SHIV NADAR UNIVERSITY
CHENNAI

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SCHOOL OF ENGINEERING

PROJECT REPORT

SMART BILLING SYSTEM

A PROJECT REPORT

Submitted by
P Nethraa(24011102069)
Rakshiga G (24011102082)
Purru.Srilalithasaiprasanna (24011102079)

Introduction to Internet of Things and Laboratory

SHIV NADAR UNIVERSITY CHENNAI

MAY 2025

SMART BILLING SYSTEM

ABSTRACT:

This project aims to make billing system in retail marts more efficient by utilizing Arduino UNO and Internet of Things(IoT) components . This model uses IR(Infra Red) sensor ,servo motor ,RFID module and tags. The IR sensor detects the item and accordingly sends signal to the servo motor for the the lid of the shopping cart to open. As the item is placed inside the cart,the RFID tag in the item is read by the RFID module. The details of item in the RFID tag is displayed and the cost is added to the rest of the bill. When the user finshes shopping and needs to make the payment,the cost to be paid is displayed. This project reduces the time consuming process of billing items not only in a retail store but also in a warehouse were items are moved. This helps keep track of things.

INTRODUCTION:

The existing billing system which involves for the customer approaching the billing counter to get all the items billed manually at the counter. Often there are long queues and waiting time.This problem can be solved by utilizing IoT technology(Arduino and RFID)

For this system,all items in store are required to have RFID tag . This smart billing system is designed to open the lid of the cart when the user wants to place an item in the cart. IR sensor,RFID module ,LCD and servo motor are all connected to the Arduino. When the item is brought close to the lid(close to the IR sensor placed in the lid of the cart),the lid opens. As the item is placed in the cart,the RFID tag on the item is scanned by the RFID module and the details . Once the customer is done shopping the amount displayed on the LCD is the amount to be paid.

This project improves overall efficiency by:

(I)Customer Friendly: The customer can view the and alter their purchase accordingly .This can be done then and there without approaching the billing counter

(II)Improved Productivity: Since customers are handled faster,more goods can be traded and it can bring more profit for the retailers.

(III)Enhanced Services: Crowds in the retail stores become easily manageable. Shop helpers can offer their services without hurdles.

This project utilises IoT technology for improving shopping experience for both customer and retailer.

Overview:

Working of the Smart Billing System:

- IR sensor can detect when an item is brought near the lid to place it in the basket.
- This signal is sent to the servo motor which aids in opening of the lid.
- Once the lid is open,the customer can place the object in the cart.

- As the object is placed in the cart,the detils about the object is placed in the cart It's details are scanned by the RFID module and the total cost is displayed in the LCD.
- When the customer completes shopping,they can pay the amount displayed on the LCD.

OBJECTIVES

- Reduced Checkout Times:
  This stem minimizes the time spent by customer in waiting in the queus for checking out the items purchased.
- Enhanced Shopping Efficiency and Experience:
  The usage of IoT technolgies like Arduino and RFID streamlines the entire shopping experience as it bills items as they are placed in the cart.
- Improved Accuracy in Computing the Bill:
  Usage of Smart Billing system eliminates manual errors that may occur during billing by each and every item is accounted for calculation
- Real-Time Inventory Tracking:
  Retialer can monitor stock levels amd movement of items real-time. Inventory management is also enhanced.
- Increased Satisfied in Customer Services:
  Since the smart billing system makes the shopping process more organized,it becomes easier for the retailers to offer customer services with ease.

MOTIVATION:

- Leveraging IoT for Smart Retail Solutions:
  By providing real-time update on the bill to the customer,this sytem helps the customer manage and track their expenditures better,thus making the shopping experience smooth. Managing large warehouses also become easier with the usage of this system. While manual monitoring of the stocks is time consuming and prone to errors,this system offers a smart and quick solution.
- Addressing Growing Customer Expectations:
  In a fast growing world where time is of utmost essence,customers prefer more personalized and shopping experience.

