UNIVERSITY OF CENTRAL FLORIDA

Senior Design

Divide & Conquer II

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Bartending Butler Bot (B3)

Group 13

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1. General

As an initial formulation and scoping of a senior design project for the 2019-2020 academic year at UCF's College of Electrical Engineering and Computer Science, we henceforth propose and introduce the **Bartender Butler Bot (B3)**. This document renders an ABET mandated composition, to outline and survey the general concept of an automated beverage mixing and delivery appliance.

2. The *Bartender Butler Bot (B3)*

2.1. Motivation

For millennia, and all over the world, people have entertained themselves at the end of a long work week with good conversation, warm feelings, and cold drinks. But any good drinking buddy can attest to how inconvenient it is to have to walk away for a moment to snag another beverage. Being gone during the best part of an episode or deepest part of the group conversation is, frankly, the worst. Further, when serving drinks, inebriation may even adversely affect the quality of the drinks and contribute to accidents or spills!

Meanwhile, the world around us continues to improve technologically. Many aspects of life have been fundamentally changed from millennia ago. However, the continuous integration of digital technology in day to day life has not yet delivered enough accessible, fun, or novel household appliances for the modern savvy socialite. It is only natural that a baccalaureate demonstration of the uses of digital technology in this age serve, at once, to entertain guests, enable more leisure time with friends, and enrich life.

For these and various other intrinsic reasons, we propose an integrated appliance for automating the process of making and delivering drinks for use in familiar locations across wide open areas.

2.2. Functional Description

The *Bartender Butler Bot (B3)* is an integration of various off-the-shelf subsystems. It consists of a compact, consistent, configurable, efficient, and quick drink mixing station we dub *the Bartender.* In addition, there is an easily programmable drink delivery bot with a simple, built-in user interface for conveniently and quickly ordering from a configurable menu of available drinks, we dub *the Butler*.

The user at some location remote from the bartending stations, selects their beverage from a menu available on the *Butler's* interface. The *Butler* navigates to the *Bartender,* and across wireless communications, informs the *Bartender* of its arrival and the drink selection. The *Bartender* verifies the arrival, precisely prepares the drink order, and releases it to the *Butler*, which then returns to the remote location at the user. The user accepts the beverage, and the *Butler* awaits further orders.

3. Requirements and Specifications

3.1. Engineering Design Specifications

Description	Unit of Measurement	Requirement
Total Appliance Cost*	USD	<$1500
Max. Avg. Appliance Configuration Time	minutes	<10
Min. Capacity for Beverage Ingredients*	ingredients	>3
Order Time	minutes	<1
Beverage Mixing Time*	minutes	<2
Drink Accuracy	% Target Vol.	<5%
Delivery Time*	minutes	<5
Delivery Range*	meters	>10
Charge Lifespan	minutes	>90
Dimensions of Bartending Bot	cm^3	<50000

Table 1: Engineering Design Specifications (EDS)

3.2. Design Objectives

Overall:
- Minimize the number of mechanical subsystems.
- Maximize the number of off-the-shelf or open-source subsystems.
- Minimize the overall cost of the system.

● Maximize use of scalable production techniques in system build.

Bartending Bot:

● The bartending station's available recipes shall be constrained to those whose beverage ingredients are both available and configured across the appliance user interface.

● The bartending station shall be optimized for simple cleaning and configuration.

Butler Bot:

● The butler shall be able to autonomously navigate a path from the bartender to the delivery location without making contact with any obstacles.

● The butler shall be able to transport the mixed beverages from the mixing station to a remote location.

● The butler shall receive the order on a built-in user interface.

User Interface and Application:

● The graphical user interface for configuring both the bartender and the butler shall be accessible across a dedicated touch-screen.

● The appliance firmware shall automatically handle and suggest drink recipes from the available ingredients configured by the user.

● The appliance firmware shall allow the user to configure recipe preferences, and ingredients available.

