Tegestologists in Training

Spring 2018 Project Proposal

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1. Introduction

Objective

Coasters are a common item used to prevent drinks from forming water rings on surfaces and act as a placemat for beverages. They are utilized in many different settings such homes, restaurants, and offices. However, its purposes are evidently very limited in functionality as they only prevent water rings. We believe that we can improve upon the average coaster by adding functionality to make people's lives more convenient. Our goal in this class is to design such a coaster that will aid restaurant workers and provide entertainment value for the user. The coaster will maintain its original purpose but it will have many more useful capabilities such as signaling when drinks are low and tracking consumer data.

To implement this idea, we want to use a load sensor to detect the amount of beer in the glass that is sitting on the coaster and then use LED lights to signal a server when a beverage needs to refilled. In addition, we want each coaster to track consumer data on beers consumed. We will track this data by also using the load sensor to detect the changes in weight in order to determine the amount of beer consumed. After the data is collected on the coaster, we will then relay this data to an iPad that will give the server access to the data that is collected through an interface on an application. We believe that this data will be useful to restaurant owners because knowing the amount of each drink they need would help them determine how much of each drink to order.

Background

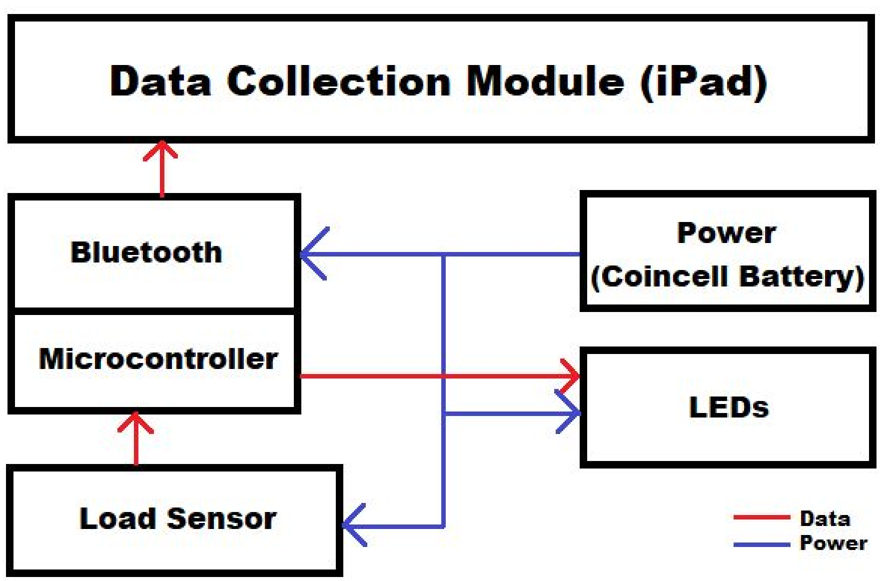
This coaster will allow us to track beer consumption statistics for consumers that can help restaurants determine which drinks are most popular and how much of each drink is consumed. Another helpful use of the coaster is that it can easily inform servers of a glass that needs to be refilled. When the glass is reaching a level that needs to be refilled, an LED will automatically light up to indicate to the server that it needs to be refilled. This is different from a simple switch that a user can flip to indicate that they need a refill because our implementation is automatic, and it also provides value to the consumer by implementing a fun visual effect to their dining experience that they do not normally see.

High-Level Requirements List

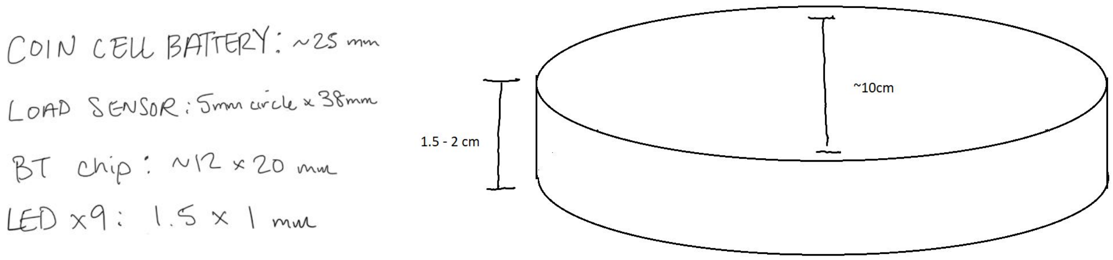
- Based off a beer glass that we had at home, we are going to assume that a beer glass weighs 14 oz. Our load sensor needs to be able to detect when a cup is empty (when the load is at base weight of 14 oz).
- The glass we measured coincidentally also holds 14 fl. oz. of liquid. After some research, we came to the conclusion that the average density of beer ranges from around 1.006 g/cm^3 to around 1.06 g/cm^3 [3]. Since these values are pretty close to the density of water, we are going to use water as the beverage for our design. Given water's density of 1 g/cm^3, a full 14 fl oz of water is equivalent to 14.6 oz wt. So, our load sensor must have a maximum capacity of at least 14.6 oz.
- As the consumer drinks their beverage the glass empties at a slow pace. In order to detect how much of the beverage was consumed, the sensor should have a reasonably granular scale. We feel that a granularity of 5% of the total weight of the beverage is a good place to start, so we want a sensor that can sense a granularity of 0.73 oz.

