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A Project Report on

“S-MART”

Submitted in partial fulfilment for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

ROBOTICS AND AUTOMATION ENGINEERING

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CERTIFICATE

This is to certify that the project work titled “S-MART” is carried out by **Yashas Kumar T (19BTRRA016), B Shashidhar Reddy (19BTRRA008), Aravind Vishwanath Chindi (19BTLRA002), Macha Avinash (19BTRRA014)** are bona fide students of Bachelor of Technology at the Faculty of Engineering & Technology, JAIN DEEMED-TO-BE UNIVERSITY, Bengaluru in partial fulfilment for the award of degree in Bachelor of Technology in Robotics and Automation, during the academic year **2021-2023**.

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Signature of Students

ABSTRACT

Modern technology has improved people's living standards. This leads to large crowds in the mall. To manage large crowds, we need to reduce payment processing times. S-MART relies on cutting-edge devices and technology to simplify and reduce the time required during shopping inside the super market. This is done using the RFID-based smart shopping system. The items placed in the smart cart are read one by one and the invoice is generated and displayed. Once the final invoice is generated, the customer will pay the bill. The goal is to reduce consumption of the time required for the payment system.

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CHAPTER - 1

INTRODUCTION

1.Introduction:

Urban cities are crowded with people in shopping malls to buy their daily necessities. As the market is getting bigger and bigger with a variety of products and consumer tastes have changed. Shopping mall is the centre of attraction because of product discounts, cashless deals, wide range of products such as household, decoration, kitchen, sports, education, stationery, all with available under the same roof. Therefore, we propose a new technology, especially technology in billing, which saves customers' time through efficient billing and savings by smart electric vehicles. By using RFID tags that are tagged for each product in the cart and scanned. Time consuming is seen when customers wait in long queues for an item. RFID can scan so many items is limitless when we look through the barcode. The space required to install the LCD monitor, RFID reader and microcontroller is limited, so the trolley proves to be efficient Hence this project aims to reduce the average time spent by the customer at the shopping mall by implementing automatic billing system using RFID technology. The main aim of the project is to satisfy the customer and to reduce the time spent on the billing process which is to complete the billing process in the trolley rather than waiting in a queue even for one or two products. The customers must add the products after a short scan in trolley and when the shopping is done the finalized amount will be displayed in the trolley. All this is the representation of the below Fig 1.0.



Fig 1.0 Present Scenario in Mall's

1.1 Literature survey:

Before we start practically working on our project, we had to do a lot of theoretical work which includes reading research papers to get a clearer image of recent advancements in the field of smart shopping. In-fact we believe research is the most essential phase of our project because this is the first time we are working on this project and it's a challenge for us. So, to make ourselves feel comfortable with this project it was quite necessary for us to understand smart shopping & its various application and the ongoing researches in this field. People have consistently imagined and built up an innovation to help their needs from the start of the humanity. The main reason for these innovations has been limiting errands and making the regular tasks quicker and simple. A task on which people are discovered spending significant measure of time is going for shopping and purchasing the products needed. In olden days we used manual billing using pen and paper then we started using the barcode system but after some years it also started to have issues like LOS (line of sight), increasing queue etc. So, to overcome this issue a concept of smart shopping with RFID technology was proposed.

To conduct a healthy literature review we looked for a variety of research paper 's all based on smart shopping and then we filtered the selected paper 's based on their relevance with the topic of our project.

Some of the research papers that we picked up to study and analyse include the following papers:

- [1] Mobeen Shahroz, Muhammad Faheem Mushtaq, Maqsood Ahmad¹, Saleem Ullah, Arif Mehmood, And Gyu Sang Choi “Smart Shopping ”, 2020
- [2] T.R. Lekhaa, S. Rajeshwari, J. Aiswarya Sequeira, S. Akshaya “Intelligent Shopping Cart”, 2019
- [3] Vaishali Rane, Krutik Shah, Kaushal Vyas, Sahil Shah, Nishant Upadhyay Smart cart Using RFID Jan 2019

This framework is utilized as a part of spots, for example, general stores. It can help in diminishing labour and in making a superior shopping background for the clients. Rather than influencing the clients to hold up in a long line while looking at, the framework robotizes the charging procedure. The client can likewise track the subtle elements of the acquired things and additionally the present bill sums on the screen.

