Initial Project and Group Identification Document

Smart Table

EEL 4914 - Senior Design I, Spring 2018

Group 16

Team Members:

- Christopher Corley - CpE
- Theodore Cox - CpE (w/ PCB design experience)
- Dhaval Desai - CpE
- Mikey Garrity - CpE

Contents of this Document

Project Narrative

PROBLEM STATEMENT:
Waiting tables is not a trivial skill. Servers only have a split second to look across a restaurant to determine if a table needs attention. Customers shouldn't have to turn around in their chair, and flail their arms. Essentially customers should feel "heard". Also even with the very best service, delays are inevitable. Why not make the customer more comfortable in the meantime?

We propose a "smart table" that is capable of communicating with the servers as well as providing a more satisfying customer experience. The core functionality desired is a table that gives customers more control of their dining experience. We believe that customers should be able to not only summon servers, but perhaps control the illumination and volume levels at their table. We would like the table to give visual cues to waiters via integrated decorative LEDs underneath the table rim. This way a server can discern when a party needs service at a glance. Ideally the table could also keep track of which servers are the most attentive. Ideally the table should check certain conditions and summon waiters automatically..

When the customer sits down at the table, there should be a "welcome routine" that intelligently adjusts the illumination within the table controls and decorative elements. The table should adjust the lighting based on its environment. The customer should be furnished with a volume knob that controls speakers embedded in the table. The customer should also be able to charge their phone via USB or wirelessly at the table. The table should respond to the presence of a new customer summoning a server.

In addition to ambient lighting on the table top for the customer, we propose embedding addressable RGB LEDs in the underside of the table. These LEDs should be programmable for seasonal events (Red/Green Christmas). More importantly the LEDs should have a unique idle state as well as a distinct pattern that indicates the need for a visit from the server. We are also considering allowing the table to generate a report for management detailing how long it takes for a server to respond to a call as well as which server responded. The table could use a technology like RFID tags / Bluetooth / CV (barcodes) to detect that a particular server has visited a table. Better servers could be rewarded by management.

As far as electronic design is concerned, we wish to make use of a technology like RFID tags / Bluetooth / CV (barcodes) to detect when a particular server reaches the table. We could also monitor the beverage pitcher with a scale, and detect customers with embedded passive infrared motion sensors. We would also like the table to utilize an ambient light sensor to intelligently adjust decorative lighting in the user controls / bezels. To furnish the phone charging, we would have to regulate the power to the ports / wireless pads for safety / reliability. Lastly at the top of

the table we will construct a box aka the “command center” which not only houses speakers and a volume control knob, but is home to a “summon waiter button” as well as the charging ports. Depending on the complexity desired, we could flex our engineering muscles by making a non - traditional knob for the volume. We could also potentially embed a 7 inch raspberry pi powered screen to display “daily specials” or more interactive content if desired.

As far as the aesthetic vision (Figure 2), we are looking to make a table for a trendy bar / restaurant. Specifically dark wood, metal (steel), illuminated frosted glass. We would like to take design cues from a vintage home radio. Frosted glass, and user controls backlit in a warm amber / white light would be soothing in a dark bar. Most importantly, making intelligent ambient lighting would be a good engineering exercise. As a matter of personal interests across the group, we would like to incorporate beautiful woodworking. One member has experience in woodworking (Figure 1). At the end of the day, a table is an excellent excuse to mount sensors on a 2-D plane.

