

S-Mart Cart Using Near Field Communication and Raspberry Pi

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Abstract - This paper presents an NFC based Automatic Shopping Cart, that offers fast track self check out shopping with an auto-billing system and a revolutionary handsfree shopping experience accomplished by means of proximity sensors to assist and enhance the average shopping experience. The proposed S-Mart Cart uses Near Field Communication tags / readers that are pre-programmed to read or write data (with admin control only). The Raspberry Pi controller controls the working of the system components for achieving wireless communication with the servers. The data is sent to the main server and a bill is generated for all the products in the cart. Hence, unnecessary delays in long queues can be avoided and overcome. Hands free shopping using proximity sensors on the cart is brought about by detecting the distance from the user and facilitating movement as well as to avoid collisions with obstacles via wheel rotation by battery operated motors.

Key Words: Raspberry Pi, Near Field Communication, Proximity Sensors, NFC Scanning, Smart cart.

1. INTRODUCTION

The word smart is trending lately in every field. Every object around us is being made smart so as to make our work easier. With the increase in internet technology, food items are available at our door steps whenever needed. But the experience of going to a mall and shopping the things all by ourselves has its own advantages and disadvantages as well. The advantage is that we can carefully select the best product according to our choice and judge the product by seeing, touching and feeling it. The major drawback of this is standing in stretched out line of customers for paying off the bill. The brought forward smart shopping structure avoids this drawback and also has additional features for the convenience of the consumer. The intensified Smart Shopping Cart System helps the customers in minimising the considerable amount of time that customers used to spend in shopping.

The main technologies that play a vital role in this proposed system are : (i) Raspberry Pi for achieving wireless communication with Server (ii) proximity sensors (iii) NFC tags for product identification (iv) Web application displaying amount payable and managing the inventories detail.

Near field communication is a swiftly and quickly advancing technology. Small NFC tags are attached to the products. The

NFC readers wirelessly read the tag attached to the product for collecting the information about it, that might be related with some random data records. Thus, NFC systems identify the objects and collect the information about it automatically, similarly as the optical bar code readers do. The Smart Shopping System with the Smart Cart has the prospective to make a very smart shopping affair easy, congenial, amiable and systematic to the customers, it also makes controlling of the inventories more comfortable and easier for the store management.

Our main impetus is to bring down the chain delay in hypermarkets. Product acquisition in gross convenient shop with numerous products is a tedious and time consuming process. This cart uses modern and cheap technology to make it intelligent and time saving. This system is about designing and developing a Smart Cart system that will simplify shopping experience of customers in hypermarkets, reducing their waiting time and reducing human swarms in front of cashiers. NFC tracking is the key technology required for the implementation of this project. Smart Cart system involves effective communication between two separate systems: a billing software, Smart Basket Cart electronic hardware. Main emphasis was made for the Smart Basket Cart hardware while other two systems were left for the consideration of market owners. Therefore, this project proposes a novel approach in designing a Smart Basket Cart system which is intended to reduce billing time in supermarkets.

2. OBJECTIVE

The main objective of the project is to overcome delays owing to long and rushed billing queues at hypermarkets with the help of modern and cheap technology to make a smart shopping cart that is not only time saving and convenient but also aids the overall shopping experience. The aim is to provide revolutionary handsfree shopping experience that is smart, interactive and convenient, accomplished by means of proximity sensors to assist and enhance the average shopping experience.

3. LITERATURE REVIEW

1. Design and Implementation Of Smart Basket Cart Using Near Field Communication-D.Mohanapriya,R. Mohammed Anas, P.Nandhini, N.M Deepika Indian Journal of Emerging Electronics in Computer Communications Vol.5, Issue 1 (2018), talk about the design and development of a Smart

Cart system that will simplify shopping experience of customers in supermarkets, reducing their waiting time and reducing human swarms in front of cashiers as well as the benefits and uses of NFC for the wireless transmission part in the projects / products.

2. BillSmart-A Smart Billing System Using Raspberry Pi and RFID- Dr.Mary Cherian, Disha DH , Chaitra KB , Ankita , Aishwarya International Journal of Innovative Research in Computer and Communication Engineering , Volume 5 . Issue 5 , May 2017, a smart billing system for convenient shopping, the main technologies that play a vital role in this proposed system are : (i) Raspberry Pi for achieving wireless communication with Server (ii) Infrared sensors (iii) RFID tags for product identification, and (iv) Web application displaying amount payable and managing the inventories detail.

