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Ingenious Shopping Cart: RFID Enabled for Automated Billing

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ABSTRACT: ***Today's world thrives making human life easier than it already is with every passing moment. Creating a smart cart that takes care of comfort while shopping is another step taken in the same direction. Product acquisition in large grocery stores with wide range of products is a tedious and time consuming process. The smart shopping cart explores the mini computers and automatic identification technology. Instant billing without queuing and keeping track of the expenditure is the main but not the sole motive of this intelligent cart. The paper is based on development of a project with the aim to reduce the time spent in the store and to make shopping of day to day items an experience instead of a headache. This cart uses modern and cheap technology like RFID and mini computers to make it intelligent and time saving. It helps the consumers to utilise the time saved in other fruitful activities instead of wasting their time by standing in long queues at the checkout counter.***

Keywords: Radio Frequency Identification (RFID), Raspberry Pi, Arduino, Bluetooth.

1. INTRODUCTION

The grocery industry sector is extremely important, not only now but has been so for a very long time. The recent evolution in technology and people's understanding towards the technical advancements have made it possible to develop comfort in the grocery industry. Also consumer perceptions of privacy, security and trust in present commerce mentioned that the proliferation of electronic commerce technologies has utterly transformed the way business is conducted.

Products are lined up in stores, customers check their price and may be their nutrition value too. Put all the stuff in a cart and push it around to fill until its bloating. Standing in a queue for billing wastes an ample amount of time and customers realise they have stuff in their cart more than they can afford to buy. With that starts the segregation of important and useless stuff wasting more time than already has been wasted. Furthermore, the unavailability of exact change starts another round of loitering.

The recent couple of years have witnessed explosive interest in RFID and supporting technologies due to rapid expanding use to track products. Similar technology can be used for unique identification of each product in the supermarket. Since, item-level tagging is not practical due to relatively high cost of RFID cards deployment in respect with the very low profit margin of products, a situation with item tagging with RFID labels can be easily envisioned. Accessorizing each cart with one (or more, depending on the size of the cart) RFID reader makes easy enlisting of items and their cost as and when the items are put into the cart. This enlisting is possible on practically every screen with the personal choice of size. This helps to generate an automated bill along with keeping track of the expenditure.
The addition of items into the system is very easy. The RFID reader are non-contact sensors that can read over a considerable distance. The items are added just by hovering the item over the reader once only. Deleting the item from the cart is just as simple, which can be done by hovering the item over the reader a second time.

Every cart can be uniquely identified by its RFID reader. Once shopping is complete the user can use the buttons on cart to "Enlist" the items, "Calculate" the total cost and "Send" the generated bill to the billing counter. There the customer can quickly pay and leave. This not only saves money but also helps in easy tracking of lost carts.

Putting another concept to use, the entire bill memo along with the date and time of purchase, taken care of by a real time clock, can be made available over the internet for helpful maintenance of the mart's product database. This is achieved by creating a server attached to Wi-Fi at the billing counter.

2. LITERATURE REVIEW

In today's world shopping is rather a difficult task which is due to the fact that one needs to stand in long queues to get their products scanned and then pay for the same. This long and tedious process results in lots of wasted time and unhappy customer base for the retail stores.

All the major retail stores only use one single technology currently, which are barcodes which was developed in the 1970s and are still used today universally in retail stores. The barcode readers enable the store owners to read as well as print the barcode on the in store products. The most common difficulty faced in barcode scanning is that the barcode on the product should be in Line of Sight with the barcode reader.

According to the research paper by T. Shanmugapriyan, the smart cart design comprises of four main components which are the hardware, software, a wireless communication interface and an online database maintenance system. The interface between the hardware and the software is also very important for the accurate function of the smart shopping cart and the other components as well. The wireless technology helped the data transfer from the cart to the billing counter hassle-free, secure and instant. And the maintenance of an online database helped in the monitoring of the bills, days sales and was also an efficient way to maintain a global live inventory dealing with the problem of items going out of stock. [3]

In a study done by the University of Arkansas, Information Technology Research Institute, it shows the business value as well as benefits of tagging the items with RFID for the daily operations at any major retail store. The study was conducted in the denim category using the RFID tags instead of the barcodes. The study results showed that the inventory accuracy of the store was improved by 27% and the understock products was decreased by 21% as well as decreasing the over stock by 6%. The management also compared the time taken for counting the items both by barcode and RFID technology. The scanning of 10,000 items when done by RFID took 2 hours whereas scanning the same number of items by barcode reader took 53 hours thus resulting a 96% decrease in the item counting time [1].