Figure 1: Example of Texture

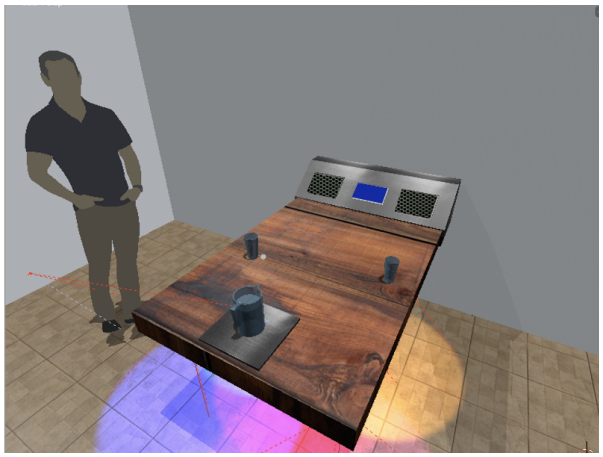


Figure 2: Early Conceptual Rendering

Requirements

1. Table shall detect a new occupant, signalling the customer greeting routine.
2. Table shall illuminate with unique pattern to signal a waiter to come over.
3. Table shall maintain a digital record of which server responds.
4. Table shall maintain the response time in minutes and seconds of how long it takes for a server to respond to a table.
5. Table shall recognize when a particular server visits table.
6. Table shall have embedded lighting underneath the seating surface.
7. Lighting under table shall be able to change color and display unique patterns.
8. Table shall detect when a communal beverage pitcher is empty.
9. Table shall signal server to fill pitcher.
10. The table shall ask the occupants whether they would like a refill on their communal beverage pitcher.
11. Table shall have embedded speakers.
