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Iot Based Intelligent Trolley for Shopping Malls

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Abstract **-The project is based on the development of a project with the aim to reduce the time spent in the store and to make shopping of day to day items an experience instead of a headache. This cart uses modern and cheap technology like RFID and minicomputers to make it intelligent and timesaving. It helps the consumers to utilize the time saved in other fruitful activities instead of wasting their time by standing in long queues at the checkout counter.**

Keywords **– RFID, Arduino, shopping carts, timesaving, IOT.**

I. INTRODUCTION

The past few years have witnessed an explosion of interest in RFID and supporting technologies primarily due to their rapidly expanding use to track products through the grocery supply chain. We see these days RFID's are widespread and taking role in many advanced projects due to its fast and effective response. RFID are tags that are used for unique identification of products by using radio waves. These RFID's offer more advantages over conventional Barcodes as they have a major drawback which is Line of sight technology and these barcode tags have constraints in its durability whereas the RFID's tags are more durable and able to read/write data which could even be encrypted. These tags could hold plenty of data like products name, price, size, weight and other information using their identification number. By implementing this RFID technology for unique representation of each product in a market shopping is done more easily [1].

Such applications monitor Store-Keeping Units (SKU) rather than individual product items since item-level tagging was not yet practical due to the relatively excessive cost of RFID deployment and the very low-profit margin of supermarket products. But decreasing economic and other technical concerns to a substantial extent, one can easily envision a situation where each item in a supermarket is tagged with an RFID label, shopping carts feature RFID readers and potentially onboard computers that recognize products put in the cart, and display information and promotions retrieved wirelessly/wired from the system back-end. Item-level deployment of RFID technology would also allow for quick checkout aisles that scan all products at once and thus eliminate queues, which are consistently reported as one of the most negative aspects of supermarket shopping. A simple extension of this system would be to use RFID embedded in consumers' loyalty cards to identify individuals. In metro cities purchasing and shopping at super shops, big malls is a daily activity. We have seen big lines for payment of the bill at malls on holidays and weekends. When there are exclusive offers and discount the rush is also even more. Customers will purchase many items and put it into the trolley. After customers done the purchase, they need to go to billing counter for payment. At the billing counter, the customer will prepare the bill using bar code reader which is a time-consuming process and will create the long queues at billing counters. All the products in the shop are attached with RFID tags.

When a customer put any products in the trolley, its unique code will be detected, and the price of those products will be get stored in memory. As we put the products on the trolley then costs will automatically get added to total bill. Thus, the billing will be done in the trolley itself. Total bill information will be transferred to PC by wireless Transmitter and receiver modules at the billing counter. When the customer purchases a product, she/he first scans the RFID tag of the product using the RFID reader and then put it into the trolley. While purchasing the products customer needs to scan the RFID tag of the product, a price of the product is taken and stored in the system's memory.

II.LITERATURE SURVEY

The proposed system "IOT based intelligent trolley for shopping malls" uses main components which are; RFID cards and readers, Arduino UNO kit, and IOT.Today's world thrives making human life easier than it already is with every passing moment. Creating a smart cart that takes care of comfort while shopping is another step taken in the same direction. Product acquisition in large grocery stores with wide range of products is a tedious and time-consuming process. The smart shopping cart explores the minicomputers and automatic identification technology. Instant billing

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without queuing and keeping track of the expenditure is the sole motive of this intelligent cart.

1. TITLE: Smart Shopping Cart with Automatic Billing System through RFID and ZigBee

In this report, they have shown automatic billing of the products. They have used ZigBee and RFID technology for the construction of the module. All trolleys in the mall are attached with the device which contains the RFID reader, Micro-controller, ZigBee. So, each trolley will send the item information to the main billing server for calculating the final bill of purchased items. To send information of each trolley we are using ZigBee. As ZigBee has some advantages over Bluetooth and Wi-Fi. Working is started when customer enters in the mall and take the trolley.

The customer puts the items into trolley, here item is attached with RFID tag, so when customer put the item into trolley the RFID reader reads the data. The data is nothing but the tag number. Then reader send this data to EEPROM through micro-controller. By using ZigBee this data is get send to main server for fetching cost of item. So that the cost of item is displayed on the LCD attached to trolley. If Customer want to remove the item from the trolley, then cost of that item is get subtracted from the total bill during the process. At the last, the bill is get calculated from the main server [2].

