University of British Columbia
Electrical and Computer Engineering
Electrical and Biomedical Engineering Design Studio
ELEC291/ELEC292

Module 2 – Interrupts / Alarm Clock

Introduction

Interrupts are very important and useful for embedded systems. An interrupt is an event that triggers the automatic execution of a predetermined piece of code. The code used to handle interrupts is often referred as the Interrupt Service Routine (ISR). The normal or default flow of code in a microcontroller system can be interrupted by different events, for example: timers overflowing, external events, critical errors (such as division by zero or illegal op-codes), power failure, communication events, etc. In this module you will be using timer interrupts in the AT89LP52 microcontroller in assembly language.

References

A51 (8051 assembler) user manual included with CrossIDE. 'A51.pdf' not only describes how to use the assembler, but also includes a detailed description of all the instructions supported by the 8051 family of microcontrollers.

AT89LP52 Microcontroller Datasheet. Information about timers and other hardware peripherals in the AT89LP52 can be found in the datasheet.

Pre-laboratory

1) Draw in your notebook the block diagram of timer 1 working as a 16-bit timer.
2) Write down the assembly instructions to set and enable timer 1 interrupts using the AT89LP52 microcontroller.

Laboratory

1) Provided in the web page for the course is the example "ISR_example.asm". This demonstration program carries three 'concurrent' tasks: a) Increments (when P0.0=1) or decrements (when P0.0=0) a BCD variable every half second using an ISR for timer 2; b) Generates a 2kHz square wave at pin P3.7 using an ISR for timer 0; and c) in the 'main' loop it displays the variable incremented/decremented using the ISR for timer 2 on the LCD and resets it to zero if the 'BOOT' pushbutton connected to P4.5 is pressed. Download, compile, and load the program into the AT89LP52 microcontroller system and verify its correct operation using the lab oscilloscope to check the 500.000Hz square wave output of pin P3.6.

2) Write/compile/run an assembly program for the AT89LP52 microcontroller system with LCD for an alarm clock. The alarm clock must display hours, minutes, seconds, and AM/PM using the LCD. The clock's current time (hours, minutes, seconds, and AM/PM), must be settable using pushbuttons. The clock must have at least one settable alarm. When the alarm is trigger, a speaker should produce an alarm sound. Use the mini speaker available in the microcontroller system parts kit for this purpose. Don't forget to add extra functionality and/or features for bonus marks!