12. Users shall furnish a volume control for embedded speakers.
13. Table shall furnish a way to charge smartphones.
14. Table shall seat two people.
15. Table should employ “warm” decorative back-lighting in controls and on surface for the purpose of illumination.
16. These shall light sources should dim during the day time when not needed.
17. Table components should be able to endure spills and cleaning.

House of Quality

Figure 3 below, represents the tradeoffs between marking design features (Ease of Use, Cost, Lighting Quality, Build Time, and Durability) and the engineering design features (Brightness, Number of Lighting Profiles, Dimensions, Power Consumption, and Seating Capacity). House of Quality analysis provides insight as to whether the proposed design requirements are suitable to fulfilling the needs of the market.

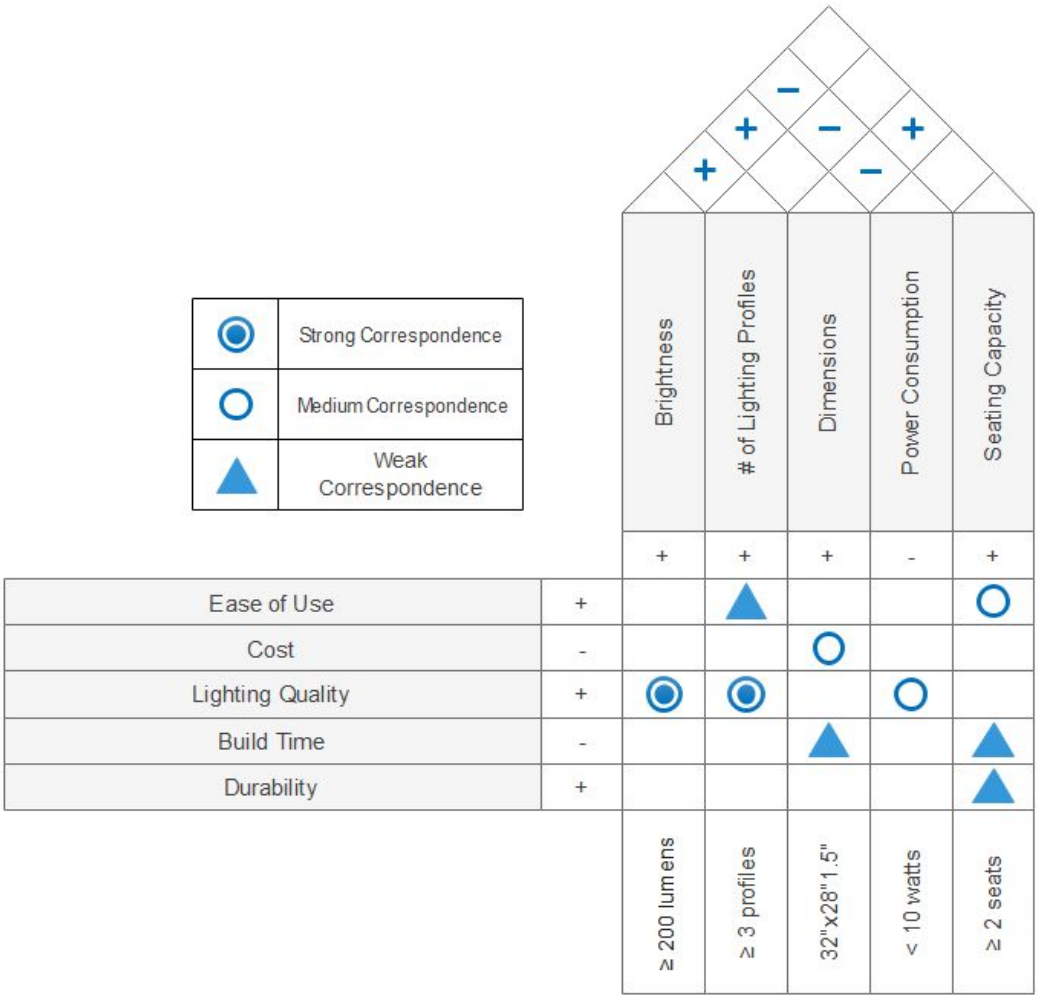
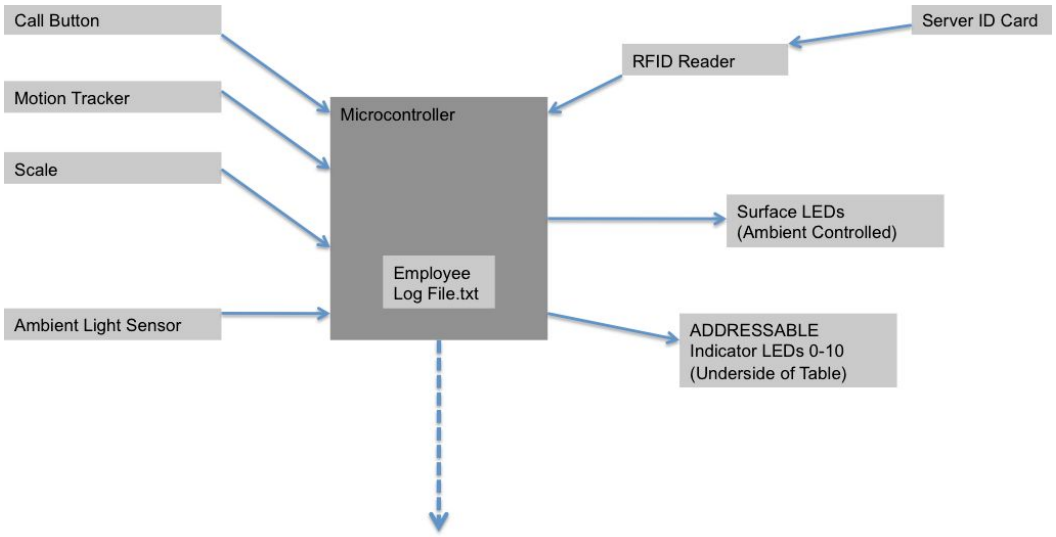


