Guide for testing controller

1. finish implementing the code, don't forget to update the current idea speed for translation and rotation movement every millisecond in systick. You will need to create variable of acceleration/deceleration rate(constant value) to make the mouse accelerate and decelerate in a constant rate. Also, don't forget to accumulate the error for both translation and rotational movement since I put a integral sign on the block diagram in the lecture notes(lecture 3)

2. make the mouse run at a low constant speed on a straight path. It won't go straight as you expected as always since the actual size for 2 wheels are not exactly same. So you need to find the speed difference between left and right wheel in order to compensate the side with less counts to make the mouse go straight with encoder. For example, if right side encoder get 5% less counts than left side wheel every millisecond, then every millisecond, right\_speed += left\_speed \* 5%. However, since the encoder counts are not that large on every millisecond, left\_speed\*5% will get some value smaller than 1, which will not take any efforts of right wheel, so you need to keep this 5% and accumulate them until it get big enough(equal or greater then 1) then apply on right wheel.

3. Make the mouse accelerate and decelerate for certain distance on at straight path. This is what you need: you need to create a global variable called distanceLeft, and sign the value for it before it starts to run. Ex) if the mouse is going to run for 5 cell distance then stop, you need to overwrite the value for distanceLeft as what encoder counts equals to 5 cells, then keep calling distanceLeft-=((leftSpeed+rightSpeed)/2)

 to keep track of the remaining distance.

then you need to utilize equation 2as = Vt^2 - V0^2,  by calculating a = abs((Vt^2 - V0^2)/2s) every millisecond to calculate the deceleration rate need in order to reach the target speed within the remaining distance, where parameter "s" is the distanceleft, Vt is the initial speed, V0 is the target speed. IF we want to decelerate to zero speed, then Vt is the current speed, and V0 is the target speed which is zero. Apply them into equation to get the a, which is the deceleration rate needed, compare with the deceleration rate you set, if it is larger than your, it's the time to decelerate, and just simply set your target speedX to zero and mouse will decelerate back to 0 automatically. If the acceleration rate needed is smaller than yours, remain the target speed when you set at the beginning(which is the max speed you want).

4. After test with very high acceleration/speed on the straight path, you will find the mouse gets unstable, now you need to add gyro as feedback to help mouse keep straight since encoder gets noisy at high speed. Before you do this, you need to calibrate gyro as I mentioned in lecture 2, then scale the angular velocity down with certain value as part of the rotational feedback, you need to pay attention of the sign of gyro feedback when you add them with encoder feedback.

5. After you add gyro feedback and make it go straight at high speed, now it's the time for you to add the scaled sensor error as part of the rotational feedback to keep the mouse in center of the cell with the help of both encoder, gyro and IR sensor. Since value for sensor error is significantly larger than any other feedback, you need to scale it down, test and find proper scale, also pay attention with the sign of the sensor error.

6. after you make step 5, you get go test pivot turn with same controller by setting targetSpeedX as 0 and targetSpeedW as a constant, where positive value makes mouse spin to one direction and negative value makes the mouse spins to the opposite way. During pivot turn, you still only use encoder as translational feedback, but you only use either encoder or gyro as the rotational feedback. when you want to turn certain angle, use angle of the gyro as the terminate condition to make the mouse stop spinning at the designated angle. After you finish this, you have all you need to make a basic search other than search algorithm.