Lab 1 Embedded Systems Lab Report

Objective

To navigate around a sequence of cinderblocks, making up a ‘wall’ containing gaps and both concave and convex corners, without touching it or deviating too far from it.

Method

• Avoid getting confused by gaps

• Turn concave corners (i.e. corners which the robot would run into were it to travel in a

straight line)

• Turn convex corners sharper

• Implement both the bang-bang and P-type controllers, each is contained in their own .java files. Build the “Stronger with Rotating US” robot.

Data

Bangbang controller:

motorHigh speed is 200, motorLow speed is 100.

Create variable deltaSpeed =50 as a speed buffer, for turning not sharp corner.

Create variables count and countBound to avoid getting confused by gaps.

When too far from the wall, leftMotor.setSpeed(motorHigh-deltaSpeed);

rightMotor.setSpeed(motorHigh)

When too closed from the wall, either rightMotor.stop();

leftMotor.setSpeed(motorHigh);

or

leftMotor.setSpeed(motorHigh);

rightMotor.setSpeed(motorHigh-deltaSpeed);

When turning a convex corner

leftMotor.setSpeed(80);

rightMotor.setSpeed(motorHigh);

pc controller:

The way to calculation distance correction:

public int calcP(int error){

int correction;

if (error<0){

error = error\* (-1);

}

correction = (int)(PConstant\*(double)error);

//Pcconstant = 10;

if (correction>= motorStraight){

correction = MaxCorrection;

}

return correction;

}

Summary: correction is depends on the error between distance and bandCenter.

Correction = error\*10 until it reaches maximum value(100).

Data analysis

Bangbang controller:

Each time if robot detect a distance value that is too large from the bandCenter (In the code, this threshold is twice bigger than bandCenter), robot will enter a mode to detect if it is facing a gap or a convex corner. During each detection loop, count will increase 1.

Set countBound = 60, the detection loop will operate 60 times, approximately equals to 3s in total. If during any loop, robot detect value smaller than threshold, it will exit detection mode, which means robot is facing a gap. When count pass over conntBound, robot will operate turning convex corner method.

PC controller:

Correction is depends on the error between distance and bandCenter. Correction = error\*10 until it reaches maximum value(100).

Observation and conclusion

When ultrasonic sensor is too far from the object(>255cm) or too close to the object(<1), it produces false positives very often. The value returns from sensor is significant large (usually >2000).

Further improvements

1/ Fix the position of ultrasonic sensor. Don't let sensor rotate and oscillate.

2/ Install the sensor as close to the left wheel as possible. In this case, the radius of turning will be smaller, therefore the risk of collision with the wall while turning will be lower.

3/ Use timer instead of filter. When sensor detects errors or gaps, robot starts timer. During the timer period, keep checking the sensor value, and after timer stop, take corresponding action.