Smart Cart Using Wireless Sensor Networks

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Abstract: Nowadays large grocery stores are used by millions of people for the acquisition of an enlarging number of products. Product acquisition represents a complex process that comprises time spent in corridors, product location and checkout queues. On the other hand, it is becoming increasingly difficult for retailers to keep their clients loyal and to predict their needs due to the influence of competition and the lack of tools that discriminate consumption patterns. Purchasing and shopping at big malls is becoming a daily activity in metro cities. We can see huge rush at malls on holidays and weekends, the rush is even more when there are special offers and discount. People purchase different items and put them in trolley, after the total purchase one needs to go to the billing counter for payments. At the billing counter the cashier prepares the bill using bar code reader which is a time-consuming process and results in long queues at billing counters. This project aims at developing a system that can be used in shopping malls to solve the above-mentioned challenge. The system will be placed in all the trolleys with a RFID reader. All the products in the mall will be equipped with RFID tags. When a person puts any product in the trolley, its code will be detected and the price of those products will be stored in memory. As we put the products, the costs will get added to total bill. Thus, the billing will be done in the trolley itself. Item name and its cost will be displayed on LCD SCREEN. Also, the products name and its total cost can be calculated. At the billing counter the total bill data will be transferred to the main server by ZigBee Modules. In this project it presents the proposal of an architecture and solution of an innovative system for the acquisition of products in grocery stores (Smart Cart). The Smart Cart explores emerging mobile technologies and automatic identification technologies (such as RFID) as a way to improve the quality of services provided by retailers and to augment the consumer value thus allowing to save time and money.

Keywords: WSN, RFID, ZigBee, LCD

I. INTRODUCTION

Shopping mall is a place where all walks of life will get their daily necessities from food product, apparels, toiletries, gardening tools electrical appliances, and others. A modern futuristic product is the one that aids to comfort, convenience and efficiency in everyday life. The numbers of small and large shopping malls keep on increasing over the years throughout the globe due to the demand of the public. Thus, the level of advancement of the shopping mall system and infrastructure also varies. Compared to some foreign countries shopping mall system, there are still plenty of spaces for improvement in terms of providing quality shopping experience to the consumers.

Consumers often face problems and inconvenience when shopping. These problems include worrying about the insufficient information of the items, expired products that are for sale and also wasting unnecessary time at the cashier. These are the problems that are currently faced by most consumers. There are some existing methods to solve the problems that are stated above but the effectiveness still considers improvable. Examples of existing problem-solving techniques are substituting the conventional way of keying item per item by hand to the cash register with the technology of barcode scanning where the price are stored in the barcode, and also set up a customer information counter to help the consumer if there are any enquiries about the items at shopping mall. The problems stated above might eventually be solved or else improved by the implementation of RFID technology in shopping mall. This can be done by simply attaching a RFID tag to all the items in shopping mall and attaching a RFID reader with a LCD display on the shopping trolley can solve all the problems above.

With the implementation of this system, consumers can know the price of every item that are scanned in, total price of all of the items, and also brief details of the item such as the expiry date. The rise of wireless technology along with other communication techniques has helped in making electronic commerce very popular. Because of rise in wireless technology, we will be using Wireless Senor Network for the billing process which would be done on the cart itself instead of waiting in painful queue. We seem to propose an "Smart Cart" which aims to reduce, and possibly eliminate the total waiting time of customers, lower the total manpower requirement and expenses for and increase efficiency overall. In a world where technology is replacing the ways we pursue everyday activity, the future of the retail industry also lies in more and more automated devices. This shopping cart will change the way people shop, this trolley will reduce and eliminate time taken in billing counter in supermarkets. Thus, allowing users to self-checkout and increase productivity. Here is a system with these benefits:

- It creates a better shopping experience for the customers by saving their time

- It minimizes the man power required at shopping mall, as the checking out process at the check-out counters is eliminated altogether.

- User friendly and cost-efficient.

- Requires less power and less space.

- Finally, it handles the cases of deception if any, thereby making the system attractive not only to the customers but also the sellers.

