The RFID Based Smart Shopping Cart

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Abstract—Ever since the debut of wireless technology, electronic commerce has developed to such an extent to provide convenience, comfort and efficiency in day-to-day life. In this paper, we discuss a ground-breaking concept of RFID based smart shopping cart in the field of retail merchandise. Our whole shopping experience is often marred by the long checkout lines. Soon we can end this problem by replacing the ubiquitous Universal Product Code (UPC) bar code by smart labels, known as radio frequency identification (RFID) tag. The key idea here is to provide assistance in everyday shopping in terms of reduction in time spent, eliminating the daily hassle of locating the right product and standing in long lines. The primary goal is to provide a technology oriented, reduced cost, time saving, hassle free, commercially oriented system for an enhanced shopping experience.

.**Keywords**— RFID (radio frequency identification), ZigBee, universal product code(UPC)

. introduction:

   With the growing economy, urbanization, industrial growth in recent years, there has been a significant change in the global market. With the grocery sector playing an important part in the worldwide economy, it has become one of the most convenient and diverse business across the globe. The emergence of RFID makes the traditional retail process faster, transparent and efficient. With the proposed system, soon, when the UPC codes would be replaced by RFID tags these tags would communicate with an electronic reader (through an infrared sensor) that will detect every item in the cart and this reader would be connected to a large network that will send information of the products to the retailer and product manufacturers (through ZigBee). The bank will be notified and the amount of the bill would be deducted from one's account.no lines. No waiting. This smart shopping cart secures mobility of consumers and accelerates their purchasing thereby enhancing their shopping experience along with making the inventory control easier for the store management.

A comparison between the existing system and our proposed system is as shown below:

| EXISTING SYSTEM	PROPOSED SYSTEM
Person is required to read barcode on product.	Automatic reading of RFID tag from product.
Barcode must be visible on the surface of product.	RFID can be placed inside the product
Line of sight required to a read barcode.	No line of sight required to read RFID.
The readability of barcodes can be impaired by dirt, moisture, abrasion, or packaging contours	RFID tags are not affected by such conditions.
Short reading distance.	Long reading distance.
Barcode does not have READ & WRITE capability	RFID tag having READ & WRITE capability.

SYSTEM ARCHITECTURE:

The architectural implementation of the system and the main end of the system is to allow the consumer a new enhanced way of shopping. The normal shopping experience till date, after the invent of various supermarkets is: 1] enter the store 2] take a trolley and push it around the entire store in search of the products needed 3] load them into the trolley 4] stand in queue 5] pay the bill 6] exit from store. From the proposed model, the usage of RFID comprehends benefits such as consequent reduction in product cost, reduced human intervention and labour cost, availability of accessing the real time information about the diverse products inside the shopping cart. The necessary requirements for the proposed system are:

FREQUENCY	MODE	RANGE	TRANSFER RANGE	PENETRATING CAPABILITY
125-135 kHz	Passive	Short range (up to 0.5m)	low	Liquid
13.56 MHz	Passive	Medium range (up to 1.5m)	Moderate	Liquid
860-930 MHz	Passive	Medium range(up to 5m)	Moderate to high	Liquid and metal
433 MHz	Active	Ultra long range (up to 100m)	High	Liquid and metal
2.45 GHz	Active	Long range (up to 10m)	Very high	Liquid and metal