3. Automated Shopping Trolley System Using Raspberry Pi Device- Ravindra Jogekar , Ruchita Ghodeswar , Payal Kadu International Journal of Research Culture Society. Vol 2 Issue 2, Feb 2018. Demonstrate, for an enhanced shopping experience, the smart trolley which consist of raspberry pi device, barcode scanner and LCD touch screen will help the customer to save his time during the bill payment at the bill counter.

4. Smart Shopping System Android Application-Mansi Mhaske , Mayuri Sawant , Ekta Bhattad , Amruta Gaikwad, Manoj Mulik on International Journal of Advanced Research in Computer Science and Software Engineering , Volume 6, Issue 11, November 2016 , wherein with the help of mobile payment, customer will speed up the transaction process and can check the balance, and if customer needed then add balance from their bank accounts. NFC (Nearest Field Communication) is used for the mobile transactions .The system contains the items attached with NFC tag, android phone having NFC reader which reads the tag information when put into the trolley.

5. Smart Shopping Trolley-Dr. S. Poornachandra, M. Brindha, MI. Arsath Ariff, C. Raviraj , K. S. Srikanth International Journal for Research in Applied Science & Engineering Technology (IJRASET) , Volume 6 Issue II, February 2018. consisting of Raspberry pi which follows the customer while purchasing the items and ultrasonic sensor maintains the safe distance between the customer and itself. When a person drops any products into the trolley, its bar code will be detected and the price of those products will be displayed .By using this trolley, customer can buy large number of products in a lesser time with less efforts. The system is also subjected to anti-theft management where the system doesn't let any customer take non-billed items.

4. PROPOSED SYSTEM

In the current system, bar codes are used for scanning product details and generating the bill.

At times, the barcodes would have been damaged and that particular product cannot be scanned by the barcode scanner leading to confusion and delays. Also, the customer will have to wait until the checkout to see whether have remained within their budget.

The proposed S-Mart Cart is a new age smart, convenient and time saving approach to the existing shopping procedure. In this system we are implementing an NFC based Automatic Shopping Cart, that offers a fast track self check out feature that enables an auto-billing system and a revolutionary handsfree shopping experience accomplished by means of proximity sensors. The proposed smart cart uses NFC to read the product details and display the data on a screen. Then the data is sent to the main server and a bill is generated for all the products in the cart. Smart Cart system involves effective communication between two separate systems: a billing software, Smart Basket Cart electronic hardware. It is unique because the working principle of the entire system is different from all other similar projects presented in the literature review chapter and it grants some flexibility in choice for market owners.

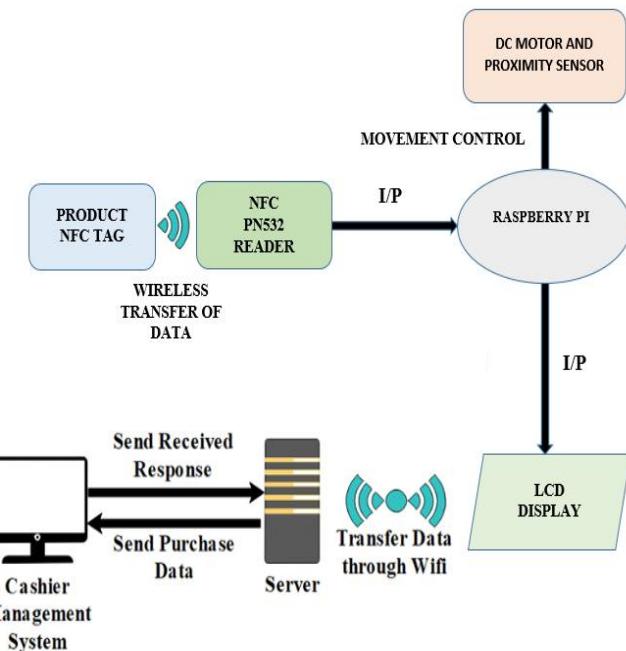


Fig 1: System Architecture

4.1 HARDWARE AND SOFTWARE REQUIREMENT

- **Hardware Requirements:-** The proposed S-Mart Cart system , implements the following hardware components :

- Raspberry Pi 4B: It is a controller which controls all the system components. The Raspberry Pi 4 Model B is the latest product in the popular Raspberry Pi range of computers. It offers ground-breaking increases in processor speed, multimedia performance, memory, and connectivity compared to the prior-generation Raspberry Pi.

