1. Overview
   1. Objectives:

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

* 1. Process:

The project will be developed using the LM3S1968 board. There will be buttons for input and the system will be built on a solderless breadboard and run on the usual USB power. The system will use an external speaker and an LED to display a heartbeat. There will be five hardware/software modules: switch/keypad input, time management, OLED graphics, sound output, and menu. 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.

* 1. 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.

* 1. Interactions with Existing Systems:

The system will use the LM3S1968 board, a solderless breadboard, and be powered using the USB cable.

* 1. Terminology:
     1. Power budget: The amount of power available to be distributed between various components (for example, the speaker)
     2. Device driver: A program that operates or communicates with a device
     3. Critical section: A piece of code that accesses a shared resource
     4. Latency: Time delay (often between an input and a response)
     5. Time jitter: The deviation from periodicity in the regular timing interrupts
     6. Modular programming: A programming technique where different parts of the program are sectioned into self-contained modules based on a specific function.
  2. Security:

The system includes software fro StellarisWare and the book. 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.

1. Function Description:
   1. Functionality:

The clock must be able to perform five functions. 1) It will display hours and minutes in both graphical and numeric forms on the OLED. The graphical output will include the 12 numbers around a circle, the hour hand, and the minute hand. It will also display an AM/PM indicator when needed. The numeric output will feature both a 24-hour and 12-hour mode. The 12-hour mode will display an AM/PM indicator when needed. Both the numeric and graphical output will be easy to read. 2) It will allow the operator to set the current time using switches. 3) It will allow the operator to set the alarm time and enable or disable the alarm. 4) It will play pre-recorded music (The Empire’s Theme from Star Wars) at the alarm time. 5) It will allow the operator to stop the sound using the select button. An LED heartbeat will show when the system is running.

* 1. 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.

* 1. Prototypes:

A prototype system running on the LM3S1968 board and solderless breadboard will be demonstrated. Progress will be judged by the preparation, demonstration, and lab report.

* 1. Performance:

The system will be judged by three qualitative measures. First, the software modules must be easy to understand and well-organized. Second, the clock display should be beautiful and effective in telling time. Third, the operation of setting the time and alarm should be 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 jumpls 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 OLED I/O occurs in the main program. The average current on the +5V power will be measured with and without the alarm sounding.

* 1. Usability:

There will be five switch inputs: Up, down, left, right, and select. In the main menu, the left and right switches can be used to navigate between menu items 1) set time; 2) set alarm; 3) turn on/off alarm; and 4) display mode. When select is pressed, either the specified action is performed or a new screen is entered. In the set time and alarm screens, left and right switch between hour and minute increments, up and down change the hours or minutes, and select returns to the main menu. The display mode menu option toggles between graphical and numeric displays. The alarm on/off menu option turns the alarm on or off. The switches will be debounced, so only one action occurs when the operator touches a switch once.

The OLED display shows the time using 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 will be a hard-coded music file. The sound amplitude will begin just loud enough for the TA to hear when within 3 feet, and will increase until the alarm is reset.

* 1. Safety:

The alarm sound will be VERY quite 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.

1. Deliverables
   1. Reports:

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

* 1. Audits:

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

* 1. Outcomes:

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