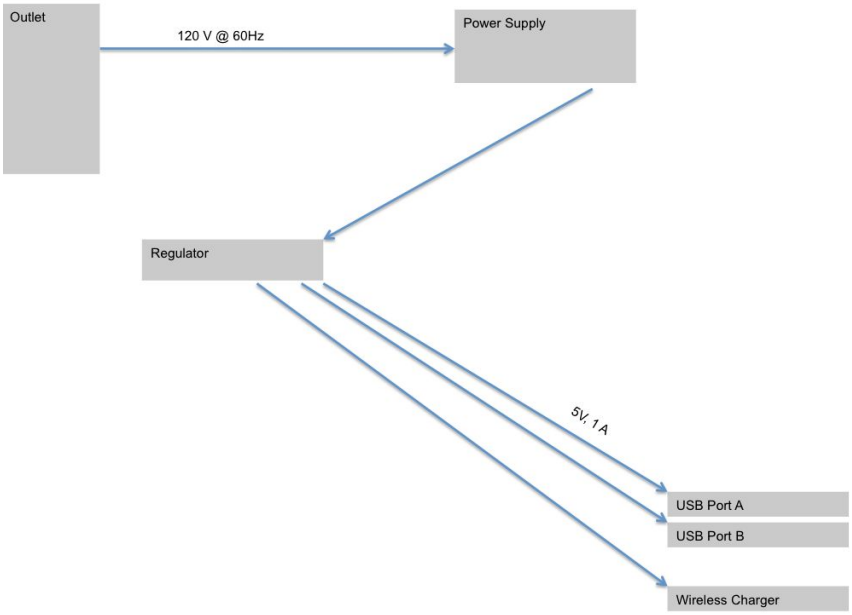
Figure 3

Block Diagrams

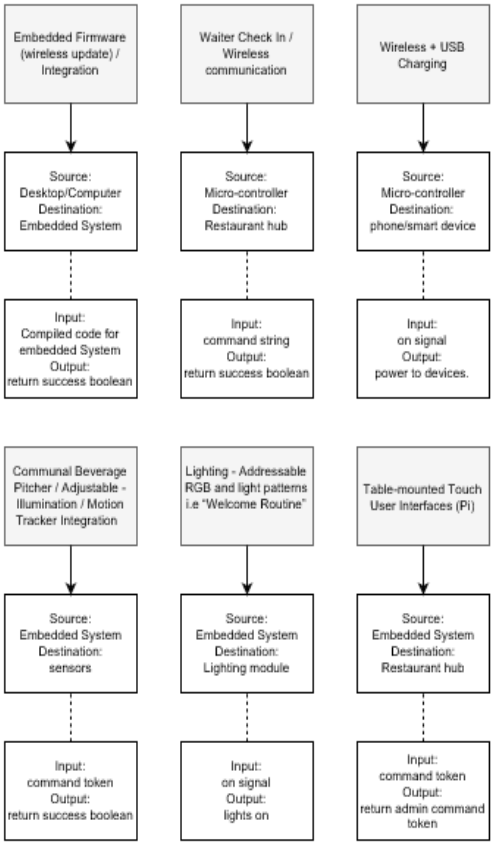


Block Diagram 1: (Main Board)

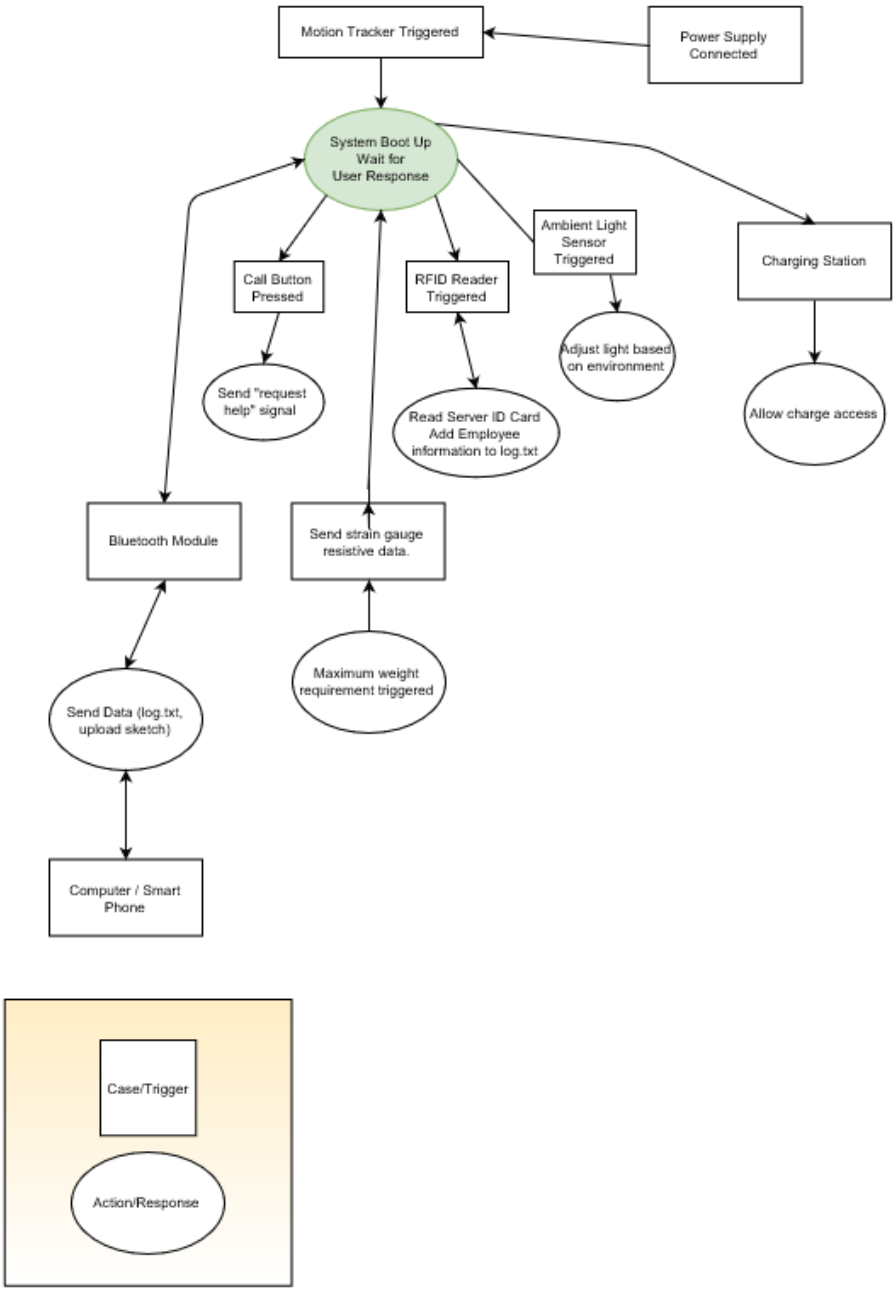
As seen in Block Diagram 1, the MCU will handle incoming data from many different sensors. The status of the sensors will be stored in memory and periodically sent to a receiver; waiter hub. The user (restaurant customer) will be able to interact with the table via sensors that communicate directly to the main MCU. Depending on the input command, the MCU may adjust outputs to various sensors and devices or send log information to the nearby hub.