1.2 Limitations of the Current Work:

1. Express retail self-checkout counters:

Retail checkout counters are one of the most seen types of checkout counters, seen in most stores today. The simplicity of self-checkout counters is one of its main advantages: the customer uses a machine to scan items and puts them in a bag.

2. Cost of space:

When it comes to cost of space, checkout counters take up less space than registers. Since self-checkout is typically faster than registers, there is typically one queue per several checkout counters, which saves additional space.

3. Efficiency:

When it comes to efficiency, here are some of considerations about self-checkout counters: Reduced wait times compared to using a cashier lane. However, the speed of transaction is significantly lower compared to some of the other systems covered in this article. Reduced labour costs as one member of staff can overlook several self-checkout counters.

4. Customer experience:

Speed of transaction, perceived control, reliability, ease of use and enjoyment are the most influential factors leading to customer satisfaction. Taking this into account, smart checkout is the form of checkout is at an advantage compared to cash registers.

5. Mobile scanners and smart carts:

A next-level self-checkout system compared to counters are mobile scanners and smart carts. They allow shoppers to scan goods as they add them to the shopping basket or cart using store- provided technology.

1.3 Problem Statement:

As seen in shopping malls barcode system is used for billing of the product. This system makes customers to wait in a long queue for billing of their shopping products. This system is invented by using Microprocessor and RFID tag. So the customers can scan the products by their own. And no need to pull heavy trolley up to billing counter.

An innovative product with societal sentence it the one that must the comfort convenience and efficiency in everyday life. Purchasing and shopping at big malls is becoming daily activity in metro cities. There will be rush at these malls on holidays and weekends. People purchase different items and put them in trolley. After completion of purchases, one needs to go to billing counter for payments. At billing counter, the cashier prepares the bill using bar code reader which is very time-consuming process and results in long queue at billing counter.

In this Project, we are implementing a system "RFID Based Automatic Shopping Cart" being developed to assist a person in everyday shopping in terms of reduced time while purchasing the main objective of proposed system is to provide technology oriented, low-cost, easily scalable, and rugged system for assisting shopping in person.

1.4 Objectives:

Smart shopping cart start up is to eliminate the long queues and decrease customers' complaints and dissatisfaction, of course, the smart shopping cart also help saves customers' time. With more functions been developed, the smart shopping cart could provide customers more. The objective of the project is to make an application platform to purchase items in an existing shop. The main concept of the S-MART system is designed into an automated self-checkout system on a shopping trolley with a user interface on a smartphone which allows customers to make payment for items scanned and placed in the trolley before leaving the entrance of the store. In order to build such an application complete web support, need to be provided. A complete and efficient web application which can provide the shopping experience is the basic objective of the project. The web application can be implemented in the form of an android application with web view.

1. The S-MART is an autonomous mart which uses advanced technology for autonomous shopping experience.
2. The goal of S-MART is to use advanced technology which totally differs from a regular mart, where S-MART is equipped with scanners and tags using sensors which allows users to buy products without any difficulty.
3. To Provide customers a hassle-free experience and make them feel they are in a store equipped with technology and smartness.

1.5 Methodology:

The product in the smart trolley, the Radio frequency ID reader automatically senses the product by scanning the tag. And its corresponding electronic product code number is generated automatically. To store the item price and total billing data, microcontroller memory is used LCD display. The RFID tag is attached to a product and the reader (EM-18) is attached to the trolley When a person puts that product in the trolley the RFID reader automatically scans the products and the details regarding the product name, cost, quantity is displayed on the LCD.

At the time of purchase, the tag attached to the product is scanned by the reader. Each tag has a unique Encased on the Electronic Product Code™ (EPC) received by the

Microcontroller; the information of the product is displayed on the LCD along with the updated cost. This information is also sent to central PC with transmitter at the trolley and at the PC. If the customer wants to remove the added product, the product should be scanned again. Then the cost of the corresponding product will be deducted from the bill. And the final bill is displayed on the LCD.

