

Smart Shopping Cart using RFID

Reshmi Anantapalli, R. Rajyashree, Sri Haripriya Nutulapati, Ria Singh

Abstract--- *In the present day, the most preferred approach to any task is one that provides maximum comfort and convenience and consumes the least time. A shopping cart is generally provided to the customers in a supermarket in order to assist their customers with the transportation of the merchandise. The paper proposes a system for a human-following cart (smart cart) that uses Radio Frequency Identification tags to identify and follow the customers. Each customer entering the shop is given a Radio Frequency Identification card and its respective sensor is installed on a shopping cart. As the customer moves inside the mart, the smart shopping cart follows him/her while maintaining a safe distance from its respective customer and also the racks and other customers in the mart. Customers can enter their budget before they begin shopping so they get notified if the total bill exceeds their budget. Optical Character Recognition/ Intelligent Character Recognition software is used to scan customer's shopping list. Global Positioning System installed in the tablet helps customer in finding the products in the mart. The system includes automatic billing of the products which have Radio Frequency Identification tags on them and the exit gate that has Radio Frequency Identification sensor will scan each product in the cart and the total cost of products purchased is given. Payment method is chosen by customer and payment is done. Calories of food products are also displayed on the screen of smart phone or tablet used to curb the customers from purchasing excessive junk food. The key is to design the cart in such a way that it reduces man power and daily hassle of long queues. The paper promises a more cost efficient system for the smart shopping cart than any of its predecessors.*

Keywords--- *Shopping Cart, Radio Frequency Identification, Radio Frequency Identification tag, Radio Frequency Identification Sensor, Passive Tags, Radio Frequency Identification Antenna, Reader, Micro-chip.*

I. INTRODUCTION

The main objective of the project is to design a smart shopping cart which follows the customer from a safe distance, in a shopping store or complex. The customer-following cart is achieved by the Radio Frequency Identification (RFID) Technology. The electromagnetic field produced by RFID is automatically used to identify and track tags attached to objects. The tags contain electronically-stored information. The tags present are passive and collect energy from a nearby RFID reader's interrogating radio waves.

The system proposed, is a system which reduces the human effort of dragging the trolley throughout the store and provide stress free shopping. The smart-cart is so designed

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that it follows the customer who has the RFID tag that matches the frequency of the tag attached in the card. The trolley is allotted to per customer for a limited period of time and has a timer.

The customer can focus on shopping meanwhile the cart follows the customers everywhere he/she goes. When the time is about to get over the sensor attached to the cart alerts the customer about the time that is left to return the cart, with making a beep sound. This makes the customers aware of the time that is left for them to wind up the shopping. Alerting the customers through alarms helps in preventing the shortage of carts for other customers. This would decrease the chaos that would be created during rush hours. In addition to this, a screen is attached to the cart where the items to be purchased by the customer is loaded. As the customers continue the shopping, the items which are purchased are stroked out of the list. After all the items are purchased, the final bill is generated by calculating the price of the purchased items. This system would help the customers to prevent the time wasted by standing in long queues on billings counters.

The proposed system aims to reduce the efforts of the customers in a complex and thus saving them a lot of time. Furthermore the RFID technology makes the system cost efficient and accurate. The customer would have a relaxed shopping experience after using the proposed smart-cart.

II. RELATED WORK

One of the existing systems deals with Smart Shopping cart using wireless sensor networks [1]. This design ensures detection of cases of deception invoked by dishonest customers who intend to rob the mart. The drawback of the barcode reader used in the system is that it is a line of sight operation therefore product being scanned should be positioned precisely.

The system also deals with an automatic billing trolley [2], in which the system makes the billing easier by using a RFID tag and microcontrollers.

The system aims to reduce manpower and make the billing system very efficient. The main disadvantage of the system is that it uses some hardware that is very costly thus preventing the system to be cost efficient. Also, the number of shopping carts needed cannot be determined exactly at a certain time and may cause shortage of shopping carts in the rush hour.

