South Asian Journal of Research in Engineering Science and Technology
Volume 4, Issue **3**, **March 2019**

www.sajrest.com
IXplore SAJREST ⓒ2019 ISSN 2455-9261
pp. **9—20**

BRILLIANT BUGGY USING ARDUINO UNO

D.MUTHULAKSHMI[1], B.AISHWARYA SUMA*A.MENAL*

Assistant professor[1]

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

E.G.S.PILLAY ENGINEERING COLLEGE, NAGAPATTINAM, TAMIL NADU, INDIA

arullakshmi30@gmail.com,aishwaryasuma.97@gmail.com, menalguna98@gmail.com

Abstract:

A supermarket or a hypermarket is a form where wide variety of product items is available. These product items can be food, beverages or any household product. The main purpose of supermarkets is to provide availability of all the products and save the time of the customers but sometimes customer gets frustrated while waiting in the queue at billing counter and sometimes they get confused while comparing the total price of all the products with the budget in the pocket before billing. To overcome these problems, we have designed a smart trolley using Arduino. With this system, there is no need for customer to wait in the queue for the scanning for the product items for billing purpose. In this paper we are using Arduino Uno r3 Board, 16x2lcd display, wireless ZigBee and RF-ID module. When the person wants any item must and should show the item to reader. RF-ID reader will read that number and compares that number in to the internal database and display the amount on to the LCD display. We can continuously add the item in to the trolley. Otherwise if we are not interested any item we can show the same item to the reader. RF-ID reader will detect particular card and erase the money. LCD display will show the amount and item in trolley. Finally we need to press the switch Button. All the Selected items with final cost is display on the receiver computer on HyperTerminal.

Keyword: Central billing system, central database, fid reader module, wireless ZIGBEE module, Arduino UNO

1.1 Introduction

The invention of wireless technology with other communication techniques has been helping us in making electronics domain very popular. A modern futuristic product is the one that provides the comfort, convenience and efficiency in everyday life. Shopping is one of the interesting things and basic need for every human. At present no such embedded system is used in shopping. But this simple task cannot be easily perform because customer has to wait for billing procedure for longtime. Small tags present in the RFID systems are attached to the products. The RFID 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, RFID 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.

. The aim of this paper is to utilize new updated technologies and overcome from the difficulties during shopping in consumer retail shop. Thus we are proposing the smart trolley system by using microcontroller as an updated technology. The System consists of an RFID based trolley which communicates with the billing counter wirelessly through Zigbee Transmitter. Each trolley will consist of a same type of hardware with unique trolley address. The customers will be able to scan the items by their own and the LCD screen on the shopping cart will keep updating the total. The billing counter can at any point of time inquire about the current items present in the trolley. This will turn out to be very beneficial for the retail stores as more people will enjoy the shopping experience and come more often to shop. The system helps the store management section with an automatic update of the inventory on every purchase of a product. The Smart Shopping Cart has the potential to make the shopping experience more comfortable,

pleasurable and efficient for the customer and the inventory control easier for the store management. Thus Item-level deployment of RFID technology allows for quick checkout aisles that scan all products at once and generates total automatically, eliminating different sectional counters and long queues, which are consistently reported as one of the most negative aspects of supermarket shopping

1.2Literature survey:

In a study done by the University of Arkansas, Information Technology Research Institute, it shows the business value as well as benefits of tagging the items with RFID for the daily operations at any major retail store. The study was conducted in the denim category using the RFID tags instead of the barcodes. The study results showed that the inventory accuracy of the store was improved by 27% and the understock products was decreased by 21% as well as decreasing the over stock by 6%. The management also compared the time taken for counting the items both by barcode and RFID technology. The scanning of 10,000 items when done by RFID took 2 hours whereas scanning the same number of items by barcode reader took 53 hours thus resulting a 96% decrease in the item counting time . In the research paper Smart Trolley in Mega Mall by J.S. Awati and S.B. Awati, the use of various optical sensor and a driven motor was proposed with the barcode scanning system. This making the cart even more efficient. The cart with the help of a motor makes motion easier and supports two motions: front and reverse. Also as a safety measure, they proposed the use of an optical sensor in order to prevent any accidents in case the cart motor did not turn off and might hit the customer, thus the optical sensor is useful in maintaining a safe distance between the motor driven cart and the customer. [4]