WORKING OF RFID TECHNOLOGY:
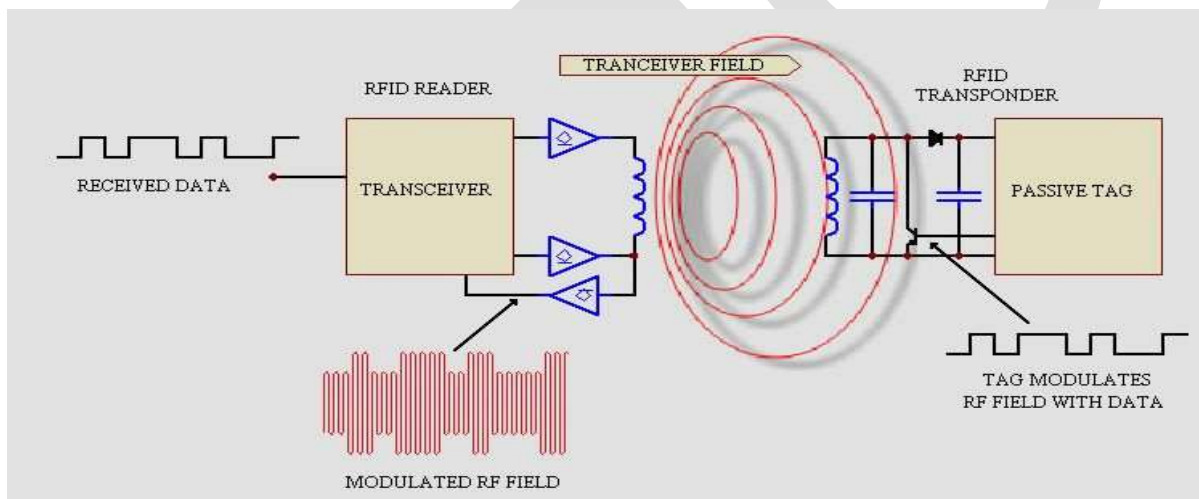
Every RFID system the transponder Tags contain information
Information can be as little as a single binary bit, or large array of bits like an identity code, personal medical information, or literally any type of information that can be stored in digital binary format
Reader generates RF carrier sine waves
Once tag receives sufficient energy, Tags output transistor shunts the coil corresponding to the data being clocked out of memory array
Reader performed digital data encoding.

