

# ECE 445 Project Proposal

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## 1 Introduction

### 1.1 Objective

Responsible drinking has been a concern for a long time. In 2020, despite COVID restrictions, drunk drivers caused an average of 29 deaths every day and 28% of all traffic deaths [1]. In 2016, over one million drivers received DUIs - and that's just 1% of the self-reported cases [1]. As a result, 43 of the 50 states have adopted the Dram Shop Law, which can hold bars liable for drunk driving accidents [1]. In most states, this also extends to within the bar if any accidents occur. Patrons are now able to hold bars liable and file Dram Shop Cases for reasons ranging from recklessness to intentional conduct [2]. Therefore, it is in the best interest of the bars and public to find a way to actively track alcohol consumption.

Our goal with Bar Watch is to facilitate safe drinking and also offer a more COVID-safe experience. It is a reusable accessory that bars can use to monitor their patrons' alcohol consumption and purchases. This device will be given to customers upon entry. It will be able to interact with different dispensers and track the user's purchases. This has the added benefit of contact-free delivery and reduced waiting times for consumers. Each device will be connected to a central database through a wireless communication module. The database contains the different prices and alcohol information, and tracks the user's consumption. If a patron reaches a dangerous level of alcohol consumed as determined by their physical features and time between drinks, the bar is alerted to offer ride services if necessary. When the customer leaves, the device is returned and sanitized for use again. This endeavor would be a big first step towards responsible drinking and making the experience COVID-safe.

## 1.2 Background

There have been efforts to track alcohol consumption and automate dispensers, but none have sought to combine the two into an ergonomic, multipurpose wristband. With COVID still a threat, our solution's features appear to be even more valued.

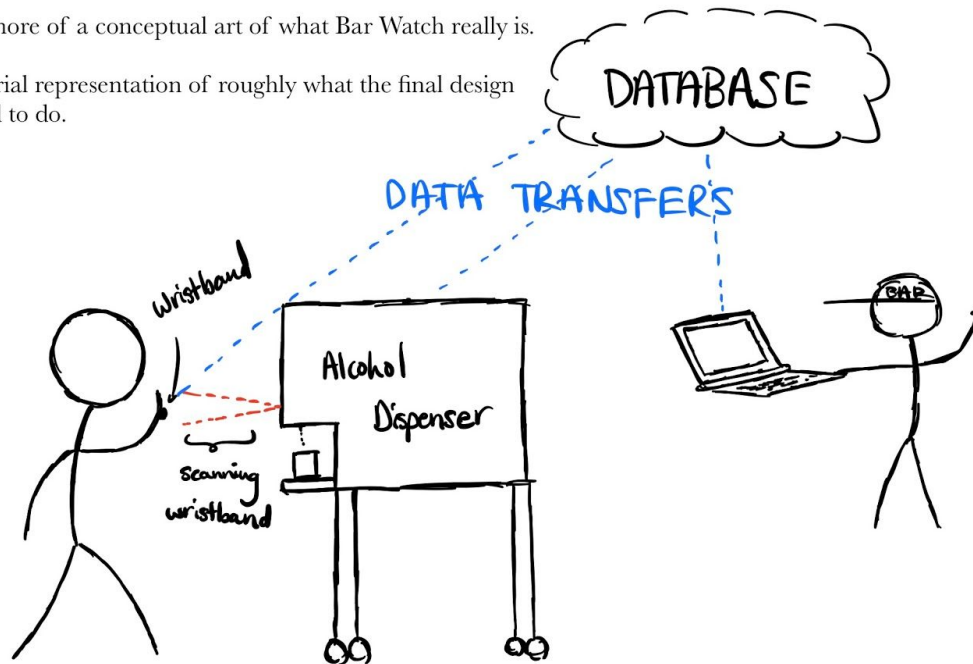
With regards to dispensers, Smartender is the closest product that mirrors this notion of automated dispensing [3]. Taproom bars also offer cards that patrons can use at dispensers without contacting a bartender. However, what they do not have is a BAC-tracking system to notify both the bar and patron about their alcohol consumption. Such features exist separately in downloadable apps that do not properly hold individuals accountable. By notifying bar employees, our product gives them the tools to ensure those under the influence are properly guided to potential ride services or otherwise taken care of appropriately. In addition to this, patron information is added to the wristband and database until they exit bar. In the event of any altercation or emergency on premise, the necessary information is ready on hand without delay.

