

Clever Coasters



An intelligent coaster system that tracks the amount of drink left in your cup

University of Central Florida

Department of Electrical Engineering and Computer Science

Dr. Lei Wei

Group C

Rubba Ashwas	Computer Engineering	rubba@knights.ucf.edu
Mitchell Crozier	Computer Engineering	mitchell.crozier@knights.ucf.edu
Teodotas Kursevicius	Computer Engineering	kurseviciust@knights.ucf.edu

2.0 Project Narrative

2.1 Motivation

Most people who have eaten at restaurants know that their experience can vary wildly depending on the attentiveness of their waiter. A conscientious waiter can always keep your drinks filled up, take your order when you decide what you want, make sure you have everything you need, and hand you the check when you're ready to go, all while seeming almost invisible and completely unobtrusive.

Unfortunately, **restaurants tend to get very busy at certain times** of the week and each waiter has to handle a large number of tables, all of which could be scattered around the restaurant. A waiter has to constantly monitor all of his tables while going back and forth to the kitchen to get food moving. It can become exhausting and stressful for the waiter managing numerous tables and **frustrating for the thirsty customer with their empty glass** at the corner of the restaurant. The customer would like to ask the waiter a question as well, but hasn't seen him for several minutes.

What if a waiter had tools that let him know when to refill a specific customer's drink or when to check in on a table that requires attention? That is the motivation behind the smart coaster system for restaurants: **A tool to help improve the workflow of restaurant staff and the improvement of the guests' dining experience.**

2.2 Goals and Objectives

The goal of this project is to create a **system of low-power, cost-efficient smart coasters** that can wirelessly connect to a table hub, which then connects to a main display where information about their current state is provided. The coasters should be able to charge easily and in large quantities, ensuring that a minimal number of wires are needed. The coasters should last through at least a full day of service before needing to be re-charged. Also, they should seamlessly connect to the hub at any table they are placed. The coasters should have

the **ability to detect if a drink placed on them is empty or full**. They should give the customer the ability to call their waiter, request to not be disturbed, and ask for the check.

The table hubs and smart coasters should be rechargeable to save costs. The table hub should act as the communication point between the coasters and the central display panel. They should connect to the coasters wirelessly and transmit their status to the central display.

The central **display panel should provide information to the waiters about the status of each table**. It should be able to separate the tables into groups based on which waiter is assigned to which table.

2.3 Function

Clever Coasters would allow waiters to spend less time worrying about refilling drinks and **more time having meaningful interactions with customers**. The smart coasters would individually estimate when a cup needs to be refilled and notify the waiters wirelessly. They would also give customers the ability to change the modes of the system to better suit their individual preferences. This system's function is to **increase the efficiency and effectiveness of waiters, thereby decreasing their work-related stress while improving the customer experience**.

