67ECE-3226/CSCI-3451 EXPERIMENT #8

Pulse Width Modulation/Analog-to-digital conversion

Objective:

To get familiar with the PWM and Analog to Digital converter of the Amega32A Microcontroller

Pre Lab:

Please turn in the following parts as pre lab.

Part2 First week

Show all your work.

All equations and calculations should be included in your pre lab.

Part6-B Second week

Show all your work.

All equations and calculations should be included in your pre lab.

Procedure:

Part 1) Using the Timer0/Counter0 subsystem:

One of the applications of the PWM is controlling the servo motors. The output of the PWM can supply pulses to rotate servo motors. The following link provides information regarding operation of the servo motors.

http://www.servocity.com/html/how_do_servos_work_.html

Part 2) Use the PWM mode of the Atmega32A to write a program such that:

a. Outputs a pulse with a pulse width of 1ms and period of 20ms continuously, upon receiving a high to low transition from SW0.
(Note: Check the signal for returning to high.)

b. Outputs a pulse with a pulse width of 1.17ms and period of 20ms continuously, upon receiving a high to low transition from SW1.
(Note: Check the signal for returning to high.)

c. Outputs a pulse with a pulse width of 1.33ms and period of 20ms continuously, upon receiving a high to low transition from SW2.
(Note: Check the signal for returning to high.)

d. Outputs a pulse with a pulse width of 1.5ms and period of 20ms continuously, upon receiving a high to low transition from SW3.
(Note: Check the signal for returning to high.)

e. Outputs a pulse with a pulse width of 1.67ms and period of 20ms continuously, upon receiving a high to low transition from SW4.
(Note: Check the signal for returning to high.)

f. Outputs a pulse with a pulse width of 1.84ms and period of 20ms continuously, upon receiving a high to low transition from SW5.
(Note: Check the signal for returning to high.)

g. Outputs a pulse with a pulse width of 2ms and period of 20ms continuously, upon receiving a high to low transition from SW6.
(Note: Check the signal for returning to high.)

Part 3) Connect the output OC0 pin (PB3) to the servo's white wire on the STK500 board. The red wire should be connected to a VTG and the black wire should be connected to ground (GND) on the STK500 board. A paper protractor will be placed on the motor.

Part 4) A. Apply a high to low transition on SW0 and observe the rotation on the servo motor.

B. Repeat Part A for the remaining switches.

Part 5) Write a detailed conclusion from your observations of part 4.

Part 6) Using the Analog to digital subsystem:

A. The LM34CA temperature sensor will be used. The following link and section 13.3 of the textbook ((Mazidi) provide information for the sensor.

https://datasheet.octopart.com/LM34DH-National-Semiconductor-datasheet-22596.pdf

B. Use the A/D subsystem of the Atmega32A to write a program such that reads the analog voltage from the output of the sensor (10mV/^{o}F):

i) Displays the temperature on LEDs of the board.

ii) Applies appropriate length of pulse (use PWM) to turn the servo motor:

0 degrees for temperatures between 0 - 31^{o} F range.
30 degrees for temperatures between 32 - 40^{o} F range.
60 degrees for temperatures between 41 - 50^{o} F range.
90 degrees for temperatures between 51 - 60^{o} F range.
120 degrees for temperatures between 61 - 70^{o} F range.
150 degrees for temperatures between 71 - 80^{o} F range.
180 degrees for temperatures between 81 - 90^{o} F range.

C. Connect the output of the sensor to the ADC0 (PA0) pin.

D. Observe the temperature change on LEDs and rotation of the servo motor.

Part 7) Write a detailed conclusion from your observations of part6-D.