# A Survey on Smart Trolley Shopping

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***Abstract-*** *This paper explains about various techniques done in smart shopping system for automatic billing.. Shopping mall is a place where people can buy all types of products. Large crowd occurs in shopping malls especially in weekends and when special offers are announced. This results in more waiting time due to non-availability of staffs in billing counter and large queue occurs. Another disadvantage is that sometimes the system performance may not be efficient because the cashier has to scan every product item and then enter it into the billing record. To overcome the performance smart shopping system is opted. For smart shopping system barcode reader and RFID reader are used for product identification*

***Keywords***- Billing, Barcode Reader, RFID Reader, Smart Shopping

## I. INTRODUCTION

For shopping, Supermarkets are the stores, where many customers purchase large amount products in daily life. The supermarket management staff maintains the stock management by keeping the track of the products they sell and also checks whether the products are in stock along with that billing system is also maintained. These new technologies are being very useful in today's life by reducing a lot of efforts and human work. There are many such technologies like Barcode, QR(Quick Response Code) Code, RFID(Radio-frequency identification), OCR(optical character recognition). The organization of the analysis work is given as follows:

In section 2, the basic function of smart trolley has been explained

In section 3, explaining the basic billing method.

In section 4, various research work which is implemented based on automatic billing trolley is discussed and evaluated.

In section 5, the research works that have been discussed in the previous section is evaluated by listing their merits and demerits.

In section 6 the final conclusion of this entire analysis work is listed.

## II. BASIC BILLING METHOD

Currently used billing method in shopping malls is barcode based. Here the accountant at billing counter scans the product through the barcode scanner and gives us the total bill. But this becomes a slow process when lots of products are to be scanned which results in long queues, making the billing process very slow. Another thing found is that most of the people prefer to leave the shopping mall instead of waiting in long queues to buy a few products. To solve the identified problems, recent years have seen the appearance of several technological solutions for hypermarket assistance. The developed system have objectives such as : save consumers time and money and help the retailers to win loyal clients.

## III. LITERATURE SURVEY

(2013) In [1 ]Varsha Jalkote introduced a Trolley System, where each product consists of RFID tag and unique product code. The Electronic Product Code gives information such as product name and price. When a person puts a product into the Trolley, the RFID module scans the tag and the Product Code number is generated by 2.4 GHz RF module. In this system, RFID reader passes the Product Code to the microcontroller 89S52. The Product Code is then compared with the database of the system through Serial Peripheral Interface (SPI) Programming of EEPROM , which has information about various products. When comparison is done, the name and price of the product is displayed on the LCD display of the Smart Trolley, where the user can see the product details. The data obtained from the database is then transmitted to ZigBee transmitter through microcontroller 89S52 for billing system. The data's are sent to the system through ZigBee receiver using Max 232 interface. Thus the final information of all products is transmitted to a computer with the help of serial communication for making the system efficient for billing purpose.

*(*2013) In [2] Udita Gangwal proposed a paper for Smart Shopping cart automation. The system consist of barcode scanner attached to every shopping cart. Here the

design includes a camera-based barcode scanner, which is fitted to the cart. The barcode scanner is used to identify a product and determine the cost of the product from the database. It consists of information about various product's name, product barcode, price and weight. The weight attribute is included in order to double check the identity of the particular product in a system. Weight sensor also known as load cell is used for determining the output through decision making process. When the weight of the product determined by the sensor doesn't match the product weight, then discrepancy occurs. For further enhancement of decision making process, a third level design is included. The third level design involves image processing which is enhanced using image comparison algorithm. The product is scanned by barcode and the picture of product is taken by camera which also works as barcode scanner. If a person wants to change a product there will be a slab attached at the top of the cart. The slab is placed in order to trigger the products which are to be exchanged. When the scanning is done a picture of another product is taken for placing in the slab and the corresponding images are stored in cart. By using the images taken the products are verified by image comparison algorithm. If there is no match for the corresponding product then discrepancy occurs. In order to maintain memory usage the images are removed after the result is determined by image comparison algorithm. The process is done in such a way there is no transmission but the system is energy efficient and achieves efficient performance.

(2013) In [3] Dr. Sheifali Gupta developed a system in order to control theft in smart trolley shopping. To avoid theft security mechanism is included. The system consists of RFID for shopping and billing, AVR microcontroller for peripheral interfacing and inventory management. The system is developed in such a way the sales are raised with more customers. There are three stages: In the first stage, the Products are added to the stock and are registered using the product registration form. In second stage, if a customer is new to this system, then he/she will be directed to the registration counter where a RFID rechargeable card is issued to the customer for smart shopping. If a customer already registered arrives at the store he can get his RFID loyalty card recharged and can proceed for shopping with smart cart. In the third stage, after shopping are done the customers moves to the billing counter along with their respective cart. At the billing counter, cart is then connected to the server through the serial port and the system is authenticated. The details of the purchased RFID tagged products are automatically transferred to the server. The bill is computed and the customer is provided with a facility to remove undesired products The user RFID loyalty card is scanned and the balance is checked. If the balance is less than the calculated bill then the user can get the card recharged and pay the bill.

