Electrical Engineering Technology - WWU

“Scale Alarm Clock”

Project Description

Ryan Duvenez
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INTRODUCTION

For the Scale Alarm Clock, I plan to integrate a weight scale and alarm clock into a unique style alarm clock. The purpose of creating this unique alarm clock is to revolutionize the way people wake up. The Scale Alarm Clock will combine the functions of an alarm clock with a scale to wake the user effectively while providing a measurement of their weight. The uniqueness of the Scale Alarm Clock is that with an integrated scale the user will be forced out of bed on to the scale that will function as the snooze off of the alarm and as a body weight measuring scale. The user will still be able to program the alarm clock just like a normal alarm clock while benefiting from being provided with a morning health rating of their weight in pounds.

DESCRIPTION & SKETCH OF HARDWARE

Enclosed in a hard rectangular case, the Scale Alarm Clock will be designed for placement on a typical bedroom floor. Sitting roughly four inches off the ground and then two feet by one and a half feet, the Scale Alarm Clock will be a convenient size for just off someones bed or off in a corner.

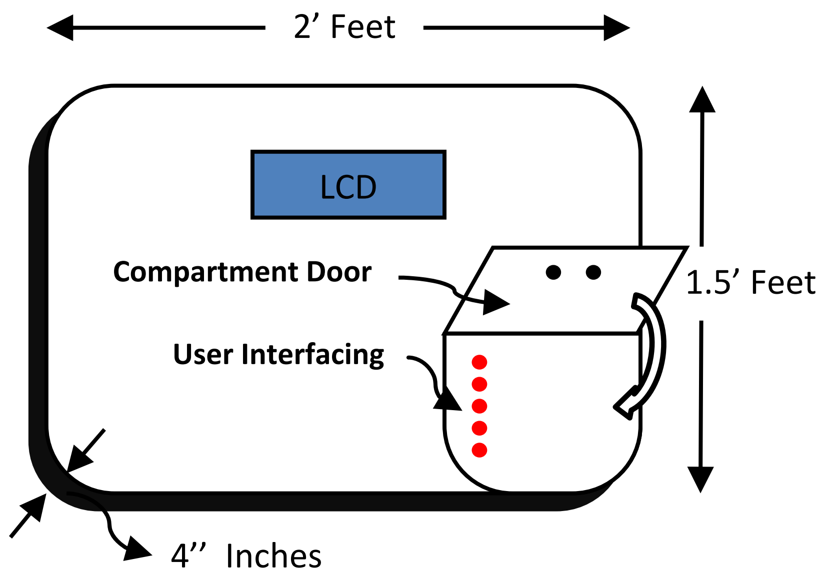

Figure 1. Project Hardware

DETAILED FUNCTIONAL DESCRIPTION OF HARDWARE

The Scale Alarm Clock will utilize the PSoC CY8C29466 microcontroller. This particular MCU provides most of our necessary analog components on the board with a total of 12 analog blocks. On the board, we will use a 16-bit ADC, an 8 pole low pass filter, and 4 op-amps with selective gain up to x48. The 4 op-amps will be used to build a programmable-gain amplifier with high gain to amplify the small output signal from the load cell sensor. The 8 pole low pass filter will be used to filter out the noise from the load-cell sensor for the ADC. The entire range of the 16-bit ADC will be used to provide maximum weight scale resolution. With 32 KB of flash ROM and 2 KB of RAM, the MCU has plenty of memory for coding of the alarm clock and scale functions. The maximum bus frequency(operating frequency) is 12.3 MHz. External to the MCU, we will need a load cell sensor, LCD display, user interface keypad, audio amplifier, and a speaker.

The Load Cell Sensor will convert the weight force of the user to a usable electrical output. Use of a HANYU AMQ Load Cell will suffice. Providing 150Kg load cell cap, and rated output of ~1.2mv/v, the load cell will be configured with the board's Op-amp, LPF, and ADC.

The LCD will constantly display time and the weight when the user is on the scale. Using a two line character, 2x20, LCD display would fit a constantly displaying clock time leaving room for a display of body weight when needed. Using a 4-bit LCD will require 8 I/O pins from the PSoC MCU for control.

