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A Review on RFID Based Smart Shopping System

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Abstract -India is one of the fastest growing economies in the world and aspires to become a 5 trillion dollar economy. E-commerce has surely spread itself and there have been many advancements in this field. The working class and most of our community prefers to go to malls or supermarkets and get their shopping done. Due to increasing populations, shopping is a cumbersome process as one has to wait in long queues to get their processing done. Clearly, it is a waste of time and a tedious affair. The major problem lies with the system of barcodes where every item is being scanned individually which makes the process slow and time consuming. RFID based shopping cart is a new way of shopping and avoiding long queues. The object would be tagged with a unique reader tag, which will be identified by the RFID reader attached to the trolley as the object is added to the cart. As the scanning is done the cost of the product will automatically be displayed on the screen attached to the cart. The bill value changes dynamically as the objects are added and subtracted. Now days purchasing and shopping at big malls is becoming a daily activity in metro cities. We can see huge rush at malls on holidays and weekends. The rush is even more when there are special offers and discount. People purchase different items and put them in trolley. After total purchase one needs to go to billing counter for payments. At the billing counter the cashier prepare the bill using bar code reader which is a time consuming process and results in long queues at billing counters. Our aim is to develop a system that can be used in shopping malls to solve the above mentioned challenge. The system will be placed in all the trolleys. It will consist of a RFID reader. All the products in the mall will be equipped with RFID tags. When a person puts any products in the trolley, its code will be detected and the price of those products will be stored in memory. As we put the products, the costs will get added to total bill. Thus the billing will be done in the trolley itself. Item name and its cost will be displayed on LCD. Also the products name and its cost can be announced using headset. At the billing Counter the total bill data will be transferred to PC by wireless RF modules.

Key Words:E- commerce, Economy, RFID reader, RFID Tags, Smart Shopping, Trolley

1. INTRODUCTION

RFID (Radio Frequency Identification) is a versatile and easy to use technology in the IoT domain. RFID tags are generally used for identification of products using radio waves. RFID sensor are in great demand due to effective working and faster scanning and detection. It possesses a great advantage over the barcode scanning system technology as in RFID there is no assigned of line of sight, as opposed to barcode scanners, where the object is scanned if and only if it is placed under a line of sight. RFID scanning distance can be easily adjusted as per needs. Every customer would be provided with a unique RFID tag enabled cart.

The concept addresses the expectations of customers whose basic demand is to reduce the various Problems in the way of making their purchase. By initiating the idea of an RFID based shopping cart, people would easily understand the bill of products themselves, irrespective of the presence of staff of the shop as details of product would be readily available and would be displayed on the trolley as they add the product in the trolley. This outcome of this project will not only be in favour of the customers but also the mall owners who can make a one-time investment which can lead to long-term benefits in terms of business as well as customer satisfaction.

In the world of Internet of things [IoT] is a major technology by which we can produce various useful internet applications. Basically, IoT is a network in which all physical objects to be controlled remotely across existing network infrastructure. IoT is a very good and intelligent technique which reduces human effort as well as easy access to physical devices. This technique also has autonomous control feature by which any device can control without any human interaction. There has been a lot of IoT experimentation on various applications such as smart homes, e-health frameworks, wearable gadgets, and so on. IoT has brought a new revolution in industrial, financial and environmental systems and triggered great challenges in data management, wireless communication and real-time decision making. Also, numerous security and protection issues have risen, and lightweight cryptographic techniques are in high demand to fit in with IoT applications. This paper is around a shopping framework based on Radio Frequency Identification (RFID) technology. All things available to be purchased are embedded with an RFID tag, so they can be tracked by any gadget outfitted with a RFID reader in the supermarket.

