

Smart Shopping Cart

Group 5

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I pledge my honor that I have abided by the Stevens Honor
System

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I. Abstract

In today's technology, many companies are developing products that ensure convenience towards all people. One of the conveniences that are involved will be providing them with a new and easy shopping experience. With the problem of waiting in a long queue to checking-out the shopping items, new technologies must be implemented to provide the lowest delay time. Thus, the project team is developing a Smart Shopping Cart, a system that allows faster check-out. The user would scan the Universal Product Code (UPC) that is on the shopping item using the barcode reader. The barcode information will be stored into a computer's memory, and checked against a database from which it would retrieve the appropriate information. A software package will link up the device with the database and Bluetooth device. It will also enable the microprocessor to calculate the total price for all scanned items, and display it on the LCD screen. If the customer is ready to make a payment, he would pass the cart through the cashier. The total price will be sent to the cashier using Bluetooth, and the receipt will be automatically printed. All the customer has to do is to pay for the total price without unloading the items from the cart. The team expects that the smart shopping cart will be a more reliable form of check-out process that will decrease the amount of time a customer has to wait while shopping.

The team's prototype unit consists of a barcode scanner, a PDA to act as a user interface, and a laptop computer that stores the database, and acts as a check out counter. In the system, WiFi will be used to connect the PDA and the database, while Bluetooth will be used to connect the PDA with the check out counter.

II. Project Final Design Plan

II-1 Introduction

What is the smart shopping cart? If you haven't already heard of the smart shopping cart, you are missing out. This technology began sweeping the nation after its debut on the Today Show in July of 2004. Prominent companies such as IBM, NCR, Fujitsu, and Hewlett-Packard have recently invested in this industry. The concept of a smart shopping cart utilizes a small computer integrated with a commercial retail shopping cart. The technology features a convenient display (usually a touch screen) that interfaces with existing Universal Product Code (UPC) barcode system. The onboard computer is wirelessly linked to a central database operated and updated by the system owner that provides real-time product information to the consumer. The customer can scan their items while they shop using the computer attached to the cart. The items are then aggregated to a list that tallies how much the user is expected to spend while they are shopping. In addition to price, many products will provide extra information about the scanned items such as nutritional information, environment impact, calories bought, discounts and sales, recipe ideas, and other matching items such as wines and cheeses.

The newest product from IBM is a wireless web page application where the customer can create a shopping list from home on the internet. Then at the store scan their frequent shoppers' card in the smart shopping cart to see their list. The list interacts with the store telling the customer where they can find the items they are looking for as well as the best prices. On top of that, the customer can order from the deli using their shopping cart and just pick up their order when it's done. In one Stop & Shop in Massachusetts, they use projection technologies to project an image either on the floor or over some products. When the customer walks over a part of the image it interacts with them. One example is a floor projection where there are three blocks of colors with the options reading, Low Calorie, Low Carb, and Low Fat. All the customer has to do is step over the option they want and it will point an arrow to where the products in that area are located. One major technology not yet used in stores is the RFID cards. However, use of this technology is

very costly and complicated to program if the store has a lot of items, as grocery stores do.

Currently, deficiencies exist within the smart shopping cart design. Most computers attached to the handle bar of the shopping cart are cumbersome to the consumer. The consumer cannot utilize the front basket to seat a child or place delicate products. Another problem is the scanning of large products. With the existing models, the consumer must lift the items to be scanned up to the computer. This is not an issue for smaller products but awkward and heavier products present difficulties in the scanning process for disabled, feeble, and elderly consumers. Finally, most of these devices lack a method by which the information about the items in the cart is transferred to the checkout counter. In other words, the data displayed on the customer selected items is only accessible to the customer. When the consumer reaches the checkout line, the cashier needs to rescan all the items in order for the consumer to pay.

The group intends to make a Smart Shopping Cart device which will optimize the basic function of scanning items using barcodes into a database where they can then create a tally of the items bought and send it wirelessly to the checkout counter. When the customer is finished shopping they can pay faster because their items are already recorded. The new technologies that the group is intending to use are as follows: A Personal Digital Assistant (PDA) will replace the shopping cart's computer. This will be much smaller and ergonomic than existing computers, making it a sleek and space saving design. The group will also use a wireless bluetooth barcode scanner so the customer can scan larger items without having to lift them. The design will also use bluetooth technology to send the billing information to the checkout counter when the customer is finished shopping.