All the products in the shop are attached with RFID tags. When a customer put any products in the trolley, its unique code will be detected, and the price of those products will be get stored in memory. As we put the products in the trolley then costs will automatically get added to total bill. Thus, the billing will be done in the trolley itself. Total bill information will be transferred to PC by wireless Transmitter and receiver modules at the billing counter. When the customer purchases a product, she/he first scans the RFID tag of the product using the RFID reader and then put it into the trolley. While purchasing the products customer needs to scan the RFID tag of the product, a price of the product is taken and stored in the system's memory.

2. TITLE: Automated Shopping Trolley for Super Market Billing System

The main objective of this project is to reduce and eliminate time taken in billing counter in supermarkets by designing an Intelligent Shopping Basket which uses Barcode scanners to allow users to self-checkout and increase productivity time. The Automated Shopping cart system integrates a Shopping cart (trolley) with 2 sets of barcode scanners placed at 2 different checkpoints – the entry and exit points respectively. It facilitates the user to self-scan the barcode of the purchased products which he intends to purchase [3]. Wrongful entries can be corrected by making use of a keypad that changes the functionality of the machine from addition of products to removal of products and activates the other barcode scanner at the opposite end. A wireless smart-device makes note of all the scanned commodities of the trolley (with allotment number); and is linked with the Supermarket's backend database which contains details of the products such as Cost Price, Available Stock.

The scanned products are automatically billed in the wireless smart device for their purchases, thereby significantly reducing turnaround time and reducing and transmitted to the Shop's central Billing program. By this mechanism, the time-consuming work of scanning and billing every specific product at the cash counter can be avoided. Users can then make use of the counter to pack and pay labor time which has become a real problem in the modern era. The tray in which the two barcode scanners are embedded is fitted with a lock and keys for which are with the people at the billing section. This allows users to take out all their products and place them into carry bags during the checkout process.

The proposed system in this project uses RFID system instead of using barcode scanner which are expensive and way too much space consuming. RFID card and readers don't take up much space and plus they are cheap. This project also eliminates the use of keyboard instead a switch is used to remove the extra products.

3. TITLE: Smart Trolley using Smart Phone and Arduino

In this system, RFID tag is attached to the membership card of the customer which is provided by the supermarket to their regular customers. RFID Reader is attached to shopping trolley or shopping basket which detects the presence of the regular customer and with this, shopping trolley will act as a Smart Trolley. The regular customer requires downloading a mobile application and then the smartphone act as a barcode scanner. With the help of barcode scanner, the barcode is generated which is send to Arduino through Bluetooth Module.

Arduino interfaces with the Memory Unit where all the description about the product and its price is stored. Barcode ID is compared with the information in the memory unit and the result will display on the LCD which is attached to the shopping trolley or shopping basket. Once the user is done with his/her shopping and near to billing counter, user press the button on the trolley and data which is displays on the LCD would transfer to the computer. This is done by using NRF24L01 which is a serial peripheral interface and with this data will be transfer from the trolley to the computer at the billing counter. So, this system saves

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the time and effort of the customer and mall staff. This smart system works only for those customers which having a membership card in which RFID is attached to it. Otherwise, it will act as a normal trolley. Supermarkets or Hypermarkets use this approach as their business strategy to increase the customers [6].
In our system we have can use the membership idea as future scope. Instead, here we attach every product with the RFID tag and the RFID tag contains the unique ID and the product details such as the product name and the price. These details will be displayed on the LCD display.

III.SYSTEM REQUIREMENTS

1. Functional Requirements

- The system must display the bill on the LCD screen.
- The RFID card should be detected by the RFID reader.
- The data collected should be passed on to the admin PC.