LITERARY SURVEY

I.RFID Enabled Smart Billing System
Citation: Indian Journal of Science and Technology by M.Vanitha Sheba and Brintha Rajakumari
Link: https://indjst.org/download-article.php?Article_Unique_Id=INDJST6697&Full_Text_Pdf_Download=True

This project relies on RFID technology which is placed both in the shopping cart and the products. The details scanned by the RFID is sent to the server at the billing counter by a

wireless communication called Zigbee. This paper proposes a system where customers are provided with a card containing credit which can be used while shopping. As each item is placed the repective amount is detected from the card. When the customer finishes his/her shopping,it is sufficient to apporach the billing counter and inform the cashier their trolly number.The bill is created and given to the customer.Since shopping patterns interests buisness intelligence it is crucial to ensure privacy of shopping data. This is where SHARDIS(Privacy-Enhanced Discovery Service) is used. This system is designed to access RFID-based information.SHARDIS mediates the data access and makes sure the store doesn't gain access to customer habits.

II.A survey on RFID Based Smart Shopping System and Automated Billing
Citation:International Research Journal of Engineering and Technology(IRJET), Namith C Thanush S V, Vibhuti Bisht,Vishnu G Upadhya,Prof. Kiran Y C and Indu B
Link: https://www.irjet.net/archives/V10/i3/IRJET-V10I3166.pdf

This paper proposes to analyze and understand the problems faced when RFID tags are deployed at a large scale. Attemp to read multiple RFID tags at once may result in signal collision and data loss.This problem maybe faced when user tries to ineract with tags that are in other readers range.This survey highlights various benefits of incorporating RFID in the shopping system,including a system that can show the user top offers and ratings but lacking proper security and authentication. Another system which ficusses on billing att he exit gates with RFID readers and backend server integration.RFID's role in theft prevenstion is also highlighted.By using various wireless communication modules the system(BLE,GPS,Zigbee,etc) can be altered according to our needs.

III. Smart Billing System Using RFID and Weight Sensors

Citation: International Journal of Advanced Research in Engineering and Technology (IJARET),T.Ganasagar,Bhuvaneswari Balachander
Link: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3553860

This paper presents a billing system that uses RFID and weight sensors. The billing side utilises PLX DAQ which transmits the sensor information to Excel sheets.This system uses smart tags(RFID tag). The RFID reader emits radio waves that creates a magneticfield. Whne the tag is within the field,it's antenna coil captures enrgy from the waves and powers the tag's internal circuit.This eliminates the need for battery.When the customer places the item in the cart,the smart tag on the item is scanned by the RFID reader in the cart. The bill is updated real-time.The same system can deployed for inventory management.It can track date of manufacture and expiration,stcok levels etc and alert the management incase of any discrepency in the data.

IV.Real-Time Cart Checkout Using RFID and IoT

Citation:International Journal of Creative Research Thoughts, Asst.Prof.CH Laxmana Sudheer M. Tech(Ph.D.), N GOPICHAND, V GUNASEKHAR REDDY, V GANESH, S DILLI BABU, CM DHANUSH KUMAR

Link: https://www.ijcrt.org/papers/IJCRT2504355.pdf

This paper proposes a system called Real-Time Cart Checkout Using RFID and IoT . This system utilises RFID technology and Arduino to scans the tag of the item the customer decides to purchase.The detail(product ID) of the product is scanned and sent to a mobile application via Bluetooth. Then this detail is used to obtain pricing details from web server or database.This automates the billing process. This minimizes manual work and ensures faster checkout.