To put it more succinctly, our product seeks to unify two different products (automated dispensing and BAC-tracking) into one solution, while incorporating a payment feature to further reduce human interaction. Going further, we wish to add a safety feature that allows for patrons to use the wristbands as a call for help. With a single pushable button, the bar employee can be quietly made aware of a person's distress and step in. Our goal in designing Bar Watch is to make drinking at bars a safer interaction and take into consideration the COVID threat present today.

## 1.3 Physical Design

Not final design, more of a conceptual art of what Bar Watch really is.

Really just a pictorial representation of roughly what the final design would be intended to do.



**Figure 1: Physical Design**

## 1.4 High-Level Requirements

- ❖ Track purchases and alcohol level correctly for each device currently activated.
- ❖ Provide accurate visual feedback to both customers and bar employees about the amount of alcohol that the user has drank.
- ❖ Read the watch and dispense drinks to the customer when they activate the drink dispenser QR scanner with their device.



## Block Level Requirements

### 2.2) Bar Watch Wristwatch

The Bar Watch Wristwatch will have three main functional components: the User Interface, the Power Supply, and the Wireless Communication. Power from a wall outlet to the charger to the battery protection IC will be used to recharge a small battery. The watch should also not be too bulky, and be able to easily fit on the customer's wrist.

#### 2.2.1) User Interface

The components will be mounted on a small PCB board that can fit on the user's wrist. It will consist of a QR code that the scanner can read as well as an LED so that the customer can keep track of their drinks easier.

**Requirement:** The interface should be simple for both the user to get information from and to use.

##### 2.2.1.1) QR Code

This will be a small piece of paper or something etched into the board that can be read by a QR scanner.

**Requirement:** Must be large enough to be easily read by QR scanner in dispensers.

##### 2.2.1.2) RGB LED

The RGB LED will be controlled remotely by the database. It will change colors to accurately and appropriately provide feedback to the user's intoxication levels.

**Requirement:** Must be able to switch between colors depending on what the remote bluetooth or wireless instructions are telling the LED to do.

##### 2.2.1.3) Help Button

The Help Button is to be used by patrons only in case of an emergency. If this button is depressed for more than 3-5 seconds, the bar staff will be alerted to a potentially hazardous situation occurring.

**Requirement:** Should only alert when the customer actually wants it to and be able to tell between an accidental push and an intentional push.

### 2.2.2) Bluetooth/Wireless Communication

This module will be used to communicate with the database and provide real time feedback on the amount that the user has drank and their bar tab. It will also be able to send a signal if the customer needs assistance.

**Requirement:** Communicate with computer using bluetooth V2.0 protocol through a UART interface

### 2.2.3) Power Supply

The wristwatch should be able to stay powered for 3-4 hours, before customers have to exchange their watch for a newly charged watch.

**Requirement:** Should charge the battery at a max of 120mA.

#### 2.2.3.1) Charger

This is used to convert the wall voltage to a safe voltage to charge the battery at.

**Requirement:** Ensure that the wristwatch's battery is compatible with power provided by the outlet.

#### 2.2.3.2) Lithium Ion Battery

The Lithium Ion Battery should be rechargeable and provide power to the entire wrist watch.

**Requirement:** Be a rechargeable 240mAh li-on battery with an output range between 3.7V - 4.2V. Also need it to have a battery protection circuit to prevent overcharging or over-discharging.

#### 2.2.3.3) Voltage Regulator

Ensures that the voltage is at the proper level for the watch LED, Bluetooth Module, and other components.

**Requirement:** Provide a fixed output voltage of 3.3V +/- 1% to our watch components.

## 2.2) Drink Dispenser

The drink dispenser will be able to scan the watch's QR code, and if valid, allow the user to measure how much they have poured.

### 2.2.1) QR Scanner

The QR scanner is used to activate the taps before the customer is able to pour their own drink.

**Requirement:** Must be able to differentiate between a valid and invalid QR code.

### 2.2.2) Flow Measure

Either a flowmeter or some sort of volume measuring device will be able to tell how much alcohol is dispensed.

