

Design Issues

Design Team #6:

Point of Sale Grocery Cart

Ben Lauzon

Matt Rasmussen

Steven Hartz

Husain Aleid

Shuagfel Liu

Taoping Zhu

Introduction

The major issue with today's checkout system is the unnecessary stop at the checkout line. Cashiers are paid to take the items out of the cart, scan, and put them right back into the cart. A lot of the shoppers time being wasted, adds to congestion near the store's exit, and adds cost for the store, which has to pay cashiers. Our goal was to create a grocery cart checkout system. While designing the *Point of Sale Grocery Cart* for our sponsor Dr. Satish Udpa, three design issues were most important: product lifecycle management, creating a user friendly experience, and system accuracy. Product lifecycle management is critical aspect of any project. The team had to consider designing for robustness, the target audience, and the end-user experience throughout the design phase. The *Point of Sale Grocery Cart* is unlike anything in today's market. There is no way for us to observe similar systems and see how easily users are able to use them. These three major design issues were examined and targeted from the early prototype to the final product.

Product Lifecycle Management

Product lifecycle management (PLM) is a systematic approach to managing the series of changes a product goes through, from its design and development to its ultimate retirement or disposal.[1]

Design

The *Point of Sale Grocery Cart* uses a load cell amplification circuit to weigh items. The output of this circuit is fed into an Arduino Yun, which is a Wi-Fi microcontroller. The Yun converts the voltage to a weight in grams and wirelessly transmits the data to a server set up by the team. The team also created an app that can scan items, create a list, total item prices, and allow the user to checkout and pay. The app communicates with the server when it scans an item. The server compares the expected weight to the weight reading from the Yun. If it agrees, the item is added to list in the app.

Production

The manufacturing cost for the parts needed to build the *Point of Sale*

Grocery Cart is about 130\$. The most expensive aspect of the Cart is the Arduino Yun. The Yun costs around 70\$. The other large contributors to the overall cost were the load cells, wireless charger transmitter and receiver, and the battery. The load cells we purchased were taken from a dismantled postal scale, which cost 25\$ each. The wireless transmitter and receiver cost 15\$ and the battery cost about 10\$. The rest of the electronic components used to construct the amplification circuit cost about 10\$. The team spent over two months working on building, testing and developing the *Point of Sale Grocery Cart*. This was mainly because there were no clear instructions on how to build one. However, at this point, the team can write a clear manual that will reduce the manufacturing time substantially. With this in mind, a cart could be built in 2-3 days from scratch and the phone application could just be downloaded. In a manufacture setting a cart could be put together in a matter of minutes. Building a *Point of Sale Grocery Cart* in a manufacture setting would cost about \$50-70 because the parts could be all ordered in bulk, which drastically reduces the price. With such a large niche market, the cost to the customer for one *Point of Sale Grocery Cart* would be approximately 120-150\$, resulting in a profit of around 60\$ a cart after factoring shipping costs.

Distribution

The team's business model will target markets ranging from small grocery stores to large supermarkets. Inventory will be kept minimal to save money on storage space, with very little stored inventory. Taking orders and producing the carts after the orders have been placed will accomplish this. Transportation cost will be high due to the size of the carts. The system could be built in such a way that it can be integrated into the store's existing carts.

Consumption

It will be important to inform the customer about all of the features that the *Point of Sale Grocery Cart* offers. Therefore, a tutorial button could be added to the application, which would give both text and visual information on navigating and getting the most out of the application. Our team will also provide training and contact information to the stores who purchase the carts. This will allow the

store employees to address any issue that a user might have. Any issue that they cannot resolve can be taken up with a representative from the manufacturer. User feedback will be collected routinely and new versions of the app will be released through Play Store updates.

Retirement

The lifetime of the *Point of Sale Grocery Cart* is an important aspect to consider. Since the Cart is constructed of many different electrical components each having its own lifespan, the lifetime of the overall product may vary. The electrical components have numerous factors that affect their lifetime. For instance, the accuracy of the load cells will vary as they begin to age. The harsh environmental conditions of sitting out in the parking lot are another factor in the degradation of the electrical components. However, the lifetime of these components can be substantially prolonged through proper maintenance and care, which will also extend the lifespan of the overall *Point of Sale Grocery Cart*. We would implement a trade-in/upgrade plan that would allow stores to trade in their current *Point of Sale Grocery Carts* and receive a discount for an upgraded version.

