

## Project A – Timer and Calculator

### Introduction:

You are expected to develop a count-up and count-down digital timer. It includes a keypad input and LED display. It is also expected to perform simple arithmetic calculation on single-digit decimal data. The project will cover most of the I/O assignment, interrupt and timer usage. User-friendly design and functionality are expected.

### Functional Requirements:

#### As timer

- ◇ Counting with the time interval of 1 second.
- ◇ Count up and count down from any preset initial value.
- ◇ “Start”, “stop” and “reset” functions
- ◇ Buzzer for one cycle overflow

#### As calculator

- ◇ Perform +, -, ×, ÷ for a pair of single-digit decimal input data  
e.g.  $3 \times 5 = 15$
- ◇ For division, only the quotient is displayed
- ◇ Use an additional LED to represent the sign (+ or -)
- ◇ “Clear” function

#### Display

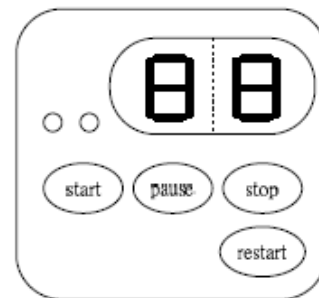
- ◇ At least two digits
- ◇ Either 7-segment LED or dot matrix LCD

#### Input

- ◇ 4-by-3 keypad
- ◇ For the preset of timer’s initial value and the input of calculator

#### Optional features

- ◇ Pause control function
- ◇ Additional LED for counting number of overflows
- ◇ Display of the remainder for division operation (by press a button)



1	2	3
4	5	6
7	8	9
*	0	#

## ***Project B – Monotonic Frequency Detector***

### ***Introduction:***

The detector is able to detect / capture the frequency of a periodic input signal. You can imagine it as a detector for tuning the musical instrument in the right scale by playing the note that is matched with the detector's expectation. However, it is not required to use a true audio signal. Artificially generated signals can be used for simulation.

### ***Functional Requirements:***

#### ***Frequency detection:***

- ◇ Accept frequency from signal generator with 5 Vpp (square wave)
- ◇ Detectable frequencies (C D E F G A B):

C	D	E	F	G	A	B
256 Hz	298 Hz	341 Hz	384 Hz	405 Hz	448 Hz	490 Hz

- ◇ Error:  $\pm 10\%$

#### ***Display options:***

- ◇ 7-segment LED for display of frequency
- ◇ LEDs for detection result

#### ***Optional feature:***

- ◇ Detection of audio signals generated by guitar or other instruments.