- DC Motor and Driver Module (L298N) : Aids the movements of the cart.
 - Proximity Sensor (HC-SR04): The ULTRASONIC SENSOR HC-SR04 is used to measure distance in the range of 2cm-400cm with an accuracy of 3mm. The sensor module consists of an ultrasonic transmitter, receiver, and the control circuit. Ultrasonic Sensor consists of two circular eyes out of which one is used to transmit the ultrasonic wave and the other to receive it. In this project it is used to facilitate a handsfree shopping experience.
 - NFC Module (PN532) and NFC Tags: Used for writing/reading the product information.
 - Display Unit: Displays the current product that is purchased and the total bill.
- Software requirement:-** The programming language used is python.

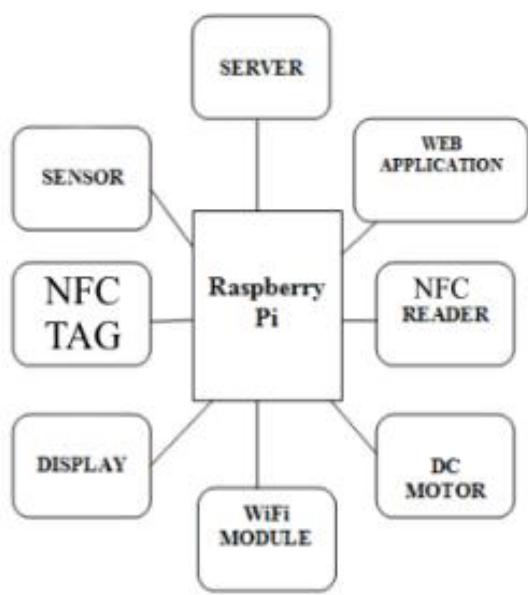


Fig 2: Block Diagram of the Hardware Components of the S-Mart Cart

5. METHODOLOGY OF THE PROPOSED SYSTEM

The proposed S-Mart Cart uses Near Field Communication tags with Raspberry Pi for achieving wireless communication with the servers as well as controlling physical movement of the S-Mart Cart with the help of Proximity Sensors, to carry out the tasks as (shown in fig 3) follows :

A. Initially , the customer is to scan a store generated Quick Response (QR) code with the help of their smartphone which will then lead them to a webpage of the mart where they can view their purchase being electronically billed and not only receive an electronic receipt of their purchase at the end of their shopping but also have options for convenient online payments .

B. As the S-Mart Cart passes the entrance gates of the mart, it gets activated to begin shopping S-Martly.

C. With the help of Ultrasonic Proximity Sensors that are attached to both the front and well as back end of the cart, distance from the customer to whom the cart belongs (back sensor) and any obstacle that may come in the way of the cart (front sensor) is continuously measured .

D. These sensors are interfaced with DC Motors and Driver Modules via a Raspberry Pi to facilitate autonomous movement for as long as the user-assigned proximity range is maintained by and between both the sensors and the user / obstacle.

E. Now, as the customer proceeds with their shopping and begins to add items to their cart, pre-written NFC Tags on the items are read by the on-board NFC Reader, yet again interfaced with the Raspberry Pi via Near Field Communication Module.

F. The product information such as description, quantity, price etc. that is read by the NFC Reader is then displayed on a display unit attached to the cart as well as uploaded to and updated on the e-Bill .

G. The above process will continue for as long as the customer is shopping. At the end of shopping, the customer can opt. to make the payment via online banking or online wallet options.

H. The customer may end their shopping as and when desired.

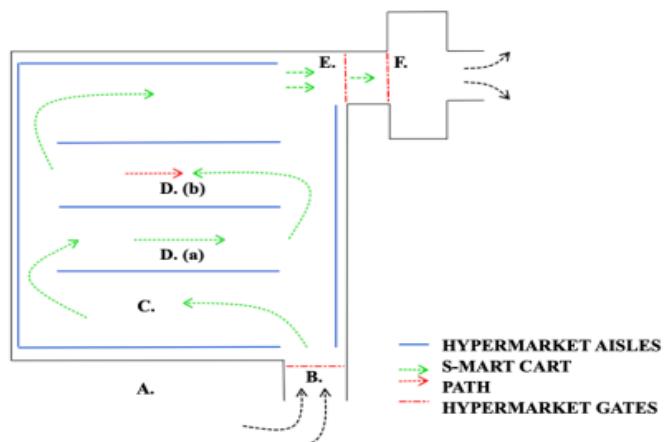


Fig 3: Methodology of the Proposed System

5.1 WEB APPLICATION AND QR SCANNING

At the trolley parking bay, a store-generated QR code on the carts is scanned by the user via a QR code scanner on his/her mobile phone, for trolley personalization. This code leads the customer to an online portal for e-billing, where the customer may choose to pay online.

