SmartKart

Group 16

University of Central Florida College of Engineering and Computer Science

Senior Design I
Initial Project Documentation

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Project Narrative:

Motivation

Currently when a person goes shopping they might have a hassle that can be averted. The average customer spends time searching and collecting coupons, only to forget them, rendering them useless. Regardless of the store, a customer can always expect to wait in long lines before cashing out. Also, customers with a budget must continuously check that they have haven't exceeded their allotted funds. With all these factors, a simple task like shopping can become hectic and waste time that can better be used elsewhere for the common shopper. Motivated by the Amazon Go Supermarket, which improves shoppers' experiences and gets rid of checkout lines, our project is a more affordable alternative. The proposed project not only removes the issue of long lines, but also assists users by providing coupons available at the current store and displaying the cost of the products in their shopping cart.

Goals & Objective

The goal of our project is to create a lightweight, portable device that can be integrated onto common shopping carts that will improve the shopping experience. Once shoppers create an account, they can login to any available cart and begin shopping. Using RFID and GPS, users will be able to add and remove items from their cart, and once they exit the store, their debit/credit card will be charged and the user will receive an electronic receipt sent to their email. There will also be a locking mechanism that will prevent theft of these cart. The wheels on the cart will lock once it surpasses a distance from a specified radius of the store. There will be a backend system that will store the current coupons available, account information, and handle payment transactions.

Functionality

The device will consist of a Touchscreen Display connected to a Raspberry Pi, allowing shoppers to interact with the User Interface of the software in order to view any current coupons or items in their cart. The Raspberry Pi is also connected to a microcontroller that interacts with a GPS module, locking mechanism, and RFID scanner. Each item in the store will have a RFID tag storing the item's unique product ID, which is read by the RFID scanner on the shopping cart. This unique ID number will then be sent from the microcontroller to the Raspberry Pi, which will then query the

database to fetch all information on the item (brand, name, cost, affiliated coupons). The information returned will then be stored onto the cost section of the UI. If the user wishes to search through the coupons, their request will fetch the next/previous page of coupons from the database. This information will update the coupon section on the UI. With the GPS, the microcontroller will activate the locking mechanism on the cart if a user tries to leave the store's premises with the shopping cart. The GPS will also be used to notify the microcontroller to send a signal to the Raspberry Pi, indicating that the user has left the store and instructing it to begin the "cash-out" workflow.

Specifications:

General

- The overall shopping cart shall be no bigger than 38 by 22 by 41 in.
- The shopping cart shall weigh no greater than 60 lbs.
- The overall system shall cost no more than $500 to build.
- The user shall be able to grasp the functionality of the GUI in approximately one minute.

Hardware

- The store items shall have a passive RFID tag attached to them.
- The microcontroller shall use RFID sensors to read the RFIDs contained on each store item's RFID tags.
- The time it takes for an RFID sensor to recognize an RFID tag shall be no greater than 50 milliseconds.
- The distance required for an RFID sensor to recognize an RFID tag shall be no less than two feet.
- The microcontroller shall keep track of the shopping cart's location via a GPS module
- There shall be four electronic locking devices, one for each wheel.
- The wheels shall have an electronic locking device attached to them, and shall lock based on the shopping cart's location.
- A raspberry pi shall be used for processing capabilities.
- The microcontroller shall send the RFIDs to the raspberry pi via serial or pin communication.
- The raspberry pi shall run a GUI on an LCD touchscreen, and shall pull and store data in a database.
- The power supply of the overall system shall supply a voltage no greater than 12 volts.
- The power supply shall power the system for at least one hour.

