Radio Frequency Identification Based Smart Shopping Trolley

Manchukonda Gautham, Pothapala Vinodh, Syed Vaseem, Darwin Nesakumar

Student, Electronics and Communication Engineering, R.M.K.Engineering College, Tamilnadu, India
Student, Electronics and Communication Engineering, R.M.K.Engineering College, Tamilnadu, India
Student, Electronics and Communication Engineering, R.M.K.Engineering College, Tamilnadu, India
Assistant Professor, Electronics and Communication Engineering, R.M.K.Engineering College, Tamilnadu, India

ABSTRACT

In metro cities we can see you a huge rush at shopping malls on holidays and weekends. This becomes even more when there are huge offers and discounts. Now a days people purchase a variety of items and put them in the trolley. After total purchasing one should approach counter for billing purpose. By using barcode reader the cashier prepares the bill which is a time consuming process. This results in long queues at the billing counters. This project presents an idea to develop a system in shopping malls to overcome the above problem. To achieve this all products in the mall should be equipped with RFID tags and all trolleys should be equipped with a RFID reader and LCD screen. When one puts any product in the trolley its code will be detected automatically, the item name and cost will be displayed on the LCD, thereby the cost gets added to the total bill. If we wish to remove the product from the trolley, you can take away the product and the amount of that specific product gets deducted from total amount and the same information passes to the central billing unit via Zigbee module. Hence the billing can be done in the trolley itself thereby saving a lot of time to customers. Along with this DC Motors are added to the trolley to make its movement easier and at the same time, low cost vacuum cleaners are placed at the bottom of the trolley for cleaning purpose.

Keywords: - *RFID, Arduino Mega, LCD, Zigbee, Trolley, DC Motors,*

1. Introduction

Generally people have a list of items written in a piece of paper when they go for shopping. However, the advancement of technology has changed how people do shopping over the last decade. In addition, the emergence of smart phone has changed the retail shopping experience drastically.

The retailers are continuously working on improving the shopping experience to make sure their customers are satisfied in overall shopping experience. There have been various attempts which were carried out in the past to eliminate lengthy shopping lines in retail stores. One of the famous approaches is the introduction of self checkout machines where customer convenience has been improved to a certain extent.

Self-check outs have been popular since then due to low overhead cost; however, the shoplifting and lower operating efficiencies are considered as major drawbacks in the retail environment. The selection of a single technology that can be used to enhance shopping experience is a difficult task as the expectation in a brand clothing store to grocery store can be quite different, and can also depend on individual perception. In addition, it was found that the consumers prefer to have item level information to make purchase decisions. Moreover, demands for visual technology and privacy have a greater influence in consumer satisfaction.

Therefore, it is important to identify ways to improve shopping experience while the factors such as return on investment, expected sales growth and meeting customer expectations are also considered. There have been three major attempts, where shopping trolley was used as the medium to improve shopping experience. In 2005, Fujitsu, a Japanese company has demonstrated a shopping trolley with an inbuilt barcode scanner. The barcode scanner was used to scan both products and loyalty cards in real time. However, this shopping trolley does not fully solve issues such as in store stock management and shoplifting. Amazon has recently come up

with a smart retail store concept "Amazon Go" where the customer pick a product from the product gets tracked and self-checked.

DC motors are used to drive the vehicles. Using four 15000rpm motors, sufficient speed can be obtained. Once a voice command is given or a manual button is pressed in the android application, the Bluetooth module recognizes the string which is already pre dumped in the microcontroller and then sends commands to the L293D IC which further drives the dc motors by various digital bit combinations.00,11 means no rotation and 10,01 are used for forward and backward rotation of dc motors. One more DC motor is used with blade propeller is used for cleaning. We used a small blade propeller and a dc motor along with a bottle to clean the dust. When the bottle has holes at the back, it sucks the air into it and a filter can be used amid to separate dust and propeller.

2.Working of motors and application

Working starts with the voice commands we give. When a voice command is given, the Bluetooth module accepts the command and passes on to the microcontroller which further gives a signal to input pins of driver IC and finally the motors start rotating. The commands we give should be included in the Arduino code we dump and according to the voice command given, the robotic car moves in any of the four directions. And by using the sensors we can find the obstacles and cleaner will start working by sucking the garbage into it and store it in a bin. If no garbage is present, cleaner automatically turns off and remains in off condition until the garbage is sensed while moving.