3.0 Requirements Specifications

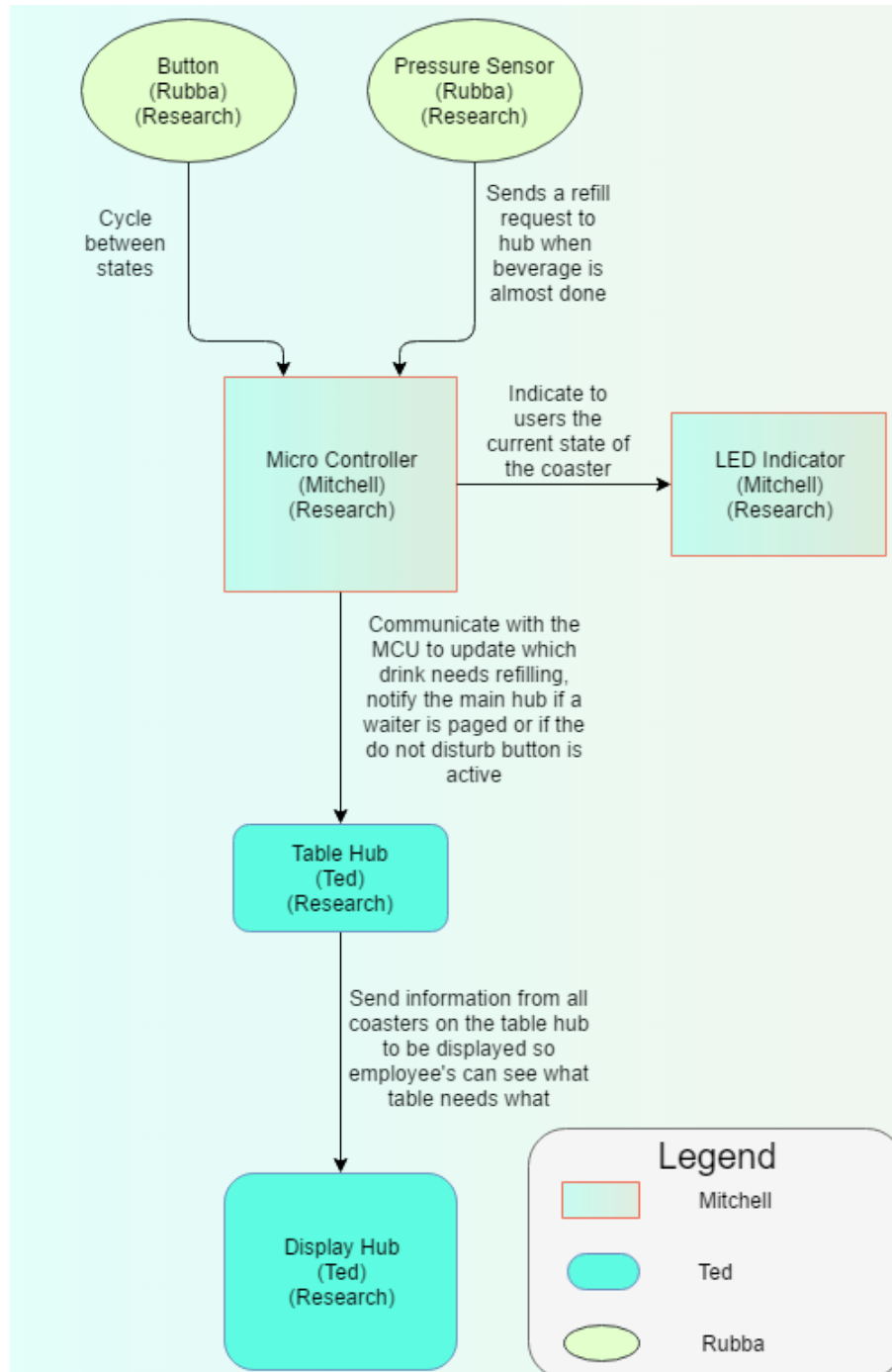
- Water shall not be able to enter the electrical system
 - Coasters and table hub shall follow IP44 standards
- Coaster shall have wireless connectivity
- Table hub shall have wireless connectivity
- Display shall have wireless connectivity
- Coaster shall have a sensor that can detect when the cup is less than 30% full given the weight of the empty cup.
- Coaster shall have an input that allows user to page a waiter
- Table hub shall retrieve information from the individual coasters
- Table hub shall send information to the employee display
- Employee display shall follow guidelines of User Interface Design
 - Employee display shall follow principle of consistency
- System shall have multiple states
 - System shall have a neutral state
 - Only one state can be on at a time
 - LEDs shall indicate which state is active
- When cup reaches 30% capacity, LEDs shall turn on
 - Option to turn off all LEDs shall be available
- Cup shall not fall over when placed on coaster
- Coasters shall establish wireless connectivity with table hub within 10 seconds
- System shall follow Wireless Standards of communication
- System shall cost below \$500
- Power consumption shall be under 5 W
- Wireless Connectivity shall reach lengths greater than 2 meters

