Learning Module 7: Arduino Radar

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Write Up

This group consisting of Michael Hoffmann and Andrew Harasymchuk plans to create a sonar system using an Arduino. This would be done with an ultrasonic sensor that will sense the distance to the nearest object and a servo motor that will turn the ultrasonic sensor so it can read a greater area. The arduino IDE will then create an image of what the sensor scans on the computer monitor with empty space shown as green and space blocked by an object shown as red. This will, in turn, create a functioning sonar that can be used to scan an area for obstacles.

Because of the deceptively simple nature of this project, both partners will work on the same goals throughout the learning module to ensure it is completed properly. The beginning of the project will be devoted to wiring the servo and ultrasonic sensor so they function properly while also having the ultrasonic sensor secured so it does not fall off or remove its wires from their appropriate places. The rest of the time will be devoted to programming the arduino so it runs the ultrasonic sensor and the motor while also creating the image of the scan.This code, while provided in the tutorial, is extremely complex compared to this group's past experience with Arduino. Therefore, the group will take time to understand the code they are using. The part that will require the most study is how to draw the representation of the sonar. This could be done relatively easily in Java, but with Arduino using C++ it will be an entirely new concept to this group. There very well may be some leftover time, and that time will be used to improve the physical design of the sonar and research a way to further apply this concept.

Timeline

Days 1&2- find a project

Days 3-6- build the radar system

Days 7-9- study the code used for the project

Days 10+- work on improvements to and applications for the system

Daily Log

Day 1 2/19/2020 - Andrew was absent. Michael spent the period looking at project ideas

Day 2 2/20/2020- Michael and Andrew discussed project ideas and settled on making a radar with Arduino

Day 3 2/21/2020 - Andrew and Michael worked on wiring the Arduino, servo motor, and ultrasonic sensor. They got it wired, but tried using the processing code instead of the Arduino code. Michael looked up what processing is and found it is a java art tool.

Day 4 2/25/2020 - Andrew was absent. Michael double checked and fixed the wiring. The code seemed to work with the servo motor working perfectly and the ultrasonic sensor functioning. Michael also set up Processing and tested the code. The code seemed to work, but it always drew the same image no matter the distance an object was from the sensor despite the sensor being stationary.

Day 5 2/26/2020- Michael spent the block trying to fix the issue with the sensor. In the end, the sensor was replaced and the new one worked properly. Andrew spent the block starting to work on the mount for the ultrasonic sensor by taking measurements.

Day 6 3/2/2020- Andrew continued working on the mount and taking measurements. He started creating the sketch for the 3D printer. Michael spent the first half of class adjusting the size of the sonar display to fit the computer screen. The second half was spent trying to figure out what the processing code does.

Day 7 3/4/2020-Michael spent the class using his knowledge of java and some trial and error to fully figure out and understand the processing code. Andrew finished the sketch for the ultrasonic sensor mount and started to print it. He then started to work on a base to hold the servo motor while it is being used.

Day 8 3/6/2020- With the ultrasonic mount printed and not fitting properly, Andrew took the full sensor and mount to the soldering iron to shave down edges in order to have the sensor fit properly. Michael spent this period trying to support Andrew while also ensuring everything worked when he was done

Day 9 3/9/2020- With the base finished, the servo was inserted and the hole in the base was slightly too large, so paper was inserted to keep it from wobbling. After that, an issue was noticed where the base would slide along the table as the servo rotated. Before that could be handled, Michael and Andrew worked on organizing the wires and playing around the with the almost fully functional sonar system

Day A 3/10/2020- Michael and Andrew spent the period discussing ways to prevent the issue with the base moving when the sonar is spinning. They decided to add longer wires, which noticeably reduced the issue, and they thought to use sandpaper to help further reduce the issue.

Day B 3/12/2020- With neither party remembering to grab sandpaper, the group reorganized the wires to help stop tangles and tried adding popsicle sticks atop the base to keep it from moving. This had decent results in the trials, and they agreed to secure them the next day.

Day C 3/13/2020- Michael & Andrew spent the period trying to finalize a method to secure the sonar in order to prevent movement while it is in use.They settled on using some putty donated by Mr. Detrick to stick the base to the table instead of adding mass with popsicle sticks.

