Lifelines: Portable Breathalyzer Project

Project Website: EugeneHasJeans.github.io

Declaration of Joint Authorship

The team "Designated Drivers" which consists of Eugene Oliver, Ryan Do, and Adriene Almacen confirms that the project of the Lifelines Breathalyzer is a combined group effort and is a combination of our own thoughts and ideas. The work of this entire project was split as equally as possible. Eugene Oliver worked with calibrating the sensors and was in charge of hardware design and working with the app layouts. Ryan Do worked with the database in terms of setting it up, connecting it with the app and maintaining it. Adriene Almacen was in charge of mobile application design and maintenance. The distribution of testing the hardware and software for bugs and issues are discussed by the three of us and worked on all together. Before any changes were done on the project, a group consensus had to be made. All work that was used for guidance and help has been acknowledged and cited in the reference area of this report.

Approved Proposal

Proposal for the development of Lifelines: Portable Breathalyzer

Prepared by Eugene Oliver, Ryan Do, Adriene Almacen

Computer Engineering Technology Students

https://eugenehasjeans.github.io/

Executive Summary

As students in the Computer Engineering Technology program, we will be integrating the knowledge and skills we have learned from our program into this Internet of Things themed capstone project. This proposal requests the approval to build the hardware portion that will connect to a database as well as to a mobile device application. The internet connected hardware will include a custom PCB with sensors and actuators for testing and finding a user's alcohol level. The database will store information on past alcohol levels of the user, and information on the legal alcohol levels in the province/state. The mobile device functionality will include information, based on the found alcohol level, of friends or taxis to call, GPS location to find the closest hotel and other features. This will be further detailed in the mobile application proposal. We plan to collaborate with the HRT – Hospitality, Recreation and Tourism department here at Humber college.

The hardware was completed in CENG 317 Hardware Production Techniques independently and the application will be completed in CENG 319 Software Project. These will be integrated together in the subsequent term in CENG 355 Computer Systems Project as a member of a 3 student group.

Background

The problem solved by project is the frequency of people that drink and drive and endanger their lives and the lives of others. Using the alcohol level tester, people can realize how much alcohol is actually in their system and from that can create a solution for their safety instead of going into a bad path. Every year there is a call of help for people to stop drinking and driving, but yet every year there are accidents that always lead to a common problem of alcohol consumption. Studies have shown that out of all the young drinking drivers who cause harm on the road, the largest age group is 19 years of age, which is also a big age group for the use of technology and phones/gadgets. We believe that the more people who

use this project will lower the rate of this problem and bring us one step closer to a solution for drinking and driving.

We have searched for prior art via Humber's IEEE subscription selecting "My Subscribed Content" and have found and read three which provides insight into similar efforts.

This first journal that was found talks about developing safety measures to prevent and detect impaired driving. (Sakairi, 2012)

The second journal talks about how to create a more precise heart rate reading using formulas. (Brüser et al., 2015)

The last journal explains and talks about a certain sensor that measures the alcohol concentration in a human.(Venugopal et al., 2008)

In the Computer Engineering Technology program we have learned about the following topics from the respective relevant courses:

- Java Docs from CENG 212 Programming Techniques In Java,
- Construction of circuits from CENG 215 Digital And Interfacing Systems,
- Rapid application development and Gantt charts from CENG 216 Intro to Software Engineering,
- Micro computing from CENG 252 Embedded Systems,
- SQL from CENG 254 Database With Java,
- Web access of databases from CENG 256 Internet Scripting; and, ☐ Wireless protocols such as 802.11 from TECH152 Telecom Networks.

This knowledge and skill set will enable us to build the subsystems and integrate them together as my capstone project.

Methodology

This proposal is assigned in the first week of class and is due at the beginning of class in the second week of the fall semester. My coursework will focus on the first two of the 3 phases of this project:

Phase 1 Hardware build.

Phase 2 System integration.

Phase 3 Demonstration to future employers.

Phase 1 Hardware build

The hardware build will be completed in the fall term. It will fit within the CENG Project maximum dimensions of 12 13/16" x 6" x 2 7/8" (32.5cm x 15.25cm x 7.25cm) which represents the space below the tray in the parts kit. The highest AC voltage that will be used is 16Vrms from a wall adaptor from which +/- 15V or as high as 45 VDC can be obtained. Maximum power consumption will be 20 Watts.