1.6 Hardware and Software tools used:

Software Requirements:

The design and implementation details for the Smart Mart the client module, the server module, and the indoor positioning module. In this preliminary study, we focus on building a complete functioning prototype that seamlessly integrates the three components. We leave sophisticated optimization of the individual components for future development.

The client side of Smart Mart is in the form of an application, coded in Frontend contains CSS, html, JavaScript. Backend contains – python. CSS for rendering (rendering is a process used to develop and render graphics and interfaces and integrate UI). HTML for webpage design.

- JavaScript for connecting the different pages and links of the website. The mobile app features two screens: a search screen and a map.
- HTML (Hyper Text Markup Language) HTML is a syntax used to format a text document on the web.
- CSS (Cascading Style Sheets) CSS is a style sheet language used for describing the look and formatting of a document written in a markup language.
- C/C++ programming language will be used Arduino configuration
- PHP Language to maintain the database.

Hardware Requirements:

- Arduino Nano
- Lcd Display
- Em-18 Chip
- RFID Tag
- Shopping cart or shopping trolley

CHAPTER 2

BASIC THEORY

Shopping is easy but waiting on the counter to pay the bill after shopping is heavy and tedious task. High volume rush and cashier preparing bill with barcode scanner takes too much time and leads to long queues. So here we have done a creative project that will be placed in the cart itself.

The system includes an RFID reader controlled by microcontroller. So, every time a buyer places a product in the cart, it will be detected by the RFID module and displayed on the LCD with price of the product. As the buyer adds more stuff, it will be detected by the module and the price will increase accordingly. If the customer changes his mind and does not want to add the product to the cart, the customer can delete the product and the added price will be automatically deducted.

Each product has an RFID tag that contains a unique identifier. Through to the RFID reader, the product is automatically scanned. Product details will be displayed on the LCD screen after scanning. It has an RF module that acts as a radio frequency transmitter and receiver. At the end of the purchase, the customer presses the button which, when pressed, will add all products along with its price and give the total bill payable. On exit for verification, the seller can verify the purchase with the primary card. The system is therefore suitable for use in places such as supermarkets, which reduces labour and creates a better shopping experience for customers.

The design of the smart shopping trolley system includes hardware and software parts. The hardware part includes the main components as Arduino Nano, RFID tag, RFID reader, LCD screen, EM-18, Power Supply. Arduino IDE (Integrated development environment) used as software part of this project.

CHAPTER 3 TOOLS DESCRIPTION

Hardware Tools Description

3.1 Arduino Nano

The **Arduino Nano** is a small, complete, and breadboard-friendly board based on the ATmega328P released in 2008. It offers the same connectivity and specs of the Arduino Uno board in a smaller form factor. The Arduino Nano is equipped with 30 male I/O headers, in a DIP-30-like configuration, which can be programmed using the Arduino Software integrated development environment (IDE), which is common to all Arduino boards and running both online and offline. The board can be powered through a type-B mini-USB cable or from a 9 V battery.