Day D 3/16/2020- Michael spent his 45 minutes from 8:45 to 9:30 setting up the sonar system and the appropriate dowloads on his personal laptop. Andrew worked on the 11:00-11:45 seeing if the distance of the detection was because of the sonic sensor or if it was the code limiting it.

Individual Hours

Michael Hoffmann

2/3/2020- 5:15-6:45 researched and tested out basic Processing to better understand the language.

3/8/2020- 11:30-1:00 researched and brainstormed ways to prevent the sliding issue when the radar is being used.

Andrew Harasymchuk

2/27/2020 8:40-9:40 got the 3d printer printing the print while in study hall. and researched ways of connecting the print to the servo.

2/30/2020 3:00-4:30 found ways of connecting the 3d print to the servo and stabilizing the servo.

3/3/2020- 3:25-4:25 researched ways to make 3d prints have more friction.

3/6/2020- 9:40-10:40 finished modeling the base and started the 3d print on the printer.

3/12/2020 - 4:00-4:30 brainstormed ways to increase mass to increase the friction to stop the base from spinning.

Resources

Arduino Uno- This was programmed to run the servo motor and ultrasonic sensor and send the appropriate feedback to the serial port.

Ultrasonic Sensor- This is the device that recorded the data used to calculate the distance to the nearest object.

Servo Motor- This motor is what turned the ultrasonic sensor, allowing the radar to scan a relatively large area instead of a straight line.

Processing IDE- Java based language that used the data from the Arduino to create the dynamic graphic of the sonar that would change based on the findings of the ultrasonic sensor

3d craftbot printer- a type of 3d printer used to 3d print objects in the class.

https://howtomechatronics.com/projects/arduino-radar-project/ - This was the tutorial used for this project. It has all the code used in this project and minimal changes were made.

https://processing.org/ - This website is where the Processing IDE was downloaded and was used to research what the processing code actually did.

https://github.com/lastralab/ArduinoRadar - This github project is seemingly based on the tutorial used for the learning module, but contains a file needed to properly run the processing code (OCRAExtended-30.vlw)

Goals

The initial goal of this learning module was to create a sonar using an arduino. This particular project was chosen due to the easy to procure materials and the fact that nobody has ever done it before. The code and wiring were lifted directly from a tutorial on how to make the project, so the group also set out to understand how the code worked. One thing changed from the tutorial was that this group wanted to 3D print a way to mount the ultrasonic sensor to the servo motor. This group really had no backup plan because the only way the group foresaw this project could go wrong was either due to bad parts or bad wiring.

Accomplishments and Problems

Overall, this group was extremely successful in their goals. They successfully created a working sonar and 3D printed the appropriate mount and base. The issues encountered were minor at best, such as early on when they struggled to find a working arduino or started off with a broken ultrasonic sensor and had to replace it. Some issues that needed more work were when the mount for the ultrasonic sensor was printed and was a few millimeters too small, so some edges had to be melted with the soldering iron so the sensor could fit. After that, the servo could not stand on its own because of the weight of the mount, so the group 3D printed a base to hold the servo up. The base worked well, but it had a tendency to slide around when the servo was rotating, so the group went to work to try to fix the issue. The result of that effort was using putty to secure the base to a surface. In the end, this group solved all the issues they came across and had a working project by the end of the learning module.

Learned

This group learned a handful of things over the course of this learning module. The first was the basics of how to program servo motors and how they work, as neither group member has worked with them in the past. Learning what Processing is and how to use it is very important to understanding how this learning module works, but will likely not show up again in the future. For reference, Processing is an offshoot of Java that focuses on 2D graphics and art. This is what allows the sonar display on computers.

Future Learning Module

The main suggestion this group has for others pursuing this learning module is try to do it over a shorter time frame. Getting the sonar working did not take too many days, most of the learning module was spent trying to improve it because of that extra time. Further uses for the sonar itself would be getting it to work over bluetooth instead of having to be connected to a computer. If one gets bluetooth working for the sonar, it could theoretically be mounted on a remote control car or similar project and be used to steer the car without seeing it.