To: Brady Augedahl, Elliot Ducharme

From: Larry Basegio

Subject: 2019 Season Software Summary

Date: 30 April 2019

CC: Mike Konkel, Mike Wyoczik, Willy Hoskins

I thought it would be advantageous to summarize some of the new things the software group attempted to implement. As it turned out, we did not use these features in competition as there was not enough time to perfect them (exception being the Raspberry PI for the video camera). Maybe next year..

Summary

This season new concepts were introduced, tested, and partially refined. Most were not used in the final robot implementation. It is noted that the more advanced teams exploit these techniques routinely and that it is anticipated that future seasons will require our team to implement some or all of these techniques. Specifically, the software group explored use of the following:

- Use of the ADXR450 gyro to compensate for differences between the left and right motor drive characteristics, i.e., drive in a straight line.
- Use of the ADXR450 gyro to turn to a specific heading.
- Use of a magnetic encoder to determine distance traveled.
- Incorporation of an additional microprocessor (Raspberry PI) to facilitate operation of a video camera.
- Use of an encoder (NEOS with SparkMax controller) to determine the angular position of the intake assembly.
- Use of a Redline encoder to determine the position of the inner lift.
- Use of a magnetic encoder to determine the position of the outer lift.
- Implementation of multi-threaded programming to allow “semi-parallel” processing of drive and sensor-based operations.

Performance

- ADXR450 gyro: The ability of the gyro to compensate for left and right drive differences was successful. Use was made of the second argument in the arcade drive function to steer the robot relative to a calculated error. The gyro was also used to turn to a specific heading. The error in turning was reduced to +/- 2 degrees.
- Magnetic encoder: A magnetic encoder was attached to the output shaft of the drive gearbox. When used to determine distance traveled and when speed was reduced as the target distance was approached the accuracy of a 30-foot travel was within 2”. The resolution of this encoder was 4095 counts per revolution making for an accurate distance determination. The use of the magnetic encoder for the outer lift was never evaluated.
- Raspberry PI: We only touched on the capabilities of this device, using it for the video camera. It should be considered as a necessary component on all future robotic configurations.

- NEOS/SparkMax encoder: The resolution of this encoder is very poor. Although convenient, the resolution is 42 counts per revolution. The library function returns a double representing the number of revolutions. In our robot the drive was reduced via a 100:1 gearbox which helped somewhat. I would not recommend use of this encoder on a drive system.
- Redline encoder: The resolution of this encoder is 1024 counts per revolution and it attaches directly to the Redline motor. Our robot had difficultly getting consistent results from this encoder and the cause was never determined. The encoder was operated in quadrature mode and the cable was extended many feet. It is not known if this was the issue or other factors were at play. More work needs to be done if we are to consider future implementations of this device.
- Multi-Threaded Programming: This technique is very promising as it allows independent processing of different robot operations – all at the same time. One can drive, operate the lifts, and orient the intake at the same time. It works by time-slicing the various operations. We were successful in test implementations and expect to use this in the future. I discussed this with several of the high-performing teams at the Iowa and LaCrosse competitions – these teams were using execution threads. One team in particular created a separate thread for reading all encoders, gyros, etc.. This looks like a good technique to investigate either in the off-season or next season.

Concluding Remarks

This season was incredibly successful – congrats! From the software perspective the previously mentioned accomplishments should be considered for future robots. I might also mention that the group had to learn and implement a new compiler/editor (Microsoft VS vs. Eclipse) at the last minute (January).