3C8 Project – Combination Lock Project

The goal of this project is to design, build and test a circuit that implements a 4 digit combination lock. Your circuit will have to interface with a numeric keypad, an electronically controlled lock and a buzzer. The keypad has 12 keys, 10 numeric keys and * and # keys. Both the lock is unlocked and the buzzer is sounded when a logical high is applied to their respective inputs. The circuit should be built using CMOS 4000 series ICs only. The circuit must be built to the following specifications.

1. The circuit should detect the entry of a pre-determined 4 digit code and produce an unlock pulse to the electronically controlled lock. When an incorrect code is entered the buzzer should sound an alarm. You need to determine appropriate periods of time for alarm and the unlock signal pulses.
2. The * and # keys should be mapped to enter and clear functionalities respectively. When the enter key is pressed, the circuit checks to see that the correct code had been entered. When the clear key is pressed the currently entered set of numeric values should be reset.
3. Should the incorrect code be entered on 3 consecutive occasions, then the circuit should be disabled for a number of minutes. i.e. all inputs should be ignored and the circuit should not generate lock or alarm signals.
4. The circuit should contain 4 7-segment displays to signify the entry of each digit of a code. For security purposes the 7-segment displays should display a hyphen for each digit entered rather than the value of the digit itself. Pressing the clear button should cause all of the segments to switch off. The segments should also be cleared after the correct code is entered or the alarm is sounded. Finally the 4 hyphens should remain lit while the lock is disabled.

PIN CONNECTIONS

Pin Number*	Key	Pin Number*	Key
1	GND	8	5
2	*	9	2
3	7	10	#
4	4	11	9
5	1	12	6
6	0	13	3
7	8		

*Pin numbers are read from left to right when facing the side of the keypad with the keys

A Note on Circuit Design & Testing

Your circuit design should come about in a top down manner. Initially you should conceive the overall circuit functionality and specify the inputs and outputs required for the circuit. Then you will have to break down your circuit into a number of high-level interlinking blocks or units. It is your job to determine what the units are and determine the required inputs and outputs of the units. Finally, the schematic for the units can be designed.

As with the dice mini-project you will be expected to use an Arduino or BASYS 3 to conduct tests on your circuit. You will have to write tests for the overall circuit operation as well as for each individual unit. It maybe be necessary to write multiple tests for each unit. For example, it may be necessary to test your circuit for invalid as well as valid usage cases. You will have to include details of your unit tests in your report.

You must ensure that the circuit schematics are drawn and your code is written in a neat manner. Neatness is essential for effective communication as it enables your design to be readily readable to your fellow engineers. It is recommended that the schematic for each unit will be drawn on a separate page inside your Multisim projects. Your test code must be properly commented, formatted and indented, and must adhere to some conventions for variable and function names etc. Marks will be awarded for neatness in your reports.