The Internet of Things (IoT) based smart carts with automated billing and customer relationship management [3] deal with reducing expenses of the management by reducing manpower at the billing counters and helps in keeping the customers aware of their budget.

The limitation of this system is that the data read by the sensor is sent to the main server but if the server fails then the sensor data will not be stored anywhere. Another limitation is that there is no provision of self-billing in this system.

The RFID based smart cart with billing using Raspberry pi 3 and IoT based Global Positioning System (GPS) navigation [4] is used inside the supermarket to find the products. It will read the price and weight of every product and the GPS navigation saves the customer's time of searching for products in the supermarket. The main drawback of this concept is that only the regular customers can make use of this facility in the supermarket.

The Cloud and RFID based smart cart with billing and anti-theft RFID gates [5] provides a significant decrease in queuing time of the customers. Billing is automatically executed using their RFID tags. Anti-theft RFID gates prevent any kind of thefts. The main disadvantage of this smart system is that only the customers who come to the supermarket regularly can make their payments using their RFID tags. Also, if the product list is not erased from the customer's database due to any error then the anti-theft gate might give false alarm.

III. COMPONENTS OF SYSTEM

A. RFID Sensor

Electromagnetic fields are used by Radio-frequency Identification (RFID) to automatically identify and track tags that are attached to objects. Electronically-stored information is contained in the tags. Energy from a nearby RFID reader's interrogating radio waves is collected by passive tags. Active tags contain an internal power source (which could be a battery) also the RFID based sensor [6] will work despite being hundreds of meters away from the source. In case of a barcode, the tag needs to be placed within the line of sight of the reader while the same is not required in case of RFID, thus it may be embedded in the tracked object.

B. RFID Antenna

The model of the RFID antenna has parameters which are radiation resistance, efficiency, Q and bandwidth must be considered in order to meet the necessities and helps it achieve the needed level of performance. The antennas are only tuned up to resonate a very narrow field of frequencies being carried out which in turn are centered on the RFID antenna system.

The antennas of the RFID will propagate in a wave like shape which may be vertical or may have horizontal dimensions. The coverage area of the RFID signals are partially supervised so that the wave enlarges as it leaves the antenna. The number of degrees describes the pattern of the signals getting covered while it also depicts the lowered strength of the antennas. The Passive Tags makes use of the induced coils energy for its operation.

This induced Alternating Current (AC) voltage is rectified to provide a voltage source for the device. As the Direct Current (DC) voltage reaches a certain level, the device starts operating. RF signals are used to provide a source of energy to a reader that could interact with a remotely placed device and had no power source such as a battery (being provided

externally). According to the various functions of the RFID systems, they have been distributed into two classes: the tag antenna and the reader antenna.

C. Microchip

The microchip also called as a chip is a semiconductor computer module (called as an integrated circuit) is manufactured using materials such as silicon at a very less scale. Microchips are computer hardware systems which are made for logic programming and also for the computer memory (also known as RAM chips). These chips have been included by both memory and logic for special objectives like the bit slicing, gateways, analog-digital and conversion used.

D. RFID Reader

The RFID Reader (Radio Frequency Identification Reader) is a device used to collect information by an RFID tag. RFID is utilized in tracking individual objects. Radio waves are used in sending data from the tag to a reader. When the right RFID software is incorporated, a identification of objects are done using the reader which provides a quicker, more accurate, a reduced overall cost.