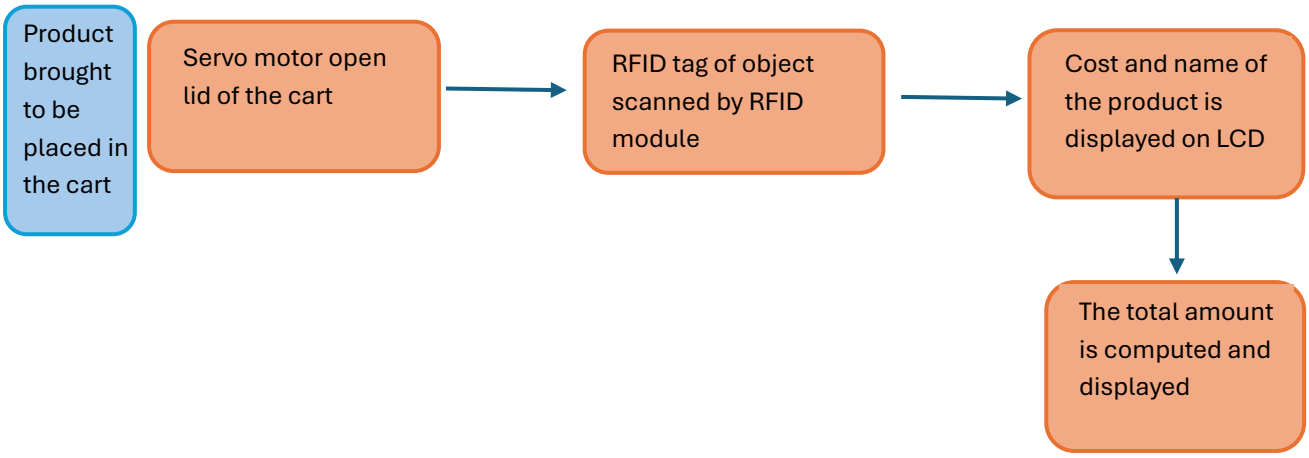
V. IoT-Based Smart Billing System using RFID and Mobile Application Citation:Intelligent Systems and Applications in Engineering, Dr. Meenakshi Thalor, Dr. Riyazahemed Jamadar, Dr. Mrunal Pathak,Dr. Vandana Kale

Link: https://www.ijisae.org/index.php/IJISAE/article/view/6807/5688

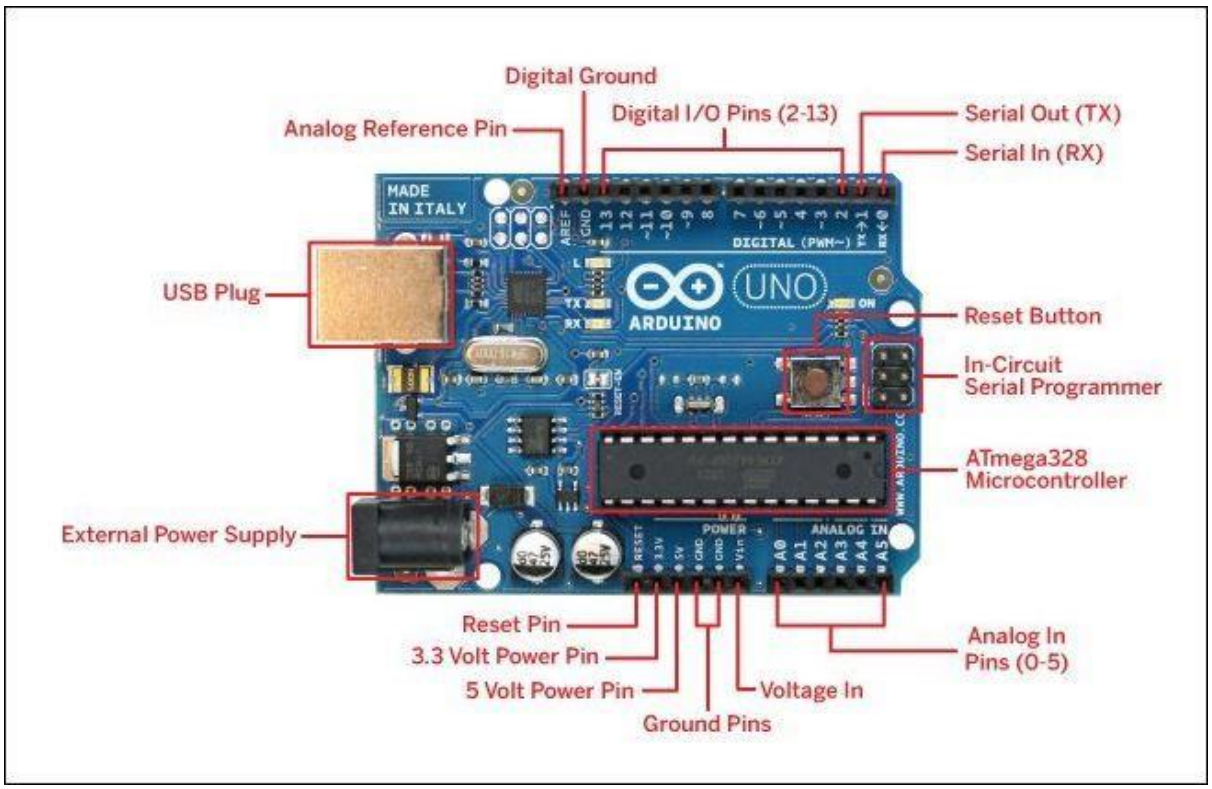
This paper proposes a smart billing system that utilizes Arduino Nano and RFID technology.This project functions with the help of LCD I2C library . This paper also suggests that RFID is a better option than bar code readers.Customers can verify information about the producton the LCD as well as on mobile application.Once the payment is done ,it can be verifies via SMS through GSM module.This ensures smooth transactiona dn pleasant shopping experience.