(2014) In [4] S. Sainath, introduced a automatic billing system which is done using a Raspberry Pi Embedded Chip. This controls the whole shopping process with two Barcode Scanners that are previously loaded into a database and the Application coding is done through a wireless network. Along with the Raspberry Pi Embedded Chip, the other specifications used are Eclipse SDK, a Graphical User Interface where the application is coded and a Battery kit for charging the trolley and allows the users to self-checkout at Super Markets.

2015 In [5] Anjali Verma1's paper describes about how much comfort, ease is provided in everyday life on social aspects. RFID technology is used to provide best service for billing process. The RFID technology reads the bar code (RFID tag) of the items to be purchased, thus reducing time to stand in a long queue.

2015 In [6] Mohit Kumar describes about smart trolley shopping using ARM7 LPC2148. The heavy crowd at malls leads to a long queue at the billing counter because the billing person has to scan every product item and then enter it into the billing record. To overcome this issue, the system is done using arm7 microcontroller fitted with an LCD and RFID scanner and a ZigBee. Here 16x2 LCD is used and ZigBee modules are used to make the wireless network to work at wide range. When a user picks a product and drops it into the trolley, the RFID scanner scans the product's unique code. The information is displayed on screen. After shopping is done consumer visits the billing counter for paying their bills. This will save the time for scanning process.

2016 In [7] Dhavale Shraddha proposed a trolley system new technique IOT. Internet of Things (IoT) is popular in 1999. Internet of Things is nothing but a network of Internet-connected objects able to collect and exchange data using embedded sensors. The trolley initialize the products that are taken, then the RFID reader reads the RFID Tag, which is connected to the microprocessor. After the information is compared with the database the cost of product, name of product and the total bill will get displayed on the LCD. If a user wants to remove any product then he/she can remove that product from the trolley. This is done by displaying the name of the product, cost of a product and the total bill again on LCD screen. The trolley is then connected to ESP module for transferring the information to the main server. The owner has own cloud server to access information from anywhere using their user ID and password.

2016 In [8]V.Padmapriya explains about the effectiveness of the trolley system where wireless communication such as ZigBee, Bluetooth etc., are used. Along with that RFID reader, LCD display and LI-FI transmitter in the smart trolley is used. The LI-FI is connected to the main computer for billing purpose. The system comprises of RFID interfaced with PIC microcontroller. Every product contains RFID tag which has unique id number to identify the product. The trolley gets the details about the product using the tag. When a customer puts the product into the trolley, the details of the product is then compared to the details of product stored in database through microcontroller. When the product comparison is done the details is displayed on the LCD screen. If the customer wants to return the product from the trolley, he/she can take off the product by pressing the remove button from the trolley. So that the quantity and cost of the product will be reduced from the total amount. Also, product details from PIC controller can be sent to the computer in the billing section through LI-FI transmitter. Finally, the computer can receive the data using MAX232 serial communication.

2016 In [9] Megha R. Mane1 introduced the Electronic Shopping Wi-Fi Based shopping with barcode scanner with server. Here LCD display helps to inform customers about product information, discounts, offers and the total bill. The barcode reader identifies the product and updates the bill. When the customer is done with shopping, he/she can just press the End button and the details are sent to the server and the customer has to pay just the amount and exit. The modules are integrated into a smart enclosed system called controller and are tested to satisfy the functionality. The customers can scan the items themselves and the LCD screen on the shopping trolley will update the total. This system can be very beneficial for the retail stores. Also more people will enjoy the shopping experience.

2017 In [10] Shweta. B. Vernekar introduced the concept smart trolley to provide a pre-determined information about total cost of the product to be purchased before going to billing. Here Raspberry Pi is used for controlling the process, an LCD for displaying the total cost of the products, a camera to click the pictures of the barcodes of the products. The barcode value of the product is now decoded using barcode detection method and the decoded value is then compared products ID stored in the database. When the product verification is done, the details will be displayed on the LCD.

