Objective: The aim of the build was to develop an alarm clock that more effectively wakes the user. The clock time and alarm time are easily programmable via the included LCD and keypad interface. After an alarm has triggered, the user will answer a series of math equations correctly before the alarm sound deflates. Effectively, this will prevent the user from simply hitting the “snooze” button as most people do on a conventional alarm clock. Ideally, after answering the math problems the user will be “more awake” and less likely to fall back asleep.

Theory of Operations: The technical operation of device is described on multiple levels. To achieve complete unison, both circuits for the DS1306 (Real-Time Clock) as well as the ISD 1110 (Alarm Voice Chip) must be fully operational. The software code is the maestro of the project as it orchestrates the hardware by accessing and controlling each device when needed. The LCD and Keypad technical details are not discusses as these are prebuilt devices whose technical and operations aspects are well known and common to many applications. The LCD routines have been written by others and are open source. The LCD software routines, however, have been slightly modified in a manner that shrinks them down by cutting out code which corrects overflow from one row to the next for our 4x20 display when characters are printing because this code was not needed for our purposes (we never have anything overflow from one line to the next). The keypad routines are also open source but the modifications we had to make are severe therefore they are detailed and discussed in the project report.

Design Alternatives: The project was originally planned to be an automated pill dispenser that would have a rudimentary, user programmable timing schedule. The operation was to be such that when the clock matched with a time that the user wanted a pill to be dispensed, a series of mechanical operations (controlled by the 68HC11) would dispense one pill from a reservoir onto a small tray with a weight sensor. The weight sensor would be used to inform the 68HC11 when the pill was picked up by the user.

Key Points for Selecting Your Design: The only design difference in the software is in terms of the routine that is run when an alarm interrupt is triggered. For a pill dispenser, it would obviously run a routine to power some motors and other electromechanical bits, then it would exit the routine once the user remove the pill from the weight sensor. As for the alarm clock design, the alarm interrupt routine executes a series of math questions and asks the user to solve those questions; once all the questions are solved then the alarm routine would exit. For these reasons, we chose to design an alarm clock that we made instead of a pill dispenser because the project’s assigned focus was to be more on programming a microcontroller rather than mechanics.

Constraints from Regulating Bodies on the Project: Due to the absence of any wireless communication devices, FCC regulations due not apply. The wiring and power supply of the project is governed by

Discussions of the Experimental Results: One of the major problems encountered due to the limited I/O was the fact that both the DS1306 SPI interface and the keypad are driven by Port D. As mentioned before, this was solved by controlling PD5 with PA5 when needed. A required supplement to said solution was to control the supply power of the DS1306 with PA6 such that when PA6 was brought low, the DS1306 would switch to backup supply via the CR2032 that is connected to the Vbat pin. While running off the Vbat pin, the DS1306 is in a power save state where all device functionality is disabled other than the counting and recording of time and alarm interrupts. Only when the DS1306 is in power save were we able to ensure that none of the Port D pins that were connected to the SPI interface pins on the DS1306 would be interfered with; this way Port D...