2. Hardware Requirements

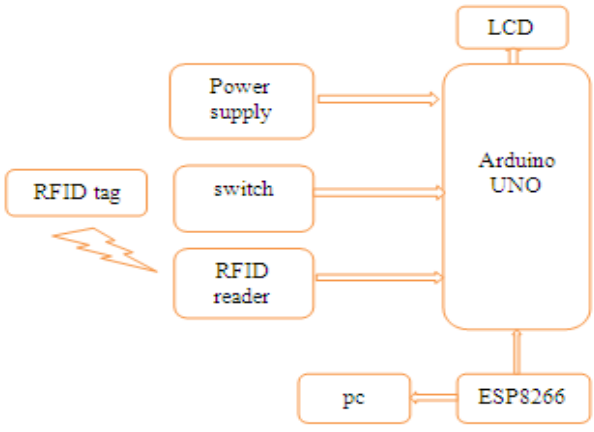
- Arduino UNO
- RFID Reader
- RFID Tags
- ESP8266 WIFI module
- Adapter (power supply)
- LCD Display
- Switch
- Jumpers wires

3.Software Requirements

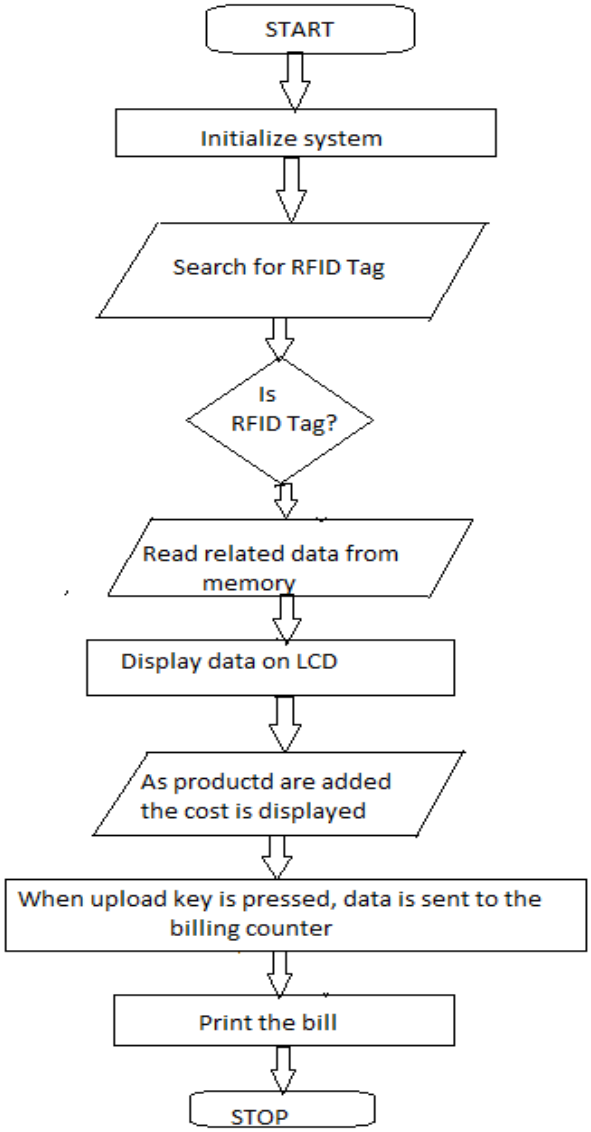
- ASP.net
- C sharp
- Visual Studio 2013
- SQL server management system
- Arduino IDE

IV.PROJECT DESIGN

1.Block Diagram



2. Flowchart



3. Working / Algorithm

Step1: start
Step2: initialize the system
Step 3: search for RFID
Step 4: check the RFID tag
Step5: read related data from memory
Step 6: display data on LCD
Step 7: Add item cost as items are added
Step 8: when upload key is pressed send data to the counter
Step 9: print bill
Step 10: stop

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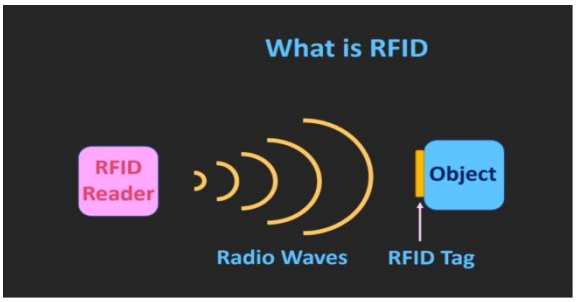
II. IMPLEMENTATION DESIGN

1. Module & Description

1.1 RFID Technology- RFID is also known as radio frequency identification; it is a technology which is working on a radio frequency of radio waves. So, this technology is used to automatically identifying the objects or tracking the objects. The object could be anything like it could be the books in the library or it could be any item you are purchasing from the shopping mall or it could be the inventory in the warehouse or maybe it could be your own car. Not only the objects but it can be used for tracking the animals as well as the birds.

