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Requirements Document

Lab 2 – Alarm Clock

Overview

Objectives

The objectives of this project are to design, build and test an alarm clock. Educationally, the students are learning how to design and test modular software and how to perform switch/keypad input in the background.

Process

The project will be developed using the TM4C123 board. **The switches will be used for user input**. The system will be built on a solderless breadboard and run on the usual USB power. The system will use the on-board switches and the on-board LEDs. The speaker will be external. There will be at **five** hardware/software modules: switch/keypad input, time management, LCD graphics, **heartbeat,** and sound output. The process will be to design and test each module independently from the other modules. After each module is tested, the system will be built and tested.

Roles and Responsibilities

EE445L students are the engineers and the TA is the client. Students are expected to modify this document to clarify exactly what they plan to build. Students are allowed to divide responsibilities of the project however they wish, but, at the time of demonstration, both students are expected to understand all aspects of the design.

Interactions with Existing Systems

The system will use the TM4C123 board, a ST7735 color LCD, a solderless breadboard, and be powered using the USB cable.

Terminology

Power budget	**Maximum power that the power supply can drive**
Device driver	**Interface between a device and a software module**
Critical section	**Multiple threads access shared memory locations/variables**
Latency	**The time between a service request and the process actually being serviced**
Time jitter	**The difference in the maximum latency and the minimum latency that occurs**
Modular programming	**Break up your software into modules with distinct tasks. Each of the modules should be kept separate so that you can easily debug or change specific features of your system.**

Security

The system will not include software from Tivaware, and the software modules will interact with the board at low level. No software written for this project may be transmitted, viewed, or communicated with any other EE445L student past, present, or future (other than the lab partner of course). It is the responsibility of the team to keep its EE445L lab solutions secure.

Function Description

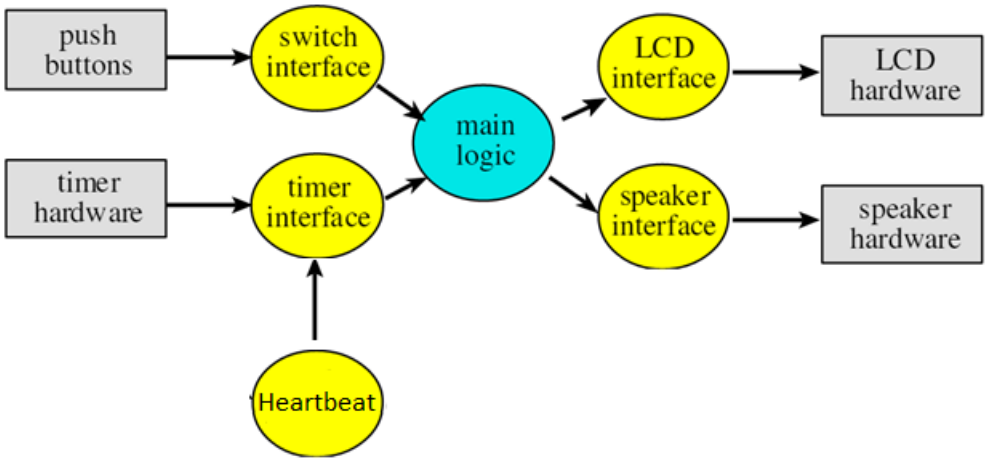
Functionality

The clock must be able to perform five functions:

1. Display hours and minutes in both graphical and numeric forms on the LCD. The graphical output will include the 12 numbers around a circle, the hour hand, and the minute hand. The numerical output will be easy to read.
2. Allow the operator to set the current time using switches.
3. Allow the operator to set the alarm time including enabling/disabling alarms
4. Make a sound at the alarm time.
5. Allow operator to stop the sound.

An LED heartbeat will show when the system is running.

Software Diagram



Scope

Phase 1 is the preparation; phase 2 is the demonstration; and phase 3 is the lab report. Details can be found in the lab manual.

Prototypes

A prototype system running on the TM4C123 board, ST7735 color LCD, and solderless breadboard will be demonstrated. Progress will be judged by the preparation, demonstration and lab report.

Performance

The system will be judged by three qualitative measures:

1. The software modules must be easy to understand and well-organized.
2. The clock display should be beautiful and effective in telling time.
3. The operation of setting the time and alarm should simple and intuitive.

The system should not have critical sections. All shared global variables must be identified with documentation that a critical section does not exist. Backward jumps in the ISR should be avoided if possible. The interrupt service routine used to maintain time must complete in as short a time as possible. This means all LCD I/O occurs in the main program. The average current on the 5V power will be measured with and without the alarm sounding.

Usability

There will be 2 switch inputs. In the main menu, the switches can be used to activate:

1. Set time
2. Set alarm
3. Turn on/off alarm
4. Display mode

The user will be able to set the time (hours, minutes) and be able to set the alarm (hour, minute). After some amount of inactivity the system reverts to the main menu. The user will be able to control some aspects of the display configuring the look and feel of the device. The switches MUST be debounced, so only one action occurs when the operator touches a switch once.

The LCD display shows the time using a graphical display typical of a standard on the wall clock. The 12 numbers, the minute hand, and the hour hand are large and easy to see. The clock can also display the time in numeric mode using numbers.

The alarm sound can be a simple square wave. The sound amplitude will be just loud enough for the TA to hear when within 3 feet.

Safety

The alarm sound will be VERY quiet in order to respect other people in the room during testing. Connecting or disconnecting wires on the protoboard while power is applied may damage the board.

Deliverables

Reports

A lab report described below is due by the due date listed in the syllabus. This report includes the final requirements document.

Audits

The preparation is due at the beginning of the lab period on the date listed in the syllabus

Outcomes

There are three deliverables: preparation, demonstration, and report.