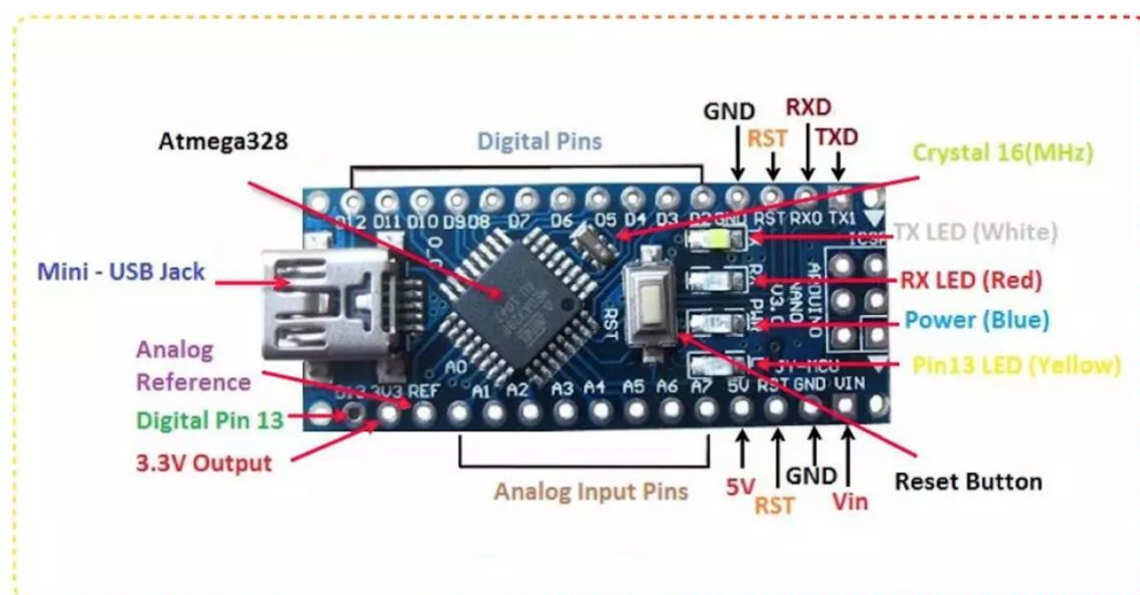


Fig 3.1 Arduino Nano

Table 3.1 Arduino Nano Technical Specifications:

Microcontroller	ATmega328P – 8-bit AVR family microcontroller
Operating Voltage 5V	5V
Input Voltage Limits	5-20V

Analog Input Pins	8
Dc per I/O Pins	40 mA
Flash Memory	32 KB
SRAM	2 KB

3.2 Em-18 Chip

Radio Frequency Identification (RFID) is the wireless, contactless use of radio frequency electromagnetic fields for data transmission for the purpose of automatically identifying and tracking tags attached to objects. The card contains information that is stored electronically. This EM-18 RFID reader is a small, easy to use RFID reader module. With the built-in antenna, the only problem is the 2mm spacing between the pins. Power on the module, hold the card, and get a serial string output containing the unique ID of the card. EM-18 RFID reader is one of the commonly used RFID readers to read 125KHz tags. It features low cost, low power consumption, small form factor and easy to use. The module radiates 125KHz through its coils and when a 125KHz passive RFID tag is brought into this field it will get energized from this field.



Fig 3.2 EM-18 Reader

Table 3.2 Specifications and Features of EM-18 RFID Reader Module: -

Operating Voltage	5V DC Supply
Reading Distance	6-10 cm
Read frequency	125 kHz
Current	<50 mA
Operating Frequency	125 KHz
Operating temperature	0°C to +80°C
Reading distance	10cm, depending on TAG
Size	32mm(length) * 32mm(width) * 8mm (height)

3.3 Lcd (Liquid Crystal Display)

A 16x2 LCD show is an essential module that is generally utilized in various gadgets and circuits. These modules more than seven sections and other multi fragment LEDs are liked. The reasons being: LCDs are affordable; effectively programmable; have no restriction of showing exceptional and even custom characters. A 16x2 LCD implies 16 characters can be shown per line and 2 such lines exist. Each character is shown in a lattice of 5x7 pixels in this LCD. There are two registers in this LCD, in particular Command and Data. LCD displays designed around LCD NT-C1611 module, are inexpensive, easy to use, and it is even possible to produce a readout using the 5X7 dots plus cursor of the display. They have a standard ASCII set of characters and mathematical symbols. For an 8-bit data bus, the display requires a +5V supply plus 10 I/O lines (RS RW D7 D6 D5 D4 D3 D2 D1 D0). For a 4-bit data bus it only requires the supply lines plus 6 extra lines (RS RW D7 D6 D5 D4).

The directions given to the LCD are put away by the order register. An order is a direction given to LCD to play out a predefined assignment, for example, introducing it, clearing its

screen, setting the situation of the cursor, controlling presentation, and so forth. The information register will store the information that will be shown on the LCD.



