Experiment 10 Fall 2012

Electronic Multi-Meter - A Voltage, Temperature, and Light Meter

Due: Week 11 Lab Sessions (11/06/2012)

For the voltage, light and temperature gauges described below use keys from the keypad to select i) temperature measurement (with choice of degrees Celsius or degrees Fahrenheit), ii) light measurement, iii) voltage measurement, and iv) A/D output.

I. Design and Implement a digital voltmeter (with 0.2 volt accuracy.) Use the ADC0804 A/D converter in free-running mode for 8-bit data conversion. See example setup from lecture notes. Test and verify the accuracy of your voltmeter.

II. Design and implement an electronic temperature gauge using a NanoCore12 built-in 8-bit analog to digital converter and a NTC semiconductor thermistor.

Make a voltage divider using the thermistor and a resistor (10K recommended) in series with the system power supply Vcc. The output of the divider will be the input to the A/D converter. Determine a method for converting the voltage from the divider into accurate temperature values and display the temperature on the LCD display. The system should allow the user to choose to display temperature in degrees Celsius or degrees Fahrenheit. Your system should be accurate over a reasonable range of temperatures.

Test and verify the accuracy of your temperature gauge. Comment on the accuracy of your gauge.

How would you improve on the accuracy of the gauge?

How could you increase the range of your gauge?

III. Design and implement an electronic Light gauge using a built-in 10-bit analog to digital converter of the NanoCore12 microcontroller and a photo cell in series with an appropriate resister. Photo cell. The output for the light meter should give five light ranges. Using your own eyes as a gauge, determine and display the five ranges of light as Dark, Medium Low, Medium, Medium High, and Bright Light. Note that the photo cell is very non-linear so dividing the range 0 to 1023 into five equal size ranges will not work to accommodate the five ranges above. Use your eyes and good judgment to determine the range breakpoints.

Give your device a product name.

At power up or reset the display should i) identify the device by the product name, ii) give instructions on how to choose the measured quantity, iii) if measuring temperature have a choice for temperature in degrees Celsius or degrees Fahrenheit.

After power up or reset the user should be able to change between measurement type without having to do a RESET.

For any measurement type the user should have a key to select making a change in the display from the normal measured units to a display of the n-bit output from the A/D converter in HEX, Binary, and Decimal. Example: if the voltmeter displays 2.5 volts then the display should change to: A/D value is: HEX = $80H, Binary = 10000000, Decimal = 128

Your report should include all of the standard sections in addition to the above inclusions.

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ECE 367: Experiment 9
Electronic Multi-Meter - A Voltage, Temperature, and Light Meter
Semester: Fall 2012

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Lab Section: T11

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User Manual:

This device is an electronic voltage meter, a thermometer, and a light meter. The user should first supply power to the circuit and then press the reset button to clear the display. On startup, the device is a voltage meter. The voltage meter can detect the voltage difference between its inputs. The thermometer displays the temperature in Celsius or Fahrenheit. The light sensor detects five different brightness values from dark to intense. All readings will be placed in the LCD display along with its binary equivalent, decimal equivalent, hexadecimal equivalent, and voltage equivalent.

'A' sets the device to volt meter mode

'B' sets the device to Celsius thermometer mode

'C' sets the device to Fahrenheit thermometer mode

'D' sets the device to light sensor mode

Questions:

Comment on the accuracy of your gauge.

My gauge does range from 0 to 5 volts exactly so it is pretty precise.

How would you improve on the accuracy of the gauge?

I could improve on the accuracy of the gauge by using more bits to do the conversion. The 9S12 allows 10 bit input modes. Another method to improve on the accuracy is to average multiple samples.

How could you increase the range of your gauge?

I could increase the range of my gauge by multiplying by difference values. For example, with 8 bits and 5V, each unit represents about 0.02V. For a larger range, use a larger voltage per a bit.

Give your device a product name.

Analog to Digital Ulti-meter

Conclusion:

Yes, my circuit meets the specifications and function properly.

I had trouble testing the volt meter, but it just turns out that I just messed up the potentiometer wiring. I also had trouble understanding why the given methods to take data work because we never mentioned portM2. . I had trouble with displaying the binary digits, decimal digits, and hexadecimal digits because I originally programmed it to use accumulator A and B to compute each digits. However, when attempting to display the binary digits from the light sensor (which uses 10 binary digits), the previous implementation did not work well so I had to restart writing to code to write to the LCD display using the IDIV op-code. Furthermore, I often messed the conversion by missing a few instructions or leaving in/out extra bits while doing the IDIV.

I would do this project differently by combining each output as one, like I normally intended to. However, the extra 2 bits from the light sensor raised a need for a new method.

The extra feature I have implemented is that instead of having to select the display format, the LCD display shows all of them together. This means that the user can look at the binary, decimal, hexadecimal, and voltage all at once.

I learned about A/D conversion, photocell, thermistor, division, and 2-byte number manipulation.