Software

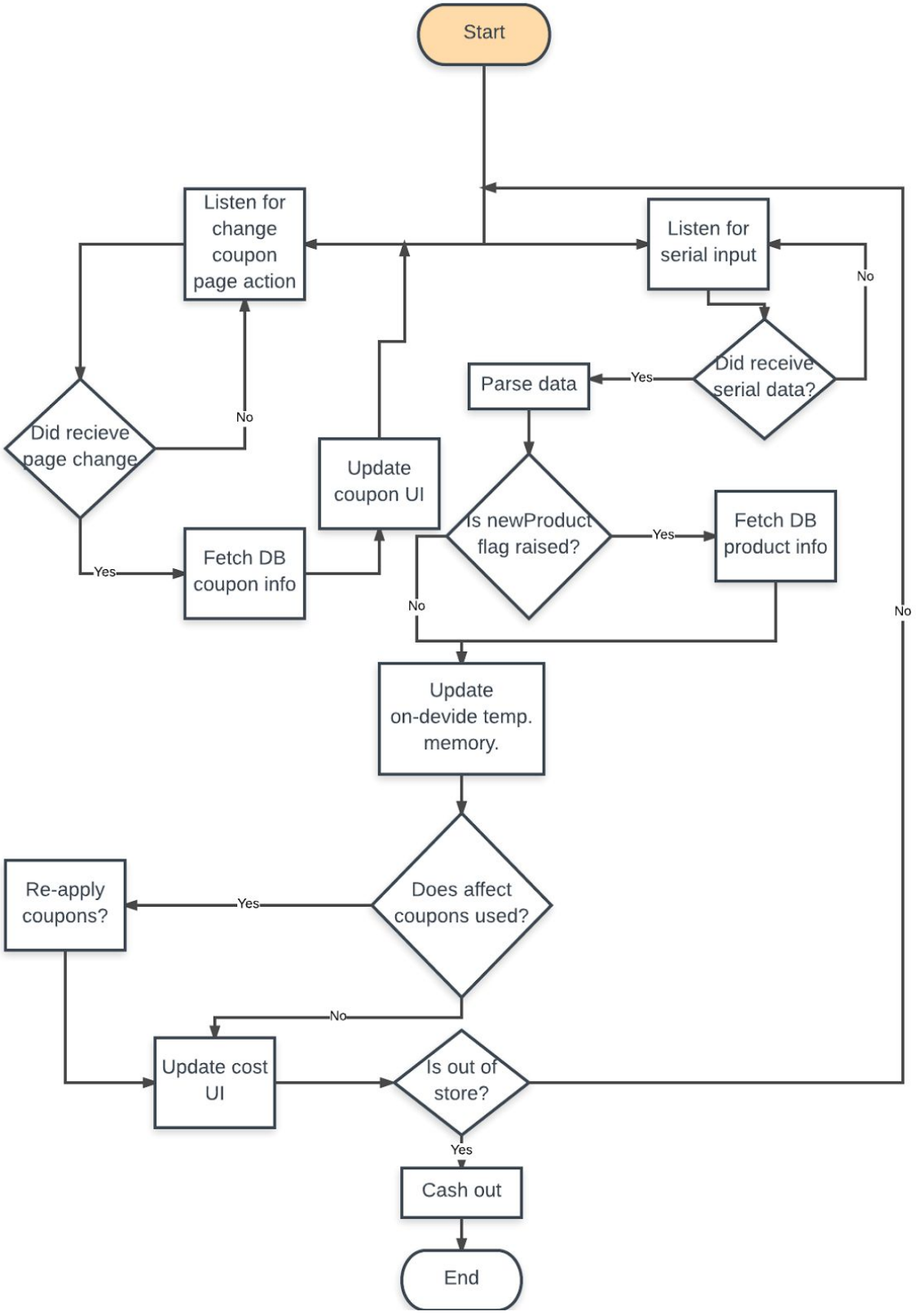
- The system will return product information from the database back to the raspberry pi within 2 seconds.
- The system will be able to display between 5 and 10 coupons at a time on the coupon section of the user interface.