Fig 3.4(a) LCD Display



Fig 3.4(b) LCD Configuration

Features:

- 5 x 8 dots with cursor
- Built-in controller (KS 0066 or Equivalent)
- + 5V power supply (Also available for + 3V)
- 1/16 duty cycle

3.4 RFID Tag

An RFID tag works by transmitting and receiving information via antenna and a microchip also sometimes called an integrated circuit or IC. The microchip on an RFID reader is written with whatever information the user wants. RFID tags are a type of tracking system that uses smart barcodes in order to identify items. RFID is short for —radio frequency identification, and as such, RFID tags utilize radio frequency technology. These radio waves transmit data from the tag to a reader, which then transmits the information to an RFID computer program. RFID tags are frequently used for merchandise, but they can also be used to track. RFID tag does not require a direct line of sight to the RFID reader, it has a much shorter read range than an active RFID tag. They are small, lightweight, and can potentially last a lifetime.

There are two main types of passive RFID tags: inlays and hard tags. Inlays are typically quite thin and can be stuck on various materials, whereas hard tags are just as the name suggests, made of a hard, durable material such as plastic or metal.

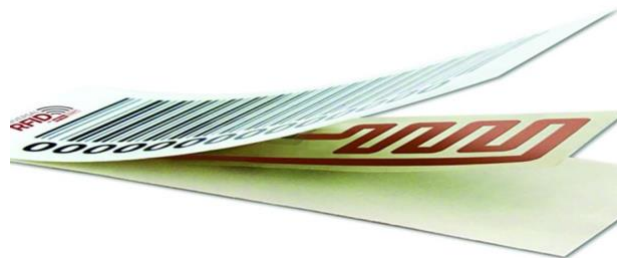


Fig 3.6(a) RFID tag

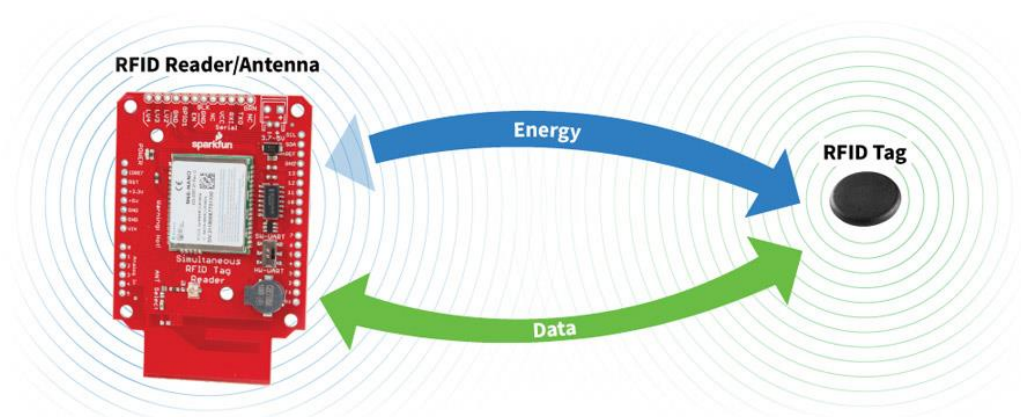


Fig 3.6(b) RFID transmission

Features of RFID tag

- A unique ID
- Automatic recognition
- No need for batteries
- Can detect 'hidden' objects
- Multiple tags can be read at once
- Rugged and weatherproof

