# Problem

People have known for many years that the consumption of alcohol can and will result in temporary mental and physical impairment if enough alcohol is consumed. The logical connection was made that when the brain was exposed to certain amount of alcohol, these physical and mental impairments would result. Naturally, blood was the original medium that was monitored to try and determine the amount of alcohol that was reaching a person’s brain. This is where the term ‘blood alcohol concentration’ or ‘BAC’ originates. The majority of the alcohol that a person consumes is absorbed in the walls of the small intestine. At this point, the alcohol or ethanol is quickly introduced into the blood stream, which carries it throughout the body. Different tissues throughout the body absorb the ethanol in proportion to their water content. This means that a person’s lungs would absorb a certain percentage of the ethanol that was in their bloodstream. In the 1930’s scientists took advantage of this fact in order to determine an easier and quicker way to determine a person’s blood alcohol concentration. The amount of ethanol vapors in a person’s breath is known as their ‘breath alcohol concentration’ or ‘BrAC’. This offered huge advantages over blood analysis, which was the only method used until that point. The disadvantages of blood analysis are that the collection process requires trained medical personnel, the sample collection is invasive, the analysis requires precise procedures by trained lab technicians, the results are not immediately available, and the overall process is costly. Once adequate machines were developed to determine a person’s breath alcohol concentration, the results were instantaneous and painless. A good machine can use a person’s breath alcohol concentration to accurately predict their blood alcohol concentration at the same point in time.Current portable breathalyzers on the market can cost anywhere between $10 and several thousands of dollars. Just like most other products, more money means that you can purchase a more accurate product. Most of the models available for around fifty dollars or less are small (pocket or keychain size) portable models. They generally use an oxide sensor to determine the breath alcohol concentration. Many of the models that can be purchased for one hundred or more dollars use a small ethanol fuel cell as their sensor to determine the breath alcohol concentration. We will attempt to design a small, portable breath analyzer that will sell for approximately fifty dollars. This will place it well in the market for the average consumer. However, we will attempt to reach higher accuracy levels than any of the competition in our price range by including an alphanumeric display to indicate the user’s BAC. Competitive products in this price range use LED’s, which merely indicate a BAC range. Other uncommon features such as an auto-calibration system, ambient temperature display, and temperature compensation will appeal to consumers.In order to construct the Portable BAC Analyzer, a sensor will be necessary with the following requirements: It should be small, lightweight, inexpensive, and accurate. Unfortunately, all of the sensors on the market seem to fall short of possessing all four of these qualities. While fuel cells are the optimum choice for accuracy, they are too large to be carried on a key chain or in a pocket and are very expensive. Semiconductor oxide sensors, however, meet the size, weight, and price requirements, but lack the accuracy of fuel cells. Oxide sensors have certain conductivity when exposed to air. The number of electrons affecting absorbed oxygen molecules decreases, increasing the resistance. The presence of a specific gas causes a reaction with the absorbed oxygen, causing an increase in the electrons in the oxide molecules and a decrease in the resistance. The measurable change in resistance is then used to identify the presence of alcohol and determine a percent concentration. One problem caused by using a device that works in this manner is that it can be somewhat inaccurate and unreliable when used under conditions that are not ideal. The device is very sensitive to smoke and other gases. Therefore, a type of self-calibration mechanism will be integrated into the design. The device also exhibits some sensitivity to temperature and humidity. Our device will incorporate a temperature sensor that will adjust the BAC reading based on the ambient temperature. There will be an external button, which the user will depress, hold for approximately one second, and release prior to each use. An alphanumeric display will “count down” from 60 to 00. When the display reads “00,” this will indicate that the breath analyzer is ready to use and a buzzer will sound. The self-calibration device will be a welcome addition to the user-friendly interface. When used properly, the system will become unaffected by the previous uses and will be as operate as well as it did the very first time it was used. In other words, the addition of the calibration system will not only improve the accuracy of the sensor, but also allow the user to know exactly when to breath into the device. Such a system can be added at a low cost and will be lightweight, so that it will not affect the design constraints of the breath analyzer. It will operate using little power from the camera battery. With the capability of enabling the oxide sensor to operate at peak performance combined with all of the unique features of this product, the Portable BAC Analyzer will be viewed as highly marketable. Portable breath analyzers in the medium market today consist of oxide sensors and cost around forty to fifty dollars. However, these devices are not dependable or accurate. The product we are designing will reduce the error-rate giving a higher precision to our customers at an affordable cost within our market. Reaching higher accuracy and dependability offers a huge challenge. Simply buying more precise and dependable components is generally not an option because they add up to more overhead cost. This would cause our product’s sell price to increase and take us out of the market that we are aiming for.We do realize that the entire market does not depend on the price and accuracy of the model. Many consumers are just as interested in appearance and convenience. After all, this is something that the consumer will carry along with them as they go out to social events where they are likely to consume alcohol. Keeping the size and weight of this product down is a must. It also needs to be an attractive device that will reflect well on the image of the consumer in public. By building a small, lightweight, attractive, accurate, and dependable device, we should be able to occupy the majority of our portion of the market.