Digitizing the Restaurant Experience

Team #36

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1. Introduction

1.1 Objective

Throughout this Covid-19 pandemic many businesses have been experiencing huge losses. Restaurants have been some of the hardest hit businesses and this is due to the fact that most restaurants online function when people are able to come in and sit down. Over 60% [1] restaurants that closed during the pandemic are closed for good. The restaurants that are still open may face a similar fate.

Our goal is to bring about improvements to the efficiency with which restaurants are able to function by improving their throughput of customers. We plan to design a system that can aid servers in determining if a table is clean and available for the next pateron. Additionally, we are going to be making a system that limits the amount of time that customers need to physically interact with the server. This will be achieved through a screen where the customers can order food and request drinks and the customers will be able to pay for these items without physically handing their card to the server.

1.2 Background

There have been previous attempts to simplify this experience. This includes companies like TouchBistro[2] which has the option of adding an iPad to each table. This is a costly endeavor for restaurants as they not only have to pay the $70 a month fee to the company but for each table they need to purchase an iPad which would significantly drive up the costs. There are a couple other competitors like Toast but they all inherently have the same problem of being too expensive.

Our solution would be a cost effective way for a restaurant to manage customer orders and update the POS system without having to pay through the nose. It would give smaller restaurants the ability to offer customers a novel way to order and keep everyone safer during the pandemic.

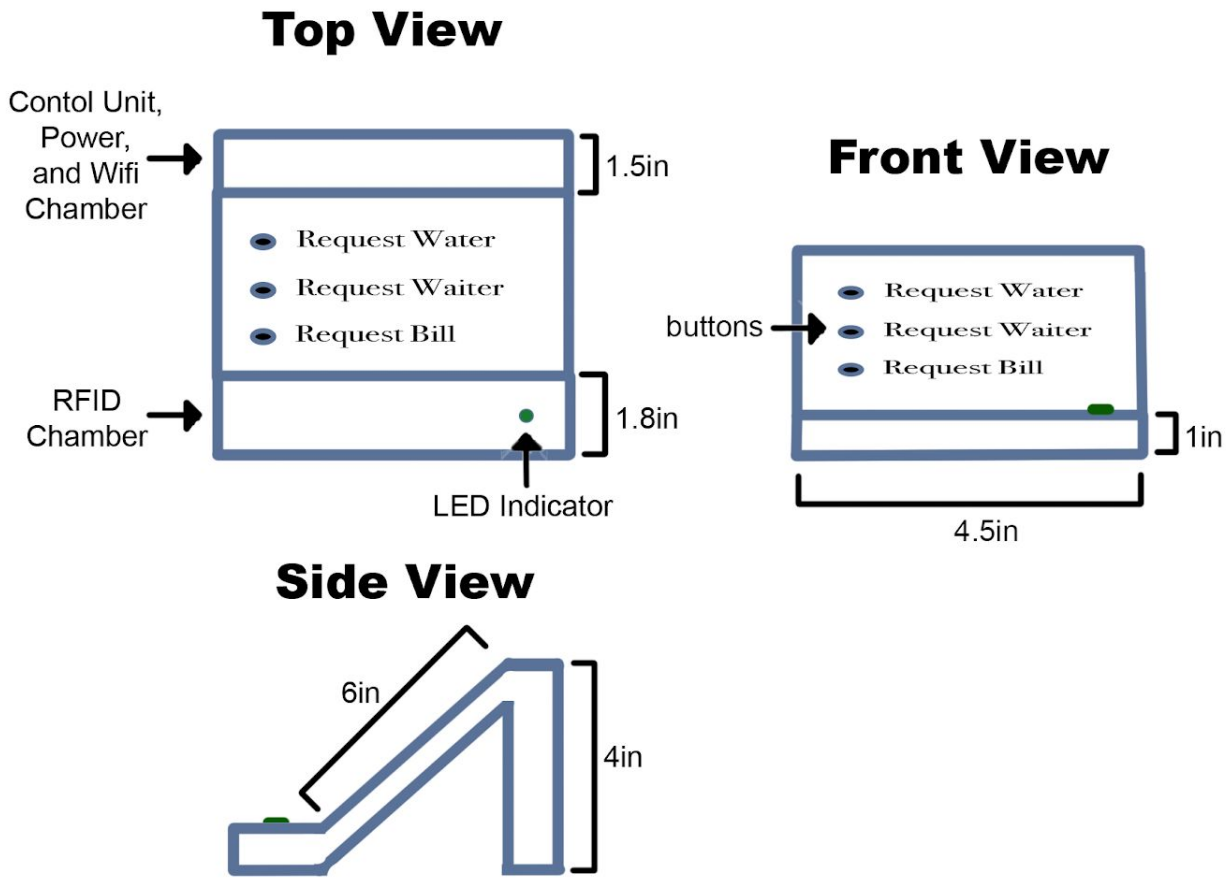
1.3 High-Level Requirements

- Using an RFID card we will give restaurant workers the ability to indicate when a table is clean with an accuracy of 90% +/- 5%.
- The screen will allow the customer to communicate with the restaurant for tasks including requesting water, requesting food, and paying the bill.