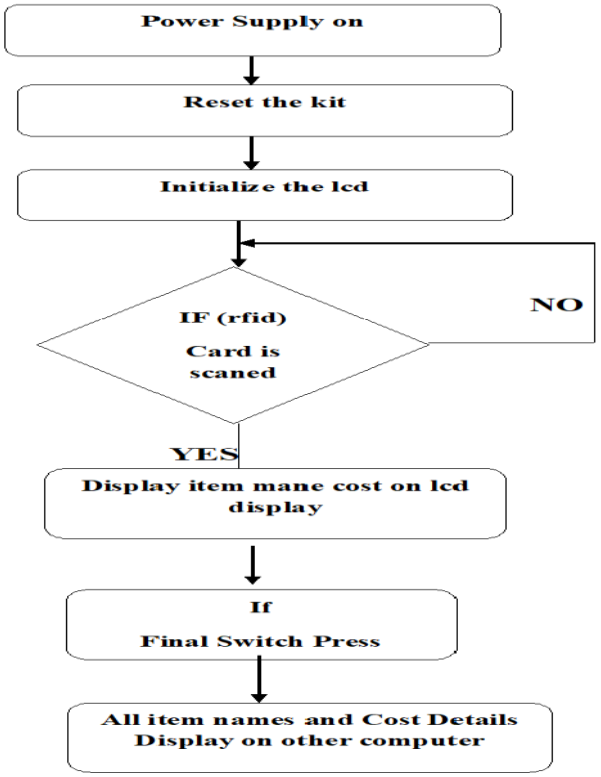
In the research paper RFID Based Automatic Shopping Cart by Ankit Anil Agarwal et al. in 2011, a new way to shop by the implementation of an automatic system is described [2]. As soon as the customer enters the supermarket, he/she is handed a technological system embedded shopping trolley having a display on the handlebar which has a Tanushree et al, International Journal of Computer Science and Mobile Computing, Vol.5 Issue.5, May- 2016, pg. 209-214 touch screen display, client card reader, product reader and a position transmitter. All the information from these components is displayed on the touchscreen display with which the customer can interact.

In the present paper we aim to develop a system that uses RFID item scanning and a wireless transmission of the details of items scanned to the checkout counter and using this RFID scanning of products to implement a live inventory that will result in a system which being cost effective will see its implementation in small and large scale stores.

1.3 Flow chart

Once the cart system is activated, it keeps checking for any RFID tag that might enter the basket. If a product tag is read, entry is made in the current record session. This log is updated with every new entry to the system. Customer can either make a new entry or remove one. After completion of this process, the customer has to select the end shopping option on the screen. This updates the status of user on the internet and generates a bill at the counter which is also stored in the company database.

www.sajrest.com
IXplore SAJREST ⓒ2019 ISSN 2455-9261
pp. **9—20**



1.4 Block diagram:

Buggy Unit:

This unit contains all the user interactive components. It is made up of six technical components- LCD, Buttons, ZigBee Transceiver, RFID Reader & Arduino and one mechanical component, the classic trolley. LCD is used to link the customer with this technology. It provides the user with details about the items in the cart and the total bill. Any settings or item deletion can be done using the buttons. RFID Reader is placed near the top ring of the basket making it easier to sense the RFID tags of the items taken in the basket by the customer. The data exchange between the data-carrying device and the reader are achieved without the use of galvanic contacts, using instead magnetic or electromagnetic fields. RFID frequency band adopted by India is between 865MHz and 867MHz [5] The microcontroller, here used Arduino 2560 is used to analyse the read tags and update the display accordingly. It is also responsible for connecting the cart with the smart cart server. This server is connected to the main server of the shopping complex providing updated information about the inventory.