Included in the user interface will be our LCD display and seven buttons to set and control the alarm clock. The buttons will be found under a compartment door on the face of the casing. Button functions include set time, set alarm, hour-increment, minute increment, volume up, volume down, and alarm off. The common snooze function of the alarm clock will be coded in as pressure on the load cell sensor snoozing the alarm and activating the scale. Each clock function button will require an I/O port. Finally, when the alarm goes off it will be sounded through a speaker which is signaled by the MCU’s DAC and an external audio amplifier.

The Scale Alarm Clock will be power with the 120 V_{AC} wall outlet a converted to $12V_{DC}$ by a AC adapter. The recommended supply voltage for our MCU, Load-Cell Sensor, Audio Amplifier, and LCD is less than $6V_{DC}$. Using a switchable power supply we can achieve a supply voltage of $5V_{DC}$ to power our MCU and external components.

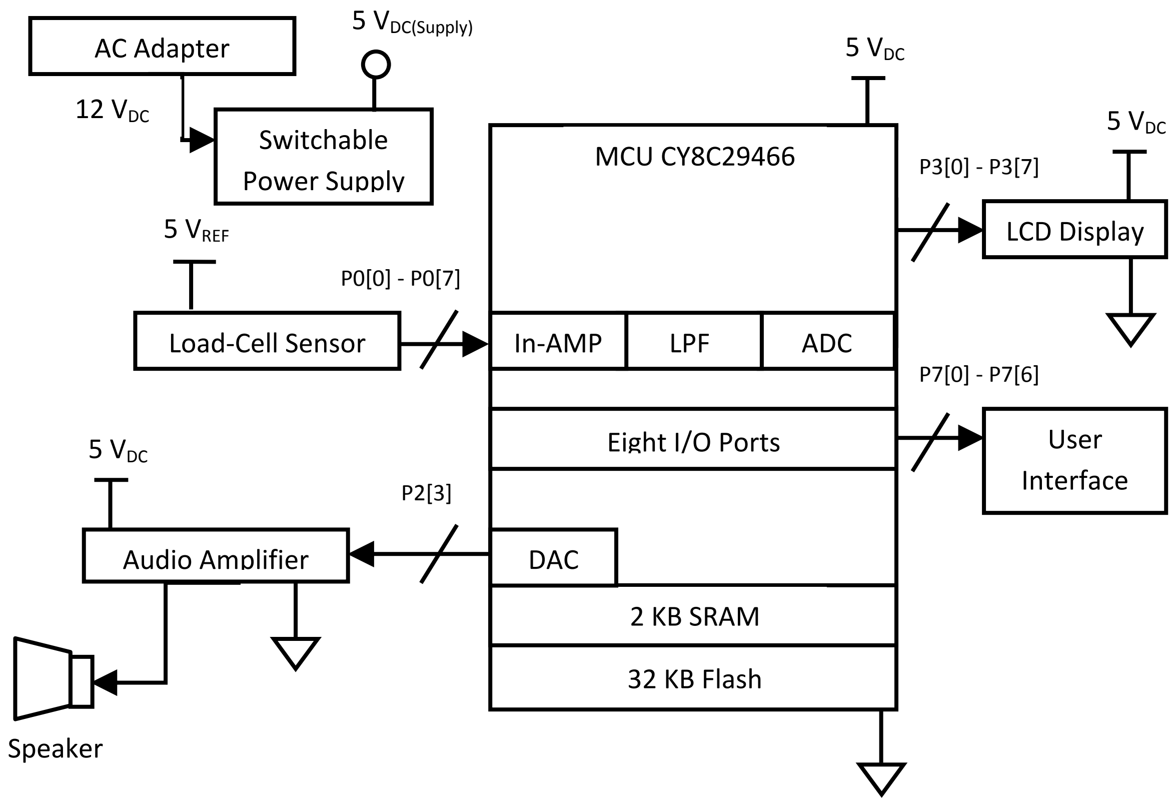

Figure 2. Block Diagram of Major Components

DESCRIPTION OF SOFTWARE REQUIREMENTS

The language of the Scale Alarm Clock will be written in the C programming language. The Scale Alarm Clock will need a User Interface module, Clock module, Display module, and Scale module. The Clock Module can be seen below, User Interface can be seen later, the Display module will control the display off the clock and scale modules.

