RFID Enabled Smart Billing System

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Abstract

RFID generally encompasses any wireless (or partially wireless) communication that allows for remote retrieval of information associated with a particular commodity, product, component, or other item. This project put forwards a unique solution to reduce the average time a customer spends at a supermarket. The product with the appropriate tag is read by the reader on the cart and the product’s details are displayed on the LCD screen placed on the trolley. As the customer puts each product in the trolley, it gets detected. The information of these products along with the bill amount are displayed on the LCD display. The bill amount is sent from the trolley to the server (database) via ZIGBEE which is a short range wireless communication.

Keywords: RFID, ZIGBEE

1. Introduction

A study, the ever-necessary shopping in our daily life can be quiet tedious and time consuming especially in big supermarkets which hosts hundreds of customers daily. The shopping cart enabled by RFID (Radio Frequency Identification) technology serves as a simple yet strong alternative to this problem which eliminates the long queue and the cumbersome processes at the billing section. This project relies on RFID devices which are placed in the products as well as the shopping carts. These devices scan, stores and transmit the details in the product tags using a reliable wireless communication called Zigbee to the server present at the billing counter. The project is implemented in real-time.

Another objective of the project is to enable the customers to view the product details like MFD, expiry date, total amount and the quantity. With the help of the innovative RFID-supported display on the cart, the customer can directly pay the total amount which she/he is already aware of, thus reducing the average time spent by a customer in shopping markets. There is a lot of manual operation involved in the existing system. The existing system specializes more in tracking and identifying the shopping cart as they move, which might be useful for the shop’s management but not for the customer. It also does nothing with regard to reducing the average time the customer spends in the market and also does not reduce the billing time in anyway.

All the additional storage of tracking the customer’s path in the market along with his time taken add unnecessary storage in the system with equivalently complex search algorithm.

Meanwhile the proposed system is characterized by Automatic control; Easiness to identify the Manufacturing and Expiry dates. Total Bill can be estimated and displayed beforehand, therefore reducing the overall shopping time.

2. Related Works

The literature¹ provides Radio-Frequency Identification (RFID) smart shelf that accurately locates tagged objects using standard passive UHF RFID tags. In order to achieve accurate location sensing of objects sitting on the shelf, we utilize a novel localization algorithm that utilizes detected changes in a tag’s readability to infer the presence of neighboring tags.

The drawbacks of this method are that it can be used efficiently only in the place of the systems which uses KNN algorithm. Also the capacity of this proposed system...
is less. When the area and the number of objects involved increases, it results in more complex LDTI algorithm.

The\(^2\) emphasises the increase in reliability of the RFID tags. This can be done by measuring the flex reliability of the tags. A gold film is sputtered on the RFID flip chip to form a conductive layer, making the inlay strap becomes a conductor, and thus the contact resistance variety of ACA bonding joint can be detected.

The drawbacks of this method are that it is not cost efficient and becomes impractical to perform it on a large scale.

The literature\(^3\) provides an automatic embedded software generation framework that can create and evolve Zigbee applications is proposed. The framework consists of two major modules, pattern extraction and code generation. A smart shopping cart application has been implemented using this pattern based software framework. The current location of a shopping cart has been monitored constantly by the WSN network.

The drawbacks of this method are that all the information has to be pre-defined in the system and since the whole system is automated, even a small error will cause backlog of the whole system.

Another related work appears in\(^4\) such that given an identifier for a real-world object, e.g., an Electronic Product Code (EPC) stored on an RFID tag, they return a list of Internet addresses of services that offer additional information about the object. Since a client's information interests in the EPC global Network can be used to create inventory lists and profiles of his physical surroundings, as well as be used for business intelligence on the flow of goods in corporate applications, protecting client privacy becomes crucial. For this SHARDIS is used.

The literature\(^5\) supports the existing system\(^1\) describes the process of designing and developing an electronic system which helps in visualizing the shopping process rather than directly helping the customers. The current system monitors the route taken by the customers using the RFID (Radio Frequency Identification) technology.

This technology is used to identify the routes taken by the customers and their shopping carts as they move around the supermarket. Each supermarket shopping cart has a RFID reader composed of Fly port module, a Wi-Fi module and a micro-controller. The RFID tags kept across the supermarket serve as points of reference which aids in finding the required trajectory. The RFID reader continuously detects the RFID tags.

The received information on the reader is converted to equivalent 4-bit ASCII code. This conversion is done by the micro-controller present in the Fly-port. This data is temporarily stored, after which it is wirelessly transmitted to the central computer using both TCP socket and wireless connections. The computers use this information to generate the path required which is processed, stored and displayed on the screen. It also makes note of the time each customer take. With all these information, the shop's manager can develop strategies for the improvement of the supermarket\(^2\).

3. Problem Statement and Propose

3.1 Problem Statement
There is a lot of manual operation involved in the existing system. The existing system specializes more in tracking and identifying the shopping cart as they move, which might be useful for the shop's management but not for the customer. It also does nothing with regard to reducing the average time the customer spends in the market and also does not reduce the billing time in anyway. All the additional storage of, tracking the customer's path in the market along with his time taken add unnecessary storage in the system with equivalently complex search algorithm.

3.2 Proposed System
The proposed system encompasses an innovative alternative to reduce the average time spent by a customer in a supermarket.