Server Unit:

The smart cart server comprises of a Arduino and ZigBee transceiver. It is connected with the internet as well. It is a counter end unit and the customer has no direct connection with this unit. All the interactions with the cart are updated here in real-time. This server is connected with the main server of the shopping complex using internet. Keeping this connectivity helps in faster billing process and easy management of the complex.

www.sajrest.com
IXplore SAJREST ⓒ2019 ISSN 2455-9261
pp. **9—20**

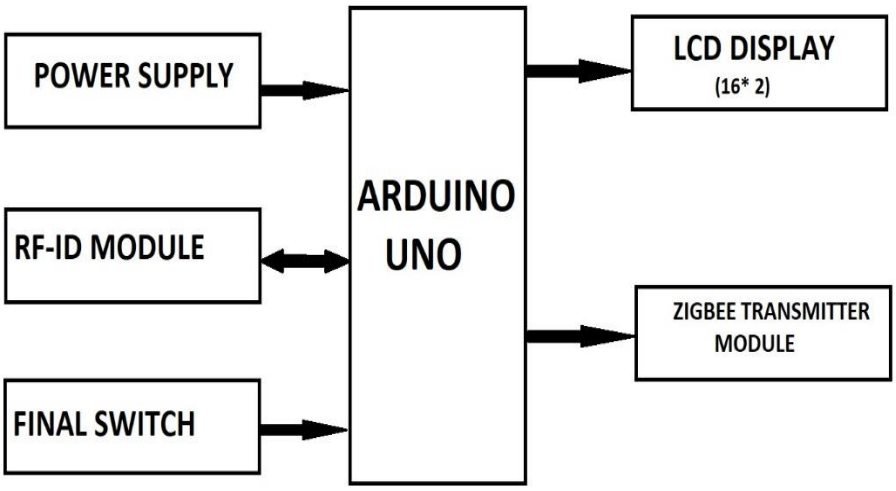


Fig.1.4.1 TRANSMITTER UNIT

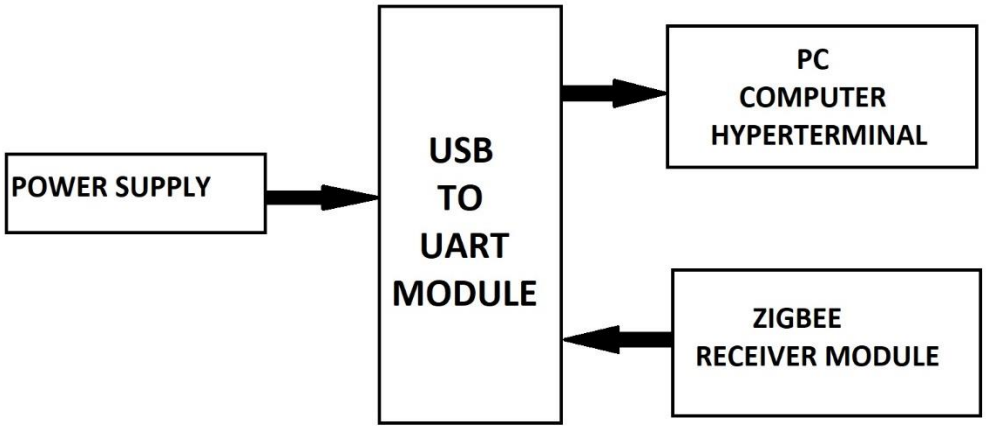


Fig.1.4.2 RECEIVER UNIT

1.5 System architecture

Smart Cart using Arduino and RFID is an efficient system when it comes to scanning of products, bill generation and payment. It uses an Arduino chip, a RFID reader, an LCD, buzzers, capacitors, buttons, etc. and also RFID tags to be attached on the products.
The RFID reader [1] shall be used to scan the RFID tags present on the product and all the information received from the tags shall be stored in the Arduino chip. The system shall have 3 buttons- total, delete and bill button. The product can be directly scanned by the reader and if the customer wishes to remove any product, they just have to press the delete button and scan the product again. The product shall be deleted. If the customers wish to see the total, they can press the total button and the total shall be displayed. While making the payment of the bill, the customers just has to press the bill button after connecting the USB to the billing section [1] and their bill shall be automatically generated in the admin's system. The following block diagrams give a brief idea about the connections and the working at the trolley side [2] as well as the billing side.