4.0 House of Quality

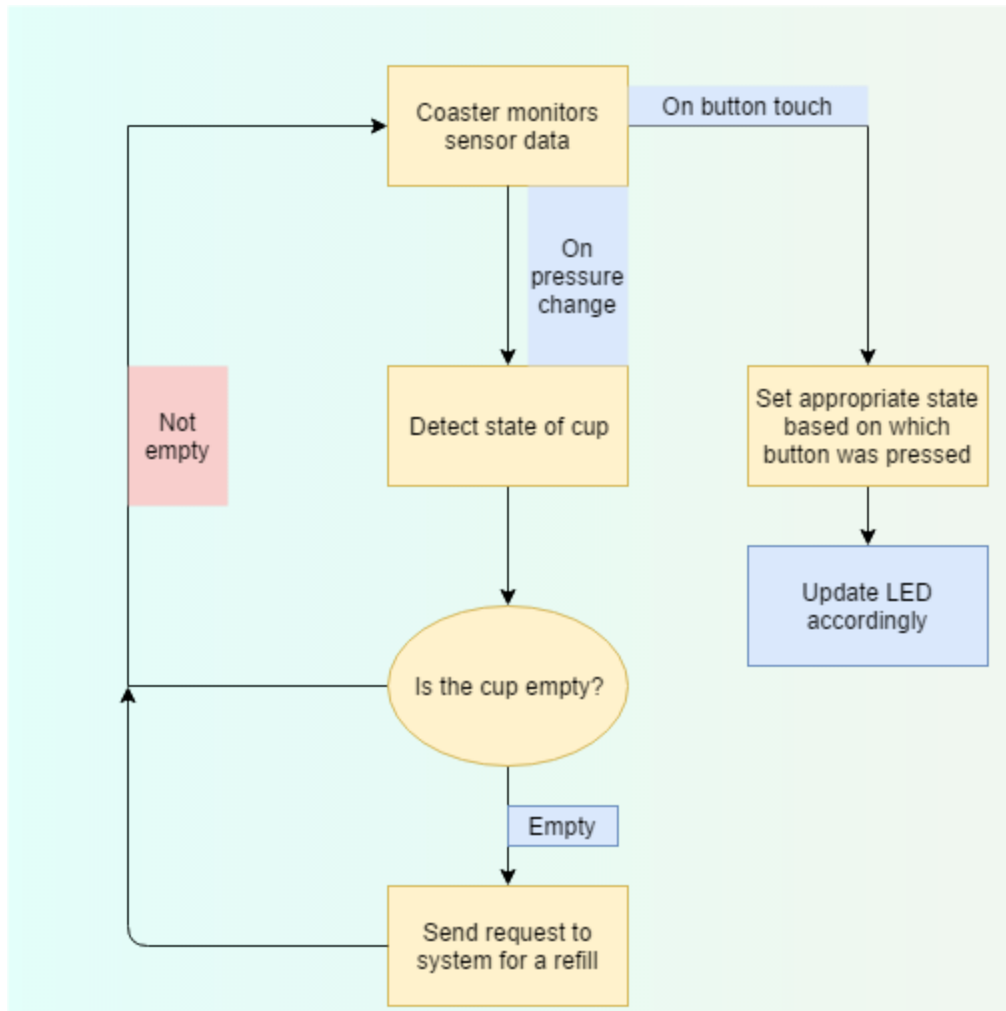
Legend		Engineering Requirements					
+	Maximize	Cost	Power Consumption	Wireless Range	Sensor Accuracy	Water Resistance	Response Delay
-	Minimize						
↑	Pos Correlation						
↓	Neg Correlation						
Marketing Requirements		-	-	+	+	+	-
Cost	-	↑↑	↑	↓	↓	↓	↓
Battery Life	+	↓	↑	↓	↓		↓
Ease of Charging	+		↑			↓	
Durable	+	↓		↓	↓	↑↑	
Smartness	+	↓	↓		↑↑		↑
Targets for Engineering Requirements		< \$500 Total	< 5 W (Table Hub) < 0.1 W (Coaster)	> 2 meters	± 50 g	At least IP44	< 10 sec