In the research paper Smart Trolley in Mega Mall by J.S. Awati and S.B. Awati, the use of various optical sensor and a driven motor was proposed with the barcode scanning system. This making the cart even more efficient. The cart with the help of a motor makes motion easier and supports two motions: front and reverse. Also as a safety measure, they proposed the use of an optical sensor in order to prevent any accidents in case the cart motor did not turn off and might hit the customer, thus the optical sensor is useful in maintaining a safe distance between the motor driven cart and the customer. [4]

In the research paper RFID Based Automatic Shopping Cart by Ankit Anil Agarwal et al. in 2011, a new way to shop by the implementation of an automatic system is described [2]. As soon as the customer enters the supermarket, he/she is handed a technological system embedded shopping trolley having a display on the handlebar which has a

touch screen display, client card reader, product reader and a position transmitter. All the information from these components is displayed on the touchscreen display with which the customer can interact.

In the present paper we aim to develop a system that uses RFID item scanning and a wireless transmission of the details of items scanned to the checkout counter and using this RFID scanning of products to implement a live inventory that will result in a system which being cost effective will see its implementation in small and large scale stores.

3. FLOW CHART

Once the cart system is activated, it keeps checking for any RFID tag that might enter the basket. If a product tag is read, entry is made in the current record session. This log is updated with every new entry to the system. Customer can either make a new entry or remove one. After completion of this process, the customer has to select the end shopping option on the screen. This updates the status of user on the internet and generates a bill at the counter which is also stored in the company database.

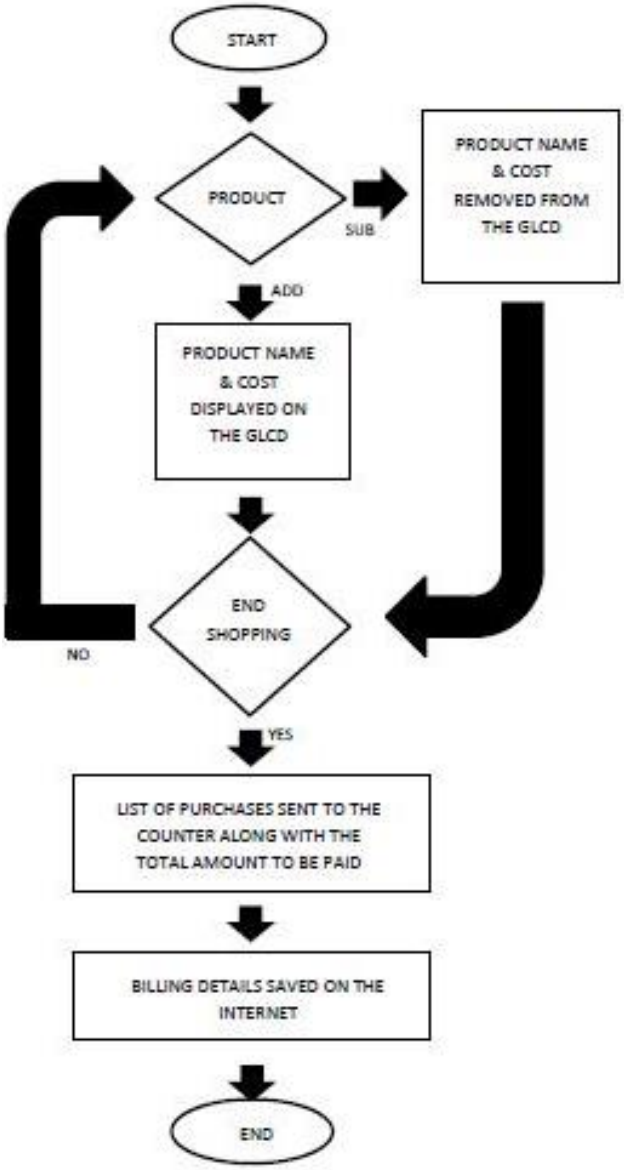

Figure. 1 Work flow

4. BLOCK DIAGRAM

The given figure 2 shows block representation of components attached to the smart shopping cart.