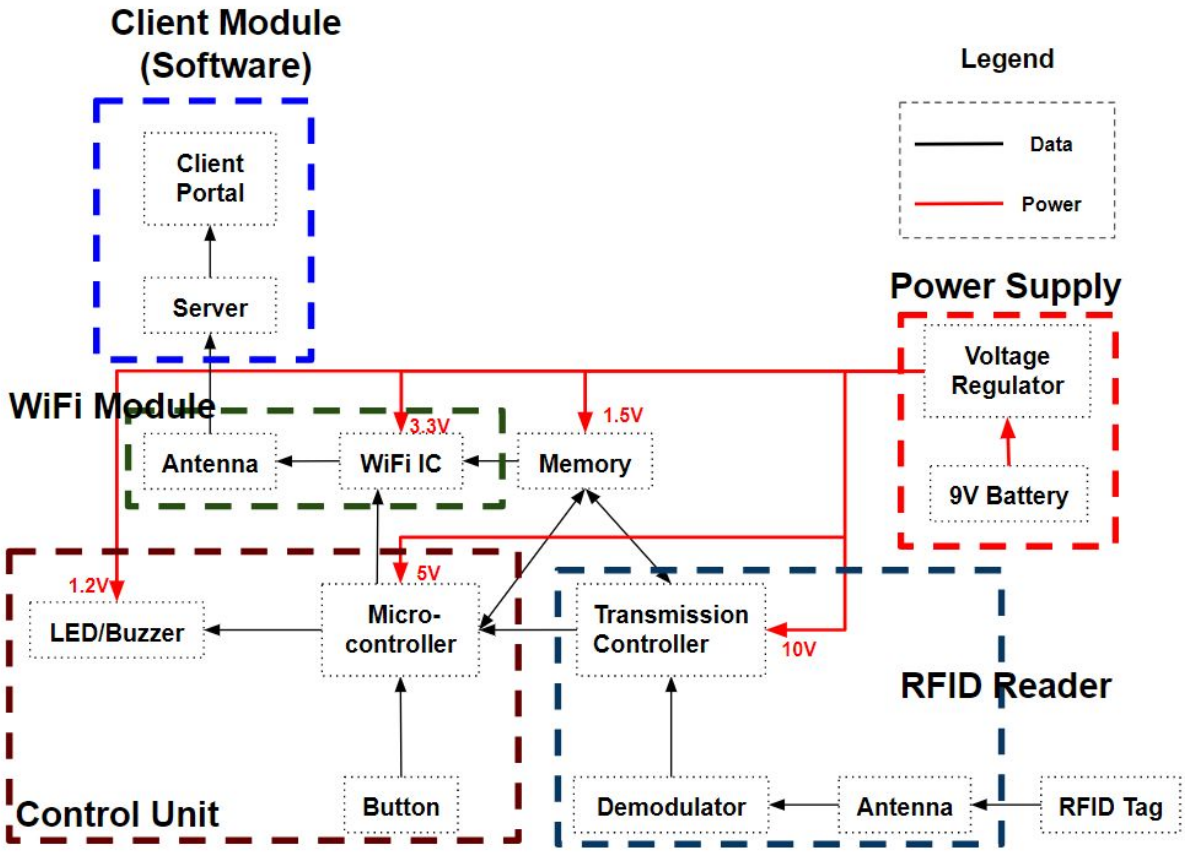
- Implement a WiFi module that can be used by the restaurant and the customers to communicate orders, communicate with the server and additionally allow the customer to pay at then end of the meal.

2. Design

Physical Diagram:



Block Diagram:



2.1 Power Supply

A power supply is required to keep the RFID, screen, and WiFi module working. We will use a Li-ion battery which is regulated to 9V for the whole system.

2.1.1 Li-ion battery

The lithium-ion battery must be able to keep the circuit continuously powered.
Requirement: The battery must be able to store enough charge to provide at least 150mA at 9V for 12 hours.

2.1.2 Voltage regulator

This integrated circuit supplies the required 9V to the node system. This chip must be able to handle the peak input from the battery (9V) at the peak current draw (300mA).
Requirement 1: The voltage regulator must provide 3.3V +/- 15% from a 9V source.
Requirement 2: The voltage regulator must provide 1.8V +/- 15% from a 9V source.
Requirement 3: The voltage regulator must provide 5V +/- 15% from a 9V source.
Requirement 4: The voltage regulator must provide 1.2V +/- 15% from a 9V source.
Requirement 5: The voltage regulator must provide 10V +/- 15% from a 9V source.