II. EXISTING SYSTEM

In the current technology we have seen people preferring to shop under one roof rather than going for different retail shops to purchase the required products. Besides this advantage there is a big disadvantage also. As more and more people are shopping in malls or supermarkets there will be long billing in the tills which would consume more time and man power. Customers usually have to wait for long duration during the billing process irrespective of the number of products purchased. Traditionally all the supermarkets use the barcodes to identify each product. Usage of barcodes are drawback because in terms of data storage barcode holds less data and more space as they are one dimension. Suppose if in any case the barcode is damaged or dirty then they are not capable of reading any data and cannot be scanned properly. The shopkeepers at the tills has to scan each and every product of the customer using the barcode reader so every time the shopkeeper picks the product they have to scan it using the readers. Customers who visit malls or supermarket do not have so much time where they can check the details of every product which they purchase. At time we have seen people getting ill because of consuming the expired eatables. Not only eatable even the cosmetic products, beverages and so on. Once the billing is done customers don't even bother to see the bill. At this point of time if the customers would not remember properly whether they have purchased or the person at the cash counter has missed this item, so if we have a message or a mail it will be useful to cross verify. We believe that the entire system can be changed to enhance the shopping experience for customer as well as the store management through digital solution.

III. PROPOSED SYSTEM

Technological development has opened up new opportunities for the company to improve its business activities. According to the report published by different researches, we compare the barcode with RFID (Radio Frequency Identification) technology which is more comprehensive. RFID is becoming more preferable technology as an alternative of barcode technology. RFID tags are advantages over bar codes because the tags have read and write operation capabilities. Data is stored on RFID tags can be modified, updated and locked for security RFID tags can be read from a large distance and it can interpret around 40 tags in one second successfully than barcode. With these advantages of RFID. Some malls that have begun using RFID tags have found that the technology offers a better way to track merchandise for stocking and marketing purposes. With the help of RFID tags stores we can see how quickly the products leave the shelves and who is buying them. Keeping the above advantages in mind we proposed a system that has a RFID tag on each and every product in the mall or supermarket. Each of developed cart has RFID reader and ZigBeetrans receive which scans all the product that are dropped into the cart and the total cost of the purchased are sent to the master server through ZigBee. This cart will have centralized server system, as and when the products are dropped or removed from the cart there will be an intimation done to the master server. The total number of products purchased and the total cost of the products will be displayed on the LCD display. This system also makes an indication if there is an expired product in the purchased lot. This system also sends the bills of the items that they have purchased to their mail so that it may be helpful for the customer in the future. This system overall gives a different experience of shopping.
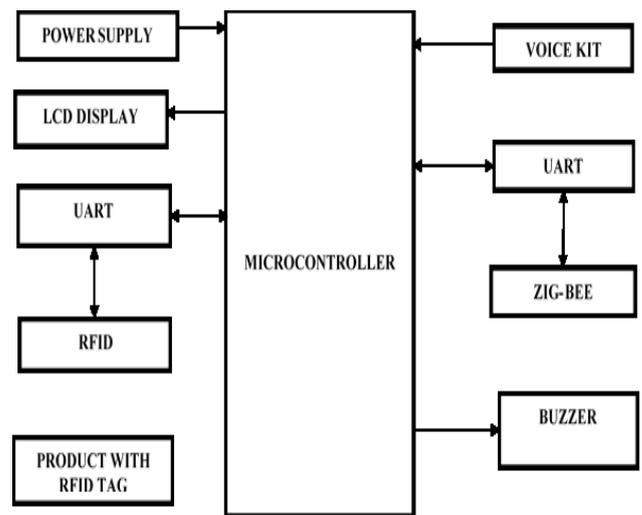
IV. ARCHITECTURAL BLOCK DIAGRAM

Fig 1. Block diagram

The block diagram consists of the following components:

- Microcontroller (SST89)
- ZigBee
- Universal Asynchronous Receiver and Transmitter (UART)
- RFID tags and reader
- Power supply
- LCD

A. Power supply

A power supply is used to supply the electric energy to an electric load. It does the function of converting one form of form of electric energy to another, sometimes they are also called as the electric power converters. In the current scenario, most of the products or the projects require the power supply which converts the main AC voltage to a regulated DC voltage. The blocks for designing a power supply are transformers, bridge rectifiers, filters and regulators. Here an AC supply is provided to12V step down transformer. The transformer output is the 12V which is rectified using a diode bridge

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and the output of Diode Bridge of 12v is filtered by capacitor.

B. RFID

Nowadays, Radio Frequency identification technology has gained position from obscurity to mainstream applications that results in the speed of handling manufactured goods and materials. RFID can detect the tags using RFID reader from the distance without the line of sight. The adverse condition such as dust, chemical, physical damage do not effect on RFID very much. RFID tag are used for identifying a person, a package or item, these are transponders that transmit data. It usually consists of two parts, one is an integrated circuit for modulating, storing, processing and demodulating radio frequency signal. Second is an antenna for receiving and transmitting signal. The RFID reader consists of a RF module that acts as transmitter and receiver of radio frequency signal.

