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LAB 9 REPORT

1. THEORY:

- We live in a world in which everything is analog. That means that measures in the real world do not come in ones and zeros so that computer can easily understand them. That is why we have analog to digital converters.
  The first feature to notice in an ADC is the vertical resolution, that is, the smallest signal that causes a change in the output. The one we have used is ADC12, that distinguishes between 2^{12} different values or (0 to $2^{12}-1$). The more vertical resolution, the more precise an ADC is. When we set up an ADC, it is important to know the reference voltages. This will allow us to set a formula to transform the analog input into a digital output.

The first program in the tutorial samples the temperature of the board in real time and in Celsius and Fahrenheit. The ADC uses an internal reference of 1.5V and just one channel (A10) which is reserved for the temperature sensor. The sensor works this way. It outputs a certain voltage proportional to the temperature. We then take that value and turn it into one that is between 0 and 4095 and get its temperature.

The second program in the tutorial plots the power percentage the joystick is outputting in the UAH serial app. Since there are two axis the joystick, we use two channels (A0 and A1). We also use timer A to do 10 samples per second; since there are two axis the program sends 20 samples per second. The reference voltage is 3V.

FORMULAS

Our board has an integrated temperature sensor. The internal voltage generator gives ys a Vref+ = 1.5V and a Vref- = 0V. After deriving the equations, we get that:

TEMP = $\frac{(4095*\frac{Vtemp}{1.5}-2692)*423}{4095}$ where Vtemp is the voltage that the sensor outputs in proportion of the temperature. If Vref+ = 2.5V the equation will not change a lot. Just the denominator when finding the adc result.

For the accelerometer, our Vref+ = 3.3V and Vref- = 0V. To know the Volts the sensor gives depending on the analog value we have that V = $\frac{3*ADC}{4095}$. By this we get that if the ADC reads 4095 (max), voltage will be 3 V (our max). Now we need to turn that into gs. The accelerometer reads values between -3g and 3g. The formula for g is g=(Vin-Veq)/S. Here Veq corresponds to half the accepted voltage, that will result in 0g. S is the V/g that can be seen in the reference sheet and in this lab, we have used 0.3. So, our final formula is g = $\frac{\frac{3*ADC}{4095}-1.5}{0.3}$.