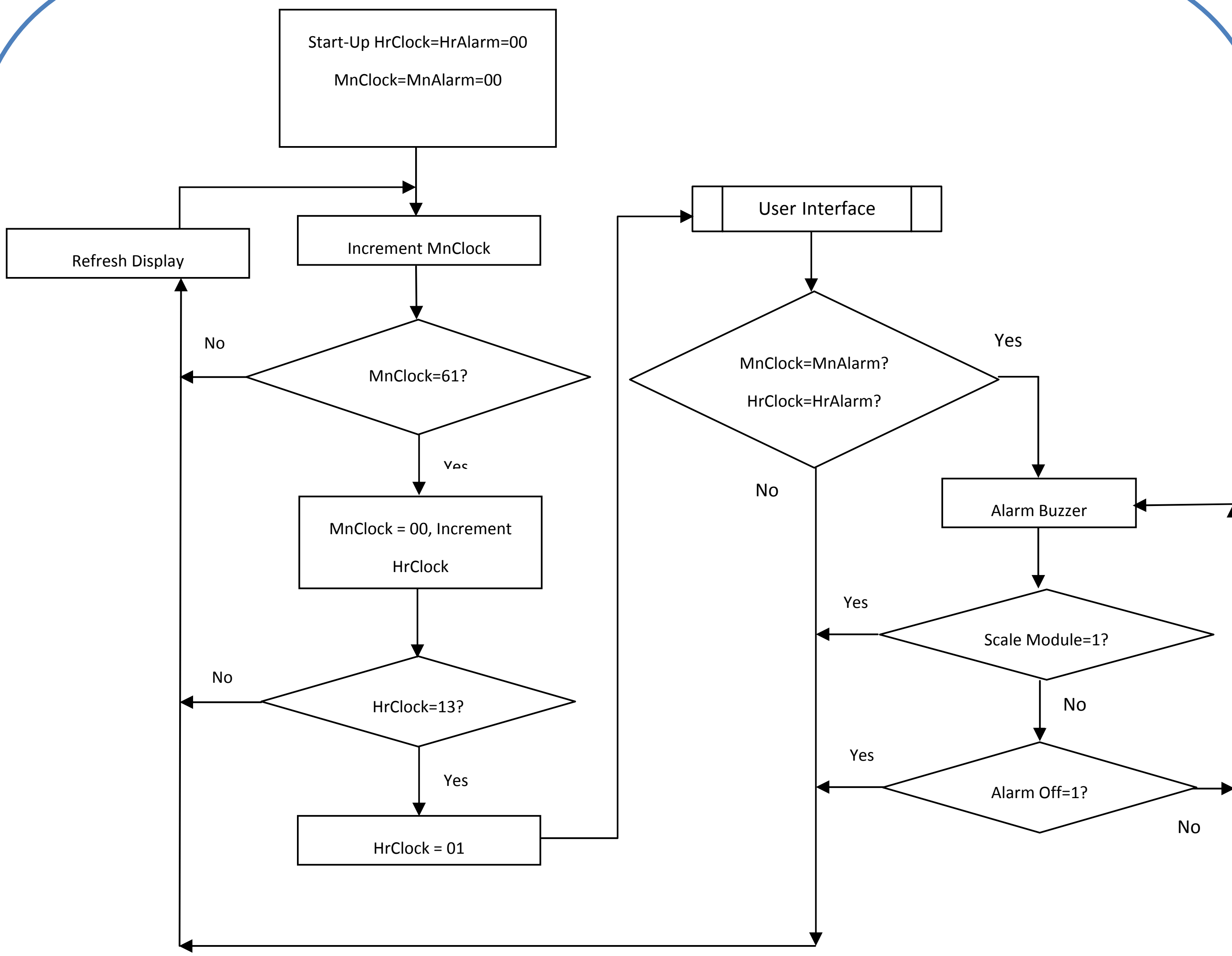

Figure 3. Block Diagram of Scale Alarm Clock

DETAILED DESCRIPTION OF USER INTERFACE

The user interface consists of 7 push buttons, Scale, and LCD display. The buttons will be volume up, volume down, set alarm, set time, hour increment, minute increment, and alarm off. The LCD will display time. The user input and activity will be recognized by the Scale Alarm Clock through the LCD display. Below is the push buttons and how they will be implemented. The LCD and Scale interface modules can be seen above.

