches the output voltage of the sensor with the corresponding input voltage for the servo.

TImeline

1) Controlling a servo with a potentiometer-

Create the circuit that will translate a change in potentiometer angle to a change in the servo angle. This will involve the 555 timer chip configuration and a power system to power the servos. Once I can determine the necessary voltages to get the full range of motion for the servo I can work backwards to make the ultrasound sensor output match.

2) Creating the Ultrasound setup and measuring values-

The next portion of the project will be testing the ultrasound and its output voltages. I need to do measurements on things like whether diagonal readings greatly affect the accuracy of the readings. If so, I may need to use two bars, instead of one object, to determine the location of the object. This setup, with an accurate understanding of how to correctly measure the object's location is my second step in completing this project.

3) Modifying the output of the Ultrasound to match the input of the Servo circuit-

This is the portion of the project that I do not know how I will build yet. Once I get the experimental measurements of the voltage range needed to drive the servos, I need to create circuitry that will map those necessary voltages to the output of the ultrasound. This may require some addition or subtraction circuits if the difference is an offset. But it may also, just as easily, require much more complicated circuitry.

4) Mount for the laser-

The last part of this project is mounting the laser on the two servos. This may end up being not as trivial as initially anticipated. The setup for the laser will need to be precise enough to work properly. This setup must be used to calibrate the previous stages to make sure we are moving the correct angle for a change in position of the measured object.

Parts list

-Two servo motors
-Two ultrasound sensors
-Laser
-555 Timer Chip
-Mounts for the sensors
-Mount for the laser

Conclusion

Overall the system takes an input, an object's position, and uses that to create an output, the laser's position. The method by which this is done consists of two ultrasound sensors that create a variable voltage output. The voltage is run into a Variable pulse-width modulation circuit which is used to drive the servo motors. The goal is to have the laser follow the coordinates of the object.

References

555 Timer Datasheet: http://www.ti.com/lit/ds/symlink/lm555.pdf
How servos work: https://www.servocity.com/html/how_do_servos_work_.html#.VSIUJvnF9gk