1.5.1 Hardware and Technologies

Arduino

Arduino is basically a software as well as a hardware project that doesn't just design but also manufactures single-board microcontrollers [3] as well as microcontroller kits for building digital and interactive projects and systems.

There is a vast variety of Arduino available. Depending upon the requirement of the system or the project, a suitable Arduino is chosen

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet) [4]. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, 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 a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. [5]

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduno, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.

All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems:

- **Inexpensive** :

  Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than $50

- **Cross-platform** :

  The Arduino software runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.

www.sajrest.com
IXplore SAJREST ⓒ2019 ISSN 2455-9261
pp. **9—20**

- **Simple, clear programming environment** :

  The Arduino programming environment is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with the look and feel of Arduino

- **Open source and extensible software**:

  The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.

- **Open source and extensible hardware**:

  The Arduino is based on Atmel's ATMEGA8 and ATMEGA168/ATMEGA2560 microcontrollers. The plans for the modules are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money

RFID Tag

Radio-frequency identification uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically-stored information. [5] Passive tags collect energy from a nearby RFID reader's interrogating radio waves

RFID tags can be classified by the radio frequency range they use to communicate (low, high, or ultra-high) [6], RFID readers are used to retrieve the information that is stored inside the RFID tags. [7] The reader consists of a transmitter that transmits the signal to tag, asking for information and the receiver retrieves the information present in the tags. And the way the tag communicates with the reader

RFID technologies are grouped under the more generic Automatic Identification (Auto-ID) technologies. Examples of other Auto-ID technologies include Smartcards and Barcodes. RFID is often positioned as next generation bar-coding because of its obvious advantages over barcodes. However, in many environments it is likely to co-exist with the barcode for a long time. The barcode labels that triggered a revolution in identification systems back in the 1970's are now cheap and commonly used, but have several limitations:

- Low storage capacity
- They only represent a family of items and not an individual or unique item
- Durability (as mostly printed paper)
- Low read range
- They can only be read when line of sight is established
- They can only be read one at a time
- They cannot be written to or reprogrammed

So, how does RFID differ from other methods of identification and data capture? A typical RFID system is made up of three components: tags, readers and the host computer system.

Tags :

An RFID tag is a tiny radio device that is also referred to as a transponder, smart tag, smart label or radio barcode. The tag comprises a simple silicon microchip (typically less than half a millimeter in size) attached to a small flat aerial and mounted on a substrate. The whole device can then be encapsulated in different materials (such as plastic) dependent upon its intended usage. The finished tag can be attached to an object, typically an item, box or pallet and read remotely to ascertain its identity, position or state.

Readers :

The reader, sometimes called an interrogator or scanner, sends and receives RF data to and from the tag via antennae.

A reader may have multiple antennae that are responsible for sending and receiving radio waves. The readers can be fixed or mobile, can read information stored on the tags and write information to them. This can be achieved without direct line of sight and in environments where traditional data collection could not operate. A major advantage is that information can be written to the tag multiple times so storing a history that travels with the article.

Host Computer :

The data acquired by the readers is then passed to a host computer, which may run specialist RFID software or middleware to filter the data and route it to the correct application, to be processed into useful information. RFID is short for Radio Frequency Identification. Generally a RFID system consists of 2 parts. A Reader, and one or more Transponders, also known as Tags. RFID systems evolved from barcode labels as a means to automatically identify and track products and people. You will be generally familiar with RFID systems as seen in:

Access Control:

RFID Readers placed at entrances that require a person to pass their proximity card (RF tag) to be “read' before the access can be made.