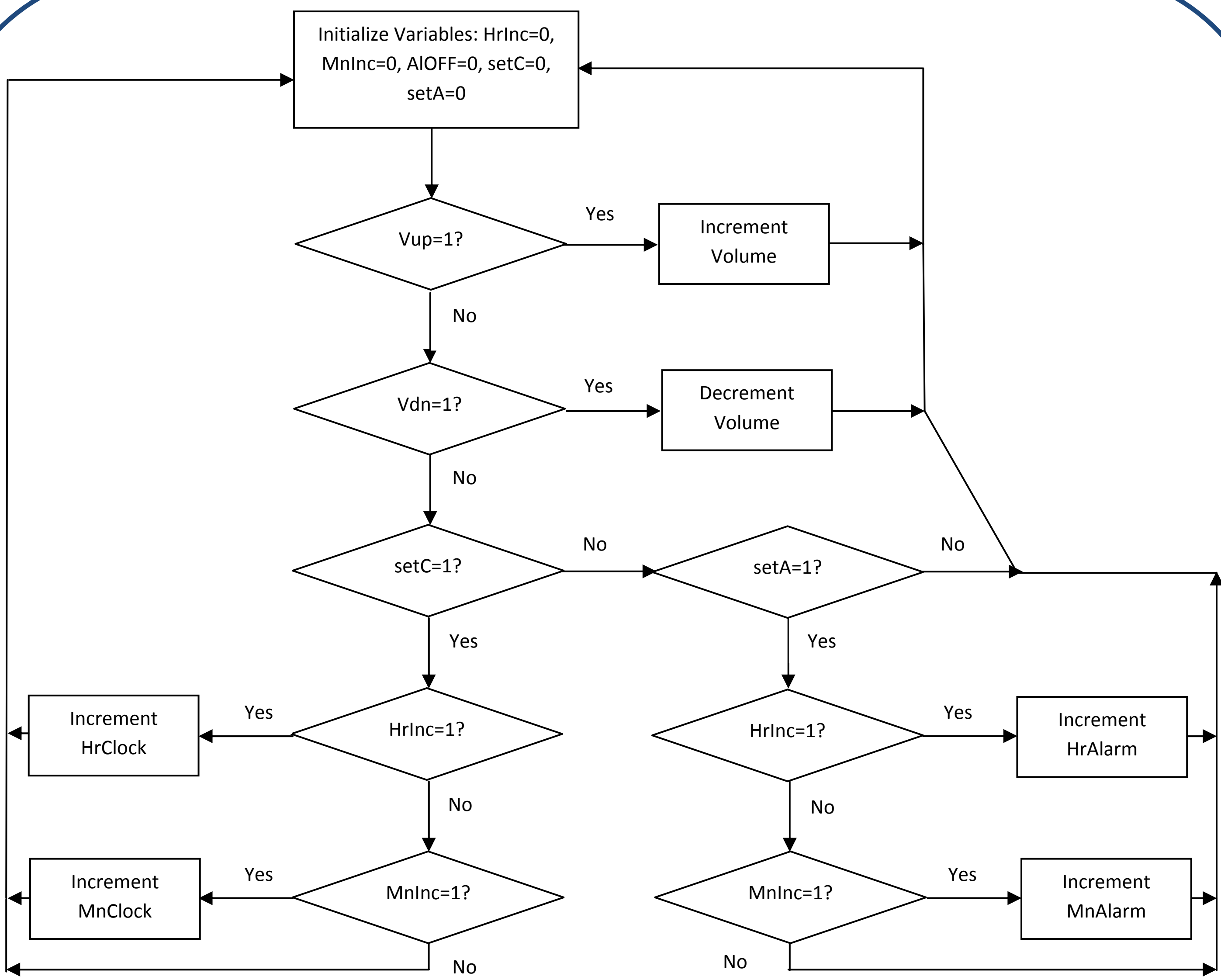

Figure 4. Block Diagram of the User Interface

DEVELOPMENT PLAN

Production of the Scale Alarm Clock prototype will take place Winter and Spring quarters of the 2011-2012 academic year. I will be setting weekly goals to be kept and updated as development progresses. Below is the starting schedule to be worked over the remaining production time.

Project Schedule

Week #	Dates	Objectives
Winter Quarter:		
1	Jan 3 - Jan 8	Get Parts and Equipment
2	Jan 9 - Jan 15	Start Developing User Interface
3	Jan 16 - Jan 22	Develop User Interface
4	Jan 23 – Jan 29	Develop and Test User Interface
5	Jan 30 – Feb 5	Develop and Test User Interface
6	Feb 6 – Feb 12	Test User Interface
7	Feb 13 – Feb 19	Start Work on Scale
8	Feb 20 – Feb 26	Integrate Scale with the MCU
9	Feb 27 – Mar 4	Integrate Scale with the MCU
10	Mar 5 – Mar 11	Scale and Dead Week
11	Mar 12 – Mar 16	Finals
Spring Quarter:		
1	Mar 27 – Apr 1	Get Parts and Equipment if Needed
2	Apr 2 – Apr 8	Final Testing of Scale
3	Apr 9 – Apr 15	Start Building Alarm Clock
4	Apr 16 – Apr 22	Hardware Reviews
5	Apr 23 – Apr 29	Code the Alarm Clock
6	Apr 30 – May 6	Software Presentations
7	May 7 – May 13	Build and Integrate Scale with Alarm Clock
8	May 14 – May 20	Finalize and Study for EET Cert Exam
9	May 21 – May 27	Code Reviews
10	May 28 – June 3	Final Test and Build
11	June 4 – June 8	Finals