Table-1: showing the rotation of motors for different digital input values

Inputs And Motor Outputs					
A	*B*	*C*	*D*	Motor1	*Motor2*
1	*0*	*1*	*0*	*FWD*	*FWD*
1	*0*	*1*	*0*	*FWD*	*FWD*
1	*0*	*0*	*1*	*FWD*	*REV*
1	*0*	*0*	*0*	*FWD*	*STOP*
0	*1*	*1*	*0*	*REV*	*FWD*
0	*0*	*1*	*0*	*STOP*	*FWD*
0	*1*	*0*	*1*	*REV*	*REV*
0	*0*	*0*	*0*	*STOP*	*STOP*

In the proposed system, automatic monitor system is implemented for scanning the product in the trolley itself. Initially, RFID Module is used for scanning the barcode which differs for each and every product even if it is of same type. Zigbee technology is implemented to transfer data from transmitter side which is the trolley to the receiver side which is at the billing counter. Arduino mega microcontroller is incorporated to control each and every component at the transmitting side by giving instructions whenever necessary. ARM7 is used at the receiver side to receive the information with the help of Zigbee network. DC motors along with motor driver are included to control the trolley with the help of an android application. Bluetooth Module is used for communicating with the android application by transferring commands in the form of strings like left, right, forward and backward. GPRS Module is used for transferring information to the webpage in real time.

3.Block Diagram

In this project, Smart and secure shopping system is implemented. Here two controllers is used for monitoring the product purchasing and product quantity checking. The updated information can be stored in the server. Here the Arduino Mega microcontroller is used for monitoring the products which are being purchased by the customer and information is passed from that Zigbee to another Zigbee. The ARM Controller receives the data every time. So, everything including the quantity and price are updated at the receiver in real time.

3.1 Transmitter side

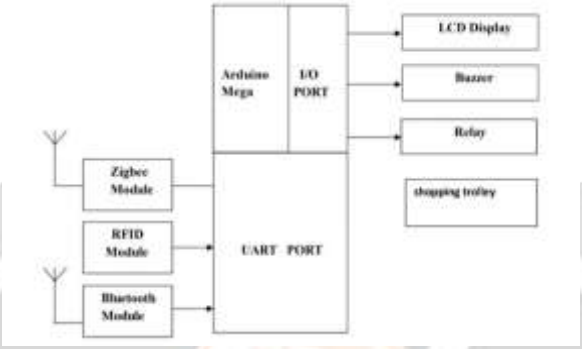

Fig -1: Block Diagram of Transmitter

3.2 Receiver side

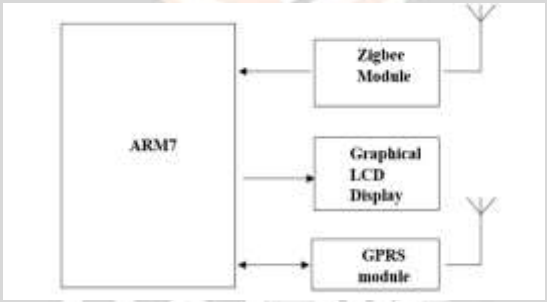

Fig -2: Block diagram of Receiver

4.Hardware Requirements

4.1 RFID READER

RFID tag is a small device which stores and sends data to RFID reader. They are categorized in two types – active tag and passive tag. Active tags are those which contain an internal battery and do not require power from the reader.Typically active tags have a longer distance range than passive tags. Passive tags are smaller and lighter in size than the active tags. They do not contain an internal battery and thus depend on RFID reader for operating power and certainly have a low range limited up to few meters.

To recognize the identity of an RFID tag, RFID reader sends radio signals which is captured by the coil (working as antenna) for the tag. The coil receives these signals as alternating current and passes to the chip. The chip extracts both the power and the information from this alternating current. By communicating with the non volatile memory of the chip that stores unique id as well as other information, it sends back the required signal to the antenna which is then transmitted to the RFID reader.

4.2 LCD

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and

circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters..

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

4.3 ARM7 LPC2148

The LPC2141/2/4/6/8 microcontrollers are based on a 32/16 bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combines the microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2141/2/4/6/8 are ideal for applications where miniaturization is the requirement, such as access control and point f-sale. A blend of serial communications interfaces ranging from a USB 2.0.

4.4 GSM SIM900

SIM Com presents an ultra compact and reliable wireless module-SIM900. This is a complete Quad-band GSM/GPRS module in a SMT type and designed with a very powerful single-chip processor integrating ARM926EJ-S core, allowing you to benefit from small dimensions and cost-effective solutions.

Featuring an industry-standard interface, the SIM900 delivers GSM/GPRS 850/900/1800/1900MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mm x 24mm 3 mm, SIM900 can fit almost all the space requirements in your M2M applications, especially for slim and compact demands of design.