CHAPTER 4

HARDWARE & SOFTWARE IMPLEMENTATION

4.1 Operation of the S-MART System

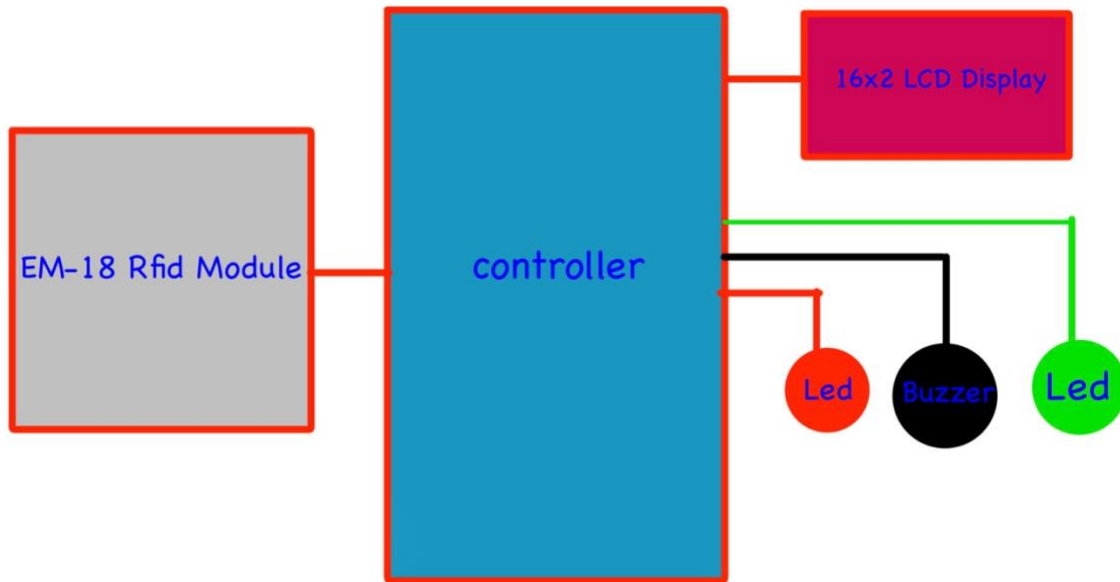


Fig 4.1 Operation of the S-MART System

4.2 Circuit

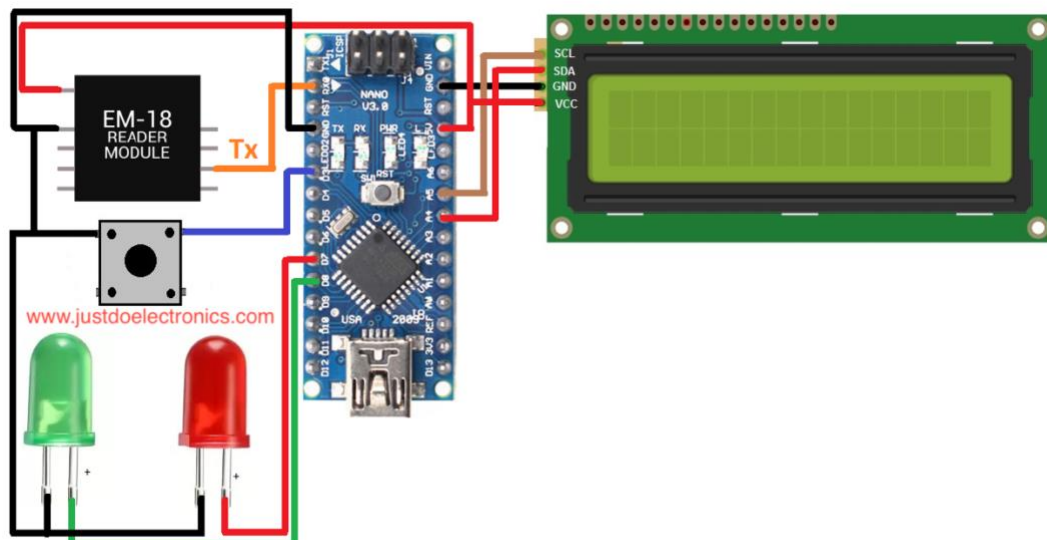


Fig 4.2 Circuit

4.3 EM-18 Circuit

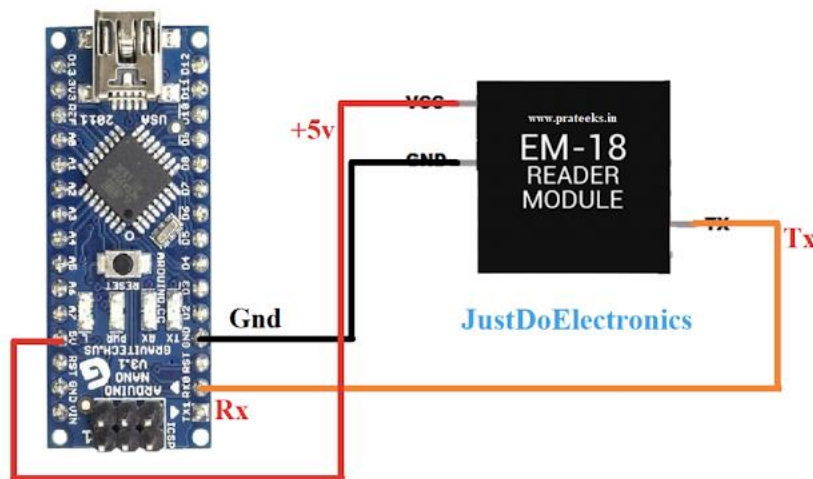


Fig 4.3 EM-18 Circuit

As shown in the block diagram above, the Arduino is interfaced with all the rest of the components. Once the microcontroller is powered by a 9v battery, it is initialized and set to the basic setting, the system is now ready to proceed meaning tags and RFID tags can be scanned. Then the RFID tag or tag is scanned, the RFID reader will retrieve all the details of the scanned item or tag and if the scan is successful, the product details will be transferred to the memory of the microcontroller. , which will then be transferred to the LCD module which will be displayed on the LCD. After the shopping is done, all the invoice details will be displayed on the LCD screen, each card or card acts as a product, where the product details are predefined or put on the card.

4.4 Software algorithm

The whole working process is done by software called Arduino IDE. Proteus simulation software is used to verify simulation results before hardware deployment.

Step 1: Start

Step 2: When the system is powered on, the initial data is displayed.

Step 3: Scan your product RFID.

Step 4: Scan the card successfully, get all personal information and display it on the LCD screen. If not, please rescan your item. The loop repeats until the scan is successful.

Step 5: Product scan is ready. If a scanned product code is detected, view all product details on the LCD. Otherwise, the product must be scanned until it is detected. This procedure applies to each product.

Step 6: If a scanned product is rescanned, it will be deleted from the memory of the microcontroller and from the current invoice .

Step 7: Finally, to complete the purchase, If the card is successfully scanned, the complete invoice summary will be displayed on the LCD.

Step 8: Stop.

CHAPTER 5

SUSTAINABILITY, ECO-SYSTEM AND WASTE MANAGEMENT

RFID (Radio Frequency Identification) technology is used in a wide range of applications, including inventory management, supply chain management, and asset tracking. While RFID technology offers many benefits, including increased efficiency and accuracy, it can also generate waste that needs to be managed.