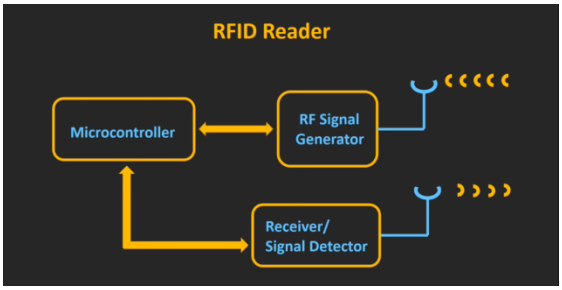
In RFID Technology the RFID tag is used to get attached to the object which we want to track, the RFID reader continuously sends radio waves so whenever the object is in the range of the reader then this RFID tag is used to transmit its feedback signal to the reader. It is very similar to the technology which is used in a barcode but in case of the barcode, the object and the scanner need to be in the line of sight position whereas the RFID technology is not a line of sight technology [7]. As far as the object is within the range of the reader it can be identified by the RFID reader and it is able to send the feedback signal back to the reader, therefore using this technology we can track multiple objects at the same time which cannot be done by barcode technology.

The RFID system contains two components:RFID Reader and RFID Tag. RFID Tag can also be obtained in many ways which area active tag,passive tag or a semi-passive tag.Passive tags do not have their own power supply so they rely on the radio waves coming from the RFID reader for the source of energy. While in the case of semi-passive tag they have their own power supply but for sending back the feedback signal they rely on the signal coming from the RFID reader. While in case of the active tag also have their own power supply but use the radio waves coming from the reader to send back the feedback signal. Therefore since passive tags do not have their own power supply their range is less than others.



RFID Components

RFID READER:RFID reader comes in many shapes and sizes. It can be a handheld reader or it can be as large as the size of the door which we normally see inside the shopping malls. The RFID reader mainly consists of three components;RF Signal Generator, this signal generator generates radio wave which is transmitted are transmitted using the antenna, also to receive the feedback signal which is coming from the tag it also contains a receiver of the signal detector. To process the information which is being sent by the RFID tag, the RFID reader has the microcontroller and many times the RFID reader is directly connected to the computer.



RFID Reader

RFID TAG:RFID tag used today are passive tags because they are quite cheaper compared to the active tags, as well as they do not require any power source that's why they are quite compact. Even this passive tags come in many forms it can be in the size of a keychain or it could be the size of a credit card or maybe it could be in the form of a label. The RFID tags contain many different components; Transponder which receives the radio waves coming from the reader and sends the feedback signal back to the reader. As the passive tags do not have their own supply so they rely on the radio waves coming from the reader, so they used to get the energy coming from the radio waves which are coming from the reader. Using the rectifier circuit that is coming from the radio waves is stored across the capacitor and this energy is used as the supply for the controller as well as the memory element inside the tag.

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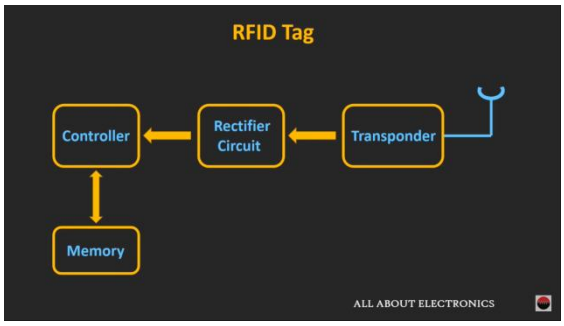


RFID Tag

1.2 ARDUINO- Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Arduino Uno can be powered via the USB connection or with an external power supply [7]. The power source is selected automatically. The power pins are as follows:

1. VIN- The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or another regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

2.5V-This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator and can damage your board. We don't advise it.

3. 3V3- A 3.3-volt supply generated by the onboard regulator. The maximum current draw is 50 mA.