Block Diagram:
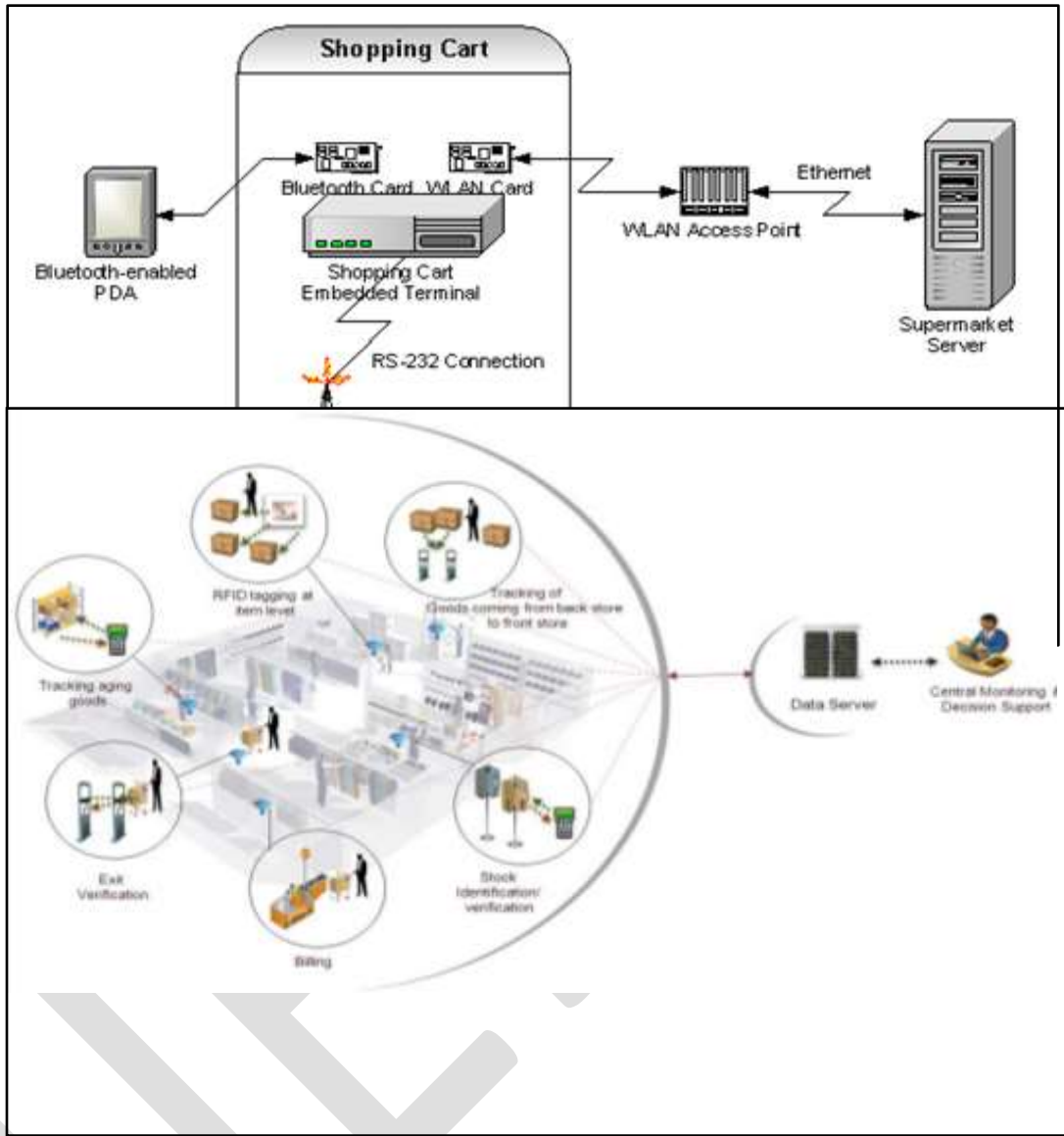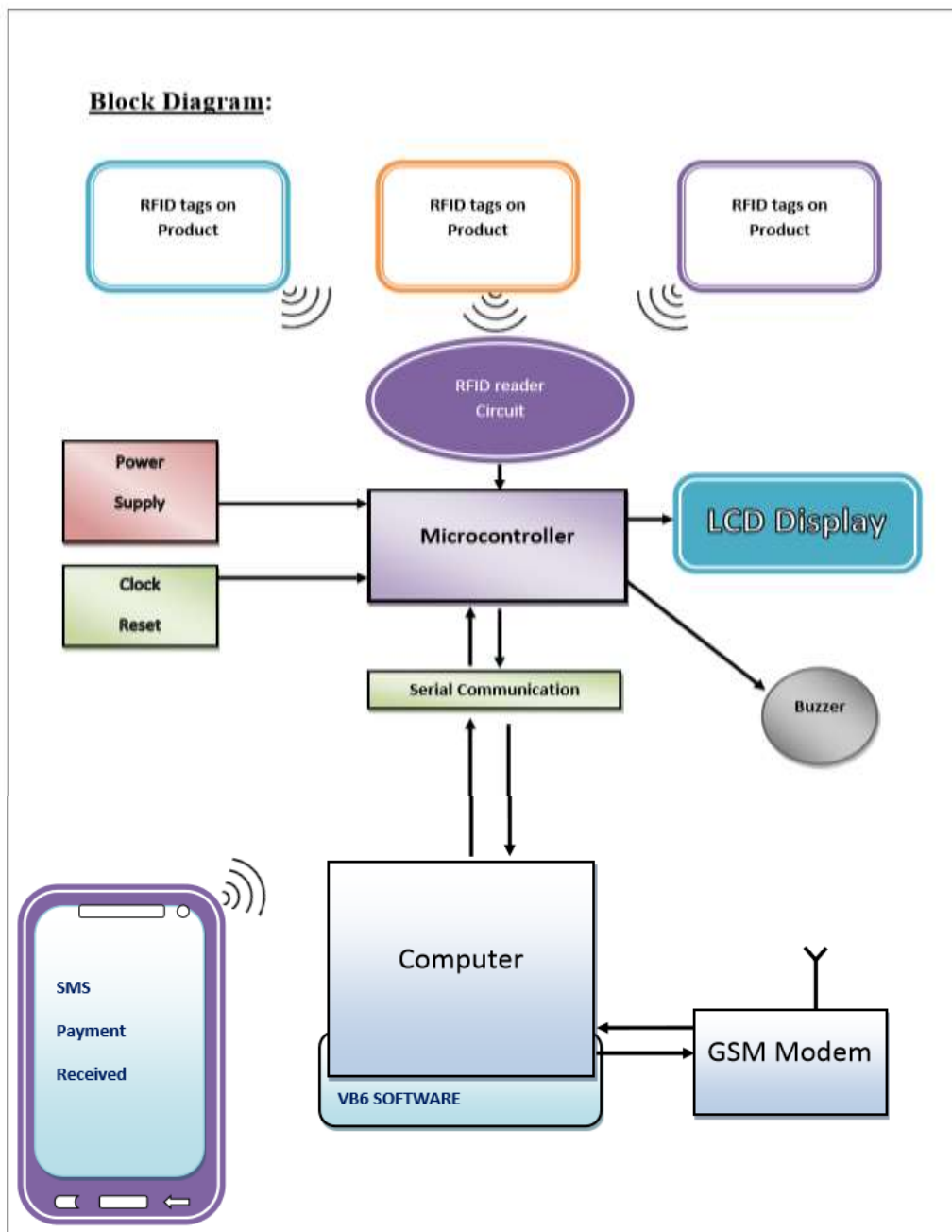
WORKING OF SMART SHOPPING CART:

When a customer with the cart enters a shopping aisle, the cart is brought in range of the IR Receiver and the microcontroller checks for the aisle information code. The aisle information code is transmitted over the ZigBee wireless from the cart to the server. Based on the aisle number received the database is queried and relevant information is retrieved and transmitted to the cart via the ZigBee module. The received information is stored in the EEPROM present on the cart. This serves as a temporary database until the customer

exits the particular aisle that he/she is in. The relevant products information is displayed on the display unit. Every product has an RFID tag which contains a Unique ID. These ID's are fed in the database assigned to the corresponding products.

If there needs to be a purchase done, then that product can be dropped in the cart where the RFID reader reads the tag. The information of the product is extracted and displayed on the LCD screen. At the same time billing information is also updated. Upon exit of the aisle, the aisle info is sent to the server along with details of purchase. Server then stores them in the database. These steps are repeated until the end of shopping button is pressed. Once the "Complete" button is pressed there is an option provided to end the shopping with the same products or to delete some of the products from the cart. This goes by the customer choice. At the end of shopping, the customer can straight away pay the bill and leave. Inventory status of the products is also updated at the end of shopping.

PROBLEM FORMULATION:

Once the consumer gets his desired product from the shelf in the retail store and puts it into the cart, the RFID reader reads the tag on the product and the product information is displayed on the LCD screen. Side by side, the billing information is also updated. The working of the smart shopping cart can be explained in the following steps:

1) When shoppers with the cart press "start button" the system turns ON and then all the components such as RFID reader, microcontroller and ZigBee start working.

2) Every product has an RFID tag which contains a unique id. They are fed in the database assigned to the corresponding products.

3) When the shopper puts any product in the cart then the tag is read by the RFID reader. The information of the product is extracted and displayed on the LCD screen. Also side by side, the billing information is also updated.

4) These steps are repeated until the end of shopping button is pressed. Once the "End Shopping" button is pressed the total bill is send to master pc via Wi-Fi (ZigBee).

5) There is also an option provided to delete some of the products from the cart and the bill will be updated accordingly, this goes by the customer choice.

6) At the end of shopping, the customer can straight away pay the bill and leave.

7) Inventory status of the products is also updated at the end of shopping.