Phase 2 System integration

The system integration will be completed in the fall term.

Phase 3 Demonstration to future employers

This project will showcase the knowledge and skills that we have learned to potential employers.

The tables below provide rough effort and non-labour estimates respectively for each phase. A Gantt chart will be added by week 3 to provide more project schedule details and a more complete budget will be added by week 4. It is important to start tasks as soon as possible to be able to meet deadlines.

Labour Estimates	Hrs	Notes
Phase 1		
a) Writing proposal.	9	Tech identification quiz.
b) Creating project schedule. Initial project team meeting.	9	Proposal due.
c) Creating budget. Status Meeting.	9	Project Schedule due.
d) Acquiring components and writing progress report.	9	Budget due.
e) Mechanical assembly and writing progress report. Status Meeting.	9	Progress Report due (components acquired milestone).
f) PCB fabrication.	9	Progress Report due (Mechanical Assembly milestone).
g) Interface wiring, Placard design, Status Meeting.	9	PCB Due (power up milestone).
h) Preparing for demonstration.	9	Placard due.
i) Writing progress report and demonstrating project.	9	Progress Report due (Demonstrations at Open House Saturday, November 7, 2015 from 10 a.m. - 2 p.m.).
j) Editing build video.	9	Peer grading of demonstrations due.
k) Incorporation of feedback from demonstration and writing progress report. Status Meeting.	9	30 second build video due.
l) Practice presentations	9	Progress Report due.
m) 1st round of Presentations,	9	Presentation PowerPoint file due.
n) 2nd round of Presentations	9	Build instructions up due.
o) Project videos, Status Meeting.	9	30 second script due.
Phase 1 Total	**135**	
Phase 2		
a) Meet with collaborators	9	Status Meeting
b) Initial integration.	9	Progress Report
c) Meet with collaborators	9	Status Meeting
d) Testing.	9	Progress Report
e) Meet with collaborators	9	Status Meeting
f) Meet with collaborators	9	Status Meeting
g) Incorporation of feedback.	9	Progress Report
h) Meet with collaborators	9	Status Meeting
i) Testing.	9	Progress Report
j) Meet with collaborators	9	Status Meeting
k) Prepare for demonstration.	9	Progress Report
l) Complete presentation.	9	Demonstration at Open House Saturday, April 9, 2016 10 a.m. to 2 p.m.
m) Complete final report.	9	Presentation PowerPoint file due.
n) Write video script. 2nd round of Presentations, delivery of project.	9	Final written report including final budget and record of expenditures, covering both this semester and the previous semester.
o) Project videos.	9	Video script due
Phase 2 Total	**135**	
Phase 3		
a) Interviews	TBD	
Phase 3 Total	**TBD**	

Material Estimates	Cost	Notes
Phase 1		
Raspberry Pi 3 Starter Kit	$119.99	(Canakit) Amazon –B01CCF9BYG

Electronics Parts Kit	$119.99	Humber – SKU #163
MQ-3 Sensor	$11.95	Amazon.ca – B01ISMV6G8
XD-58C Sensor	$18.99	Amazon.ca – B01AUVMFIS
Solder Kit	~ $40.00	Humber
Soldering Iron	~ $20.00	Humber
Phase 1 Total	**~ $330.92**	
Phase 2		
a) Materials to improve		
Phase 2 Total	**TBD**	
Phase 3		
a) Off campus colocation	<$100.00	
Shipping	*TBD*	
Tax	*TBD*	
Duty	*TBD*	
Phase 3 Total	**TBD**	

Concluding remarks

This proposal presents a plan for providing an IoT solution for the abnormal amount of people that dangerously drink and drive above the alcohol limit. This is an opportunity to integrate the knowledge and skills developed in our program to create a collaborative IoT capstone project demonstrating my ability to learn how to support projects. I request approval of this project.

Abstract (Executive Summary)

The purpose of this breathalyzer is to keep intoxicated drivers off the road. As drunk driving is one of the leading causes of accidents on the road. This breathalyzer can help eliminate drunk driving by determining the users blood alcohol content (BAC) as well as their beats per minute (BPM), so that users can determine beforehand if they are able to drive home safely. When the alcohol or heart rate test is taken, data is retrieved from the sensors and stored on a database. In addition, the data is also displayed on an android application along with the date and time of when the test was taken. Furthermore, the android application will aid the user by allowing them to determine if it is safe to drive and will be given options such as calling a friend, calling a taxi or seeking the nearest hotels in the area.