To prevent non-scanned items from being taken without payment, the group intends to design antitheft measures. Some preliminary concepts include a laser-induced grid over the main basket which counts the number of items added and a weight sensor located under the main basket that would be able to tell if the weight scanned matches the weight in the basket.

II-2 Design Requirements

In order to accomplish this project, the design requirement has to be considered to make sure that the smart shopping cart will be able to fulfill all the specifications and objectives that have been set up at the first place.

There will be a main database that has all the necessary information about all the inventories in the stores such as the description of the products, prices, quantity, and the barcode of the items. The main database will be updated every time a product is scanned and would be able to handle all the information from multiple carts in the stores. The database is designed using MySQL because of its consistent fast performance, high reliability and ease of use. The server for this project will be a Dell Precision M60 notebook computer. Moreover, the database should also be very flexible so that if there is any change in the data, it could be easily modified without any problem.

For the smart shopping cart to be more practical in processing the information, a fast and efficient networking should implemented between the main database and each of the smart shopping cart in the store. The team chooses to use WLAN for the wireless networking between the main database and the shopping carts in the stores since Wi-fi is easy to set up and inexpensive. Ideally, each time the product is scanned, the system would immediately respond by providing the customers with the product information displayed on the LCD screen mounted on the shopping cart and also updated the database system at the same time. However, in real practice, this may have some problem considering that as the numbers of carts in used increase, the main database will need more time to respond to each of the shopping cart. Therefore, the team might consider using network with high bandwidth to support the data traffic.

Moreover, the hardware will be interfaced using the C or C++ programming language because it is easy to implement and very fast to execute. These are essential to make the interaction between the software and hardware to be smooth and fast and also to avoid traffic in data transfer. Choosing the right software to be used in the project might be the most important part in the project. Several softwares dealing with barcodes are available in the market to be used. However, the team need to make sure that the software

is compatible with Microsoft Window Mobile 5.0 because iPAQ Pocket PC will be used to execute all the scanned items before it is send to the main database.

For the convenience of the customers, the display screen mounted on the shopping cart need to be user friendly and position in the place that provide easy access for the customers. The screen is also need to be light weight, not too big, durable and indestructible although it is used repetitively. Touch screen is the most suitable considering that the customers can use it easily. However, the team needed to design hard and very durable casing to protect the screen from any reckless users.

II-3 System Design

The design of smart shopping cart consisted of four main elements which are hardware integration, software interface, wireless communication and network database. The goal for each element is to get the most accurate and best performance to be implemented in the project.

There are two different designs that can be used to accomplish the goal of this project. The two designs are similar with the exception of the main computer being used. Our group spent a lot of time researching on both designs before choosing any one design for this project. The two designs that meet the requirements of this project are described in details below.

Design 1

This design includes a microprocessor which can be used with an LCD, a wireless card, barcode reader, and a portable battery. The barcode reader will be used to scan the items, and the Wi-Fi card will be used to connect wirelessly to the store's database. The device will be detachable, so that it can be used from one shopping cart to another. This design also includes external speakers which will guide the customer with voice prompt to select their option on the LCD screen. The design is illustrated in the figure 1 below.