4.5 Arduino Mega

The Arduino MEGA ADK is a microcontroller board based on the ATmega2560. It has a USB host interface to connect with Android based phones, based on the MAX3421e IC. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

4.6 RFX240 Zigbee Module

RFX240 is minimised to a greater extent to supply all suitability of transfer of power intensification for IEEE 802.11b/g/n implementation in the 2.4GHz frequency range. It produces a gain of 30DB and a range of +26dbm of linear output power with low EVM of less than 3percent for 802.11n MCS7 HT40 signals. It has argument control for CMOS, input impedance matching for on chip along with mixed RF decoupling for the electricity supply.

4.7 L293D Motor Driver IC

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC Motors with a single L293D IC.

It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, Hence H-bridge IC are ideal for driving a DC motor.In a single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due its size it is very much used in robotic application for controlling DC motors.

There are two Enable pins on l293d. Pin 1 and pin 9, for being able to drive the motor, the pin 1 and 9 need to be high. For driving the motor with left H-bridge you need to enable pin 1 to high.

5. SOFTWARE REQUIREMENTS

5.1 ARDUINO IDE

The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

6. Output Images

Fig- 3: Shopping Trolley

Fig- 4: DC Motor Arrangement

Fig- 5: Transmitting Side

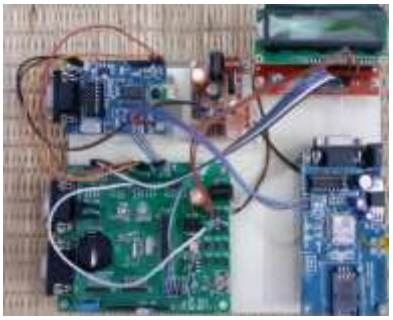

Fig- 6: Receiving Side

7. Working

When items are placed in the trolley,The RFID reader scans each item and the information is sent to the receiver module at the same time and the trolley can be controlled by a customer with the help of an android application and can move it in all four directions left, right, forward and backward. Zigbee module is used for transferring the data from transmitter to receiver. Arduino mega is used at the transmitter side and ARM 7 is used at the receiver side. Vacuum cleaners can be placed at the bottom of the trolley so that cleaning is done at the same time.

8. Conclusion

As the present system is really hectic and needs a lot of human work and physical force involved whenever the items are being scanned in the billing counter or when customers are carrying the trolleys for themselves. So,this project helps the supermarkets both in billing section and while picking up items and handling the trolley.The items will be scanned immediately after placing them in the trolley by RFID Scanner and the purchase information will be seen both by the customer and the person who is at the billing counter. So, the customer will be aware of how much money he is having and how many items he is purchasing. The android application also helps the customers to move the trolley in all four directions left, right, forward and backward. In this way two of the most important problems are solved by using this project.

9. References

[1]. Suraj.S, Vishal Guruprasad, Udayagiri R Pranava, Preetham S Nag, "RFID Based Wireless Intelligent Cart Using ARM7," *International Journal of Innovative Research in Science, Engineering and Technology*, Vol. 5, Issue 8, 2016.

[2]. Suryaprasad J, Praveen Kumar B O, Roopa D & Arjun A K, " A Novel Low-Cost Intelligent Shopping Cart," *IEEE, 2014.*

[3]. Komal Ambekar, Vinayak Dhole, Supriya Sharma,"Smart Shopping Trolley Using RFID," *International Journal of Advanced Research in Computer Engineering & Technology (IJARCET),* Volume 4 Issue 10, 2015.

[4]. K.Gogila Devi, T.A.Kaarthik, N.Kalai Selvi, K.Nandhini, S.Priya, "Smart Shopping Trolley Using RFID Based on IoT," *International Journal of Innovative Research in Computer and Communication Engineering*. Vol. 5, Issue 3, 2017.

[5]. Amine Karmouche, Yassine Salih-Alj, "Aisle-level Scanning for Pervasive RFID based Shopping Applications *," IEEE.*

[6]. Satish Kamble, Sachin Meshram, Rahul Thokal & Roshan Gakre, "Developing a Multitasking Shopping Trolley based on RFID Technology," *International Journal of Soft Computing and Engineering (IJSCE),* ISSN: 2231-2307, Volume-3, Issue-6, 2014.

[7]. Chandrasekar.P , Ms. T. Sangeetha, " Smart Shopping Cart with Automatic Central Billing System through RFID and ZigBee," *IEEE, 2014.*

[8]. Galande Jayshree, Rutuja Gholap, Preeti Yadav, " RFID Based Automatic Billing Trolley,"*InternationalJournal of Emerging Technology & AdvancedEngineering 2014.*