4.GND- Ground pins.It also has 2 KB of SRAM and 1 KB of EEPROM. Each of the 14 digital pins on the Uno can be used as an input or output.

5.Serial- 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

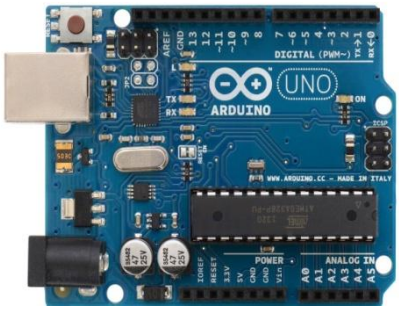
6.External Interrupts-2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.

7.PWM-3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.

8.SPI- 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.

9.LED- 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

10.TWI- A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library. There are a couple of other pins on the board. AREF. The reference voltage for the analog inputs. Used with analogReference(). Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board [9].



3.ESP8266- The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much Wi-Fi-ability as a Wi-Fi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost-effective board with a huge, and ever growing, community.

ESP8266

4. 16*2 LCD DISPLAY-A liquid-crystal display (LCD) is a flat display which is used to display the description of the product. 16*2 means we can display total 16 characters at any instance of time and we have total 2 rows, and, in each row, we can represent 16 characters. We display the product item's name and price on the LCD. The LCD is attached to the trolley.

5. Software Design- Arduino programming can be written in C or C++ programming language for the

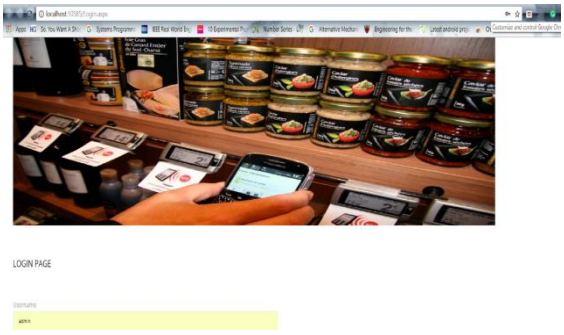
compiler which converts the programming language to binary machine code for the target processor. Minimal Arduino C/ C++ programs consist of two functions: setup function which is used to initialize variables and other libraries needed in the program. We can also initialize the input and output pin modes. After setup function, we have loop function in which function loop is executed in the main program in the repeatedly manner.

6. **Visual StudioMicrosoft Visual Studio** is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs, as well as websites, web apps, web services and mobile apps. Visual Studio uses Microsoft software development platforms such as Window API, Windows Forms, Windows Presentation Foundation, Windows Store and Microsoft Silverlight. It can produce both native code and managed code.

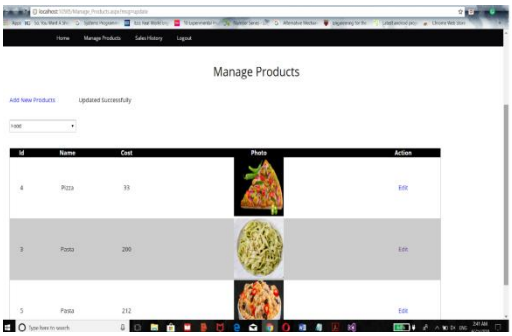
7.Arduino IDE:

Arduino is the world's leading open-source hardware and software ecosystem. Arduino is a popular tool for IoT product development.Arduino consists of physical programmable circuit board and IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