3.3. Key Components

● Drink mixing station, *Bartender*
● Autonomous drink delivery bot, *Butler*
● Docking station for drink delivery bot
● Ordering and configuring interface

3.4. Standards and Regulations*

These are relevant industry or regulatory standards externally imposed:

1. Food-safety regulations
2. Open-source licensing standards
3. Food & Beverage industry standards
4. Communication standards
5. Power safety standards

* To investigate further.

3.5. Key Constraints

These are our natural internal restrictions:

Range of expertise:

- All members of the team are electrical engineers, so we must limit the mechanical complexity of the system as much as possible.

Funding:

- We have not and do not intend to actively solicit a sponsor, so we must work within the realm of possibilities afforded by our combined investment.
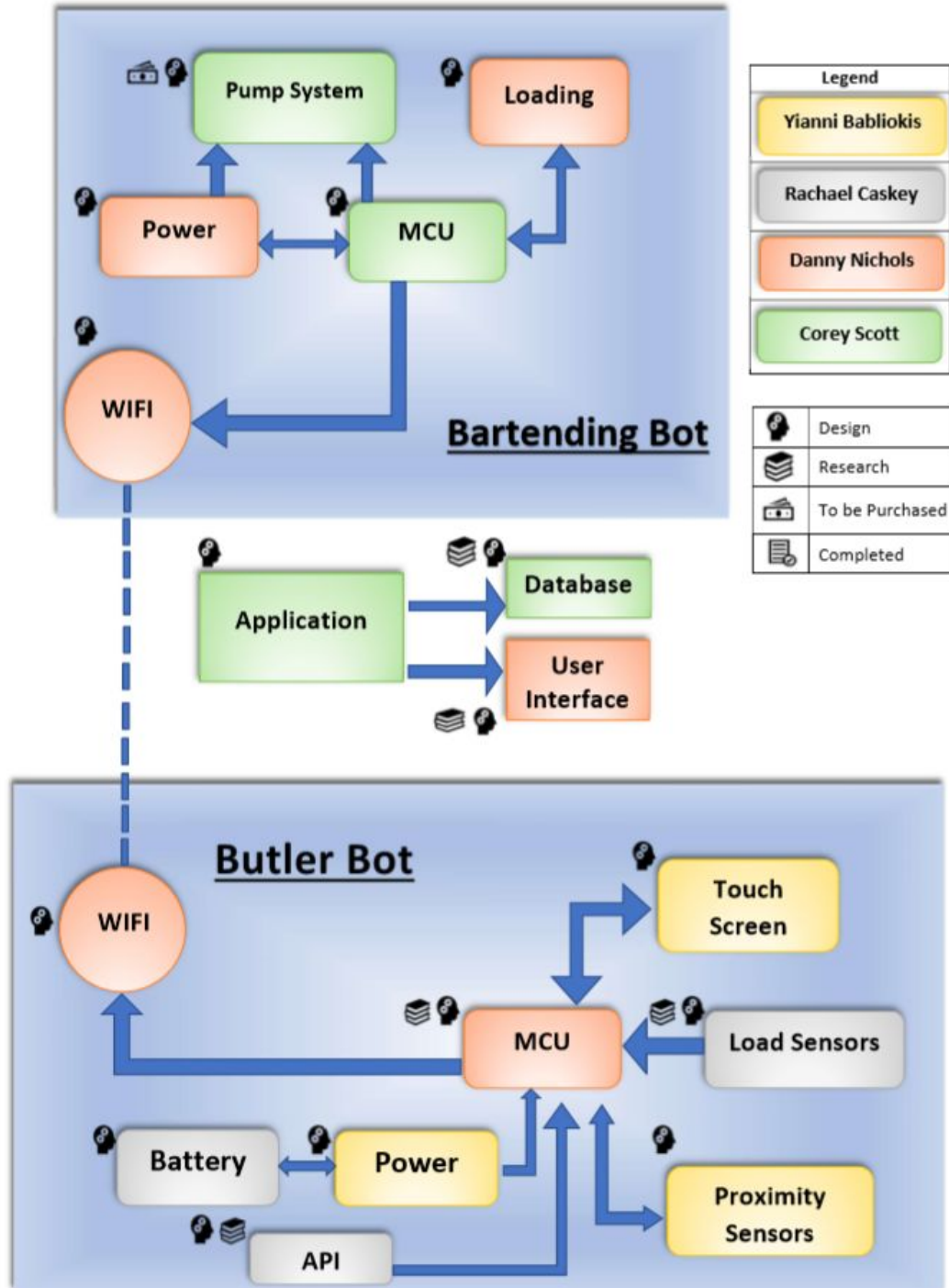
* To investigate further.