Contact less Payment Systems:

RFID tags used to carry payment information. RFIDs are particular suited to electronic Toll collection systems. Tags attached to vehicles, or carried by people transmit payment information to a fixed reader attached to a Toll station. Payments are then routinely deducted from a user’s account, or information is changed directly on the RFID tag.

Product Tracking and Inventory Control:

RFID systems are commonly used to track and record the movement of ordinary items such as library books, clothes, factory pallets, electrical goods and numerous items.

ZigBee

ZigBee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data

collection,[8] and other low-power low-bandwidth needs, designed for small scale projects which need wireless connection. Hence, Zigbee is a low-power, low data rate, and close proximity (i.e., personal area) wireless ad hoc network. [8]

Zigbee is a low-cost, low-power, wireless mesh network standard targeted at battery-powered devices in wireless control [9] and monitoring applications. Zigbee delivers low-latency communication. Zigbee chips are typically integrated with radios and with microcontrollers. Zigbee operates in the industrial, scientific and medical (ISM) radio bands: 2.4 GHz in most jurisdictions worldwide; though some devices also use 784 MHz in China, 868 MHz in Europe and 915 MHz in the USA and Australia, however even those regions and countries still use 2.4 GHz for most commercial Zigbee devices for home use. Data rates vary from 20 kbit/s (868 MHz band) to 250 kbit/s (2.4 GHz band).[10] Zigbee Operation

The Zigbee boards use a V2 XBEE module to interface to the Zigbee network. These modules are compliant with the 2007 Zigbee Pro / ZNET standard. The V2 XBEE modules come in two varieties. One is configured to be the ZigBee network coordinator (EB051C) and the other is configured to be either a router node or an end device node (EB051R). The variety of the module is marked at the top right hand side of the Zigbee board. Coordinator nodes are responsible for creating the Zigbee network and allowing other Zigbee nodes to join. Only one coordinator node can exist on any single network. Router nodes are responsible for routing signals to other routers or to end nodes. End device nodes are responsible for collecting or depositing real world data to and from the Zigbee network. The Coordinator node and Router nodes are capable of handling up to eight children devices. The children devices can consist of either other Router nodes or End device nodes. If an End device node is configured to sleep then the parent device associated for that node will be responsible for buffering any incoming data. Therefore if you are using sleeping End devices you must make sure to poll the parent for data every time the device comes out of sleep mode. 3.3V system compatibility The board is compatible with 3.3V and 5V systems.

Communications:

The XBEE modules are configured by means of using a TTL level RS232 bus to send and receive AT commands. This protocol requires a start bit, eight data bits and a stop bit.The baud rate for the XBEE modules is set to 9600, with no parity and flow control lines RTS and CTS that can be used. AT commands are strings of ASCII data that are sent over the RS232 bus. For more information on the AT commands used by the XBEE module please refer to the V2 XBEE datasheet. Example AT command ATID 234 - Assigns a personal area network identifier of 0x234 or 564 in decimal. 6. V2 XBEE Module For further data regarding the XBEE module please visit the following link.
ZigBee is a wireless network protocol specifically designed for low rate sensor and control networks. Compared to other wireless protocols, ZigBee wireless protocol offers

- Low complexity,
- Reduced resource requirements
- Standard set of specifications.
- It also offers three frequency bands of operation along with a number of network configurations
- Optional security capability.

LCD display

Liquid crystal display a type of display used in digital watches and many portable computers. LCD displays utilize two sheets of polarizing material with a liquid crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them.[8] Each crystal, therefore, is like a shutter, either allowing light to pass through or blocking the light.[9]