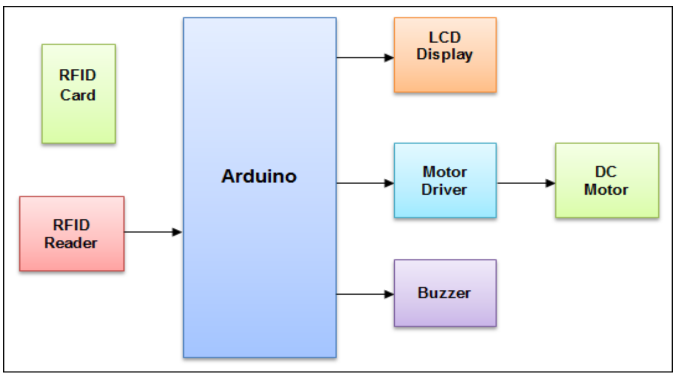


Fig -1 Block diagram Set-up

The advent of newer techniques like RFID technology and wireless networks have makes the process of shopping at a faster pace, making it more efficient as well as making it more transparent. RFID tags are nothing but small transponders, communicates to a reader wirelessly by transmitting some identifier such as serial number .By constructions, they are the special type of wireless cards which carries built-in embedded chip and loop antenna. The chip represents a dual digit card number. The RFID reader circuits generates 125 KHz magnetic signal. RFID tags have been widely used to track items and label them in various shopping destinations like supermarkets. They are treated as advanced form of barcode.

2.Problem Statement

The current system involves a large amount of manual handling on the part of the customer. It helps in tracking and identification of trolleys, which is useful for the management of the shop but does nothing for the customer. It does not provide a feasible solution to reduce the time spent by the customer in the store, mainly while standing in line for billing and payment. This is because of a lack of alternative mode of payments and collision issues as signals are easily intercepted. The main drawback is the lack of satisfaction and ease of use on the part of the customer.

3. Methodology

The proposed system consists of RFID tag, RFID reader, Arduino NANO and LCD display. All the products in the supermarket are embedded with RFID tag. When the customer put any products in to the trolley it will scan the product. Then it will display all the product details such as product name, product weight and the number of each product in the LCD display. Thus, the billing will be done in the trolley itself. At the billing counter the total bill data will be transferred to PC.

The system components are:

- Arduino Nano

The microcontroller used here is an Arduino NANO. The NANO is a Microcontroller board based on ATMEGA 328P which has a 32Kb of flash memory for storing code. The board has a 14 digital input and output pins, 6 analog inputs, 16 MHz quartz crystal, USB, an ICSP circuit and a reset button. The NANO can be programmed using the software Arduino IDE.

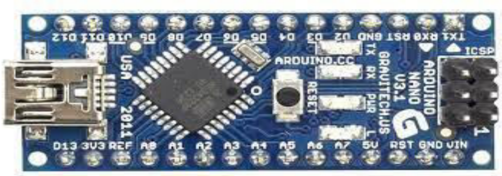


Fig -2 Arduino Nano

- RFID

RFID stands for radio frequency identification. Its operating frequency is 125khz. RFID is a technology that uses radio waves to transfer data from an electronic tag called RFID tag or label attached to an object through a reader for the purpose of identifying and tracking the object. Many types of RFID exist, but at the highest level, we can divide RFID devices into two classes: Active and Passive.

Fig -3 Types of Tag

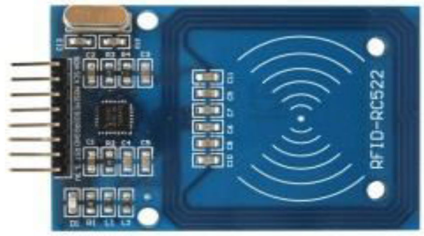


Fig -4 RFID Reader

Active tags require a power source i.e., they are either connected to a powered infrastructure or use energy stored in an integrated battery. In the latter case, a tag's lifetime is limited by the stored energy, balanced against the number of read operations the device must undergo. However, batteries make the cost, size, and lifetime of active tags impractical for the retail trade.

Passive RFID is of interest because the tags don't require batteries or maintenance. The tags also have an indefinite operational life and are small enough to fit into a practical adhesive label. A passive tag consists of three parts: an antenna, a semiconductor chip attached to the antenna and some form of encapsulation. The tag reader is responsible for powering and communicating with a tag. The tag antenna captures energy and transfers the tag's ID (the tag's chip coordinates this process). The encapsulation maintains the tag's integrity and protects the antenna and chip from environmental conditions or reagents.