4. Block Diagram

Figure 1: B3 Block Diagram

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5.   Budget and Financing

Item	Description	Estimated Cost
User interface host computer and touch screen display	A compact and low-end system for running the underlying application	$100
Packaging / Aesthetics	Frames, fasteners, paint, veneer, bow-ties, and other outfacing aesthetics	$150
Pumps, Valves, Actuators	For hygienically and precisely controlling liquid flow rates in the drink mixing station	6 x $30
Sensors, Relays, Converters	For digitally monitoring and controlling the mechanical subsystems	$100
Delivery bot base	To form the mechanical base of the autonomous bot	$250
Development boards	For prototyping the integration of pumps, sensors, actuators, valves, etc. with the interface host	$75
PCB manufacturing & shipping	For integrating the prototyping circuits into a final product	$180 $45
Final Documentation Printing/Binding, Showcase Props	For presentation and showcasing	~ $25-65
Miscellaneous	For unexpected failures and minor to moderate pivoting	$300
Total		**~ $1355**

Table 2: Estimated Budget

6. House of Quality
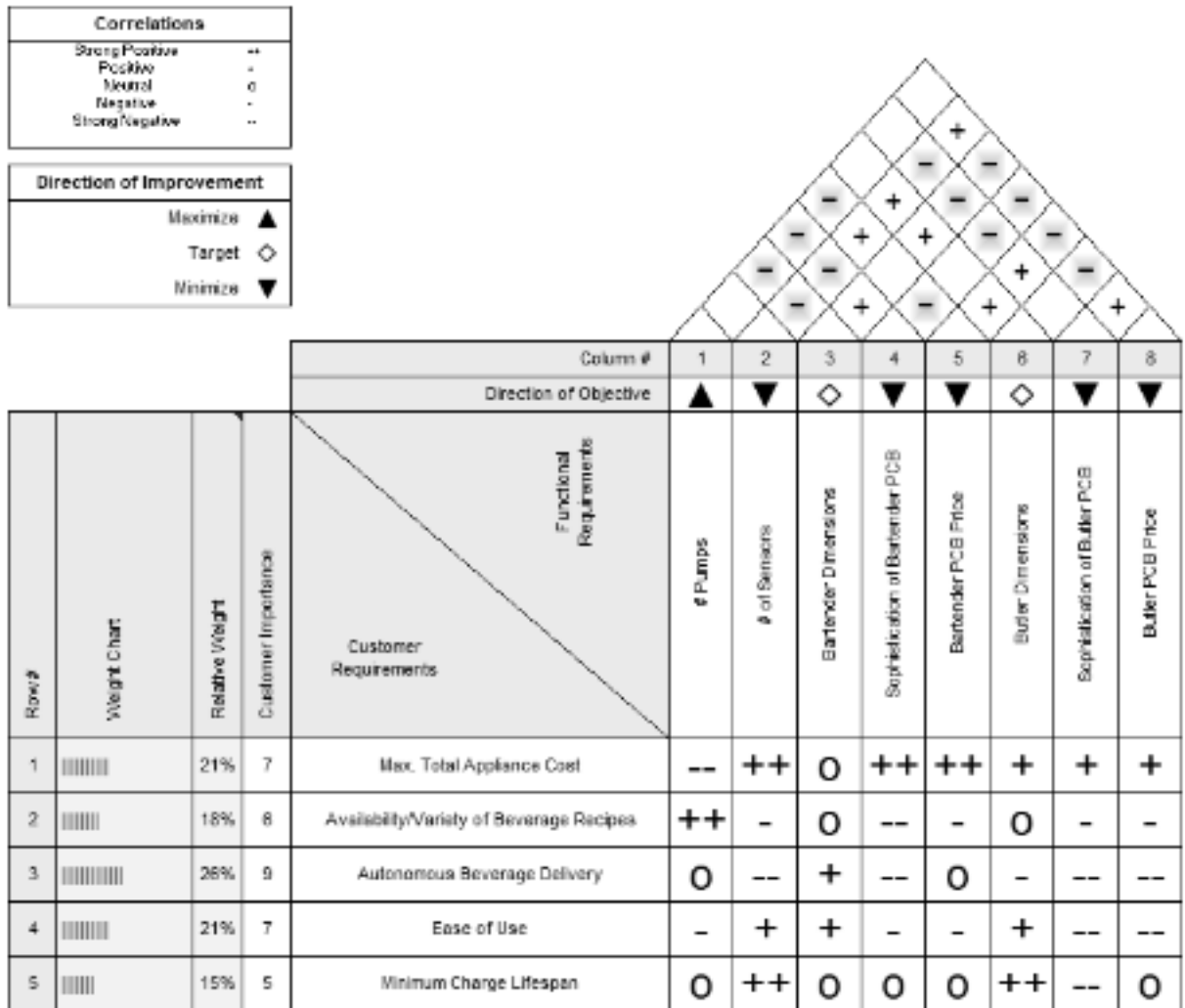
Figure 2: House of Quality (QFD)

7. Project Milestones

7.1. Design Phase

Week #	Date	Action
3	9/10	Formally initiate project brainstorming
	9/20	Set primary project objectives, scope
	9/20	Cement budget constraint
4	**9/20**	**Initial D&C Document Due**
	9/24	Meet with Professor(s) for Initial Feedback
	9/26	Re-evaluate primary objectives and project scope, pivot if necessary
5	9/27	Compile an initial list of all possible components, applicable or desirable technologies in budget
	10/4	Configure project management tracking system for development timeline: GitHub, Asana, etc.
	10/4	Cement primary project objectives, scope
6	**10/4**	**Updated D&C Document Due**
	10/8	Identify key prototyping components, tools, supplies