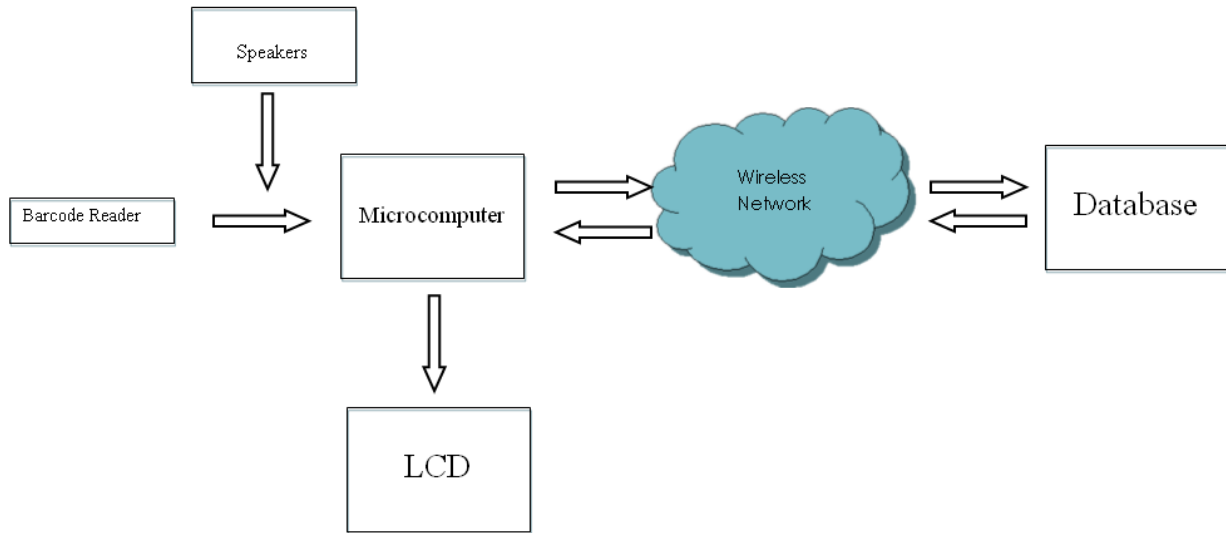


Figure 1: Design one using Microcomputer

Design 2

This design follows the same concept of design one except it has a PDA instead of LCD screen and microprocessor. In this design, a PDA will be used which includes both the Bluetooth and Wi-Fi capabilities. Bluetooth technology of PDA will be used to connect to barcode readers which can wirelessly submit the barcode data to the PDA.

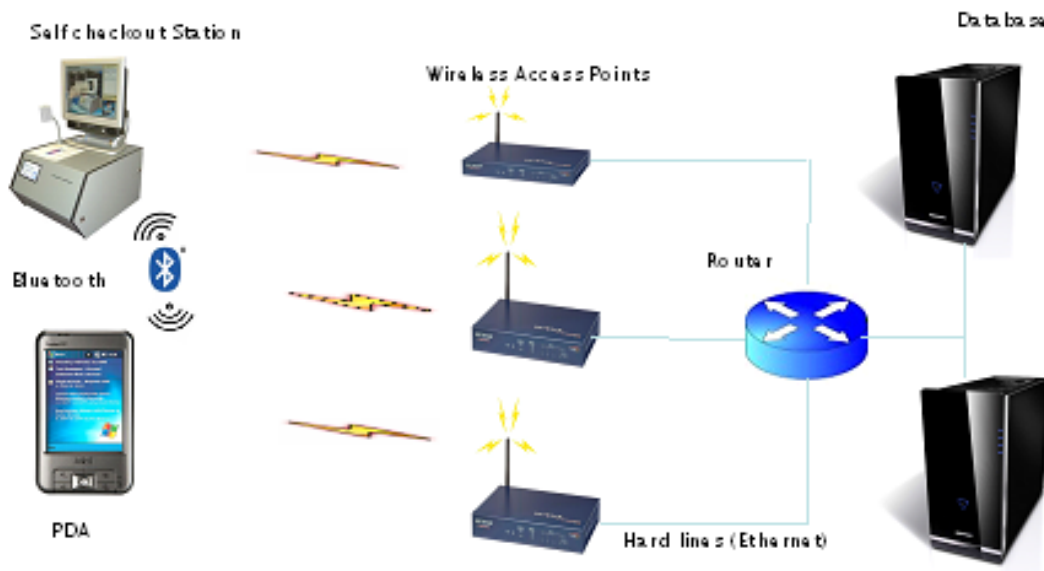
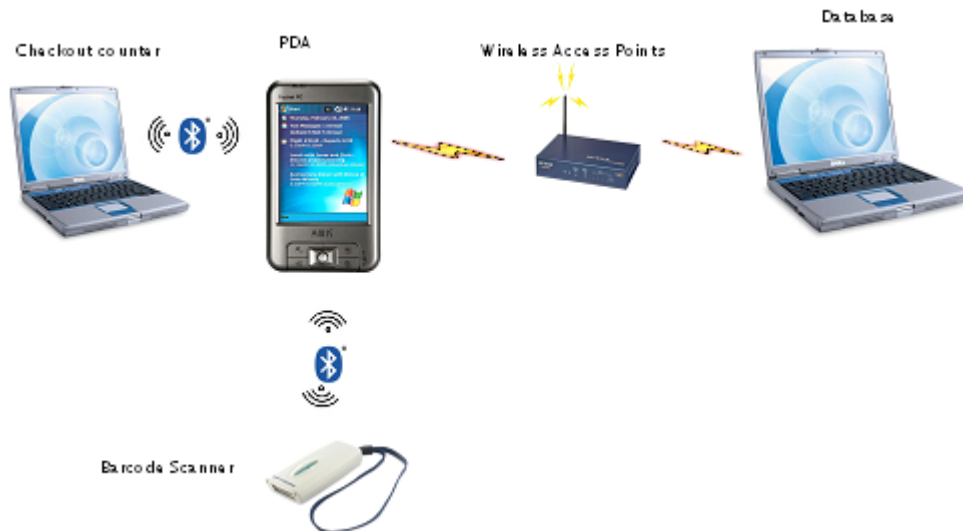