The liquid crystals can be manipulated through an applied electric voltage so that light is allowed to pass or is blocked. By carefully controlling where and what wavelength (color) of light is allowed to pass, the LCD monitor is able to display images. A back light provides LCD monitor's brightness. [10]
Other advances have allowed LCD's to greatly reduce liquid crystal cell response times. Response time is basically the amount of time it takes for a pixel to "change colors". In reality response time is the amount of time it takes a liquid crystal cell to go from being active to inactive [10]
Here the LCD is used at both the Transmitter as well as the receiver side. The input which we give to the microcontroller is displayed on the LCD of the transmitter side and the message sent is received at the receiver side which displays at the receiver end of the LCD and the corresponding operation is performed They make complicated equipment easier to operate. LCDs come in many shapes and sizes but the most common is the 16 character x 4 line display with no backlight.[11]

Pin description of LCD:

PINS	DESCRIPTION
1	GROUND
2	VoC
3	CONTRAST VOLTAGE
4	"R/S" INSTRUCTION/REGISTER SELECT
5	"R/W" READ/WRITE LCD REGISTER
6	"E" CLOCK
7-14	DATA I/O PINS

From this description, the interface is a parallel bus, allowing simple and fast reading/writing of data to and from the LCD. This waveform will write an ASCII Byte out to the LCD's screen.
The ASCII code to be displayed is eight bits long and is sent to the LCD either four or eight bits at a time.
If four bit mode is used, two "nibbles" of data (Sent high four bits and then low four bits with an "E" Clock pulse with each nibble) are sent to make up a full eight bit transfer.
The "E" Clock is used to initiate the data transfer within the LCD.
Deciding how to send the data to the LCD is most critical decision to be made for an LCD interface application.
Eight-bit mode is best used when speed is required in an application and at least ten I/O pins are available.
The "R/S" bit is used to select whether data or an instruction is being transferred between the microcontroller and the LCD.
If the Bit is set, then the byte at the current LCD "Cursor" Position can be reader written.
When the Bit is reset, either an instruction is being sent to the LCD or the execution status of the last instruction is read back

Advantages:

LCD interfacing with 8051 is a real-world application. In recent years the LCD is finding widespread use replacing LEDs (seven segment LEDs or other multisegment LEDs).
This is due to following reasons:

1. The declining prices of LCDs.
2. The ability to display numbers, characters and graphics. This is in contrast to LEDs, which are limited to numbers and a few characters. An intelligent LCD display of two lines, 20 characters per line, which is interfaced to the 8051.
3. Incorporation of a refreshing controller into the LCD, thereby relieving the CPU to keep displaying the data.
4. Ease of programming for characters and graphics.

Asynchronous serial communication:

Asynchronous serial communication describes an asynchronous, serial transmission protocol in which a start signal is sent prior to each byte, character or code word and a stop signal is sent after each code word. The start signal serves to prepare the receiving mechanism for the reception and registration of a symbol and the stop signal serves to bring the receiving mechanism to rest in preparation for the reception of the next symbol. A common kind of start-stop transmission is ASCII over RS-232, for example for use in teletypewriter operation.

In the diagram, two bytes are sent, each consisting of a start bit, followed by seven data bits (bits 0-6), a parity bit (bit 7), and one stop bit, for a 10-bit character frame. The number of data and formatting bits, the order of data bits, and the transmission speed must be pre-agreed by the communicating parties. The "stop bit" is actually a "stop period"; the stop period of the transmitter may be arbitrarily long. It cannot be shorter than a specified amount, usually 1 to 2 bit times. The receiver requires a shorter stop period than the transmitter. At the end of each character, the receiver stops briefly to wait for the next start bit. It is this difference which keeps the transmitter and receiver synchronized.

1.6 Conclusion and future work

Smart shopping trolley application creates an automated central billing system in malls. By using the ZigBee, the product information are directly sent to billing system. So that customers no need to wait in a long queue. It is trustworthy, highly dependable and time efficiency. The proposed smart shopping trolley system will reduce the customer's time in searching the location of the product. The customer just types the name of the product he/she want to purchase on android device. The trolley will automatically guide them to the location of the product and a robotic arm can be added to pick the products.
In future, the LIFI technology can be used in vehicle to vehicle communication. The LCD can be provided with a layout of the shopping market by which the customers can be able to get the exact information about the products present in the different aisles.
This increase user friendliness. The smart trolley could interact with customers during a shopping trip. For example, passing on discount voucher based on where they are in the super market. The movement of the trolley can be made automatically of the trolley can be made automatically with the help of various sensors.in this way, there is no need to pull the heavy trolley.