7	10/11	Assess and distribute research load
8	10/18	Acquire/Order key prototyping components
	10/22	Outline critical design report
9	**10/25**	**Standards Assignment Due**
10	**11/1**	**60 Page Draft Due**
	11/8	Validate control of valves, pumps, and key mechanical elements via development boards
	11/8	Validate relays, power systems, and control

		schemes via development boards
	11/8	Draft the presentation
11	11/8	Complete functional drinking mixing station breadboard prototype
12	**11/15**	**100 Page Submission Due**
	11/23	Formalize BoM, budget
13	11/23	Finalize critical design report
14	11/29	Finalize presentation
15	**12/2**	**Final SD1 Document Due**
	12/13	CAD structural components and packaging frames
16	12/13	Identify and acquire additional key components
17	12/20	Complete autonomous drink delivery breadboard prototype functionality

7.2. Implementation Phase

Week #	Date	Action
1	*1/10*	*Order/machine structural and aesthetic components*
	1/10	*Integrate functional subsystems via host application*
	1/10	*Overall system schematic*
2	*1/17*	*Mock-Up application and GUI*
	1/24	*Validate core application functionality*
	1/24	*Order/machine structural and aesthetic components*
3	*1/24*	*Mock-Up project website*
4	*1/31*	*Complete initial draft PCB layout*

	2/7	*Assemble structural framework, enclosures, and packaging*
5	2/7	*Optimize application GUI*
	2/14	*Assess possibility of additional scope*
	2/14	*Finalize PCB design and order it*
6	2/14	*Achieve overall project prototype functionality*
7	2/21	*Trial, Adjust or Accomodate*
8	2/28	*Finalize project and continue testing*
	3/6	*Continue testing*
10	3/13	*Integrate consolidated PCB(s) into appliance*
11	3/20	*Prepare Final Document*
	TBD	*Final Document Due*
	1 Week Prior Final Pres.	*Review/Revise/Practice Presentation*
	TBD	*Final Presentation*

*** Preliminary and subject to change.