Block Diagram 2: (Ancillary Charging Board)



Block Diagram 3: (modular sub-systems)



State Diagram 1

Finances and Budget

In regards to the cost of components, prices listed are slightly higher than actual prices. This is to account for price fluctuations and to provide a financial buffer for any inadvertent circumstances. We are self-funded.

Item	**Quantity for Engineering Model**	**Quantity for prototyping**	**Cost**	**Total**
Lumber/Steel	1	-	$200	$200
Stain/Polyurethane	1	-	$50	$50
Frosted Glass Panel	2	-	$35	$70
Addressable RGB Lighting	16 ft	-	$40	$40
Arduino Development Board	-	2	$10	$20
Infrared Sensors	4	10	$0.50	$7
RFID module	2	2	$2	$4
PSU/Step-down/wall-wart	1	1	$15	$30
Speakers/Audio Components	1	1	$15	$30
Grill Bezels	1		$10	$10
PCB Design	1	2	$20	$60
Buttons/Knobs	2	4	$5	$30
USB Charging Port/cable Components	1	2	$5	$15
7” Touch Screen LCD	1	1	$20	$40
Weight Measurement Components	1	2	$10	$30
			Total Cost:	~$630

Subsystems:

All - Construction - Table Finishing and Structure, OFTS 12V DC
All / Theodore - Embedded Firmware (wirelessly update) / Integration-
Dhaval - Waiter Check In - Waiter can be recognized when they visit the table.
In: "ready to receive" signal out: Unique Id code
Theodore / Dhaval - Wireless + USB Charging
Theodore / Mikey - Table-mounted Touch User Interfaces (Pi) - Touchscreen/Buttons
Mikey / Chris - Communal Beverage Pitcher / Adjustable - Illumination / Motion Tracker Integration
Chris / Mikey - Lighting - Addressable RGB and light patterns i.e "Welcome Routine"
Theodore/All - PCB
In: power Out: power

PARTS:
Lumber and Support:
Lumber
Polyurethane
Stain
Square Steel Tube

Illumination:
Frosted Glass Panels
Addressable RGB Strips

Main PCB (Inside Table): Theodore Cox
Arduino (Atmel) Family Microcontroller
Motion Tracker (passive infrared)
Ambient Light Sensor (photoresistor)
"Call Waiter" Button (electro-mechanical push button / capacitive touch pad).
AC-DC Power Supply/Step-Down (12V power)
DC-DC Converter (12-to-5V regulator)
Load Cell /Strain Gauge/ amplifier (Beverage Scale)

Sound System:
Left/Right Speakers (connected via Bluetooth or aux)
Speaker Grill/Bezels
Volume Knob (Potentiometer)

Smartphone Charger:
USB Ports X2
Power Regulator

Senior Design I Milestones

Number	Task	Start	End	Status	Responsibility
1	Ideas	1/10/18	1/20/18	Complete	All
2	Project Selection	1/20/18	1/25/18	Complete	All
3	Initial Document	1/20/18	1/28/18	Complete	All
4	Table of Contents	1/10/18		In-Progress	All
5	First Draft				
6	Final Document				

Decision Matrix

	Cost	Development Time	Aesthetic Quality (Ruin Minimalist Design)	Power Usage
Fully Addressable LEDs	++	++	--	++
Track Waiters (RFID Reader)	++	++	--	++
HUB Implementation	++	++	--	++

References:

4 Things You Should Know About Adding a Kiosk to Your Restaurant.
https://www.lilitab.com/blogs/news/118172868-4-things-you-should-know-about-adding-a-kiosk-to-your-restaurant

Ziosk Kiosks

https://www.ziosk.com/

15 Tokyo Cafes that are Downright Weird
https://blog.hotelscombined.com/15-weird-tokyo-cafes/

DIY LED, WIFI-Controllable via ESP, MQTT, and Home Assistant
https://www.youtube.com/watch?v=9KI36GTgwuQ