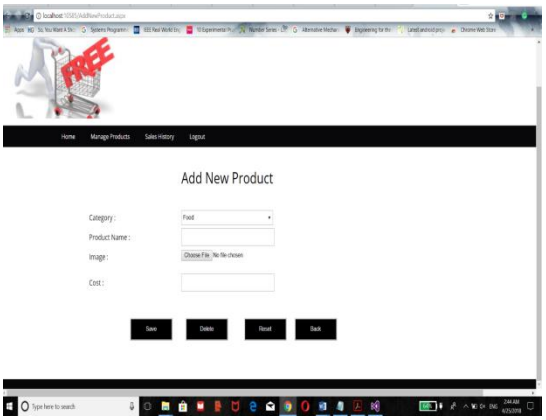
8.Screenshots



screenshot 1: login page for admin website

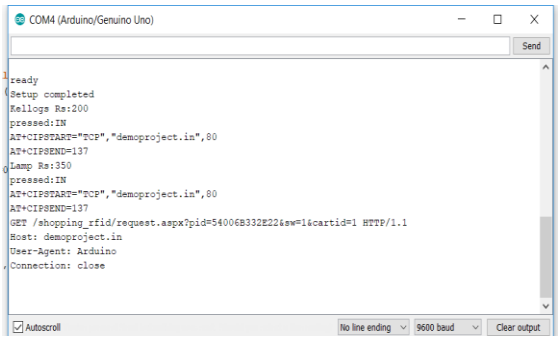


Screenshot 2: manage products page



Screenshot 3: adding new product options.

Screenshot 4: Arduino setup



Screenshot 5: Products scanned

Screenshot 6: LCD display

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Screenshot 7: LCD displaying Bill

Screenshot 7: LCD displaying Bill

4. Testing

Using the RFID cards on the products each will have its own unique ID. Each product has its own price which is stored in the card memory, thus whenever the RFID card is read by the RFID reader the unique ID and the product price is displayed on the LCD screen. The same details are passed to the admin website over the internet.

RFID Tag Id	Product Name	Price
222801	SOAP	Rs 10
257082	RICE	Rs 20
168543	No Name Assigned	Used For Confirmation

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

- Shopping cart and server communication using the ARDUINO module
- Identifying items based on RFID tags and synchronizing with a central database.
- Automatic billing
- Display the product name & price.
- Complete listings of the products along with their price on LCD display.
- Update inventory in the central system upon each purchase of a product.
- Automatic billing update when the products are dropped into the cart or removed from the cart.
- Display of total bill on the pc.

All test cases were successfully tested. The system developed is user-friendly and no special training is required to use the cart.

V.FUTURE SCOPE

The challenges here are to not only make the system intelligent by automation but also to handle the concerns that are raised due to the automation process such as the probability of false alarms, energy consumption, cost-effectiveness, etc.

- The cart can have motor and sensors due to which the cart will not be needing any physical force to move around. This feature can be helpful for elderly people.
- The customer tracks the details of the purchased items as well as the current bill amount on their smart phone as well as on the monitor that is attached to the cart.
- In addition to that, it includes the handling of the following special cases, which ensures that the system is fair in all respects. All the cases mentioned below are detected by the system.
- Attempt to take products by keeping these into the cart without scanning their barcodes.
- When the customer scans a product but forgets to keep it in the cart.
- Attempt to scan one product but place multiple products in the cart.
- Attempt to take away one product of high price by scanning the barcode of another product.
- Consumers change their mind, our implementation allows for removing any product already placed in the cart, without help from anyone.
- The client can also be helped by the navigation system, meaning that they can be guided through the supermarket avoiding time losses that occur when searching for products in unknown locations.

Through the interactive map that shows product location and the shopping cart.s current position, it is then possible to follow the route indicated by the map to reach the desired product. There will be immediate updates on the cart's position any time it is moved by the consumer. To make this possible, a shopping cart positioning technology is required in several Supermarket locations so that the permanent monitoring enables real-time cart position updates. The choice of a positioning technology to our solution is particularly difficult because of the diverse characteristics each technology presents.

VI.CONCLUSION

Experience with Smart Shopping has indicated that there are many technical challenges will be met in deploying a pervasive retail system. Technologies that capture information about interactions between physical products are not yet mature enough for the consumer

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market as they are relatively costly. Even when such data is available the task of interpreting it is often as challenging as its registration since no standardized classification scheme or appropriate taxonomy exists. Several efforts to create standards are underway but are still at least years away.

Although in the relatively controlled environment of the smart shopping trolley project it has been possible to address this problem on a wireless basis it is hard to envision a situation where widely deployed retail services can operate without such standards. A related problem is that new systems must be integrated into existing retail infrastructures, which often operate using legacy and incompatible systems. Moreover, the deployment of retail causes significant growth in electronic transaction loads which current systems are unable to cope with. Like smart shopping should be available on whatever device consumers have at hand. Although considerable advances have been made in this area, developing and maintaining such applications is still a major challenge.

Acknowledgement

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