Advanced Embedded Systems - Spring 2016

Creating a Digital Watch Prototype with the RX63N

Learning Objectives

You will design and program a prototype for a digital watch using the peripherals and features of the RX63N development board.

General Information

1. You will need an RX63N development board
2. Computers with the HEW IDE for programming the RX63N are available in EPIC 2130 and 2148

Laboratory Assignment Overview

In this lab the students will design, build, and program a digital watch using the RX63N development board. Use the RX63N's Real Time Clock (RTC) peripheral for accurately keeping track of the time. The digital watch will have 3 modes: display time, stopwatch, and set alarm. The LCD will be used for displaying the time and mode information, and the onboard speaker will be used for creating an alarm notification sound.

Requirements:

Req. 1. The code generated must be written in C for the RX63N.

Req. 2. The code must be well commented and easy to follow.

Req. 3. The RTC will be used for accurate tracking of time.

Req. 4. Switch 1 will be used to toggle between 3 modes: display time, stopwatch, and set alarm.

Req. 5. While in display time mode, the current time should be the only thing displayed on the LCD (Except for a set alarm indicator. See Req. 17.).

Req. 6. Pressing switch 1 in display time mode should change the mode to stopwatch.

Req. 7. Pressing and holding switch 1 down for 5 seconds in the display time mode should allow the time to be set.

Req. 8. In display mode, the time should be displayed as hours:minutes:seconds. Twenty four hour (Military) time may be used, so you do not have to bother with AM/PM times. (However, if you still want to, you may. This is optional)

Req. 9. When setting the current time, the first two digits (the hour indicator) should blink, while pressing switch 2 increments the value, and switch 3 decrements the value. Pressing switch 1 will set the hour, then begin blinking the next two digits (the minute indicator). Again, switches 2 and 3 will increment and decrement the value, respectively. Pressing switch 1 again will set the minutes value and move on to the seconds. Setting the seconds value will be performed the same way as the hours and minutes. Pressing switch 1 again will set the seconds and return to the normal display time mode. When a digit is not being set, the blinking should not continue.

Req. 10. While in stopwatch mode, the initial time should be set to 0 and displayed as 00:00:00 (hours:mintues:seconds).

Req. 11. Pressing switch 1 in stopwatch mode should change the mode to set alarm.

Req. 12. Pressing switch 2 in stopwatch mode should start the stopwatch.

Req. 13. Pressing switch 2 while the stopwatch is counting should pause the counting. Pressing it again will resume counting.

Req. 14. Pressing switch 3 while in stopwatch mode should clear the current count value.

Req. 15. While in set alarm mode, a default time should be displayed if a previous alarm time had not been previously set. If a previous time had been set, display that instead.

Req. 16. The alarm should be displayed in the same fashion as in the display time mode.

Req. 17. Pressing switch 1 while in set alarm mode should change the mode to display time and set the currently displayed alarm time.

Req. 18. While in display time mode, when the current time matches the set alarm time, an alarm sound should be played through the onboard speaker. The alarm should be within a clear, audible frequency.

Req. 19. Turning the potentiometer should increase or decrease the alarm volume.

Req. 20. While the potentiometer is being rotated, a volume percentage should be shown on the screen which represents the minimum and maximum volume. After a few seconds of no adjustment, the volume indicator should automatically clear and return to whichever mode the watch was in last.

Req. 21. Pressing switch 2 while in display time mode should toggle the alarm on/off. Add some kind of alarm set indicator to the LCD.

Req. 22. The LCD backlight should turn off after 15 seconds of no button activity, and turn back on when any button is pressed.

Req. 23. The designer may choose between the following options:

a. Replace the volume bar with a bar graphic which represents the volume level by filling up or emptying when the volume is adjusted.
b. Create multiple alarm sounds which the user can choose between.
c. Create a backlight mode which the user can adjust the brightness. The backlight should still turn off upon no activity on the watch.
d. The watch may enter a low-power state after a specified amount of time. In low power mode, the RX63N should enter a low power state, then re-awaken when movement is detected on the accelerometer passing a specified threshold.

To Submit:

- All C files used during the creation of the product. Code must be commented enough for the TA to understand what each line is doing.
- A zip file containing the files specified above.
- Your lab check-off sheet at the demonstration.
- A brief user manual describing the functionality of your product. The manual might include things like: How to operate the product, quick-start guide, troubleshooting, etc.

Embedded Systems Lab Demonstration Validation Sheet

This sheet should be modified by the student to reflect the current lab assignment being demonstrated

Lab Number:	Lab 1 – Digital Watch Prototype
Team Members	Team Member 1 : Team Member 2 :
Date:	

Lab Requirements

REQ Number	Objective	TA Review
1	Switch 1 will be used to toggle between 3 modes: display time, stopwatch, and set alarm.	
2	In display mode, the time should be displayed as hours:minutes.	
3	While in stopwatch mode, the initial time should be set to 0 and displayed as 00:00:00 (hours:mintues:seconds).	
4	Pressing switch 2 in stopwatch mode should start the stopwatch. Pressing switch 2 while the stopwatch is counting should pause the counting. Pressing it again will resume counting. Pressing switch 3 while in stopwatch mode should clear the current count value.	
5	While in set alarm mode, a default time should be displayed if a previous alarm time had not been previously set. If a previous time had been set, display that instead. The alarm should be displayed in the same fashion as in the display time mode.	
6	While in display time mode, when the current time matches the set alarm time, an alarm sound should be played through the onboard speaker. Pressing switch 2 while in display time mode should toggle the alarm on/off. Add some kind of alarm set indicator to the LCD.	
7	The LCD backlight should turn off after 15 seconds of no button activity, and turn back on when any button is pressed.	
8	Pressing and holding switch 1 down for 5 seconds in the display time mode should allow the time to be set. The setting of the time should perform as described in the requirements.	
9	The alarm volume should be adjustable by turning the potentiometer and display the current volume level as indicated in the requirements above.	
10	The option from Req. 23 is completed according the specifications of the requirements above.	