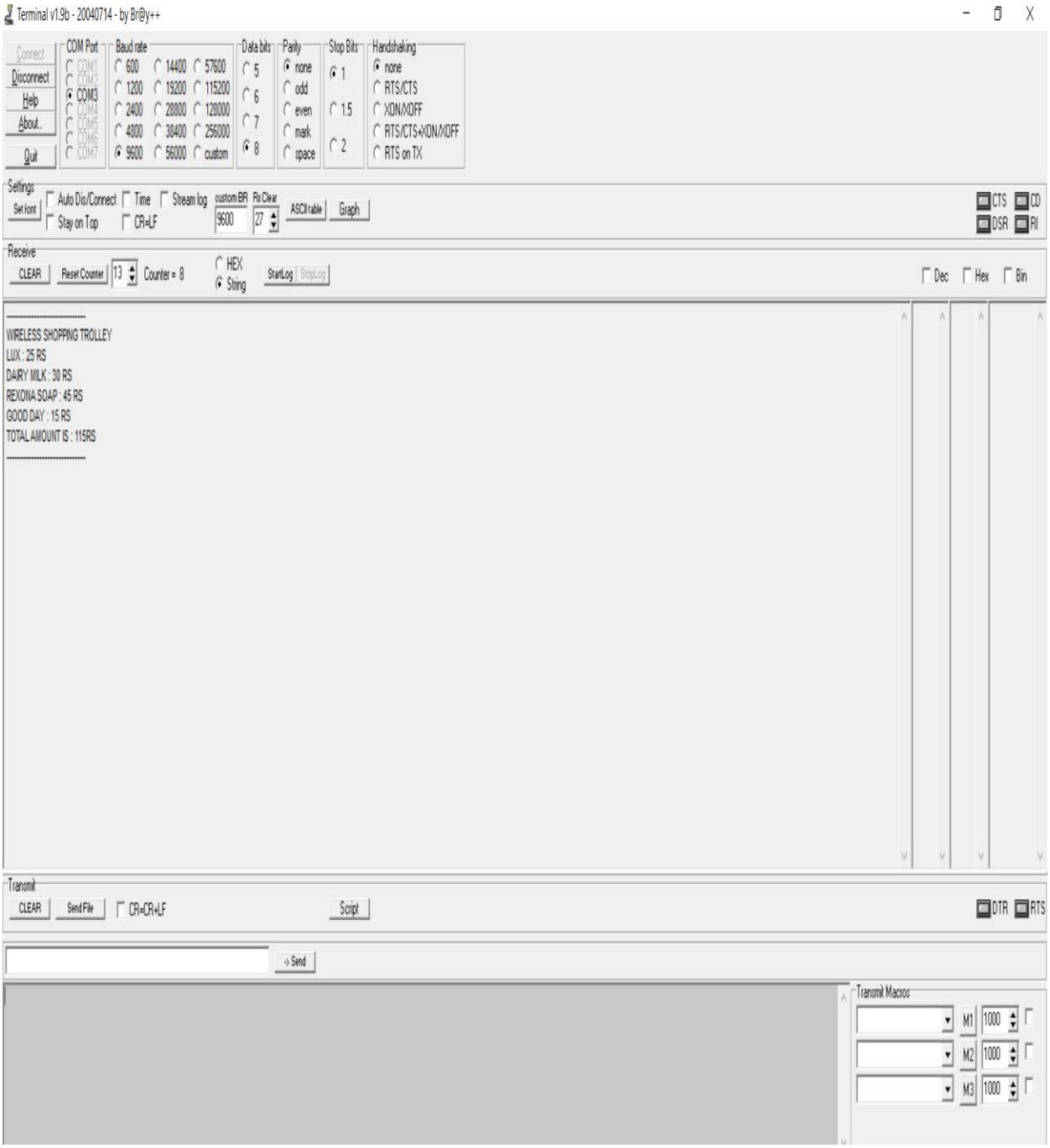
1.7 Application

It can be utilized in

- Dress showrooms.
- Grocery store
- All wholesale shopping malls
- Book stalls
- Jewelry shop
- Student's attendance system.