Trolley Unit

This unit contains all the user interactive components. It is made up of six technical components- GLCD, Buttons, Bluetooth Transceiver, RFID Reader & Microcontroller (Arduino 2560) and one mechanical component, the classic trolley.

GLCD is used to link the customer with this technology. It provides the user with details about the items in the cart and the total bill. Any settings or item deletion can be done using the buttons.

RFID Reader is placed near the top ring of the basket making it easier to sense the RFID tags of the items taken in the basket by the customer. The data exchange between the data-carrying device and the reader are achieved without the use of galvanic contacts, using instead magnetic or electromagnetic fields. RFID frequency band adopted by India is between 865MHz and 867MHz [5]

The microcontroller, here used Arduino 2560 is used to analyse the read tags and update the display accordingly. It is also responsible for connecting the cart with the smart cart server. This server is connected to the main server of the shopping complex providing updated information about the inventory.

Server Unit

The smart cart server comprises of a Raspberry Pi and a Bluetooth transceiver. It is connected with the internet as well. It is a counter end unit and the customer has no direct connection with this unit. All the interactions with the cart are updated here in real-time. This server is connected with the main server of the shopping complex using internet. Keeping this connectivity helps in faster billing process and easy management of the complex.

Raspberry Pi can be used to fetch data from internet as well used as a web server itself. [6]