Figure 2: Design two using PDA

This gives the customers the freedom to move away from the shopping cart and scan the item. The same Bluetooth capabilities will be used to connect to the checkout counters where the customers can pay by credit card or cash. The Wi-Fi capabilities of PDA will be used to connect to the wireless database of the store. The following diagram illustrates how this design would look like in a store.

After analyzing both designs carefully, the group decided to select design 2 for this project. There were many reasons to pick design 2 over design 1. One of the main reasons was that the design one was not feasible. It involves microprocessor and LCD screen which involves high level of programming, and no one in the group has the experience with such advance programming. The second reason for not going with design one is the cost. It would have been really expensive to buy a microprocessor, LCD, a separate wireless card and Bluetooth card. The second design integrates all these technologies into one PDA. Since one of the group members already had a PDA, the group decided to go with the second design. This design not only cut down the cost for this project, but also makes more sense since the PDA has all the functionalities which are required to complete this project. The following figure illustrates how the project will be presented during senior design presentation in May 2008.



As shown in the diagram above, a Bluetooth enabled laptop will act as a checkout counter for the project. Our goal is to transmit the data via Bluetooth from PDA to the laptop. A Bluetooth barcode scanner will be used to scan the barcode and transmit the

data to the PDA's software, which then can wirelessly connect to the database (wireless notebook in this project) and receive the price and other information regarding the item.

Software and Database Details

All the components will be interface using the C++ programming language because it is easy to implement and very fast to execute. These are essential to make the interaction between the software and hardware to be smooth and fast and also to avoid traffic in data transfer.

The network will use Wi-Fi wireless networking system to transmit sale information to the database. Wi-Fi is chosen because it is easy to set up and is inexpensive. Every time the customers scanned the product, the product information will be retrieve from the database and the price will be displayed on the LCD display mounted on the shopping card. The data from the shopping card will be transmitted to the check out counter by using Bluetooth technology. The customers can easily transmit the data from the shopping cart to the check-out terminal when they are in the proximate range.

The database software that will be used in this project will be MySQL. MySQL has the capabilities to execute database entries. This is most important part of the project since we need a good and most reliable database to keep track and update the inventories every time the customers scanned the product.

II-3A Parts List

1.Barcode Reader

Model: EZ One Shot® USB CCD Barcode Scanner By IDTech

Operating Power: +5 VDC \pm 5%

Power Consumption: 85 mA \pm 10 mA

2. PDA

Model: HP iPAQ hx2495 Pocket PC

Processor: Intel PXA 270 processor 520MHz

Operating System: Genuine Windows Mobile 5.0 Software for Pocket PC, Premium Edition

Power Supply: 1440 mAh Lithium-Ion battery

3. Computer

Model: Dell Precision M60

Processor: Intel Pentium M processor 2.00GHz

Operating System: Microsoft Windows XP Professional SP2

II-4 Financial Budget

The financial budget is one of the most important aspects of any project. It determines whether a project can progress or even start at all. Thus, having an accurate financial budget and a plan to stay within the budget is quite essential for any new project. In our design project case, this is even more so because our team is venturing on a new product and unexpected costs might come up as the project progresses.

The proposed financial budget for the midterm report has definitely changed as expected by all our team members. The products have been altered a little bit and their respective prices have also changed. We have decided to find the cheapest alternatives for all the products in order to keep the expenditure below the allocated amount of \$250. As we have experienced that additional expenses might occur, we are keeping an amount unused for those unforeseen circumstances.

There are a few costs that we need to consider. Since our requirements have changed a little, we no longer require a microprocessor or a LCD screen. Also, the USB cable will not be needed if we use Bluetooth technology for connectivity. We added some testing products that we will need to buy. Also some material might be needed to form the casing for the entire product. Most importantly, we will require a bar code reader, preferably one which has Bluetooth capabilities.

The unused budget will be helpful in deciding how much extra effort we can put in the project. For example, the group is thinking of implementing a laser anti-theft system which will only happen if everything else works fine.