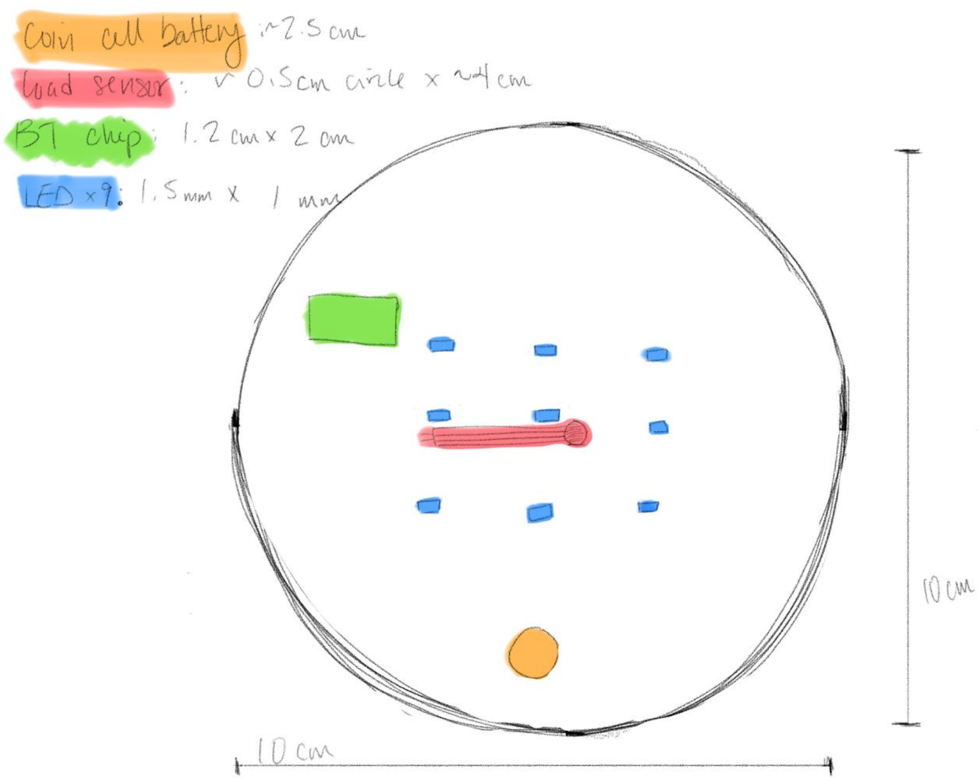
2. Design

Block Diagram



Physical Design





Functional Overview

Microcontroller

The microcontroller will be the brains behind the coaster. It will take input from the load sensor to determine when to light up the different colors of LEDs. The microcontroller will also determine when the consumer is done drinking and then send the data collected to an iPad via bluetooth. It must support connecting the LEDs, load sensor, and bluetooth chip, so the microcontroller has to be able to connect to up to 3 parts.

Requirements: Must be able to support at least three peripheral sensors/output devices.

Bluetooth Chip

The Bluetooth chip will be the data transmission method to the iPad. The data will transfer only when the coaster does not have any weight on it for a certain amount of time (i.e. 60 seconds). We will be using a Bluetooth Low Energy chip to conserve energy. We used the bluetooth protocol because of the low energy capabilities and ease of integration with an iPad.

Requirements: Bluetooth LE. Preferably Bluetooth 4.0. Unobstructed range of 30 feet (± 5 feet) for wireless transfer.