A simplified explanation is provided through the following flowchart:
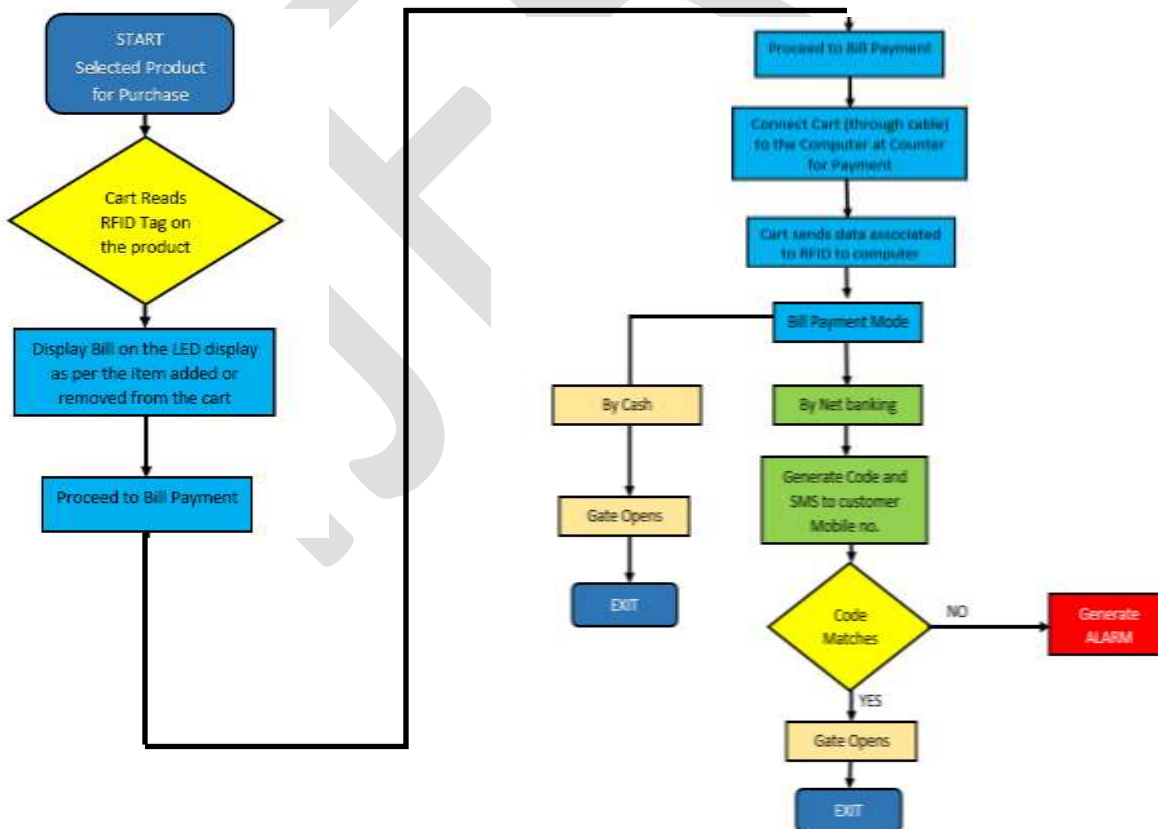
PROJECT SIMULATION:

The following test case scenarios were used in the integrated system testing to prove the working of the developed system.

a) Shopping cart and server communication using the wireless ZigBee module

b) Identifying items based on RFID tags and synchronizing with central database.

c) Automatic billing

d) Display the product name & price.

e) Complete listings of the products along with their price on LCD display.

f) Update inventory in the central system upon each purchase of a product.

g) Automatic billing update when the products are dropped in the cart or removed from the cart.

h) Display of total bill on the master pc. All test cases were successfully tested. The system developed is user friendly and no special training is required to use the cart.

CONCLUSION:

The intended objectives were successfully achieved in the prototype model developed. The developed model has easy access, is economical and showcases an intelligent and easy shopping experience to reduce time, energy of the consumers. There are a few challenges/drawbacks to be resolved to make the proposed system more robust, but there is also no doubt that with the RFID having a wide scope in supply chain management, the proposed model has the potential to improve and ease the basic retail experience to a great extent.

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