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Illustrations and Diagrams

1. Introduction

Alcohol and driving under the influence continues to become a major problem in today's society and every year, many lives are taken due to accidents caused by drunk driving. Most people do not own a breathalyzer and many bars are not required to carry one due to the high cost. The work described in this technical report was undertaken because we wanted to try to create a solution where you can track your Blood Alcohol Concentration (BAC) as well as your heart rate and present the user with options depending on what range their BAC falls under. Our breathalyzer connects to an android phone where our mobile app displays readings and stores them into a database providing past history records to lookup in the future. The mobile app provides user accounts to be able to synchronize data across multiple devices and retrieve data from the database to display the average values for the BAC and heart rate. After the user provides a breath sample and a reading shows up, a choice is presented to the user to either call for a taxi, call a friend, or find a hotel nearby.The objective of this breathalyzer is to reduce the amount of drunk drivers that danger themselves and others while on the road. When working with the breathalyzer we ran into multiple problems. One of the problems was creating a case that is small enough to bring around easily, but big enough to hold all the components. This was fixed by creating a smaller case compared to our original one. Another problem was having to find a way to power the Raspberry Pi without using the AC adapter. The solution to this, was finding a small 5V portable charger that has a micro-usb connection. A unique approach in this project was seeing the best way to calibrate both sensors. We realized that the heart rate sensor works best when there is a black surface underneath it. The alcohol sensor has a potentiometer that can adjust the sensitivity of the readings.

2. Software Requirements Specifications (SRS)

2.1 Technology Introduction

2.1.1 Purpose

The purpose of our Lifelines: Breathalyzer is to make sure people are off the roads if they are intoxicated or not safe to drive. Drinking and Driving is a huge issue in our world today, and by using this technology to check if there is alcohol is someone's body, we can keep lives out of danger.

2.1.2 Product Overview

This product is built using with a custom made PCB board, Raspberry Pi and two main sensors. The MQ-3 Gas sensor is what we use when to check if there is alcohol in your system. The XD-58C is what we use in our product to check your heart rate.

2.1.3 Targeted Audience Group

Our targeted audience group would obviously be people over the legal drinking age. This device would mainly be used for personal reasons, but in occasion you can bring it with you if you were going to a party, or hosting one to make sure everyone is safe to be behind a wheel.

2.2 Product Information

2.2.1 Main Functionality

The main functionality of the product is to test a user's Blood Alcohol Content (BAC) and determining if they are okay to drive home or not. If not, then the user will be given a number of options such as calling a friend, calling a taxi, or finding a hotel/motel to stay at for the night. The user can also measure their heart rate as well to see if there is a correlation between their BAC and heart rate.

2.2.2 Extra Requirements

This breathalyzer uses a rechargeable battery that allows it to be portable. No internet connection is needed only Bluetooth connection. This connection allows the device to connect to a user's mobile device.

2.2.3 Best Performance

For best performance out of this technology you can consider a few things. To get the most accurate reading the heart rate sensor should have a dark colour behind it, because of the LED on the sensor it works better with dark areas. Also, try not to move as much as possible because when steady you get more steady readings.

2.3 Overall Description

2.3.1 Database

We will be using Google's Firebase mobile and web application platform for user authentication on logins and our real-time database. Users will be able to sign up for an account and login to access their personal previous alcohol and heart rate results, as well as the averages for both blood alcohol content and heart rate. The database will be a JSON database which will contain the user's unique ID (UID) as

well as user information that is taken from when the user signs up for an account. Their UID is automatically generated by Firebase Auth when they sign up for an account. Under their UID, holds their name, address, city, phone number, province, and licence type. When they perform an alcohol test or heart rate test, the resulting data is stored under their UID. The data is then fetched and displayed showing the last 5 results and the averages when they navigate to the past results page in the mobile application. (Developed by Ryan Do)