PROPOSED METHODOLOGY:

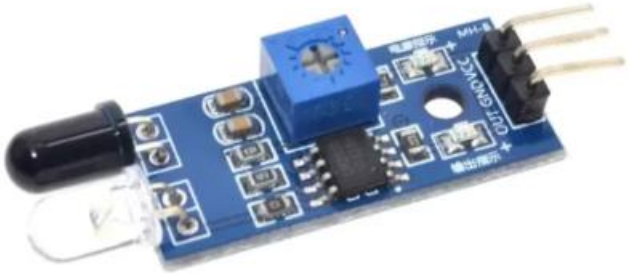
1. BLOCK DIAGRAM



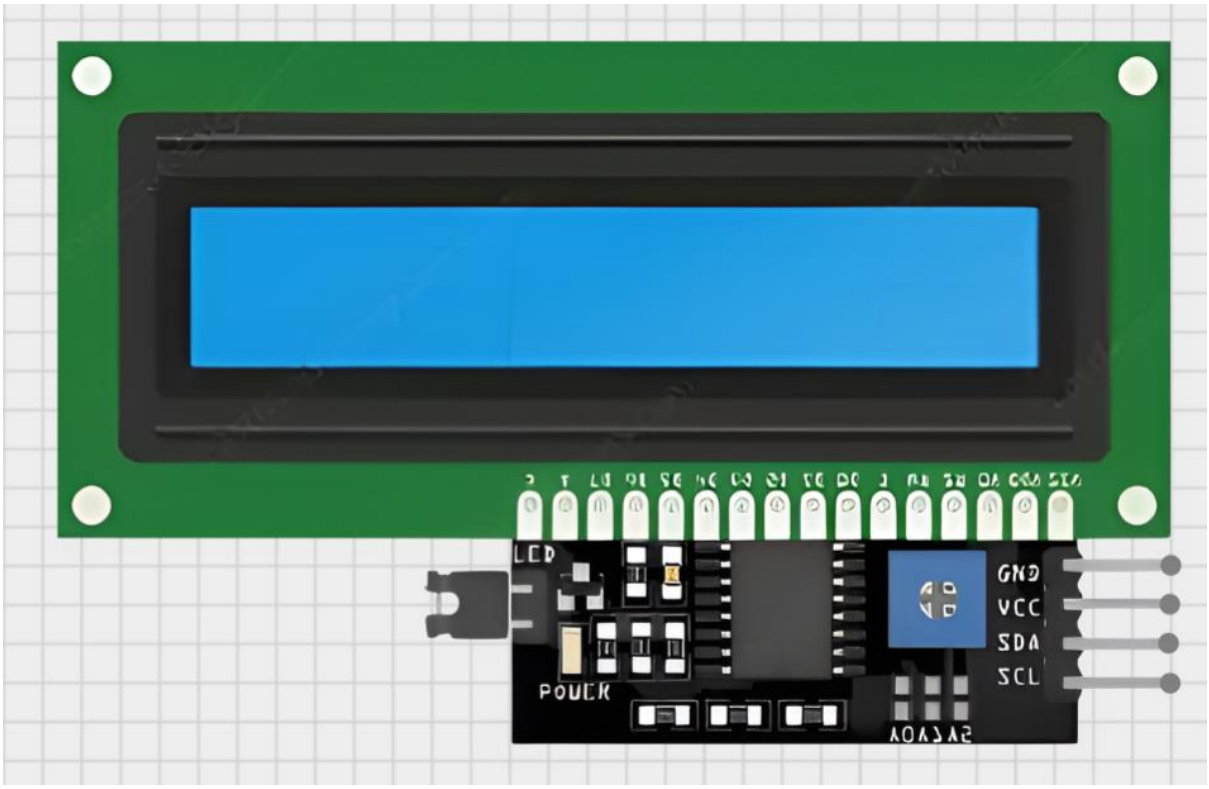
2. PIN DIAGRAM



(i)Arduino UNO



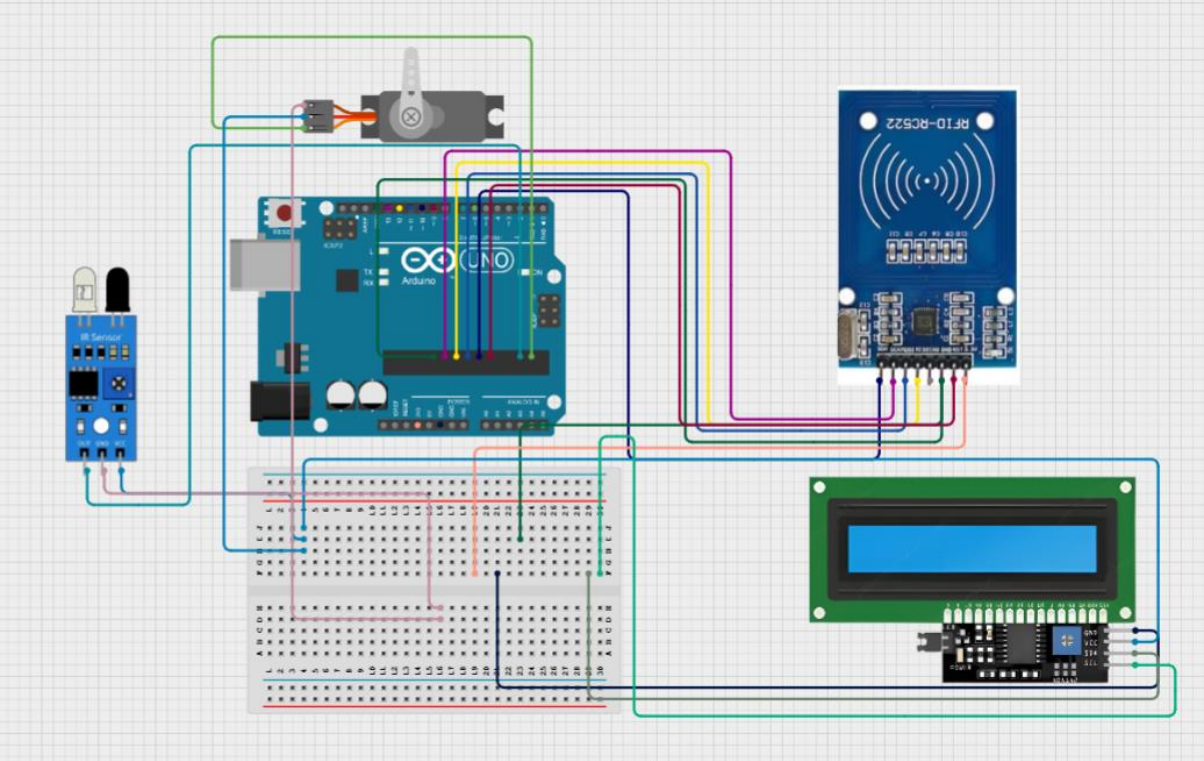
(ii)IR Sensor



(iii)LCD

(iv)Servo Motor

3.CIRCUIT DIAGRAM



4.HARDWARE REQUIREMENTS

a. Arduino UNO
b. Jumper Wires
c. LCD
d. IR Sensor
e. Servo Motor
f. RFID tags

5.SOFTWARE REQUIREMENTS

Arduino IDE

PROGRAM CODE

```
#include <SPI.h>

#include <MFRC522.h>

#include <Wire.h>

#include <LiquidCrystal_I2C.h>

#include <Servo.h>


#define SS_PIN 10
```

```
#define RST_PIN 9
MFRC522 mfrc522(SS_PIN, RST_PIN);

LiquidCrystal_I2C lcd(0x27, 16, 2);  // Check 0x3F if 0x27 doesn't work

Servo myServo;
const int irSensorPin = 7;    // IR sensor output pin
const int servoPin = 6;       // Servo signal pin

int totalAmount = 0;
int cardCount = 0;
const int maxCards = 3;

void setup() {
  Serial.begin(9600);
  SPI.begin();
  mfrc522.PCD_Init();
  lcd.init();
  lcd.backlight();
  myServo.attach(servoPin);
  pinMode(irSensorPin, INPUT);
  myServo.write(0); // Keep lid closed at start

  lcd.setCursor(0, 0);
  lcd.print("Smart Billing");
  lcd.setCursor(0, 1);
  lcd.print("System Starting...");
  delay(2000);
  lcd.clear();
```