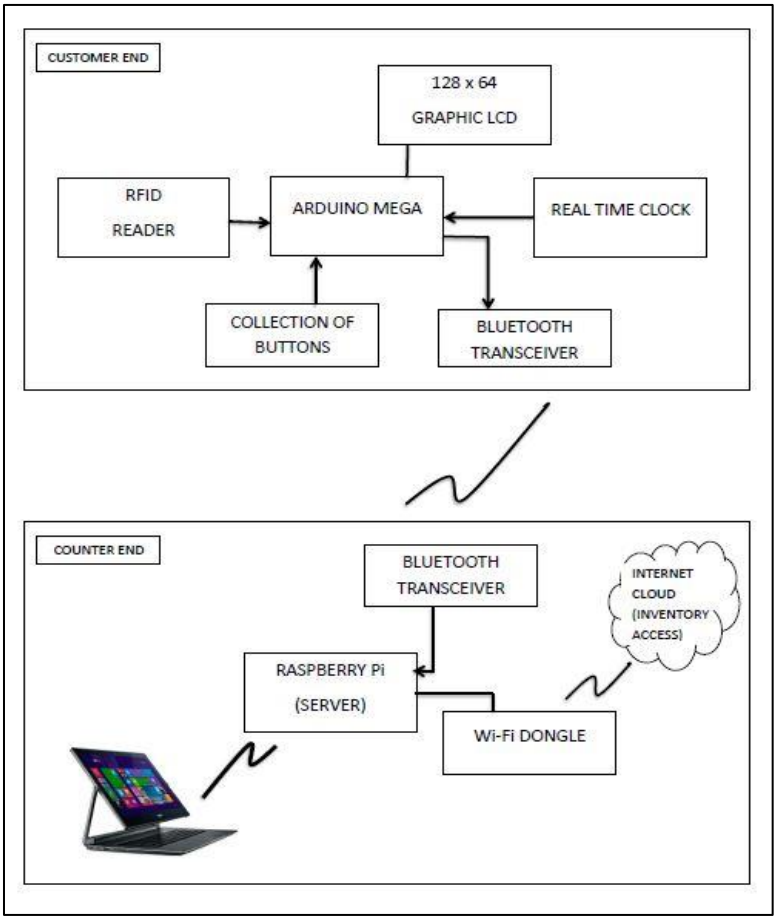

Figure. 2 Block representation of the concept

5. CIRCUITRY

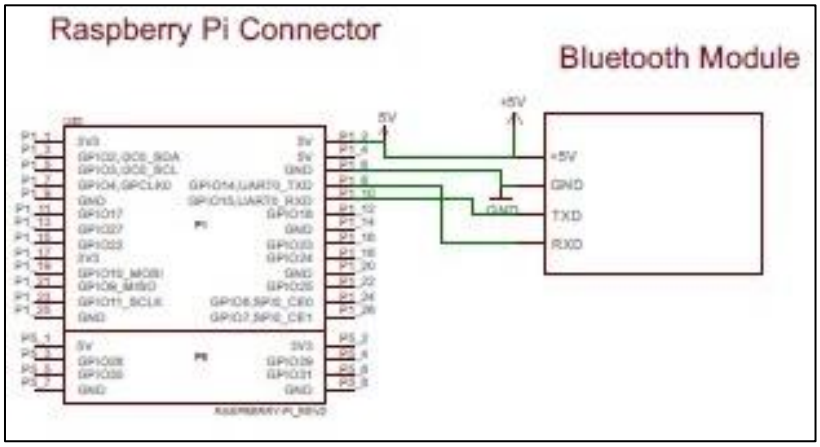

Figure. 3 Raspberry pi connected with Bluetooth module

Raspberry pi is used as a computer which receives data from all the carts and links it to the main server. Main server is also connected to a cloud server.
Carts are connected using a Bluetooth transceiver which creates a web of Bluetooth network so that carts never lose the connectivity.

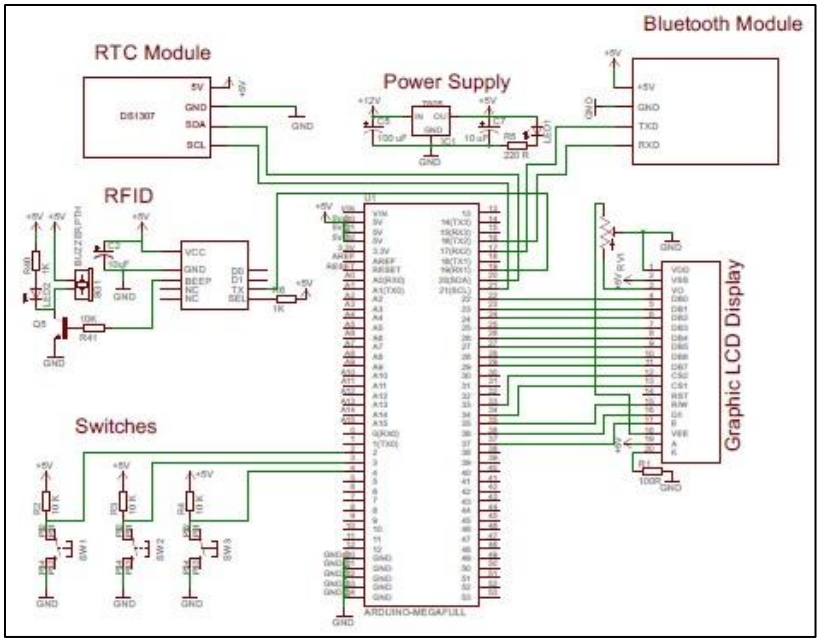

Figure. 4 Circuit implemented on a shopping cart

Each cart is RFID enabled so that the RFID tag on the products helps in easy maintenance of the bill to be generated. Real Time Clock has been added to generated user sessions for the transaction.
A list of all the items along with price of individual items and total amount has been displayed in GLCD placed on cart with ease of view to the customers.

6. FUTURE PROSPECTS

- A simple extension of this system would be to use RFID embedded in consumers' loyalty cards to that identify individuals. This option could be useful for faster login to the system by creating a swiping end at the cart itself and to charge the shopping directly to the customer account at the point-of-sale.
- Using a dynamo on cart wheels for a rechargeable battery to power Arduino.

- Using a larger screen for navigation purpose in the mart itself.
- Using the screen for promotions as a way to mint money and make better profit margin.

Figure. 5 Depiction of the product

7. CONCLUSION

This smart trolley envisions to simplify billing process by helping customers in creating a shopping session which lasts until the customer commands it to be cleared. This session maintains the data of each product in the basket by using RFID tags to make the entry. It also helps in keeping the shopping experience in budget by displaying the total cost to the customer. By the emerging trend of online shopping, which reduces the hassle while shopping at stores, introduction of smart carts not only help the stores to eliminate the surge but also help to reduce the usage of paper, unnecessarily wasted in printing copies of bill, and the number of employees making it more economical and environment friendly.

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