3.1Working Principle

A. Input: Scanning Products
B. Display Product Details
C. Transferring data to the cloud

A. Scanning Products

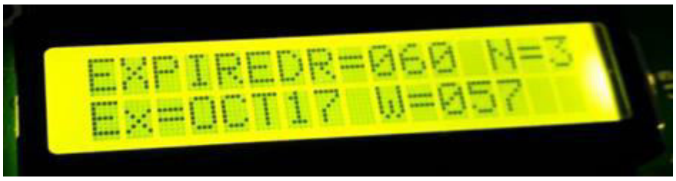
Radio-Frequency Identification (RFID) is the use of radio waves to read and capture information stored on a chip attached to an object. RFID tags are embedded to items in order to track them using an RFID reader and antenna. RFID tags transmit data about an item through radio waves to the antenna when the tag receives the transmission from the reader. RFID tags can be read out of the line of sight and at distances ranging from a few centimeters to over 100 meters. They also enable individual items to be given a unique identification number, rather than just a product code. The retailers and wholesalers are expected to use these RFID tags to track the package of goods between stores and warehouses. In this futuristic billing trolley system environment, each product will contain the passive radio frequency ID tag which is bearing a unique electronic product code. This electronic product code provides the information about the product that is its name and price and weight as soon as the customer puts the product in the smart trolley, radio frequency ID reader scans the tag then generating the electronic product code number. The fetched data is passed to the microcontroller where further processing takes place.

RFID Reader scans the RFID tag on products.

Fig -5 RFID Card

B. Disp;ay Product details

The system will display the product details such as product name, product weight, number of each products and it will also show that whether the product is expired or not.



C. Transferring data to the clouds

In order to view the list of purchased items by the store administrator and customer via website, the following steps are involved.

SEND SENSOR DATA PRIVATELY TO THE CLOUD There are sensors all around in our homes, smart phones, automobiles, city infrastructure and industrial equipment. Sensors detect and measure information on all sorts of things like temperature, humidity and pressure. They communicate that data in some form, such as a numerical value or electrical signal.

COLLECT DATA IN THINGSPEAK Sensors, or things sense data and typically act locally. Thing Speak enables sensors, instruments, and websites to send data to the cloud where it is stored in either a private or a public channel. Things speak stores data in private channels by default, but public channels can be used to share data with others. Once data is in a Thing speak channel, you can analyze and visualize it, calculate new data, or interact with social media, web services and other devices.

ANALYZE AND VISUALIZE YOUR DATA WITH MATLAB Storing data in the cloud provides easy access to your data. Using online analytical tools, you can explore and visualize data. You can discover relationships, patterns, and trends in data. You can calculate new data. And you can visualize it in plots, charts, and gauges. Storing data in the cloud provides easy access to your data. Using online analytical tools, you can explore and visualize data. You can discover relationships, patterns, and trends in data. You can calculate new data. And you can visualize it in plots, charts, and gauges

TRIGGER A REACTION Acting on data could be something as simple receiving a sensor (specified in Block) from Arduino and data send to web server via WIFI module.