```
}

void loop() {
  if (cardCount >= maxCards) {
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("Total Amount:");
    lcd.setCursor(0, 1);
    lcd.print("Rs. ");
    lcd.print(totalAmount);
    while (1);  // Stop further reading
  }

  lcd.setCursor(0, 0);
  lcd.print("Scan Card ");
  lcd.print(cardCount + 1);
  lcd.setCursor(0, 1);
  lcd.print("Waiting...       ");

  if (!mfrc522.PICC_IsNewCardPresent() || !mfrc522.PICC_ReadCardSerial()) return;

  String readString = readRFIDData();
  if (readString.length() > 0) {
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("Reading...");
    delay(1000);

    // Parse item and price
```

```
int commaIndex = readString.indexOf(',');
String item = readString.substring(0, commaIndex);
int price = readString.substring(commaIndex + 1).toInt();

totalAmount += price;

lcd.clear();
lcd.setCursor(0, 0);
lcd.print("Item: " + item);
lcd.setCursor(0, 1);
lcd.print("Price: Rs.");
lcd.print(price);

Serial.println("Item: " + item);
Serial.println("Price: " + String(price));
Serial.println("------------");

cardCount++;
delay(2000);
lcd.clear();

// Wait for hand detection after successful scan
lcd.setCursor(0, 0);
lcd.print("Place Hand Near");
lcd.setCursor(0, 1);