I will be developing and building the Scale Alarm Clock prototype in ET 340 and at home. Parts should not cause an issue of being on time. There is plenty of programming to do if there happens to be a parts delay. For the board development, I plan to use the CY3214-PSoCEvalUSB development board that will closely resemble the PSoC CY8C29466, ideal board, for production. This will allow the use of PSoC's development tool, PSoC Designer. Other necessary tools are going to be the soldering iron, multimeter, oscilloscope, and power supply provided in lab. More tools might be discovered as needed as development progresses.

For the final casing of the Scale Alarm Clock I am going create either a metal or hard plastic casing that attaches easily to the load-cell sensor for weight measurement. The casing is planned to be completed during the late development phases as time permits.

After finalized, demonstration will consist of showing all functions with a special regard to the load-cell circuit. I will show information regarding the choices of each component that went into the development so views can see why and how it effects weight resolution and over all function timing.

ELECTRICAL SPECIFICATIONS

Project Specifications

Component	Accuracy	Resolution	Range
Load-Cell Sensor	3%	0.05Kg	1.1-1.3mv/v
ADC	1:3000 count	16 bits	Full

Power Requirements

Component	Supply	Maximum
Load-Cell Sensor	+5V	+6V
Audio Amplifier	+5V	+5.5V
CY8C29466	+5V	+6V
LCD	+5V	+5.5V

Environment Requirements

Component	Operating Temperature Range
Load-Cell Sensor	-20 to +65 degree C
Audio Amplifier	-65 to +150 degree C
LCD	-20 to +70 degree C
CY8C29466	-40 to +85 degree C

Preliminary Parts List

Component	Quantity	Cost	Power Dissipation
Load-Cell Sensor	1	$1-9	36mW
Audio Amplifier	1	$2.33	317mW
4x20 LCD	1	$35	14mW
CY8C29466	1	$10.63	260mW
Push Buttons	4	$8	-