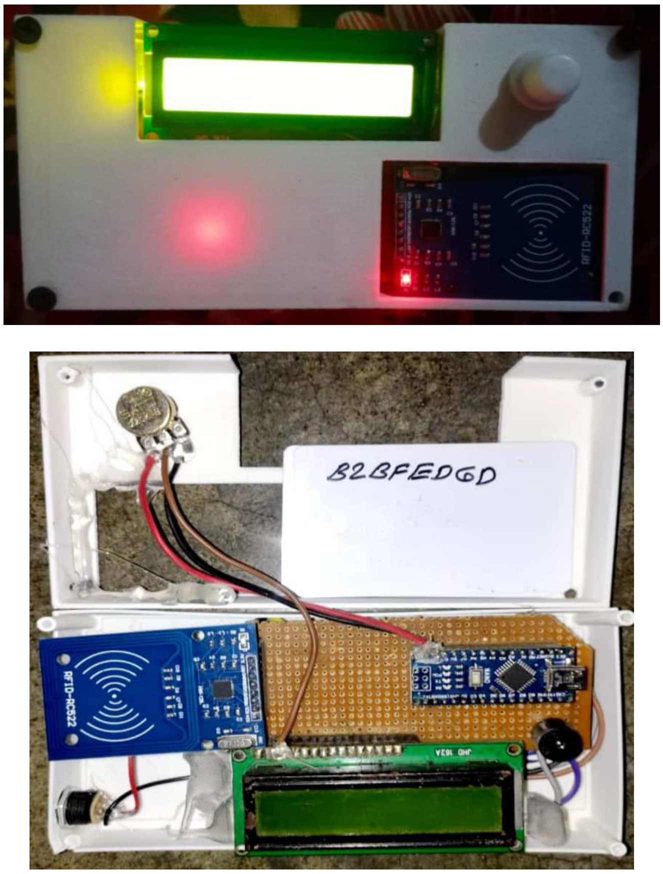


Fig -6 Actual Experimental Set-up

3.2Flowchart and Algorithm

Step1: Start

Step2: Initialize System

Step3: search for RFID

Step4: check RFID tag

Step5: Read related data from memory

Step6: Display data on LCD

Step7: Add item cost as items are added

Step8: When upload key is pressed send data to the counter

Step9: Print the Bill

Step10: Stop

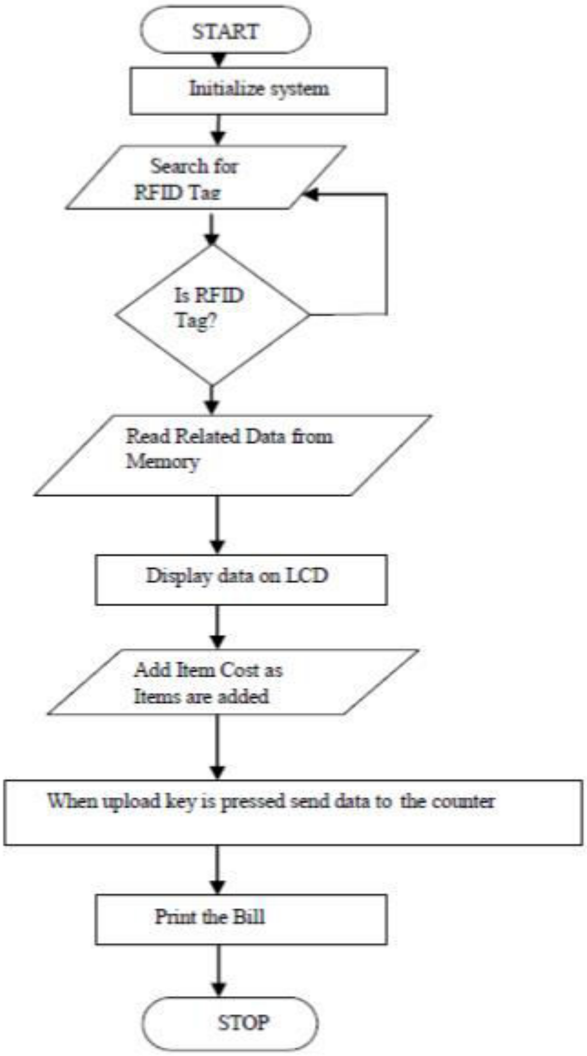


Fig -7 Flowchart of Set-up

3.3Final Coding for Set-up

```
#include <SPI.h> //These are Libraries

#include <MFRC522.h>

#define SS_PIN 10 // MACRO

#define RST_PIN 9

#include <LiquidCrystal.h>

int Buz=A1;

const int rs = 6, en =7 , d4 = 5, d5 = 4, d6 = 3, d7 = 8;

LiquidCrystallcd(rs, en, d4, d5, d6, d7);

MFRC522 rfid(SS_PIN, RST_PIN); // Instance of the class

MFRC522::MIFARE_Key key;

byte nuidPICC[4];

void setup() {

Serial.begin(9600);//Baud Rate- Bits per Sec

SPI.begin(); // Init SPI bus

rfid.PCD_Init(); // Init MFRC522

pinMode(Buz,OUTPUT);

digitalWrite(Buz,LOW);

lcd.begin(16, 2);

lcd.setCursor(0,0);

lcd.print("RFID BASED SHOPPING ");

lcd.setCursor(4,1);

lcd.print("TROLLY ");

delay(2000);

}

int i=0;

int Amt=0;

int A,B,C;

void loop() {

lcd.clear();

lcd.setCursor(0,0);

lcd.print("NO OF ITEMS : ");

lcd.setCursor(14,0);

lcd.print(i);

lcd.setCursor(0,1);

lcd.print("AMOUNT : ");

lcd.setCursor(9,1);

lcd.print(Amt);

 if ( !rfid.PICC_IsNewCardPresent())

 {

return;

 }

 // Select one of the cards

 if ( !rfid.PICC_ReadCardSerial())

 {

return;

 }

 String content= "";
```

```
for (byte i = 0; i<rfid.uid.size; i++)
{
Serial.print(rfid.uid.uidByte[i] < 0x10 ? " 0" : " ");
Serial.print(rfid.uid.uidByte[i], HEX);
content.concat(String(rfid.uid.uidByte[i] < 0x10 ? " 0" : " "));
content.concat(String(rfid.uid.uidByte[i], HEX));
}
Serial.println();
//Serial.print("Message : ");
content.toUpperCase();
if ((content.substring(1) == "E2 44 69 6E" )&&(A==0)) //change here the UID of the card/cards that you want to give access
{
lcd.clear();
i++;
    Amt=Amt+15;
digitalWrite(Buz,HIGH);
lcd.setCursor(0,0);
lcd.print("ITEM: CHOCLATE ");
delay(500);
digitalWrite(Buz,LOW);
    A=1;
}
else if ((content.substring(1) == "E2 44 69 6E" )&&(A==1)) //change here the UID of the card/cards that you want to give access
{
lcd.clear();
i--;
    Amt=Amt-15;
lcd.setCursor(0,0);
digitalWrite(Buz,HIGH);
lcd.print("ITEM: CHOCLATE ");    delay(500);
digitalWrite(Buz,LOW);