**Requirement:** Be able to measure up to 16 fluid ounces in one pour.

### 2.2.3) Feedback LEDs

Used to tell the user if the dispenser is ready to dispense a drink or not.

**Requirement:** Flash red when the tap is not ready to pour, yellow when the QR scanner is reading, and green if the QR code was accepted.

### 2.2.4) Microcontroller

An Arduino or Microcontroller will be used to keep track of the amount poured, control feedback LEDs to the user, and send data to the computer to be processed.

#### 2.2.4.1) Data Collection

Real time data input from all the sensors will be collected and sent to the computer.

**Requirement:** Have a less than 1 second latency such that the computer can quickly calculate and provide feedback to the dispenser such as if the QR code is valid.

## 2.3) Computer

Although it is not a component that needs to be built, the computer is an essential component to our design that bars will already have access to. This is where most of the software

components of the project will be performed. It will hold the data for each customer, perform calculations to estimate the BAC of the customer, respond to help signals from watches, and provide feedback to employees on customer intoxication levels.

#### 2.3.1) Logic Processing

The logic processing will be in software. This module will handle the conversion between the amount of standard drinks purchased and time elapsed between them to an estimated BAC value and then map this into a color to be displayed on the watch.

**Requirement:** Calculate BAC and map it onto a color and transmit this information via bluetooth 2.0 to the watch.

#### 2.3.2) Data Storage

This part of the project will be in software. We will be making two SQL databases; one that holds the drink menu, including the amount of standard shots in each drink, and another database that stores the user information such as the drinks purchased, time at which they were purchased, price, and estimated BAC.

**Requirement:** Have a functional SQL database that holds the information collected for each user.

#### 2.3.3) Bar Employee Feedback

An easy to view way to alert employees to people that may need to be cut-off from drinking or respond to a distress signal.

**Requirement:** Have software that gives intuitive visualizations about the BACs of the patrons of the bar and the amount of revenue generated from drink sales.

## 2.4) Risk and Analysis

One of the most significant risks to completing this project will be the Bar Watch Dispenser. Not only is it the most mechanically intensive of all the blocks, but it also has some complicated problems that may arise from its sensors. The dispenser will need to be able to measure how much liquid is poured quickly and accurately. This is important for BAC calculation levels, as well as charging the customer for their drink. The flow measure must be precise, within 0.5 fluid ounces, and update rapidly, within 1 second of pouring the drink. The dispenser should also ensure that no more than 16 fluid ounces is poured per scan. This is enough to fill a customer's cup, but it will prevent the dispenser from continuing to pour and waste alcohol if it is not turned off correctly.

Another issue may come from the QR codes and being able to properly scan them. The QR scanner should take less than 3 seconds to recognize the code and determine if the code is a valid customer code. This will prevent customers from stealing alcohol by using a fake QR code or circumventing the system. It is also important that the response time on the scanner is short so that customers are served in a timely manner.

## 3 Ethics and Safety

Our project has several potential safety hazards. The watch will be powered by a lithium-ion battery which poses the risk of causing a fire or the leaking of combustible by-products if overcharged [2]. To circumvent this, we will incorporate a battery protection IC to protect the battery from overcharge, overdischarge, and/or overcurrent. As the watch will be worn on the user's wrist, there is also the possibility that the user will wash their hands or spill their drink with it on, so we will also make sure to make the watch as water resistant as we possibly can.

According to ACM Code of Ethics Rule 2.9, we must "design and implement systems that are robustly and usably secure" [3]. To be compliant with this we opted to make the information about the user fully anonymous by storing no personally identifiable information about the user. No data about the user is recorded since the information that the system monitors is tied to a unique identifier on the watch. Upon turning in the watch, the data is also deleted.

Ethically, there is also the danger of other patrons in the bar knowing how intoxicated, and thus, vulnerable that the user is. However, since multiple security personnel will have access to this information and there will be a dedicated 'help' button on the watch, we are hoping that those risks are mitigated by security personnel's active monitoring of the intoxication levels of the users. Additionally, the watches will be returned when the customer goes to pay, which gives bar staff a chance to intervene or help if a customer needs it.

## 4 References

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