Creating a User Friendly Experience

As of January 2014 54% of adults in the United States have a smartphone. This means that system is available to many individuals. Users will have direct contact with the *Point of Sale Grocery Cart's* phone application and therefore the system must be very user friendly. When designing the application, there are few things to keep in mind. First, the layout of the app is very important. The less menus and buttons you have in the app, the less the probability of confusing the user. Second, wording within the app is very important. All buttons and menu titles must accurately describe their function. Third and most importantly, the app must be intuitive. For example, when I want to checkout I expect a button to be on the main menu that simply says checkout. The same goes for viewing the shopping cart or scanning an item. This was one of the main focuses for us when designing our project. There are some additions that we would like to make to the app, but ran short on time. We would like to add a help

section that will explain the function of all buttons and menus. Also add a way to click a button which will get you in contact with the store's own expert on the system. Figure 1 summarizes the most important things to keep in mind when designing a user interface.[2]

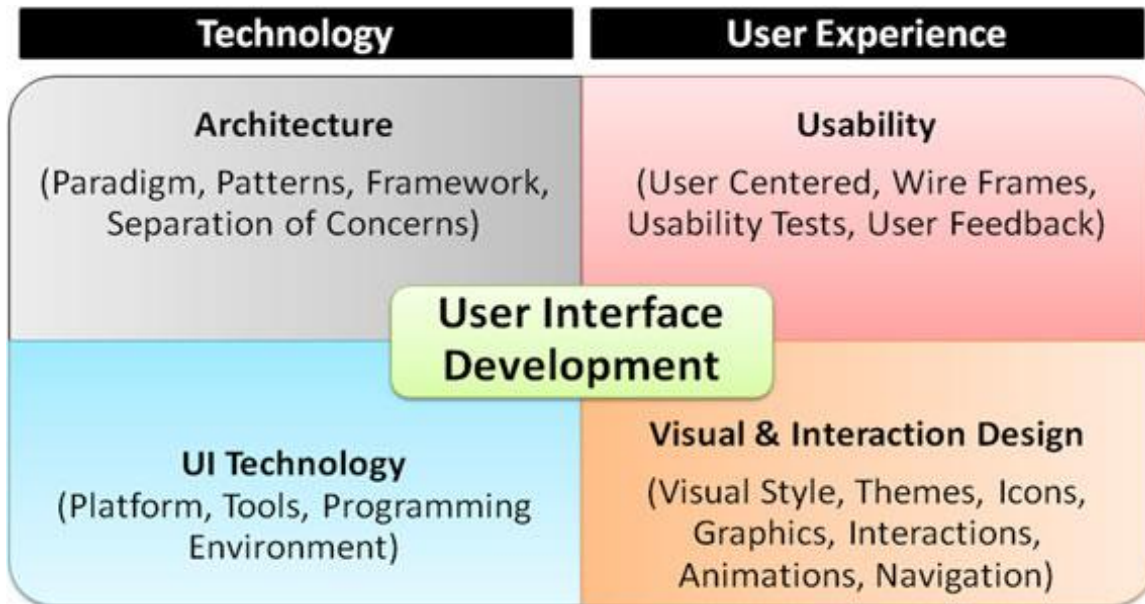


Figure 1

System Accuracy

The accuracy of the *Point of Sale Grocery Cart* system is extremely important. One of the biggest aspects of the system is its ability to weigh items. Our project combines load cells with an amplification circuit in order to give us a readable voltage. We then take this voltage and convert it to grams using a coded microcontroller. We have found that there are three things that affect the systems accuracy. First, the linearity of the load cells can drastically impact the voltage output. As the weight changes we expect the voltage to change proportionally, but that is not always the case. It is important to select a more linear load cell even if it does increase costs. Second, fluctuations in the input voltage can also affect the voltage output. To address this problem, we added a very accurate voltage regulator circuit to our system. Lastly, the code must have a section that can smooth out the input signal. Without this, the readings can fluctuate drastically. If we were to mass produce our product, we could get a

better deal on a linear load cell. This would allow the *Point of Sale Grocery Cart* to be both cheap and accurate.

References

[1] product lifecycle management (PLM)

<http://searchmanufacturingerp.techtarget.com/definition/product-lifecycle-management-PLM>

[2] How to Create Attractive, User Friendly Applications?

<http://bsix12.com/attractive-apps/>