    A=0;
}
else if ((content.substring(1) == "B2 BF ED 6D" )&&(B==0)) //change here the UID of the card/cards that you want to give access
{
lcd.clear();
i++;
    Amt=Amt+25;
lcd.setCursor(0,0);
digitalWrite(Buz,HIGH);
lcd.print("ITEM: BISCUIT ");
delay(500);
digitalWrite(Buz,LOW);
    B=1;
}
else if ((content.substring(1) == "B2 BF ED 6D" )&&(B==1)) //change here the UID of the card/cards that you want to give access
{
lcd.clear();
i--;
    Amt=Amt-25;
digitalWrite(Buz,HIGH);
lcd.setCursor(0,0);
lcd.print("ITEM: BISCUIT ");
delay(500);
digitalWrite(Buz,LOW);
    B=0;
}
else if ((content.substring(1) == "E2 F0 EE 6D" )&&(C==0)) //change here the UID of the card/cards that you want to give access
{
lcd.clear();
i++;
    Amt=Amt+50;
lcd.setCursor(0,0);
```

```
digitalWrite(Buz,HIGH);

lcd.print("ITEM: SHAMPOO");

delay(500);

digitalWrite(Buz,LOW);

    C=1;

  }

 else if ((content.substring(1) == "E2 F0 EE 6D" )&&(C==1)) //change here the UID of the card/cards that you want to give access

  {

lcd.clear();

i--;

    Amt=Amt-50;

lcd.setCursor(0,0);

digitalWrite(Buz,HIGH);

lcd.print("ITEM: SHAMPOO");

delay(500);

digitalWrite(Buz,LOW);

    C=0;

  }

rfid.PICC_HaltA();// read once

}
```

4. Conclusion

In this proposed project a secure smart shopping system utilizing RFID technology is employed in enhancing shopping experiences and security issues. The smart shelves can monitor the items on the shelves by reading the RFID signals from the tags. The smart carts can read and retrieve information of the items inside the carts and finally, the checkout points can validate the purchase made by a customer.

While there are many papers that propose an idea for shopping carts, none of them have been able to produce an economical version of the same. However, there are many options that can be used to increase the productivity of this project. Author could have provided autonomous shopping carts which move to the section as customer click on a map on either the cart screen or on a mobile application. Also, the stock of all products could be updated in real-time, so that customers get to know which products are not available now, saving their time. Future advancements could also include use of enhanced RFID readers that operate in high frequency which can read multiple tags simultaneously. Mobile application can be developed to avoid smart card and GSM.

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