- 1) Barcode Reader: EZ One Shot® USB CCD Barcode Scanner By IDTech

This is a fairly cheap barcode reader priced at \$59.

Reference: <http://www.idautomation.com/ccdreaders/idtech.html>

USB Cable: Belkin Pro Series USB 2.0 Device Cable (USB A/USB B, 10 Feet)

Priced at \$8.55

Reference: <http://www.amazon.com/Belkin-Pro-Device-Cable-Feet/dp/B00004Z5M1>

- 2) Bluetooth barcode reader: Bluetooth barcode scanner kit, MS 9535 BT scanner
USB

This is the cheapest Bluetooth barcode reader which wouldn't require a cable.

Price = \$149.99

Reference: http://cgi.ebay.com/Bluetooth-barcode-scanner-kit-MS-9535-BT-scanner-USB_W0QQitemZ160184897317QQihZ006QQcategoryZ14929QQssPageNameZWVWQQrdZ1QQcmdZViewItem

- 3) Testing: Items from a grocery store (some multiples too). Price would be around \$30.

Reference:

http://shop.mywebgrocer.com/shop.aspx?&sid=18778498&sid_guid=a67af57a-4dc1-4657-872d-db41599107ff&strid=F442733&catL0=570&catL1=-1&catL2=-1&catL3=-1&HasProducts=0&ns=1

- 4) Casing: Metals like aluminum and tools like a hammer, nails, etc.

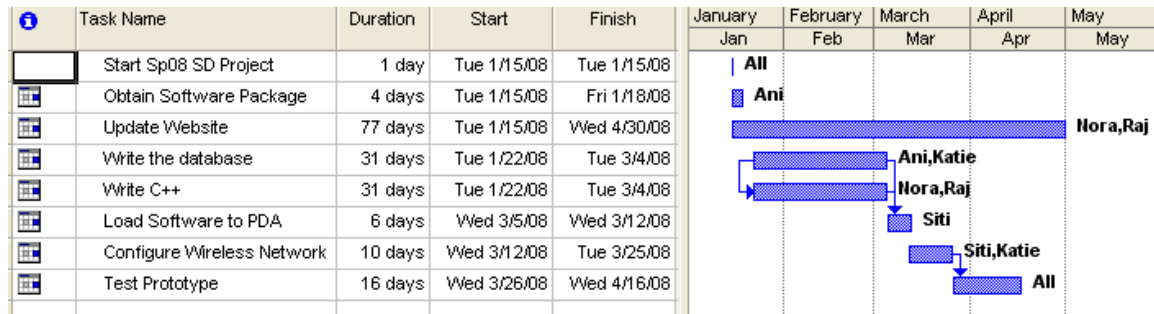
All this will cost approximately \$100.

Reference: <http://www.metalsdepot.com/>

Thus, with the Bluetooth barcode reader, the project would cost around \$280 (\$30 over budget) and with a normal barcode reader, (\$197.55, which is \$52.45 under budget). Even though the second option is financially more feasible, the team might go with the Bluetooth option to keep up with the technology. These figures could change about 25% either way at the end of the project.

II-5 Project Schedule

The following Gantt Chart represents the schedule for next semester. The main tasks will consist of creating the database, writing the C++ program, and configuring the wireless network. The team decided that all members will be involved in each task; however, each individual member will be in charge of one or two main task(s).



Gantt Chart

III. Summary

Technology is meant to make one's life easier. When a problem is found, engineers come together to solve them using technology. This problem solving will advance the technology for the human being, and thus provide them with convenience. The project was designed to accomplish this. The smart shopping cart could eliminate the hindrance of unloading the items from the cart; therefore, the time spent at the cashier could be decreased. Shoppers could enjoy the time saved by doing other things rather than standing idle and having to wait for their turn to pay.

Group 5 will implement the prototype of the smart shopping cart using the following components: barcode scanner, PDA as the user interface, and laptop as the database center and check out counter. The PDA and the barcode scanner are the devices that would be implemented on the shopping cart. It is crucial that the PDA has both WiFi and Bluetooth work, so that the project performs as the team expects it to. Therefore, it is important that the team works together next semester to implement a successful prototype.

IV. References

1. <http://www.waspbarcode.com/software/>
2. <http://www.bluetooth.com/bluetooth/>
3. http://www-uxsup.csx.cam.ac.uk/pub/doc/suse/suse9.2/suselinux-adminguide_en/ch17s03.html
4. <http://www.eweek.com/article2/0,1895,1765476,00.asp>