lcd.print("Box to Open Lid");

unsigned long startTime = millis();
while (millis() - startTime < 5000) {  // 5-second timeout
```

```
      int sensorValue = digitalRead(irSensorPin);
      if (sensorValue == LOW) {  // Detected
        lcd.clear();
        lcd.setCursor(0, 0);
        lcd.print("Opening Box...");
        myServo.write(90);   // Open lid
        delay(2000);
        myServo.write(0);    // Close lid
        lcd.clear();
        break;
      }
    }
  }

  mfrc522.PICC_HaltA();
  mfrc522.PCD_StopCrypto1();
}

String readRFIDData() {
  String result = "";
  byte buffer[18];
  byte size = sizeof(buffer);
  byte block = 1;

  MFRC522::MIFARE_Key key;
  for (byte i = 0; i < 6; i++) key.keyByte[i] = 0xFF;

  MFRC522::StatusCode status;
```

```
  status = mfrc522.PCD_Authenticate(MFRC522::PICC_CMD_MF_AUTH_KEY_A, block,
&key, &(mfrc522.uid));
  if (status != MFRC522::STATUS_OK) {
    Serial.println("Auth failed");
    return "";
  }

  status = mfrc522.MIFARE_Read(block, buffer, &size);
  if (status != MFRC522::STATUS_OK) {
    Serial.println("Read failed");
    return "";
  }

  for (int i = 0; i < 16; i++) {
    if (buffer[i] != 0 && buffer[i] != 255) {
      result += (char)buffer[i];
    }
  }
  return result;
}
```

