

Lab3 Assignment

Note that all students are required to work on this lab assignment in teams of two. Teams cannot change during labs. The deadline for team member changes (email instructor) is Thursday, February 23. A change in team members will result in a loss of bonus points for consistency/teamwork (i.e., same partner for all labs and project).

For Lab3, one report per group is sufficient. All software development for Lab3 must be done in assembly language.

Note that each team member must be able to explain all hardware and software components.

Objective

Gain some experience with digital I/O, timers, complex timing issues, and rotary pulse generators (RPGs).

Mid-lab review (March 1) - show the TA your progress towards completing the lab (see below)

Deadline: March 8 (see calendar on ICON for checkoff sign up)

Lab Description

In this lab, you will construct a simple electronic door lock system. This device will be capable of accepting a 5 digit hexadecimal code. Each lab group must use a different unlock code (see Appendix). The device must utilize a rotary pulse generator (RPG), an 8-bit shift register, a pushbutton switch, and a 7-segment LED display. The code must be entered by utilizing the RPG and a pushbutton switch.

When the device is powered on, it will show “-” on the 7-segment LED display. The RPG is utilized for selecting a value for each hexadecimal digit (Fig. 1). A clockwise (CW) operation of the RPG will increase the displayed value (“-” -> “0” -> “1” -> ... -> “F”), and a counter clockwise (CCW) operation of the RPG will decrease the displayed value (“F” -> “E” -> ... -> “0”). To confirm the selection and enter the next hexadecimal digit, the user needs to press the push button for less than 1 second. If “F” is reached in CW operation, a further CW rotation will not change the display. Similarly, if “0” is reached in CCW operation, a further CCW rotation will not change the display.

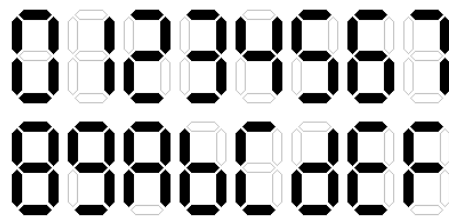


Figure 1. 7-segment-based display of hexadecimal digits.

After the last hexadecimal digit has been selected and the push button is pressed for less than 1 second, the code is compared to the pre-programmed unlock code. If the code is correct, the yellow *LED L* (see Arduino UNO v3 schematic) will be activated for 5 seconds. During this time, “.” will be shown on the display. Subsequently, the lock will display “-” and accept a new code entry. However, if the code is incorrect, the display will show “_” and only accept a new entry after 9 seconds.

To reset the entered code at any point during code entry, the user must press the push button for more than 2 seconds and “-” will be shown on the display. Subsequently, a new number can be entered by following the steps described above.

Note that all action must be applied once the pushbutton is released. Your implementation must use a suitable debounce approach for RPG and push button. Different approaches have been previously discussed in lecture.

Design the interface to the 7-segment display such that the current to drive a segment is equal to or less than 6 mA. Your implementation must utilize the *8-bit Timer/Counter0* hardware (at this stage without interrupts!) for generating all required time sequences. More details regarding the hardware timer will be covered in class, and the corresponding lecture slides and other relevant resources (e.g., data sheets) will be available on ICON.

After completing the assignment, upload your source code and report to ICON (note that one source code file and report per group is sufficient). If you plan to see a TA on the day the lab is due, a sign up for check off is required (see calendar on ICON).

Mid-lab review - Show a TA your progress towards completing Lab3 (use the ICON calendar for sign up). It is expected that you can demonstrate that your program successfully utilizes the RPG as an input device (interactive update of display).

Appendix

Codes for each lab group.

Lab3_01	7807C	Lab3_21	B1E27
Lab3_02	830EF	Lab3_22	DA181
Lab3_03	E2344	Lab3_23	65913
Lab3_04	C6B69	Lab3_24	546F4
Lab3_05	825D4	Lab3_25	AA5C4
Lab3_06	6D77D	Lab3_26	15347
Lab3_07	77FBC	Lab3_27	B6EFD
Lab3_08	D8D19	Lab3_28	80FE4
Lab3_09	55969	Lab3_29	87C51
Lab3_10	9E453	Lab3_30	5BC8F
Lab3_11	E220B	Lab3_31	7728B
Lab3_12	7E0E2	Lab3_32	3826C
Lab3_13	4D22E		
Lab3_14	65362		
Lab3_15	22725		
Lab3_16	A3800		
Lab3_17	E859A		
Lab3_18	AB058		
Lab3_19	54393		
Lab3_20	9E193		