Each customer is given a card containing the credit which can be used by the customer while shopping. The default total amount registered is Rs. 900/-. As each item is placed in the trolley, the respective amount is reduced from the total credit. For an illustration, consider from the total of Rs.900/-, Rs.120/- will be reduced when a talcum powder is placed in the trolley. Thus the remaining amount is the card presently is Rs.880/-. Further items and their corresponding total is reduced from this Rs.880/-. Eventually, after the customer has finished his/her shopping, it is sufficient enough for the customer to verbally tell their trolley number at the counter (billing section). And the bill is generated quickly and given to the corresponding customer. This ends the shopping process here.
It is important to note that all the data about each customer’s items and their corresponding amount is stored in the shop’s database simultaneously as the customers shop in the market.

4. System Design

4.1 User Section
Each and every customer is a user. User is allowed to select the trolley in which they add the products of their choice, whose details are displayed on the LCD display unit on the trolley. The details of the products are simultaneously stored to the database using zigbee\(^3\)\(^4\).

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4.2 Product Section
Each and every Product has its own unique RFID tag. The details of each product such as the price, manufacturing date, and expiration date are encoded to this tag using 8421 binary code. These tags help in identification of every product when kept inside the trolley\(^6\)\(^7\).

The RFID tags contain the above present information in the form of 8421 code. This code is read by the RFID transmitter present in the trolley itself. An encoder is also present here, which converts the digital information into analog signal. This conversion takes places so that transmission of the signal containing the product information can be sent while the product is placed in the trolley. As we can see, tags play an important role in the process and thus as a safety measure, the project inculcates a measure to send a message when the tags gets misplaced or gets removed under any situation. This is covered under module 5 and 6\(^8\).

![Figure 1. System architecture.](image1)

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![Figure 2. Product section.](image2)
4.3 Trolley Section
The trolley module consists of all the components present in the trolley, which does the function of getting the information from the RFID tag and then subsequently sending it to the billing section. Thus this section has a two-way function of both receiving and sending the data appropriately. The trolley module consists of two parts—Display unit and the transceiver unit. The information from the tag is sent to the transceiver. The information in the tag is present in the digital format. Thus a conversion is required in order to transmit it. Thus the digital data in each tag is level converted to analog using MAX 232 IC.

![Trolley section diagram]

Figure 3. Trolley section.

The receiver present in the transceiver decodes the signal back to digital, which is fetched by the LCD display unit to exhibit the details about the respective products. This details can be any random details of the product like its price on the current date, quantity of the product. Its manufacture date, expiry date. A battery supply too is attached to it. The display is done using a micro controller, using c code. The digital information is again converted to analog, which is sent to the Zigbee present in the trolley. The contained information is sent to the billing section.

4.4 Billing Section
The billing section is again composed of all the components present in the billing section. It is composed of Zigbee and a server system. The received analog signal is decoded back to digital which is sent to the system's database. It consists of information about all the trolleys and the products. The attributes present in the databases include product ID, issued by the market, code, used by the database to match the product and recognize it. Particulars, regarding the name of the product. The quantity of the product, and finally the rate and amount of product. This reduces the average time spent by the customer in the supermarket as they can proceed with the billing by saying their respective trolley number at the counter.

![Billing section diagram]

Figure 4. Billing section.

4.5 Missing Section
The problem of products missing from the shelf is a major one in the grocery retail sector, as it leads to lost sales and decreased consumer loyalty. Yet, the possibilities for detecting and measuring an out-of-shelf situation are limited, mainly conducted via a physical shelf check. The existence of an automatic method for detecting the products that are not on the shelf based on sales data would thus be valuable, offering an accurate view of the shelf availability both to retailer and the product suppliers. Suppose the tag gets detached from the product, the signal gets lost, indicating the missing product and sends a precautionary SMS.

4.6 SMS Alert Section
As mentioned above, when a tag gets displaced, it is imperative that the shop’s management should be aware of it. For this, an Alerting SMS is sent to the respective people concerning the missing tag. Consequently, the product is identified and the tag is replaced. The mobile numbers of the managers and the respective authorities are present in the database, which is updated regularly. This is only a precautionary module, but an integral part as RFID tags are of prime importance containing all the details.
5. Implementation

5.1 LCD Display Initialization
Input: Details of each product that need to be displayed on the screen.
Output: The product name, cost, manufacture and expiry date are displayed on the screen.
Process: It fetches the information from the RFID tags and then it displays into LCD display using RFID TRANSCEIVER.

5.2 First Line Display
Input: Command line Declaration - 0xC0
Output: It makes Display On, Cursor Off.
Process: This is used to display the first line of the display. It has a for loop that ensures all the characters are displayed (i.e) until zero.

5.3 Second Line Display
Input: Command line Declaration - 0x94
Output: It makes Display On, and sets the cursor to the position of the second line.
Process: This is used to display the second line of the display (cost). It has a for loop that ensures all the characters are displayed (i.e) until zero.

5.4 Third Line Display
Input: Command line Declaration - 0xD4
Output: It makes Display On, and sets the cursor to the position of the third line.
Process: This is used to display the third line of the display (date of a product). It has a for loop that ensures all the characters are displayed (i.e) until zero.

6. Conclusion and Future Work

6.1 Conclusion
The paper is characterized by Automatic control; Easiness to identify the Manufacturing and Expiry dates. Total Bill can be estimated and displayed beforehand, therefore reducing the overall shopping time. This paper demonstrates the importance of RFID and how well it can suit our daily day-to-day life and make it relatively less burdensome.

6.2 Future Work
Future work encompasses a swiping card facility at the trolley. The card may be any credit or debit card of the respective customer. After the bill amount has been displayed on the trolley, the customer can directly swipe the card containing the credit, which is sent directly to the shop's account. Thus there is absolutely no need of the queue and the average time spent by the customer gets reduced to a great extent. Other technologies may as well be incorporated into this domain to take shopping into another dimension where real time shopping becomes as painless as virtual, online shopping.

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