PROBLEMS SOLVED BY THIS SYSTEM:

1.Less Prone to Errors

Traditional system involves manual billing of items hence it is prone to errors such as icorrect prices,missed items or doube billing. This significantly reduces human errors and ensures accurate billing

2. Long Checkout Queus

Manual scanning of all products is often slow.Automating the billing process is much more faster and time efficient. The system scans the items as they are placed in the cart and computes the bill in a matter of seconds.

3.Inventory Management:
Maintaining records becomes easier.Keeping track of all the products manually can be

tedious.This system keeps track of products in the inventory by keeping track of date of manufacture and expiry.

4.Customer experience and services

Faster billing and smooth shopping experience accounts for content customers. This system also ensures transperancy since the customer can view the details .

APPLICATION

- Retail Stores and Supermarkets
  Automating the billing process that is usually time consuming enhances customer convenience,minizes losses occurred and improves buisness for the retailer.
- Multi-Outlet Chains
  The data of multiple outlets can be stored and managed by automating the billing process. These data can be used to gauge customer satisfaction and demand of goods and services.
- Warehouse and Inventory Management
  Warehouse and inventory facilities often have large amount of produce that are hard to manage and keep track of manually. Using this system can prove to be extremely helpful.IT can be used to keep track of expiry dates and send alerts .Since this system can also keep track of the quantity ,in case of any discrepency the retailer can be notified.

INFERENCE

The Arduino, RFID, and IoT-based intelligent billing system greatly simplifies the process of checkout in retail and warehouse settings. Automatically detecting products and billing as the items are pushed into the cart, the system shortens customer waiting times at billing points, decreases errors made by humans, and makes shopping easier. Dynamically updated bill and inventory also enhance operational effectiveness for retailers. The incorporation of IR sensors and servo motors provides an additional level of security and precision, whereby items are effectively scanned prior to being charged. Simulation as well as real-life testing has established heightened responsiveness, accuracy, and customer satisfaction, resulting in this solution being an invaluable innovation for today's retail operations

LIMITATIONS

RFID Tagging Challenges:

It may be challenging to affix RFID tags to some products, particularly those with odd shapes or surfaces, which can restrict the system's use across all products in a store.

System Complexity and Setup Cost:

The setup of RFID and IoT infrastructure initially can be costly and technically demanding, involving specialized hardware, software, and integration with existing systems.

Power and Network Dependency:

The system is dependent on constant power and, in certain deployments, consistent network connectivity. Network downtime or loss of power may compromise operations, impacting both billing and security functionality.

Security and Privacy Issues:

RFID systems are susceptible to hacking or unauthorized usage, with the risk of transmitting sensitive product or customer information. Strong security protocols are needed to preclude these threats

FUTURE WORKS

- Integration of AI and Machine learning to analyze customer buying patterna nd draw useful conclusions.
- Clound based billing system to access,monitor and manage purchase of items in large scale.
- Enhance the wireless communication between cart and billing counters using other wireless IoT protocol like Zigbee.
- While implementing this billing system in large scale,blockchain technology can be used for maintaining secure and tamper-proof payment records.

REFERENCES

Youtube-https://youtube.com/shorts/ZZO3dIJ6BVE?si=bGzOFg3X7TgybowR

Cirkit diagram- https://app.cirkitdesigner.com/project

https://components101.com/sensors/ir-sensor-module

https://www.arduino.cc/en/Guide/HomePage

https://circuitdigest.com/microcontroller-projects/arduino-servo-motor-control