NeeleyAir™ Density Gauge

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Purpose of Project

- To design a watch-sized air density gauge.
  - Detects air pressure and temperature
  - Displays the density of the air
  - Allows players to improve their game performance
  - Application for many sports

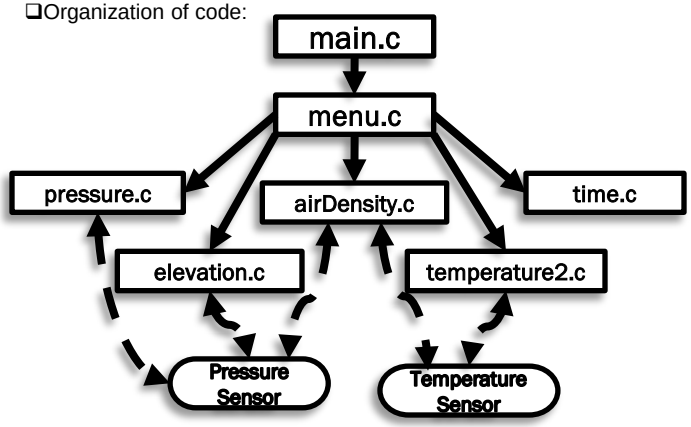
Development Environment

- **EZ430-Chronos Sports Watch**
  - Created by Texas Instruments
  - A highly integrated, wearable wireless development system based for the CC430
  - Fully reprogrammable using a USB programming interface
  - Features:
    - 96 segment LCD display (including 4 characters on top display, 5 characters on bottom display)
    - Integrated pressure sensor, temperature sensor, and battery voltage sensor
    - 3-axis accelerometer for motion sensitive control
    - Integrated wireless capabilities
- **Code Composer Studio (CCS)**
  - Computer programming software
  - Based on the Eclipse open source software framework
  - Combines the advantages of the Eclipse software framework with advanced embedded debug capabilities from Texas Instruments
  - Used C programming to program software for the watch
- **EZ430-RF USB Debugging Interface**
  - Allows the programmer to download the code to the watch:
    - Plugs into a USB port on the computer
    - Interior display module of the watch is removed from its case and connected to the prongs on the other side of the USB Debugging Interface
    - Using Code Composer Studio, the programming code is downloaded to the watch through the USB Debugging Interface

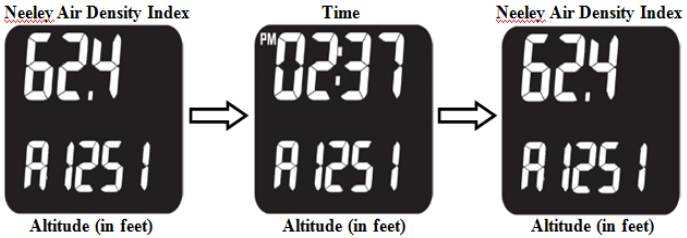
Design

Structure of the code:

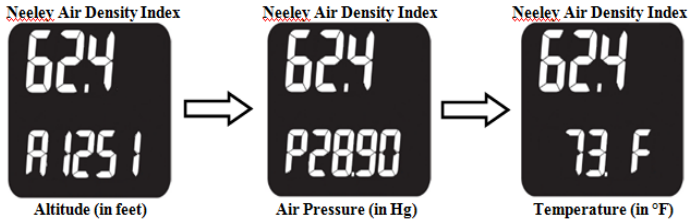
- Display is split into a top half and a bottom half, with a respective button switching between each respective displays
- Top half displays:
  - NeeleyAir™ Density Index
  - Time
- Bottom half displays:
  - Air Pressure (in Hg)
  - Temperature (in °F)
  - Altitude (in feet)
- Two separate files of code for each of the five displays
  - Source code (.c) and header code (.h)
- A unique menu object is created for each of the five displays
- Buttons on the side of the watch navigate between each menu object
- Organization of code:



- For example, when pressing the * Button:



- For example, when pressing the # Button:



Input from sensors and use of equations:

- The air pressure and the temperature is calculated by the pressure and temperature sensors built into the watch and then stored as a variable
- The code for each display uses those variables as needed and plugs them into equations to compute and output the desired result
- Nine complex equations were used to compute the NeeleyAir™ Density Index, using temperature, pressure, and humidity

Application

- The density of the air affects the air resistance of a ball when it travels through the air
  - Lower elevations, lower temperatures, and higher humidity produce thicker air, and therefore more air resistance
  - Higher elevations, higher temperatures, and lower humidity produce thinner air, and therefore less air resistance
- This gauge allows the player to detect the density of the air and adjust his or her game play accordingly

Market for the Watch:

- Main application is golf, however this gauge can be practically used in any sport that can be affected by air resistance, such as football, baseball, tennis, skeet shooting and many others.
- Other applications too, such as regulating air density in batting cages for training, adjusting air density in hospitals, and displaying air density in helicopters.

Conclusions

- It is challenging to develop new functions for this air density gauge due to the problems with code limitations, display restrictions, and complex development environment
- However, this can be very beneficial to professional players who wish to improve their game play
- Adds a new level of improvement and detail to golf and other sports