Load Sensor

The load sensor will sense the weight of the drink plus glass it is in. It will be able to detect the increase and decrease in beverage weight so we can track how much a customer is consuming.

Requirements: Sense at least 28.6 oz, with accuracy resolution of at least .73 oz.

LED

The LEDs will illuminate from under the drink. They will be placed immediately below the surface of the coaster and emit light through the top. They will show different colors depending on the amount of liquid in the glass. It will be a gradient from one color to another as the glass is being emptied. This will help servers identify if the consumer’s drink needs to be refilled and provide entertainment value for the consumer.

Requirements: Must be visible at a distance of 50 ft in a typical restaurant setting. Wide viewing angle of at least 30 degrees. LED brightness of at least 400 millicandelas.

Coin Cell Battery

The coin cell battery will be the source of power for all the components in the coaster. It will power the microcontroller, Bluetooth chip, LEDs, and load sensor. We decided to go with a coin cell battery because of its small size. We looked up our parts and found out that they all can take 3V straight from the coin cell battery.

Requirements: 3V (±0.3V).

Risk Analysis

The challenge that poses the greatest risk to successful completion of the project is integrating the microcontroller with the other sensors and chips in the circuit. Mainly, integrating the microcontroller with the bluetooth chip. We believe that this will be difficult because dealing with wireless signals is a complicated task, and using the bluetooth chip correctly will be challenging to properly execute.

3. Ethics and Safety

The majority of the time spent on the project will be in the Senior Design lab or other similar electronic lab facilities. There are many rules and safety guidelines that need to be obeyed in these environments. In terms of lab equipment, the most concerning would arguably be soldering. It is important to perform soldering on our design in the designated workstations that includes the soldering iron and the elephant hood [2]. If the iron is not properly turned off or if the hood is incorrectly positioned over the fumes, it immediately poses a safety hazard to us and other people in the lab. Since every design has electronic hardware components, there is potential of electrical shock, electrocution, burns, and fires. To avoid these dangerous situations, there are printed safety procedures that are posted in the laboratory and general guidelines online that we can follow to ensure that we stay safe. One of the most important rules to abide by is the one-hand rule [2]. Only one hand should be on an electrical circuit to prevent current from entering the body. In addition, it is against the rules to work in the lab alone [2]. That means it is important to ensure that there is at least one other individual in the lab with us in case either person finds their self in a dangerous situation. These safety rules adhere to #9 IEEE Code of Ethics [1]. When we work on our project, whether in the design lab or in another facility, we will always prioritize safety for the sake of ourselves and others.

With regards to ethics, we will strive to design what we can do ourselves and make detailed references to the designs or implementation strategies that we utilize. We will make sure that all our designs are either made by us or properly cited in our final project paper. This complies with #1 of the IEEE Code of Ethics because we want to pursue an “ethical design” and “sustainable development practices” [1]. Although the finished project poses very little safety hazards to the general public, we will fully disclose any possible hazard to the user in order to promote and practice good safety protocol. This is a team project within a large class, so it is possible for conflicts of interest to arise. The best way to approach such situations is to follow #2 of the IEEE code of ethics and fully disclose any issues with the affected parties [1]. While we are in the process of creating the design, it is very common to receive criticism and advice from fellow colleagues, professors, teaching assistants, and other people who are not working with us. Criticism is important for us to correct any unforeseen mistakes or improve upon a current idea and we will readily accept any criticism that is given to us with the best intentions. Any of these improvements or suggestions that are implemented in the project will be properly credited and cited within our final paper [1]. This behavior is in compliance with #7 of the IEEE Code of Ethics. Lastly, it is important to know that even though this is an independent team project, we should be able to support the other teams in "their professional development" as well [1]. This can include sharing equipment, lending them an extra hand if needed, reminding them of safety rules, and encouraging them to further push themselves.

References

[1] "IEEE IEEE Code of Ethics." IEEE - IEEE Code of Ethics. Accessed February 08, 2018. https://www.ieee.org/about/corporate/governance/p7-8.html.

[2] Smith, Casey. "Senior Design Lab Use and Safety." Lecture, January 30, 2018.

[3] Elert, Glenn. "Density of Beer." Density of Beer - The Physics Factbook. Accessed February 08, 2018. https://hypertextbook.com/facts/2000/BlairElefant.shtml.