CS3651 Project Documentation
Svyatoslav Kucheryavykh
Michael Sharpe

Our Project

The goal of our project was to create a robot which could localize and accurately approach sounds. To detect the direction of the sound, we decided use four sound sensor chips, with one placed in each corner of a breadboard. By using the time each microphone picked up the sound, a differential was calculated, which in turn was used to calculate the direction of a sound. This direction would then correspond to motor values, and the robot would approach the source of the sound.

What We Did

We accomplished our project goals within the limited ability of our materials. The robot listens for sounds, calculates the delay, and moves in the one of eight directions it finds to be the most accurate. While it's not entirely accurate due to the inconsistency of the sensors and DC motors, the calculation used as the basis for the localization is entirely sound (pun intended). Even if the DC motors are unreliable and the sound sensors output inconsistent data, the robot's movement was carefully calibrated, the sound localization code is bug-free and effective, and many additional accuracy measures were put in place to counteract errors. The robot only moves if all sensors detect a sound within a small time frame, and illogical readings are discarded, so consistency is enforced in the software as much as possible to make up for deficiencies in the hardware.

What Failed

Our project had to change due to the limitation of our sound sensors. Because they weren't reliable enough at range, or possibly due to our inability to create a system to improve their accuracy, our initial operational definition of accuracy (determining the direction of the sound to at least ten degrees) became inapplicable. Now, our operational space is generally 45 degrees. We were not able to achieve higher accuracy due to very large delays in sensor readings, which may be caused by a large sound detection time variations or by some other limitations that we weren't able to detect and correct.

What We Learned

The main lesson that we learned was that working with sound is very difficult due to the time scale involved with calculating accurate headings. Just few microseconds can cause inaccurate readings, with very incorrect and unusable data. After much trial and error, we managed to refine the accuracy to consistently judge sound to be in eight general headings, but this was still not as accurate as we expected in the beginning.

Nice Message About Our TA

The TA was really good about answering problems and sticking around until you knew how to progress, then occasionally coming back unprompted to check how things were going. That was very appreciated, especially because getting help from different people on the same problem can lead to a lot of redundant explaining and error checking.

Possible Future Work

If this project were to be expanded, or we had more time to work on it, we would first try to further improve our sound detection with more sensors. Because our current four sensors localize using digital reads, having sensors dedicated to reading the analog noise level could help up get the distance detection that we had in mind originally. However, the analog reads may take too long, even with the localization done entirely digitally through the other sensors. In that case, more sensors could be used to read the sound digitally, and be placed far apart from each other to give more distinct readings. The current setup has them all on one board, which makes the delays especially small, and having sensors set up in more separate locations could make readings more distinct. We would also attempt to figure out why the sensor readings in general were not as accurate as we had expected. This would improve all aspects of our localization even without the use of additional sensors, and potentially get the robot's accuracy to our originally proposed bounds.