IV. ALGORITHM

- Step 1: Start
- Step 2: Initialize system
- Step 3: Allot RFID tag to customer and cart
- Step 4: Add the item attached with RFID tag into smart cart
- Step 5: RFID reader interprets the information of tag
- Step 6: Reader send the data to the micro-controller
- Step 7: Micro-controller evaluates the program
- Step 8: Total cost is displayed on a Liquid Crystal Display (LCD)
- Step 9: Micro-controller sends the total amount in the billing system
- Step 10: Billing Server prints the bill
- Step 11: Stop

V. PROPOSED SYSTEM & Results

The smart shopping cart is conceptualized keeping in mind the interest, comfort and satisfaction of the customers. The smart shopping cart mainly helps in reducing the burden on the customers while shopping in a supermarket. The system engages as soon as customers enter the super market. Firstly, they have to register with the system and immediately a Radio Frequency Identification card is allotted to them. Similarly, a mirroring RFID sensor is attached to a shopping cart which will follow the customer throughout the shopping period. Once the cart is handed over to shopper, the message "Wish you a happy shopping experience" is displayed along with the customer's name on the Liquid Crystal Display (LCD) screen, such as a tablet, attached to the smart cart. If the customer is a regular shopper at the supermarket, their previous balance and their last purchase history are displayed on the LCD screen. Depending on their purchase history products are suggested to the customer. This RFID based smart cloud cart system [7] is used by the customers.



If a new customer or a regular customer has his or her own shopping list then the OCR (Optical Character Recognition) or ICR (Intelligent Character Recognition) software installed in the tablet will scan the 'to-buy' list of the customer. If the

software fails at reading the products of the list accurately, then the customer can manually select products in the tablet.

