EE445M Lab 6 Report

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1 Objective

The goal of this lab is to prepare for the final Robot race. In this lab we will interface various components, including Ping)))) ultrasonic distance sensor, IR distance sensor, and DC motor. A layered communication system using CAN protocol will transmit the information between two microcontrollers. We will design and implement a software communication protocol to transmit the sensor data and other things.

In this lab we will also form a team of 4 or 5, which requires us also to apply communication skills to function as a team.

2 Hardware Design

3 Software Design

4 Measurement

5 Analysis

(1) What is one advantage of the Ping))) sensor over the GP2Y0A21YK sensor?

Ping))) outputs a PWM signal which duty cycles changes linearly with respect to the distance, so it's easier to convert the raw data to distance.

(2) What is one advantage of the *2Y0A21YK* sensor over the Ping))) sensor

GP2Y0A21YK measures the distance by an analog voltage. It is easier to convert voltage to digital data using ADC compared to measure time in Ping.

(3) Describe the noise of the *GP2Y0A21YK* when measured with a spectrum analyzer.

The noise of the sensor is periodic square waves. An square wave contains all different frequencies, with Maximum amplitude at the frequency of the square wave. You can see that the spectrum detects many different frequencies.

(4) Why did you choose the digital filters for your sensors?

What is the time constant for this filter? I.e., if there is a step change in input, how long until your output changes to at least 1/e of the final value?

Since the transition bandwidth of the analog filter is too large for a 2-pole low-pass filter, therefore we use the digital filter to filter out the noise.

An analog filter with higher poles is more expensive.

Since we're using a 51 point FIR filter, and $1/e = 0.36$, we need to sample about 17 points to get enough data to represent 0.36 of the input.

Therefore, time constant $= \frac{17}{f_c} = 8.5\,ms$

(5) Present an alternative design for your H-bridge and describe how your H-bridge is better or worse?

Alternate design :

(6) Give the single-most important factor in determining the maximum bandwidth on this distributed system. Give the second-most important factor. Justify your answers.

Since the system bandwidth was much less than the most possible theoretical bandwidth according to bit rate, the most important factor is the amount of time needed to prepare a package to be sent in the CAN driver, and the amount of time to receive and interpret an incoming package.

The second-most important factor is the bit-rate that determines the amount of time it takes for a single package to be transmitted over the bus.

6 Post-Mortem Team Evaluation