Project Proposal
Digital Altimeter
October 30, 2003
**Introductory Description:**

When spending time in the mountains hiking, biking, or traveling by car, one would often want to know their current altitude above sea level. Knowing the altitude can be important in locating different regions on a map. The only time that this figure would be known is if it is posted on informational signs or read from difficult to read analog altimeters. This is why I propose to design a digital altimeter. Many high end commercial altimeters are expensive, which often makes them unavailable to many consumers. The cost of the proposed design would only be a fraction of the cost of a commercial device.

In addition to measuring altitude, the proposed design will measure temperature and atmospheric pressure. All of this information will be displayed on an LCD. The temperature and pressure measurements will be used to calculate the current altitude in either meters or feet. When a user wants to track the differences in altitude they have traveled, the digital altimeter will have the option of storing altitude values over a certain period of time.

**Description:**

The digital altimeter will be implemented using a Motorola 68HC12 microprocessor. Two sensors that will be interfaced with the microprocessor are a pressure sensor and temperature sensor. Both of these sensors will be used in calculating the altitude and will also allow the user of the device to view the current temperature (°C or F) and the atmospheric pressure (kPa). Additional peripheral devices used for the design will be a DC-DC converter for battery operation and a piezo buzzer. The altitude measurements derived from the two sensors will be stored on the EEPROM of the 68HC12 microprocessor. This will allow altitude values to be stored over a certain period of time. An additional feature of the digital altimeter will be an altitude level alarm that will sound when a user reaches a user-defined altitude. A buzzer will
sound when the target altitude is reached. The input/output devices used in this project will be an LCD and an alpha-numeric keypad. Figure 1 shows a block diagram of the entire system including the peripheral devices.

Figure 1: System Block Diagram
The LCD and keypad will be used to select the different modes of operation of the digital altimeter. In the normal mode, the LCD will display the current altitude and temperature and can be alternated between metric and English units. The digital altimeter modes will include the altitude level alert, absolute pressure readings, and storage of altitude levels over time. For the altitude level alert, the user will enter a desired altitude using the keypad so that when the user reaches this altitude a buzzer will sound. Since the design will incorporate a pressure sensor, the digital altimeter will also be able to display the absolute pressure of the surrounding air. If the altimeter is left in a fixed location, a change in pressure could indicate a change in weather patterns, therefore making the altimeter useful as a barometer as well. Another feature of the altimeter will be the storage of altitude levels over time. This feature would be useful if the user, for example, was on a hiking trip and wanted to keep track of the difference in altitude that has been traveled. All of the altitude measurements will be stored in the EEPROM of the digital altimeter. After the altitude measurements have been made, the user will have the option of sending the values to a PC using the serial port of the computer. These values could then be placed in a spreadsheet program and be displayed on a graph.

The overall design of the digital altimeter will be for portable use. Therefore the design will be battery operated and have relatively small dimensions. A preliminary sketch of the digital altimeter is shown in Figure 2. All input to the device will be made through the keypad and on/off button, and the output will be through the LCD and serial port.
Figure 2: Preliminary Product Sketch

Benefits of the Project:

The primary application of the digital altimeter is to provide outdoor enthusiasts or travelers with an up-to-date altitude reading. It also serves as a useful tool in measuring current weather conditions such as temperature. One major benefit of the altitude measurements is that these values could be used for navigational purposes. The altitude measurements in conjunction with detailed maps can help users determine their location.

Enough features will be present on the digital altimeter to make it a useful device. Not only will it display altitudes, but it will serve as a barometer if the user decides to stay at a fixed location for a period of time. Therefore, the altimeter will have the capability to detect possible weather changes, which could be critical when spending time outdoors.

Comparison of Similar Products:

There are currently many different types of digital altimeters on the market. All of these devices are typically very compact in design. Due to the resources available, my design will not be as compact as these commercial products. However, the design will have the same
functionality as many of the high end commercial digital altimeters. The price of these altimeters is usually $130 or more. Below are some critical specifications for a popular commercial altimeter (the Suunto Escape 203).

- Altitude Range: 0-9000 m
- Altitude Resolution: 1 m
- Atmospheric Pressure Range: 30.2 kPa to 109.8 kPa
- Altitude Memory: Up to 5 data points
- Temperature Range: -21 to 60 °C

The specifications below will be attempted in the proposed design.

- Altitude Range: 0-2000 m
- Altitude Resolution: 1 m
- Atmospheric Pressure Range: 15 kPa to 115 kPa
- Altitude Memory: Up to 128 data points
- Temperature Range: 0 to 50 °C

**Project Development and Demonstration:**

The project development will take place in the ET340 lab. For the project, the 68HC12 microcontroller will be used due to familiarity and available resources for this device. The ET340 lab software tools will be used to complete the programming task of the design. Additional project components such as the temperature sensor, pressure sensor, and other parts will be obtained through electronics distributors.

Demonstration will take place in ET40. For the demonstration, the digital altimeter will be on display and visitors will be able to test the operation of the device. At this time, a PowerPoint presentation should be available that will present the details of the project.