www.sajrest.com
IXplore SAJREST ⓒ2019 ISSN 2455-9261
pp. **9—20**

OUTPUT:



References

[1]International Engineering Research Journal (IERJ) Volume 2 Issue 3 Page 1418-1421, 2016, ISSN 2395-1621Smart Shopping Trolley Using RFID #1Supriya Sharma, #2Komal Ambekar, #3Vinayak Dhole, #4Tushar Wadekar

[2]International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056Volume: 05 Issue: 03 | Mar-2018 www.irjet.net p-ISSN: 2395-0072Smart Cart Using AVR Microcontroler and RFIDSarika S. Pandey1, Soumya R. Gupta2, Meenaz M. Shaikh3, Komal M. Rawat4, Prof. Pravin Jangid5, Prof. Ragini Mishra6

[3]International Journal of Technical Research and Applications e-ISSN: 2320-8163,www.ijtra.com Volume 5, Issue 3 (May-June 2017), PP. 120-121SMART TROLLEY FOR MALLS1 Pratik Nagdive, 2 Pranit More, 3 Aniket Baraskar, 4 Dr .D.R. Shende

[4] "Smart Trolley in Mega Mall", J. S. Awati, et al., IJETAE, ISSN 2250-2459, Vol. 2, Issue 3, March 2012.

[5]International Journal Of Engineering And Computer Science ISSN:2319-7242Volume 4 Issue 3 March 2015, Page No. 10886-10889Aniket Wani1 IJECS Volume 4 Issue 3 March, 2015 Page No.10886-10889 Page 10886RFID Based Intelligent Trolley System Aniket Wani1, Krutika Thakur2, Nikhil Vaze3, Meeta Vadhel4 , Prof. Rupali Advirkar5

[6]International Journal of Pure and Applied Mathematics Volume 118 No. 20 2018, 3783-3786SMART SHOPPING TROLLEY USING RFID P.T. Sivagurunathan# ,P. Seema*, M. Shalini*, R. Sindhu*

[6] R. Kumar, K. Gopala Krishna, and K.Ramesha, "Intelligent shopping cart, "International Journal of Engineering Scienceand Innovative Technology, vol. 2, no. 4, pp.499–507, 2013.

[7] S Gupta., A. Kaur, A. Garg, A. Varma, A. Bansal,and A. Singh, "Arduino based smart cart," InternationalJournal of Advanced Research in Computer Engineering& Technology, vol. 2, no. 12, 2013.

[8] Z. Ali and R. Sonkusare, "Rfid based smartshopping and billing," International Journal ofAdvanced Research in Computer and Communication Engineering, vol. 2, no. 12, pp. 4696–4699, 2013.

[9] P. Chandrasekar and T. Sangeetha, "Smart shoppingcart with automatic billing system through rfid andZigBee," in Information Communication and EmbeddedSystems, 2014 International Conference on. IEEE,2014, pp. 1–4.

[10] M. R. Sawant, K. Krishnan, S. Bhokre, and P.Bhosale, "The rfid based smart shopping cart,"International Journal of Engineering Research andGeneral Science, vol. 3, no. 2, pp. 275–280, 2015.

[11] A. Yewatkar, F. Inamdar, R. Singh, A. Bandalet al., "Smart cart with automatic billing, productinformation, product recommendation using rfid &ZigBee with anti-theft," Procedia Computer Science,vol. 79, pp. 793–800, 2016.

[12] Z. Cai, Z. He, X. Guan, and Y. Li, "Collectivedata-sanitization for preventing sensitive information inference attacks in social networks," IEEETransactions on Dependable and Secure Computing,2016.