- Once the raspberry pi receives the product data from the database it will update and apply the coupons under 1 second.
- The device will allow users to purchase at least 25 items.
- Communication between the system and device must be encrypted(SSL/TLS/HTTPS) when user is cashing out.
- The system will process a transaction (submit payment) and send an electronic receipt to specified email.
- Validate an input user enters before submitting information.

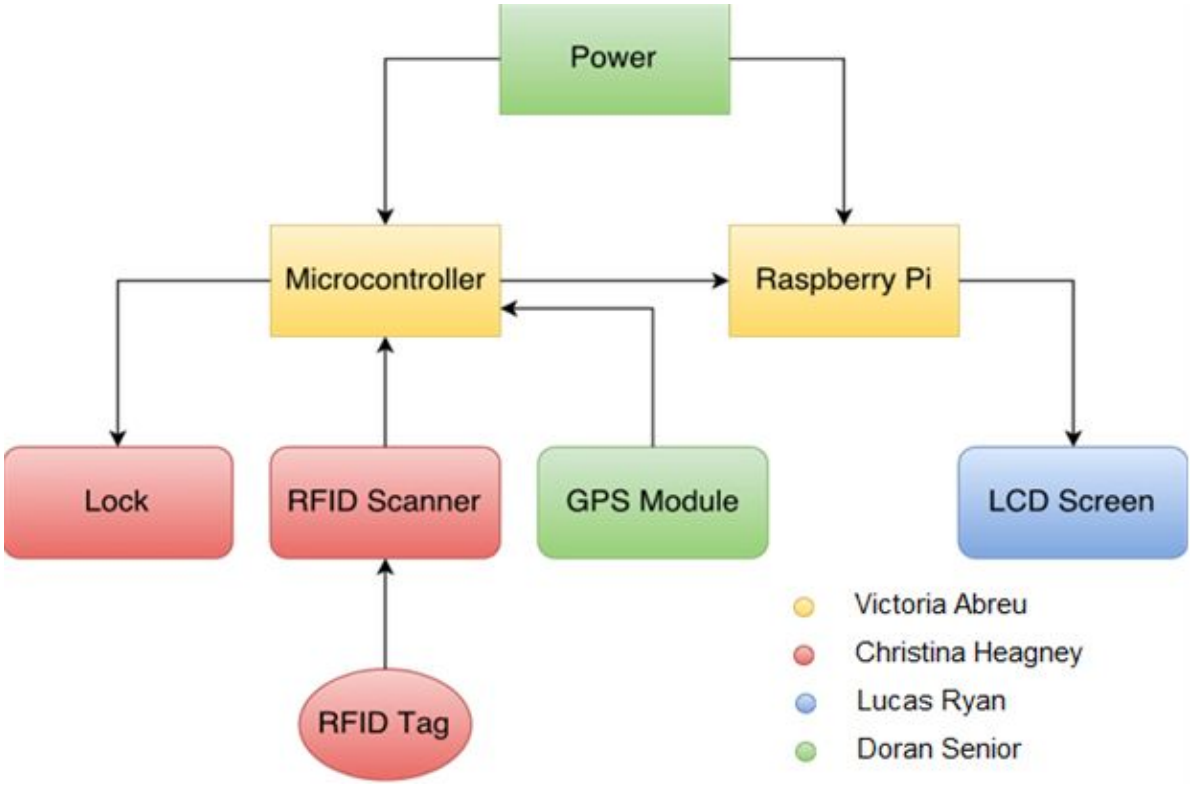
House of Quality: Marketing/Engineering Requirements

		Battery Life	Time To Learn	Dimensions	Cost	Weight	Startup Time
		+	+	-	-	-	-
RF Sensor Scanning Distance	+	↑	↑	↑	↓↓		↑
Cart Usability Radius	+		↑	↑		↑	↑
Input Voltage	-	↓↓	↑	↑	↓	↓	↑
Sensor Scanner Accuracy (ms)	+	↑			↓↓	↓	↑
Cost	-	↓		↓		↓	↓
		> 1 hour	< 2 min	38 x 22 x 41 in.	< $500	< 60 lbs	< 1 min