Requirement 6: Must maintain thermal stability below 125°C at a peak current draw of 250mA.

2.1.3 Risk Analysis

The power supply may not be wired correctly so we will need to ensure that the wires are properly insulated and grounded.

2.1.4 Contingency Plan

In case the school shuts down this part of the project will be unaffected.

2.2 RFID Tag/Reader

We create an RFID reader which will be simple to use and effectively indicate when a table is ready or served.

2.2.1 Reader

The RFID reader will be able to recognize the unique RFID card which is in the possession of wait-staff which, when read, will indicate the table has been helped/cleaned. When the reader recognizes a tag, it will trigger an LED indicator and send a signal to the SQL server to clear their request.

2.2.2 Tag

The tag will be on a card which can be easily held in a pocket or on a keychain. The RFID reader will only accept this card's unique signal.

2.2.3 Risk Analysis

There is a risk that this RFID reader will be unable to communicate with the RFID tag that we create. In that case we may have to simplify our design and purchase an NFC tag.

2.2.4 Contingency Plan

In case the school shuts down this we will try to continue working on this part if we have the materials/base otherwise we will purchase a replacement.

2.3 POS/Customer Interface

The Customer Interface's primary use is to communicate a customer's needs with the client. This is accomplished through a series of labeled buttons which, when pressed, will cause the control unit to send a signal which populates a server with the appropriate data which is monitored by the client via a web-portal.

2.3.1 Client Module

The Client Module includes the server which stores the data which the customer is trying to communicate with the establishment and a web-portal to view such data. The restaurant will use the portal to see which tables are making requests and will have the ability to clear requests through the portal. The server will hold a collection of SQL tables to organize the data which will be displayed through the web-portal. Most of all software will be hosted by Google Cloud Services. A python-Flask backend will interpret API calls from the table units to determine their status and update the database accordingly. The Client portal will be a simple javascript React portal. By using a ID and password unique to the restaurant, staff will be able to see the status of tables through this portal. Ideally, in the future, this project will expand to having a customer-facing application which will allow diners to accomplish much of this project's functionality through a mobile application (out of the scope of this project).

2.3.2 Microcontroller

The Control Unit will interpret signals from the RFID reader and buttons to send data through the WiFi Module. On the storage of the microcontroller will be a series of API commands which will send to our flask application hosted on the Google Cloud Services given that certain conditions have been met (I.E., button has been pressed and/or RFID reader recognizes a valid tag). The entirety of software that is NOT hosted on the Google Cloud Services will be here.

2.3.3 Wifi Module

The Wifi Module will allow the customer's table-unit to communicate with the server and ultimately communicate their requests with the establishment. The Wifi Module's primary purpose will be to transmit simple API commands, stored on the control unit, which will update SQL tables on our server.

2.3.4 Risk Analysis

There is a risk that the Wifi module will not have enough range, we will try our best to solve this issue. The client issue should be risk free.

2.3.5 Contingency Plan

In case the school shuts down the client module will be unaffected however the wifi module may be difficult to complete. In this case we will use this as a proof of concept.

3. Safety & Ethics

There are several safety hazards that we will need to handle when it comes to this project. Firstly the safety hazard that we face is that all of the power needs to be properly grounded. If there is an exposed wire there is a chance of electrical. Additionally we will need to make sure that our project has some level of waterproofing. If a customer accidentally spills water on our system then it could cause some electrical issues not to mention that it will be extremely unsafe for the consumer.

Some safety considerations to take into consideration when designing this project are as follows. We need to ensure that when we are constructing each module that we are cautious of common electrical standards (like always grounding).

In order to ensure that our project is ethically sound we will need to ensure that all of the user data that is inputted in our POS will be encrypted and not stored locally. This is especially important when a user makes a payment. Looking at section 7 of the IEEE code of ethics [3], we need to ensure that the technology is understandable and discloses exactly what information it needs from the user.

References:

[1] Croft, Jay. “Yikes! Yelp Says 60% of Restaurant Covid-19 Closures Are Permanent.” *CNN*, Cable News Network, 25 July 2020, www.cnn.com/2020/07/25/business/restaurants-reopen-coronavirus-shutdown-trnd/index.html.

[2] “IPad Restaurant POS System.” *TouchBistro*, 25 Aug. 2020, www.touchbistro.com/.

[3] “IEEE Code of Ethics.” *IEEE*, 1974, www.ieee.org/about/corporate/governance/p7-8.html.

[4] Karygiannis, Tom, et al. *Guidelines for Securing Radio Frequency Identification (RFID) Systems*. Recommendations of the National Institute of Standards and Technology.