2.3.2 Hardware

The hardware portion of our project is a breathalyzer. This breathalyzer will be used to help eliminate drunk driving by giving the user the ability to test their blood alcohol content (BAC) level as well as their beat per minute (BPM). The device tells the user if it is safe to drive home or gives the user alternative options if their unable to drive. The device uses two sensors that help determine the users BAC and BPM; it uses an alcohol gas sensor and heart rate sensor. The sensors are connected to a Raspberry Pi that runs a program that gathers a reading from the sensor. The device itself is inside a small acrylic case that holds the contents inside as well as a small rechargeable battery to make the device portable. Data from the sensor are also sent to a connected device and displayed on an application as well as sent to a database. (Developed by Adriene Almacen)

2.3.3 Mobile Application

For our project, there will be a mobile android application which will be able to show data collected from our Lifelines: Breathalyzer. Once the application is open you must sign up and log in to be able to see past results which were read from our two sensors on our hardware, MQ-3 Gas Sensor and XD-58C. Without logging in/signing up, the past results button would be hidden, which leaves a button to start the alcohol test or heartbeat test. After these tests, you will be brought to a results page that presents the readings. If the reading from the alcohol test detects alcohol in your body, it will give you options to take such as calling a friend, calling a taxi or seeing hotels close by to you. The last option you would have is to look at past results (if you are logged in). This is where the data is taken from the database. The user will be able to look results stored in the database which will show them their past BAC and BPM readings that were done previously, along with their average BAC and BPM readings. If you are logged in, once you run a test it would be added and updated to the database. (Developed by Eugene Oliver)

2.4 Future Considerations

2.4.1 Operating Environment

To be able to use our product, you would need an android smartphone or tablet that is on android API 19 (Android 4.4 KitKat) or above.

2.4.2 Safety Considerations

In order to maintain safety when using this technology you must keep some things into consideration:

- Make sure to keep sanitation in mind when passing the breathalyzer around
- Do not expose the technology to any liquids to prevent errors in accuracy or malfunctions
- 5 Volts DC is what should be used when providing power to the Lifelines: Breathalyzer
- Be sure not to tamper with the technology while it is powered on

2.4.3 Future Additions

Before the end of the term, we plan on designing and cutting out a new acrylic case to house the Raspberry Pi and the sensors we need. We plan on trying to make this as portable as we possibly can, given the resources that are provided.

3. Conclusions

4. Recommendations

5. Progress Reports

Third Week of Winter Semester:

As of today we are currently on track with our project. Our project proposal with inline citation has been submitted as well as both the skeleton, and our software requirement specification. In the near future we plan to discuss our project with the HRT – Hospitality, Recreation and Tourism department at Humber College for guidance, help and additional planning.

In terms of our actual project, everything is on schedule. The layout for our Database and mobile application has been created and we just need to connect the following to our Hardware. We plan on having the data from the alcohol gas sensor and heart rate sensor display on our mobile application and store it on a database.

A problem that we have encountered and realized in the past weeks is that since we are using Eugene's hardware, the size of the acrylic case he made has his name on it from last semester. It is also a bit large in size, and in order to solve this we plan on creating a smaller more compact case. We also initially planned to have out Brethalyzer as a portable device for users to move and bring around easily. However, we currently power our Raspberry Pi with a Micro-USB power adapter plugged into a wall outlet. To fix this issue, we are planning to include a micro-usb portable charger to our budger/project that can power the Lifelines: Breathalyzer.

In regards to the budget, a small addition will be included in the future as we will be ordering a portable battery so that we can power our Raspberry Pi and make the device portable. This portable battery will cost somewhere between $20-$30 for a power bank strong enough to power the Raspberry Pi.

In the future, we plan to keep working on the things required to get us to the end goal of our Lifelines: Breathalyzer, along with doing thing things to complete our technical report. We hope in the near future to be able to merge our database, mobile application and hardware into a complete working project.

References

Brüser, C., Kortelainen, J. M., Winter, S., Tenhunen, M., Pärkkä, J., & Leonhardt, S. (2015). Improvement of force-sensor-based heart rate estimation using multichannel data fusion. In *IEEE Journal of Biomedical and Health Informatics* (Vol. 19, pp. 227–235). https://doi.org/10.1109/JBHI.2014.2311582

Sakairi, M. (2012). Water-cluster-detecting breath sensor and applications in cars for detecting drunk or drowsy driving. *IEEE Sensors Journal*, *12*(5), 1078–1083. https://doi.org/10.1109/JSEN.2011.2163816

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