## IV. ARCHITECTURE OF SMART TROLLEY SHOPPING

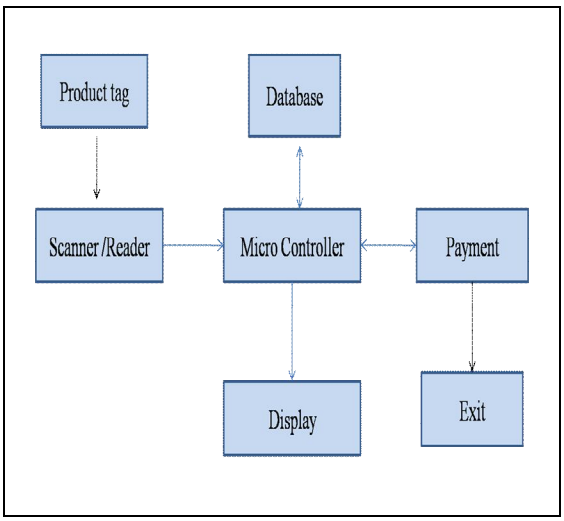


Fig . IV.1 Block Diagram of Smart Trolley

The above architecture diagram explains about smart trolley shopping which consist of four modules:

- Product tag
- Microcontroller
- Reader
- Database.

In this system, reader is connected to microcontroller which is also interconnected to the database. The products to be purchased are detected by reader. The reader detects the product tag and information about the product. The detected information is checked with database through the microcontroller and is also stored in server. When the information is displayed ,payment options occurs for final billing. After payment is done, the purchased items are deducted from the database which manages the stock and quantity. The stock management can be developed and interfaced with this system.

### *A. Product tag*

The particular product tag is used to identify the product details.

There are two types of tags used.

- Barcode Tags
- RFID Tags

#### *A.1. Barcode tags*

A barcode is machine readable which is used to detect information in a visual pattern. The first barcode was appeared in June 1974. This can be used on every items to get product prices for purchase within a store.

*A.2. RFID tags*

RFID tags "Radio-Frequency Identification" is a wireless communication technology where digital data is encoded in RFID tags. It consists of an integrated circuit and has antenna made up of durable plastic.

Table 4.1. Comparison of RFID TAGS

| Parameters | Low frequency | High frequency | Ultra high frequency |
|---|---|---|---|
| Overall range | 30 kHz to 300 khz | 3 to 30 MHz | 300 MHz to 3 GHz |
| Systems work at | 125 kHz to 134 kHz | 13.56 MHz | 900 and 915 mhz. |
| Distance coverage | 10 cm | 10cm and 1 m | 12 m |
| Applications | Control and domesticated animals following. | Ticketing, installment, and information exchange applications | stock administration, pharmaceutical hostile to forging, to wireless device design |

**B . Reader / Scanner Part**

Reader/Scanner is used to identify the product details from reading/scanning the particular tag which may be barcode tag / RFID tag. The technologies used are barcode scanner and RFID reader to read barcode and RFID tag respectively.

*B.1 Barcode Scanner*

Barcode scanners consist of three parts: the illumination system, the sensor, and the decoder.

*B.2. Process steps in reading barcode*

- Start code - reader can begin reading. If the stop code is found, it knows to read the message and reverse it.
- Data - multiple digits as many as 12 in UPC(Universal Product Code). In UPC the first 6 digits belongs to the manufacturer and next 6 digits are assigned for individual part numbers.
- Checksum – Acts as a error checking method. It makes sure that no data's are missed or misread.
- Stop code - This should occur after the last checksum is found.

*B.3. Calculation of Barcode checksum:*

For example - barcode digits are 748493000484
First The value of all digits are added together in odd positions (digits 1, 3, 5, 7, 9 and 11). 7+8+9+0+0+8=32.

1. After addition is done ,Multiply the value by 3. 32 * 3 = 96.
2. Now add together the value of all of the digits in even positions (digits 2, 4, 6, 8 and 10). 4+4+3+0+4=15.
3. Sum to the value in step 2. 96 + 15 = 111
4. Make the check number from value of step 4, by adding value to number 9 and check it is multiple of 10. 111+ 9 = 120. The checksum digit is therefore 3.