5.2 MOVEMENT CONTROL

In order to facilitate a hands-free shopping experience, proximity sensors are fixed on either end of the S-Mart Cart to execute forward movement of the cart via use of dc motors as well as avoid any collisions with obstacles in its path.

When powered, Raspberry Pi measures the distances of objects, in front of it, by using Ultrasonic Sensor Module and stores in a variable. Then RPi compares this value with predefined values and take decisions accordingly to move the cart Left, Right, Forward, or backward. For example, consider 30cm distance. Whenever Raspberry Pi gets less than the 30cm distance from any object then Raspberry Pi stops the cart and moves it back and then turns it left or right. Now before moving it forward again, Raspberry Pi again checks whether any obstacle is present within the range of 30cm distance, if yes then again repeats the previous process, else move the robot forward until it will detect any obstacle or object again.

We are using Python language here for the Program. The programming part of this project plays a very important role to perform all the operations.

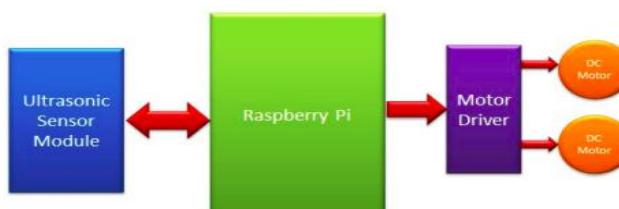


Fig -3: Movement Control Interfacing Block Diagram

5.3 NFC TAG / STICKER SCANNING

NFC technology features small little NFC tags that can be used to store and transfer information. These tags can store Wide ranges of information, from short lines of text, such as A web address or contact details, to links to apps in the Google Play Store. It's a quick and efficient way to quickly push information to your phone and these little tags can replace bar and QI codes, and could even be used instead of Bluetooth in some cases.

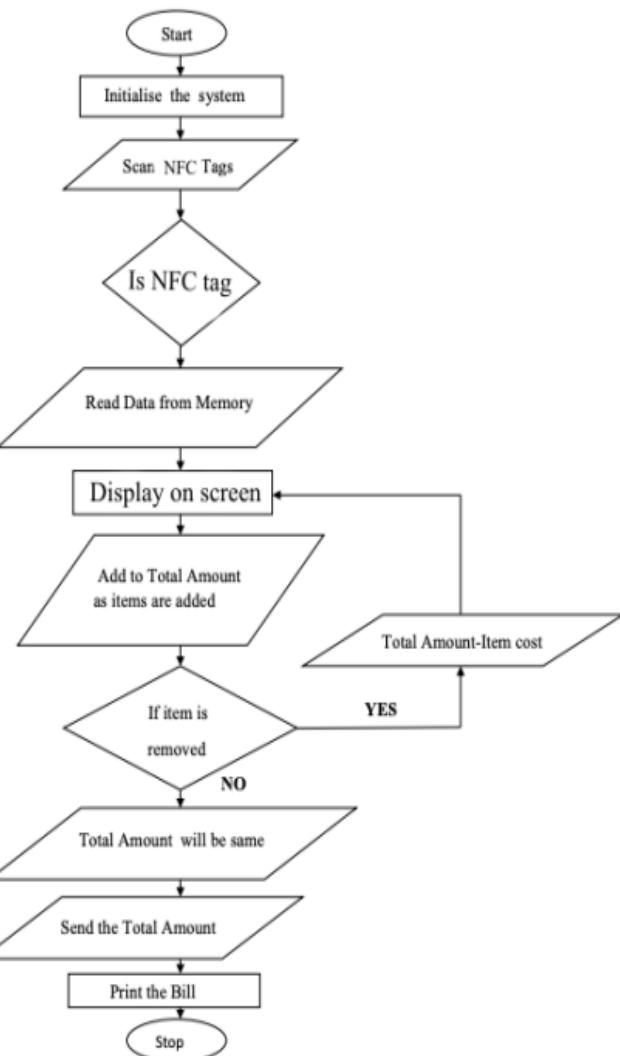


Fig 4: NFC Scanning Flowchart

6. EXPECTED RESULTS

1. At the trolley parking bay, a store-generated QR code on the carts is scanned by the user via a QR code scanner on his/her mobile phone, for trolley personalization.