5.0 Block Diagrams

5.1 Hardware



5.2 Software



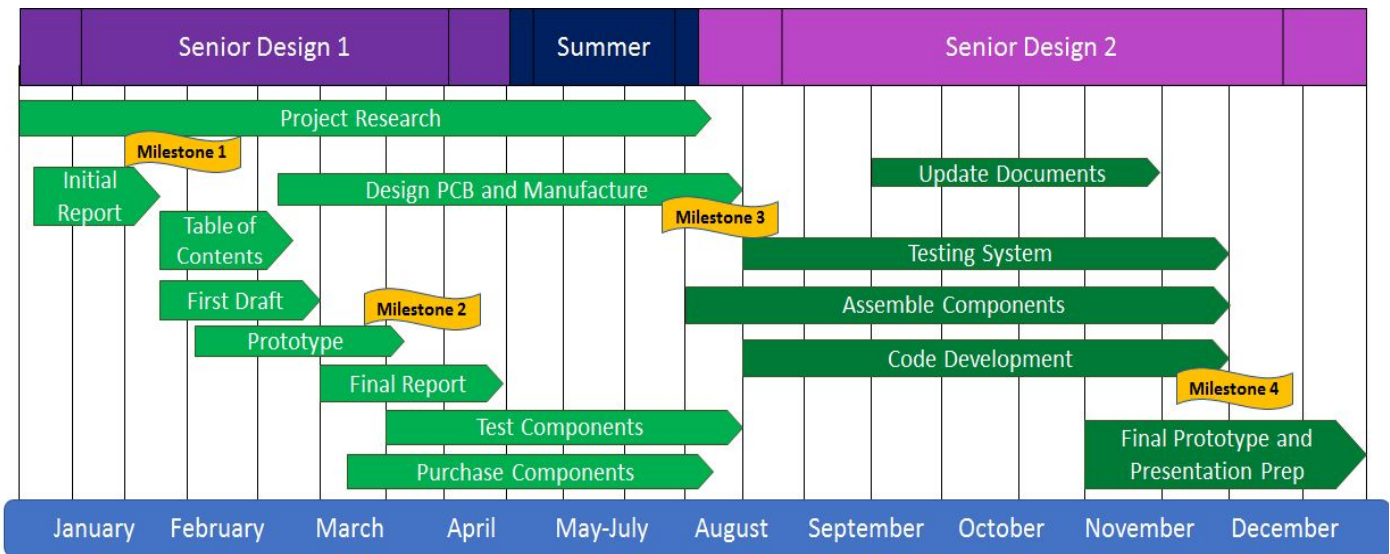
6.0 Estimated Project Budget and Financing

Description	Quantity	Estimated Cost (each)	Total Cost
MCU for Display Hub	1	\$70	\$70
MCU for Coaster	2	\$10	\$20
MCU for Tablehub	1	\$15	\$15
Wireless Components	4	\$10	\$40
PCB	8	\$12.50	\$100
Battery pack	3	\$6	\$18
Coaster outer shell	2	\$10	\$20
LEDs (pack of 80)	1	\$7	\$7
Weight sensor	2	\$7	\$14
Button	4	\$1.25	\$5
Table hub outer shell	1	\$7	\$7
Frosted plastic	2	\$1	\$2
Miscellaneous components	-	-	\$32
TOTAL			\$350

For each coaster, we will **require a microprocessing unit** to run the code responsible for analyzing the data from the sensors, controlling the LEDs, and connecting and wirelessly sending data to the table hub. We also need a microprocessing unit for both the table hub, to process the data sent wirelessly from the coasters connected to it, and the display hub, to take the information sent from table hub(s) and display it to the employee's. The display hubs microprocessing unit needs to be able to drive a full screen display, hence the higher cost. However, our team already owns a microcontroller suitable for the job. We budgeted for extra PCB boards to accommodate for any mistakes we make on our first designs.

With our **demo system of 2 coasters, a table hub and a display hub**, we need three batteries, one for each coaster, and one for the table hub device. The outer shell for the coaster is going to be tricky to handle, since we have to find a material that's not only waterproof, but also heat and cold resistant, pliable enough for our pressure and touch sensors to get a good reading, and fit all our components inside without being flimsy. In addition to all this, the material cannot reduce the signal strength of the signal to the point where it can no longer satisfy our requirement for minimum connectivity range. The LEDs will be of several different colors to allow user feedback with a variety of flashing patterns. They also serve to indicate to the server at a glance which drink needs to be refilled, and but not be so bright that customers might find them obnoxious, hence the frosted plastic to act as a diffuser for the lights.

7.0 Project Milestones



2017

- Milestone 1 will be our agreement on a project idea
- Milestone 2 will be finishing our design and final report
- Milestone 3 will be finishing and manufacturing the PCB design, and testing all parts
- Milestone 4 will be finishing the final working product

8.0 Conclusion

Overall, we believe that our project will benefit the end users by providing an intuitive and cost-efficient system available for continuous usage. We predict our **biggest challenge to be getting all the wireless components to connect seamlessly together**, and employing an energy-efficient system that doesn't waste too much power when idle. This project integrates computer engineering and electrical engineering pretty evenly, allowing us as a team of 3 CpE students to meet PCB requirements.

8.1 References

Examples of coasters <http://gizmodo.com/243535/smart-coaster-alerts-bartender-of-empty-drink>
<https://www.youtube.com/watch?v=KaGuFAYgmfU>

Ingress Protection (IP) ratings <http://www.dsmt.com/resources/ip-rating-chart/>

Analog <http://www.instructables.com/id/How-to-Make-a-Ridiculously-Cheap-Analog-Pressure-S/>