*B.4 There are two types of barcodes:*

- Linear Model
- 2Dimensional Model

Table B.2. Comparison of Barcode

| Characteristics | linear barcode | 2D barcode |
|---|---|---|
| Efficient | Most recognizable | More complex |
| Capability | Holds any type of text information | Information in the code are price, quantity, web address or image |
| Process Method | 12-digit UPC ID number. The 1st-6 digits- manufacturer's id number. Next 5 digits represent the item's number. The last number is called a check digit. | Requiring the use of an image scanner for reading the information embedded in a 2D barcode |
| Model | Linear Barcode Model  | 2D barcode Model  |

*B.5. General algorithm to read Barcode* :

**Step 1** – Pre-Process Source image.
**Step 2** – If any remaining unprocessed regions exist then continue to step3,otherwise go to the last Step
**Step 3** - Select region and trace region contour.
**Step 4** - If contour acceptance test failed to go to step 2, otherwise, continue to step 5.
**Step5**- Select best two candidate segments corresponding to the current region.
**Step 6** - If the two segments can't form a marker go to step 2, otherwise continue to step 7.
**Step 7** - Approximate the fourth corner (worst case).
**Step 8** - Arc-circle fitting method.
**Step 9** - If fitting failed then go to step 2, otherwise continue to step 10.
**Step10** - Optionally refit region / the four quadrilateral segments.
**Step 11** - Find synchronization pattern. An approximate synchronization midpoints coordinate.
**Step 12** - If synchronization pattern doesn't exist go to step 2, otherwise continue to step 13.
**Step 13** - Extract binary pattern information based on midpoint positions under perspective.
**Step 14** - Decode barcode region information and add to result in a queue. Go to step 2 (searching for another barcode).
**Step 15**- Process result queue. End.

C . RFID Scanner

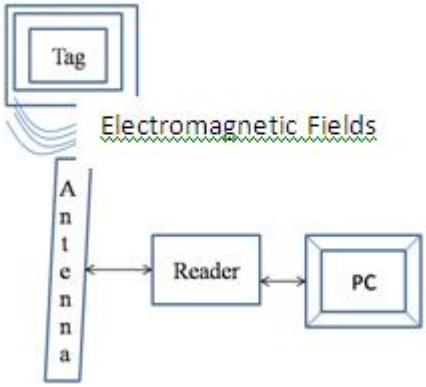


Fig C.1 Working Principle of RFID Scanner

The RFID scanner consists of an integrated circuit and antenna, which is used to transmit the data to the RFID reader. The radio waves are converted to data by the reader form of data. The collected Information is then transferred through a communications interface to the server .In this the data are stored in database and can be used for future reference.

## V. COMPARISON OF METHODOLOGIES

This section provides an overview of the pros and cons that are occurred in the research methodologies whose functional scenarios are discussed in depth in the previous section. From the following table, it can be predicted a better approach that provides considerable improvement in the proposed scenarios

Table V.1 Comparison of Methodologies

| Title | Description | Hardware and Software Description | Pros and Cons | Citations |
|---|---|---|---|---|
| Futuristic Trolley for Intelligent Billing with Amalgamation of RFID and ZIGBEE | When a tag is detected, read the tag and compare it with database and displays the tag details and add the cost to the bill. | Hardware<br>ARM processor,<br>AT45DB161 memory card ,wireless ZigBee transmitter, RF module (2.4 GHz),passive type RFID tags(125 KHz).<br>Software<br>Visual Basic 6.0 | Pros: Easy of control<br>Can use for Other applications. | [2] |
| Smart Shopping Cart with Automatic Billing System through RFID and Bluetooth | RFID reader identifies the Tag Information of the product and by Bluetooth module then the information will be send to the mobile device . | Hardware<br>RISC based ARM7 processor ,LCD, RFID Reader, EEPROM, Bluetooth module. | Pros: the PID owner can track the cart information<br>Cons: The microcontroller does not support I2c protocol | [9] |
| Automated Billing Cart | The trolley scanner Is linked with the android application and billing , that track the records of all the brought products | Hardware:<br>Shopping Cart,<br>Wi-Fi module<br>Software: Android Application,<br>Wamp Server, | Pros : Android application used to get inventory management of shopping mall .<br>Cons: Registering new user at counter may take more time. | [60] |
| LIFI Based Automated Smart Trolley Using Rfid | RFID Tags are used for Identification of Products. Through the LI-FI receiver and transmitter, the purchase details will send /receive to server and trolley. | Hardware:<br>PIC Controller (PIC 16f877a), RFID tag, RFID Reader, LCD, LIFI transmitter & receiver. | Pros :Multi-User Communication<br>More feasible compared with other billing methods | [2] |

## VI. CONCLUSION

There are many technologies which are currently being used for billing systems in supermarkets. The selection of the technology depends upon the performance, efficiency, and QoS of the technology regarding particular task and environment. The solution is found in order to reduce time consuming. RFID and barcodes are used to automate the data collection process of various products. Smart trolley differ in many areas based on the Name of the product, cost, weight etc., Bill payment done by standing in a long queue is a tedious process. The proposed smart trolley shopping will overcome the problem which makes the task easier. The system is simple and flexible which also makes secure transmission of account information. This will save time, energy and manpower of Customer, Owner, and supplier.

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