Breathalyzer Design

**Van Do**

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Excelsior College

ELEC495

Integrated Technology Assessment

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**Team Report**

Conner Brentzel will use a light sensor module in order to determine if a vehicle is approaching a traffic light that is transitioning from green to yellow and finally to red. The thought is to include an ultrasonic sensor in order to determine if the vehicle is close to the traffic light and will emit an alert audibly via a speaker and visually via a LCD.

Joshua Danyeur will build a simple switch mode power supply to take the 120V AC from a home outlet and turning it into a 24V DC signal; utilizing a transformer and a few circuit parts.

Scott Adamson will create a sensor system that will detect and alert an object’s whereabouts in regards to the device.

**Introduction**

This project will aim to build a breathalyzer used to detect the level of alcohol in the body system. It is not enough to face the consequences of inhibition when it is too late, and a driver is pulled over. Instead, responsible drinkers can use this device to judge a tolerable level of sobriety before leaving. This can be used wherever there is nightlife, or a gathering of friends in which alcohol is served. Measuring blood alcohol content is all but reliable in terms of weight,

What encapsulates this project is the materials needed to accomplish functional breathalyzers that police often use. Additionally, the project will aim to serve as a learning challenge as PCB design will be implemented into the overall product. This endeavor focuses on aiming to learn PCB design that was not available as a course at Excelsior University. This will result in well-rounded knowledge of electronics as a focus in the major.

**Background**

An Arduino Uno R3 will be used to develop the device using an FDA approved commercial breathalyzer, called BACtrack, as reference (BACtrack GO, N.D.). To justify the feasibility of this project, the components are easily exchangeable if any were to fail, while regular periods of calibration are required for the commercial alternative. The components include a piezo buzzer, an LCD module, and an MQ3 Gas Sensor. This will be fitted onto a custom designed PCB for ease of use. According to the datasheet on the MQ-3, it is a SnO2 semiconductor which features lower conductivity in clean air. In the presence of gasses, the conductivity rises and can be programmed to measure BAC (Alcohol Gas Sensor, 2014). A study was conducted to determine the overall perception of a personal breathalyzer. Min, A., et al, showed that young adults below the age of 34 that are at risk of the consequences of binge drinking are highly receptive towards a personal device that helps aid in decision making (Min, A, et al, 2020).

**Project**

Diagram

Description automatically generated

Figure - Logical flowchart of Breathalyzer

Figure 1 shows an illustration of the approach of the program that will later be developed. The PCB will need an overall review of what components will be implemented and how to fit the components into the design. This will be learned and demonstrated by the end of the project to include design engineering and soldering. The overall concept is to take the voltage of the sensor during clean air and develop a comparator circuit in the presence of alcohol. Then, the input should be programmed to convert into the equivalent result in alcohol per mg/l. The formula for conversion will later be developed as the design is further researched.

**PERT & Gantt Chart**

**Gantt:**

Chart, timeline

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Figure 2 - Gantt Chart for M2Project Report

Following this timeline, I expect the earliest to be done with my design is in early November. I do expect timeline changes as this may not be realistic.

**PERT:**

Diagram

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Figure 3 - Pert Chart for M2Project Report

**Summary (9/25)**

Parts have been ordered from online. I am awaiting its arrival for initial circuit setup. During component research I have found that the MQ-3 sensor returns a constant value during clean air. I plan on building the code first to test and debug while figuring out a formula to convert the value to a BAC.

Chart

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Figure 4 - MQ-3 Sensor Rs/R0 per mg/L of alcohol

(Technical Data MQ-3 Gas Sensor, N.D.)

From the above chart the sensor resistance of various concentrations of gases versus clean air is lowered when in the presence of higher concentrations. From this I can conclude that if I can determine the value of Rs in clean air, I can also determine R0 and in turn Rs/R0.

**Summary 10/8/22**

A simulated circuit has been drawn via LTspice and is ready for connection. The components will be connected via breadboard first to confirm correct operating procedures. Coding will then commence to follow the flowchart detailed in an earlier report. The code will define each input/output port and will output the results of the converted detected alcohol signal from the MQ3 gas sensor. This will be converted by the microcontroller into an appropriate BAC in order to help determine sobriety. Although the sensor returns a signal in a range of 25 – 500 ppm, an equivalent value in the form of BAC will help achieve project goals.

Diagram, schematic

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Figure 5 - Block Diagram of Breathalyzer via EasyEDA

BAC formula:

According to the previous reference of Rs/R0, the sensitivity of the sensor is dependent on the measured BAC in grams per deciliter (g/dL)

So far, an equation to determine the relationship between the Rs/R0 and BAC is inspired by the data chart for the MQ-3 sensor. For now, it is only an assumption that the relationship is logarithmic in nature, and as such should be solved from the various plots in the graph.

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Chart

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Where F0=1, X0= 0.4

F1 = .2x, X1 = 4

Since this is the first result for BAC conversion, multiple rounds of testing must be done to ensure that the BAC falls in line with an accurate measure of alcohol consumed.

A picture containing text, electronics

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Figure 6 - Device powered on and sample code loaded.

**Milestones**:

Module 1: Submit Project Proposal

Module 2: Develop Gantt and PERT chart along with costs.

Module 3: Design the PCB along with necessary components using JLC PCB software and printing. Document the process so far whether it is successful or not.

Module 4: Identity and reflect on areas of improvement. Prepare material for presentation at Team Webinar.

Module 5: Begin soldering components to PCB and testing connections.

Module 6: Build the product and video document accordingly.

Module 7: Test the product and video document accordingly.

Module 8: Presentation development and Final Webinar.

**References**

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