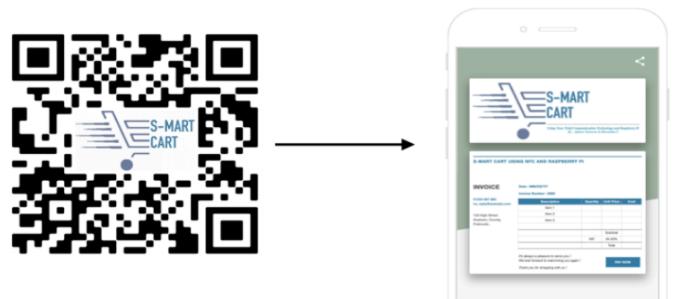


Fig -5 QR Leads Customer to the e-Billing Portal.

2. When the trolley passes through the gates at the entrance to the hypermarket, NFC tags on the cart are written to activate the cart and make it ready to be used as a S-Mart Cart.

3. As the customer proceeds through the store adding items to his/her cart, product specific information stored on individual NFC tags on the products, is updated to display screens attached to the cart as well as sent to the user's mobile phone via a web application that bills the items added to the cart simultaneously to generate an e-bill. The customer can opt. to make the payment via online banking or online wallet options.

Checkout

Product	Quantity	Rate	Price
Chocolate Biscuits	1	50	50
Baguette	1	150	150
Fruit Juice	1	20	20
Total:			220

Pay Now

Fig-6 e-Bill

4. Use of proximity sensors on the cart detect the distance from the user and;

- Facilitate movement of the cart via wheel rotation with the help of battery operated motors.
- Avoid collisions.

5. A first gated exit prompts the user to make the payment of the items in the cart and only on payment of the bill (either via card or online payment) allows the user to pass through. At this gate, in case of non-payment of the bill the wheels of the cart seize to rotate.

6. The final exit gates deactivate the S-Mart Cart which may then be trolleyed as a conventional cart.

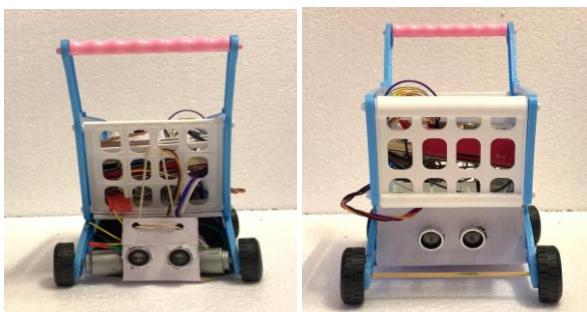


Fig -7 Complete system (a) Back View (b) Front View

7. MERITS ,DEMERITS AND FUTURE SCOPE

-MERITS

- It provides flexibility during the shopping thus giving the customers a better shopping experience.
- Reduces billing time by avoiding queues.
- Proximity sensors facilitate a revolutionary hands free shopping experience.
- NFC protocol provides a convenient, smart and efficient way of shopping.
- The customer can stick to / plan their budget without having troubles at the cash counter.

- When a person is unable to find the price printed on the product, they just have to scan the product and the product details will be displayed.

-DEMERITS

- A stable internet connection is required for the servers to be able to integrate working of all components successfully.
- NFC reader can read an NFC Tag placed only within range of the reader.

-FUTURE SCOPE

In today's world of ever evolving technology, there are ample possibilities for innovation. The future of the S-Mart Cart could include the following additional features :

- In-Store Navigation .
- Stock/Availability Details.
- Offers/Deals Details.
- Complete Self-driven Technology.
- Interactive Shopping for the Visually / Hearing Impaired.

8. CONCLUSION

The smart shopping using NFC technology may be considered to be a best alternative for the existing barcode and RFID technology. Thus our project that is "S-Mart Cart Using Near Field Communication and Raspberry Pi " provides a convenient, smart, interactive and efficient way of shopping by using a simple architecture which is considered to be as enhanced and cost efficient mechanism for shopping providing flexibility and convenience to the customers in the shopping malls during the entire shopping process. New technologies are implemented to provide the lowest delay time and smarter solutions. This shopping cart will enhance conventional shopping. Our hypothesis was to design a user friendly shopping cart that would enhance the shopping experience. The customer doesn't have to wait till

the checkout or use their calculators or prick their heads to know how much the shipping cost has come up to and to see if they got it within their money constraints using the alert. Also for a person who is unable to read or find the product price printed on the product while purchasing doesn't have to seek the help of anyone to know it. They just have to scan the product and the product details are displayed. This shopping cart is user friendly, reliable and very convenient for the customer.

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