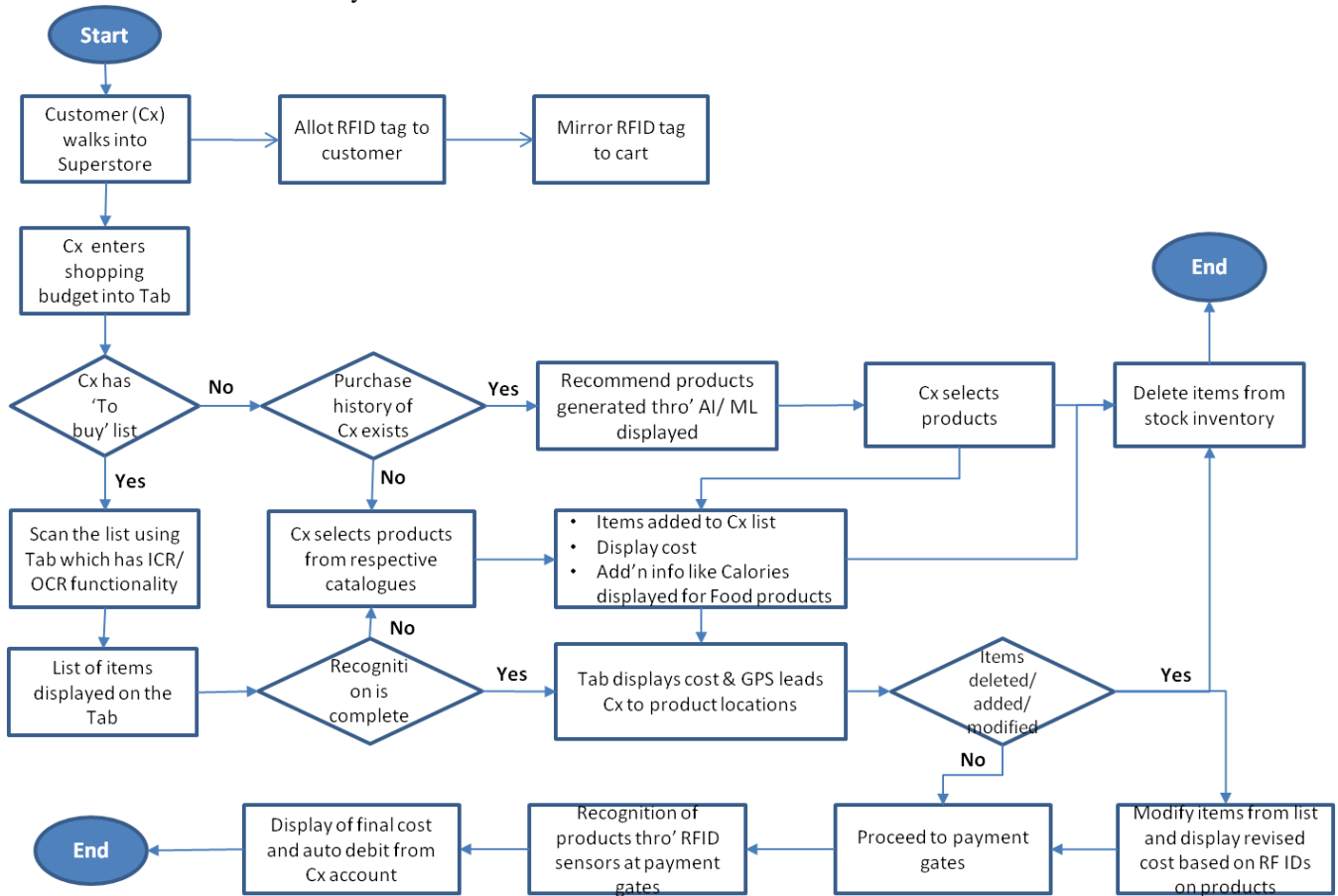


Fig. 1: Architecture of Smart cart using RFID

Most supermarkets being huge in size, searching for products is a laborious task and at times some customers are lost in space. Hence, a smart cart with Global Positioning System (GPS) [8] based concept is planned to be installed in the tablet which will lead them to the product if it is available else the message "Sorry, product is currently unavailable" will be displayed on the screen. This helps in saving some precious time of the shoppers. Fig. 1 illustrates the architecture of the entire smart shopping cart and smart shopping process.

The shoppers can also enter their budget as soon as they are allotted their smart carts so they can be intimidated when the total cost of products in their cart exceeds their budget. Thus, the smart cart will not only help the shoppers by organizing their shopping list but will also prevent them from spending excessively.

The smart list system has been proposed along with the smart shopping cart where once the item is picked by the customer it gets scanned by the RFID scanner and all the details of the product will be displayed on the LCD screen [9]. Additionally, the smart cart would also display the calorie count for each item (if the item is an edible one) being placed in the cart, as nowadays people have become more conscious of their health and look for healthier options to consume. This would help the customers to keep a check on their shopping items and deter indiscriminate purchase of junk and unhealthy food. The final quantity and cost of the item is displayed as soon as an item gets added to the basket

along with the total cost of items purchased. If any item is to be removed from the cart or number of items is modified then total cost of the products will also be modified accordingly and the shopping process will continue until customers are done with buying goods.

Each product in the supermarket will have RFID tags on it. This will help in scanning the products at the exit gate which has RFID sensors. Billing of products is also done at the exit gate. As a customer passes through the gate with his/her products in the cart, all the products are scanned and the total amount is displayed in the tablet. The customer can now pay the bill using his/ her choice of payment method or the IoT (Internet of Things) based smart billing system [10] will in fact make the customer need not resort to any manual or card payment after shopping because, the same would be debited from the bank account to which the RFID tag is linked. After payment the customer can sign off from his/ her account.

Thus, this new technology cart system [11] completely enhances the practice of queuing for billing as well as payments thus saving valuable and scarce time of customers for effective and better utilization in more important activities and human bonding.

VI. CONCLUSION

In today's life of hustle and bustle, customers are balancing various chores simultaneously and running against time endlessly. Due to the problems of choices, every individual would love to spend long hours on shopping, which is hard pressed. But, compromisation can't be achieved on higher standards of living which are increasing day to day and need to be readily available also easily affordable. In fact, every human expects a stylish experience while shopping and shops for the ease of living, hence wishes to relax while shopping without the hassle of searching for the products, carrying them and pushing the cart. Thus, the proposed smart shopping cart system aims at making the daily shopping experience of a customer an enjoyable and convenient one by providing a completely intelligent and personalized assistant that can assist the shoppers throughout their shopping period.

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