Principles of Embedded System Design (ESD505)

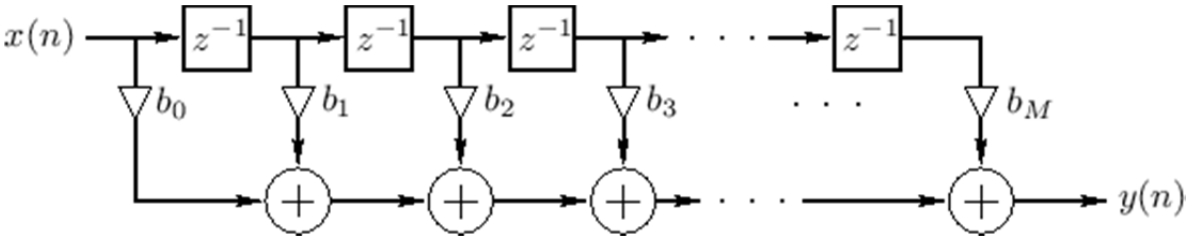
Assignment (14th Aug 2014) To be submitted by 18th Aug 2014

1. How many switching functions of n variables are possible? How many switching functions of n variables are there which actually involve all the variables? Note that f(x,y) = x+y is a function of both x and y. While f(x,y) = x involves only x.

2. Reading exercise: Chapter 1 & 2 of Wayne Wolf's book. Chapter 1 for a systematic method of designing embedded systems by putting down requirements, specifications, Architecture, Components and System integration aspects as clearly as possible. There is also some discussion on use of UML (Unified Modeling Language). A clearly specified design should be verifiable and implementable by anyone anywhere who understands the language.

3. Design a combinational circuit to find 4bit Quotient and 4bit Remainder when fed with two 4 bit positive numbers.

4. Write a C code to compute y (n) for 0 <= n < N, given integer x(n) and all past values of x(refer the figure given below). Assume that x(n) = 0 for n < 0; Coefficients b are integers. Find the number of multiplications, additions and shift operations required for computing N values of y. Assume zero initial conditions for the FIR filter.



Write a C code to use circular buffer to avoid shift operations by suitable modification.

5. Consider an embedded system which accepts two channel 16bit audio inputs whose frequencies are in the range of 300Hz to 17KHz and two camera inputs at a frame rate of 30 frames/second and 320x240 frame size with each pixel having R,G and B components having 8 bit resolution. Calculate the amount of memory needed to store 1 second input data. Embedded system does FIR filtering on audio channels with 64 coefficient FIR filter and 9 sample median filtering on the image. If each operation takes 1 clock cycle of the embedded system which runs with a clock speed of 600MHz does the system work in real time? Median filtering is done for each pixel, say p(x), by considering its 3x3 neighbors. Arrange 9 pixels including p(x) in ascending order and replace p(x) by the middle value. Such filters are useful to reduce salt and pepper noise. Assume memory access time is also 1 clock cycle.

6. Write a C code for finding integer roots of a quadratic equation with 32 bit integer coefficients. If integer roots don't exist a message must be printed out.

"There are no secrets to success. It is the result of preparation, hard work, and learning from failure." -- Colin Powell