C. LCD

A liquid crystal display is a thin, flat display device made up of numerous number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules between two transparent electrodes. Without the liquid crystal between these electrodes, the light passing through one end will be blocked by the other.

D. ZigBee

ZigBee provides low cost and low power connectivity for equipment that the battery needs, so it increases the battery life. It provides a data rate of 250kbps at 2.4GHz, 40kbps at 915MHZ. ZigBee can be implemented in mesh networks that is twice larger than Bluetooth connection. Wireless device using ZigBee can transmit 1075 meters depending on the RF module.

V. MODULES

The system consists of 5 key modules:

- Product detection.
- User interface and display component.
- Server communication component.
- Automatic billing and on-cart payment.
- Expiry date detection.

A. Product detection

During shopping the customer drops the required product into the cart which will be detected by Radio Frequency Identification (RFID) technology, the components of RFID are readers and tags. RFID technology is used over the barcode and QR code because the RFID technology can retrieve the entire data even if the RFID tag is damaged which is impossible in barcode and QR code. RFID can detect the tags using RFID reader from the distance without the line of sight. The adverse condition such as dust, chemical, physical damage do not effect on RFID very much. RFID tag are used for identifying a person, a package or item, these are

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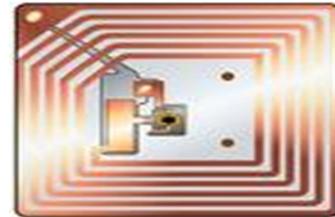

Fig 2.   RFID tag

B. User interface and display component

The user interface for the customer is provided by the Liquid Crystal Display(LCD). A liquid crystal display(LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. The main purpose of LCD is to make the customers to know about the products information which the customers has purchased, the information includes the product name, product cost and so on will be displayed on the LCD which would be convenient for the customers.

C. Server communication component

Server Communication Component (SCC) establishes and maintains the connection of cart with main server using ZigBee. ZigBee is a low-cost, low power, wireless mesh network standard targeted at the wide development of long battery life devices in wireless control and monitoring applications. It provides a data rate of 250kbps at 2.4GHz, 40kbps at 915MHZ. ZigBee can be implemented in mesh networks that is twice larger than Bluetooth connection. Wireless device using ZigBee can transmit 10-75 meters depending on the RF module.

D. Automatic billing and on-cart payment

Once the shopping of the customers is completed they have to move towards the tills to make payment which is a time-consuming process because of the long queues. To overcome this challenge Automatic Billing and On-cart Payment module was introduced, so that the customer can save time by billing on cart itself. This module ensures better shopping experience for the customers.

E. Expiry date detection

During shopping the customers do not check each and every product which they are purchasing, at times they may even buy an expired product which is quite dangerous. To overcome this challenge Expiry date detection module was introduced. If the customer drops the product into the cart, then the product which is expired is detected and indicated to the customer using voice kit.

VI. FUTURE SCOPE

The movement of the cart can be made automatic with the help of various sensors. In this way there is no need to pull heavy cart. The LCD side can be improvised by providing a layout of the shopping market by which the customer can get the exact information of the products present in different aisles. The offers can be updated to the customers through the smart phones. And also large LCD screen can be used for navigation so that it will increase the friendliness. A secure communication with server will be much more convenient. This issue will have to be resolved to promote customer confidence.

VII. CONCLUSION

Currently, the usual comment of the cart at other related supermarket are used to store goods in the cart after shopping. Taking into account the changing trend in retail shopping and after the detailed study about the related work and application in the domain of RFID based systems which makes identification easy and also after reviewing the solutions proposed by different researchers, we came up with an idea of Smart Cart. The Smart Cart system is developed using the wireless sensor network which automates the entire billing process thereby minimizing the time spent by customers at tills. This system also indicates the expiration of the products which is done through the voice kit. It also shows the total products in the cart and total cost of products in the cart. This system is economic and provides security through RFID techniques, this makes super market shopping easier and it will also provide online transaction procedure for billing. This developed system is highly reliable, fair, cost-effective, and simple to operate and requires no special training. We come to a conclusion by saying that the Smart Cart is certainly a necessity for the marketing.

ACKNOWLEDGEMENT

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