Software Block Diagram:



Hardware Block Diagram:



Component Work:

COMPONENTS	PRIMARY	SECONDARY
Database	Lucas Ryan (CS)	Victoria Abreu (CS)
Email & Payment System	Lucas Ryan (CS)	Victoria Abreu (CS)
Communication Btw. Raspberry Pi & Arduino	Victoria Abreu (CS)	Lucas Ryan (CS)
User interface	Victoria Abreu (CS)	Lucas Ryan (CS)
Power Distribution	Doran Senior (CpE)	Christina Heagney (CpE)
GPS	Doran Senior (CpE)	Christina Heagney (CpE)
Locking Mechanism	Christina Heagney (CpE)	Doran Senior (CpE)
RFID System	Christina Heagney (CpE)	Doran Senior (CpE)
PCB	Christina Heagney (CpE)	Doran Senior (CpE)

Budget:

OBJECT	QUANTITY	EST. COST
RFID Scanner	1	$39.95
RFID Tags	50	$19.20
GPS 66 Channel Breakout Board	1	$39.95
Arduino Uno	1	$0.00
Raspberry Pi	1	$0.00
7" Touchscreen Display	1	$70.86
PCB	2	$70.00
Amazon AWS RDS MySQL	1	$0.00
Shopping Cart	1	$40.00
BreadBoard (830 pins)	1	$2.99
40W Soldering Iron	1	$40.68
Solder Soldering Wire	1	$7.00
	Total:	$330.63
Est. Total	$330.63	
Number Group Members	4	
Est. Indv. Total	$82.66	

Project Milestones:

Number	Task	Start Date	End Date	Status
Senior Design I				
1	Ideas	1/9/17	1/17/17	Completed

2	Project Selection & Role Divisions	1/18/17	1/21/17	Completed
	Project Documentation			
3	Divide & Conquer	1/22/17	2/3/17	Completed
4	Updated Divide & Conquer	1/22/17	2/17/17	In Progress
5	Table of Contents	1/22/17	3/24/17	In Progress
6	Draft of Documentation	1/22/17	3/31/17	In Progress
7	Final Documentation	1/22/17	4/27/17	In Progress
	Research & Design			
8	Research Resources	1/25/17	2/10/17	In Progress
	Purchase Resources	2/4/17	TBD	Not yet started
9	Design cart layout	2/5/17	2/8/17	Not yet started
	Prototype Hardware			
10	RFID setup	2/11/17	2/25/17	Not yet started
11	Lock mechanism	2/26/17	3/12/17	Not yet started
12	GPS System	2/11/17	2/25/17	Not yet started
13	Serial communication	2/26/17	3/12/17	Not yet started
14	PCB Schematic	2/18/17	4/1/17	Not yet started

	Prototype Software			
15	Database system	2/11/17	3/1/17	Not yet started
16	User Interface	2/11/17	3/1/17	Not yet started
17	Serial communication	3/2/17	4/1/17	Not yet started
18	Socket IO w/ database	3/2/17	4/1/17	Not yet started
19	Microcontroller	2/18/17	3/18/17	Not yet started
20	Raspberry Pi	2/18/17	3/18/17	Not yet started
21	**Finalize & Test Prototype**	4/13/17	4/27/17	Not yet started
Senior Design II				
22	Purchase cart	8/24/17	TBD	N/A
	Hardware Development			
23	Print PCB	8/24/17	TBD	N/A
24	Integrate code	TBD	TBD	N/A
	Software Development			
25	Integrate code	TBD	TBD	N/A
26	**Integrate components onto Kart**	TBD	TBD	N/A
27	**Peer presentation**	TBD	TBD	N/A

28	**Final documentation & presentation**	TBD	TBD	N/A