5.1 Recycling

Ways to recycle RFID waste:

1. **Metal Recycling:** RFID tags are often made of metal, which can be recycled. When recycling RFID tags, it is important to separate the metal from other materials. This can be done through a shredding process that separates the metal from other materials, such as plastic and adhesive.
2. **Plastic Recycling:** Some RFID tags are made of plastic, which can also be recycled. However, it is important to note that not all types of plastic can be recycled. It is important to check the plastic recycling codes before recycling.
3. **Repurposing:** Some companies repurpose RFID waste by using the tags in other applications, such as in the manufacture of new products or as part of an art project.

5.2 Repurposing

1. **Use Reusable RFID Tags:** Reusable RFID tags can be used multiple times, reducing the need for new tags. This can be done by using a reusable tag that can be reprogrammed with new information. Reusable tags are typically more expensive upfront than disposable tags, but they can save money in the long run by reducing the need for new tags.
2. **RFID Tag Monitoring:** Companies can monitor the lifespan of RFID tags to determine when they need to be replaced. This can help reduce unnecessary waste. By tracking the usage of the tags, companies can identify which tags are still functioning properly and which ones need to be replaced. This approach can help optimize the lifespan of the tags and reduce waste.

5.3 Sustainability

Sustainable ways to store and recycle RFID wastage:

1. **Use Sustainable Materials:** Companies can reduce RFID wastage by using sustainable materials for the tags, such as biodegradable or compostable materials. For example, some companies have developed RFID tags made from biodegradable materials such as corn-starch. These tags can be composted after use, reducing waste.
2. **Recycling Programs:** Companies can partner with recycling programs that specialize in RFID waste to ensure that the tags are recycled properly.
3. **RFID Waste Bins:** Companies can provide RFID waste bins to collect used tags, making it easier for employees to dispose of them properly.
4. **Waste-to-Energy Programs:** Some companies use waste-to-energy programs to generate electricity from RFID waste. This process involves burning the waste and capturing the energy released.

CHAPTER 6

RESULTS & CONCLUSIONS

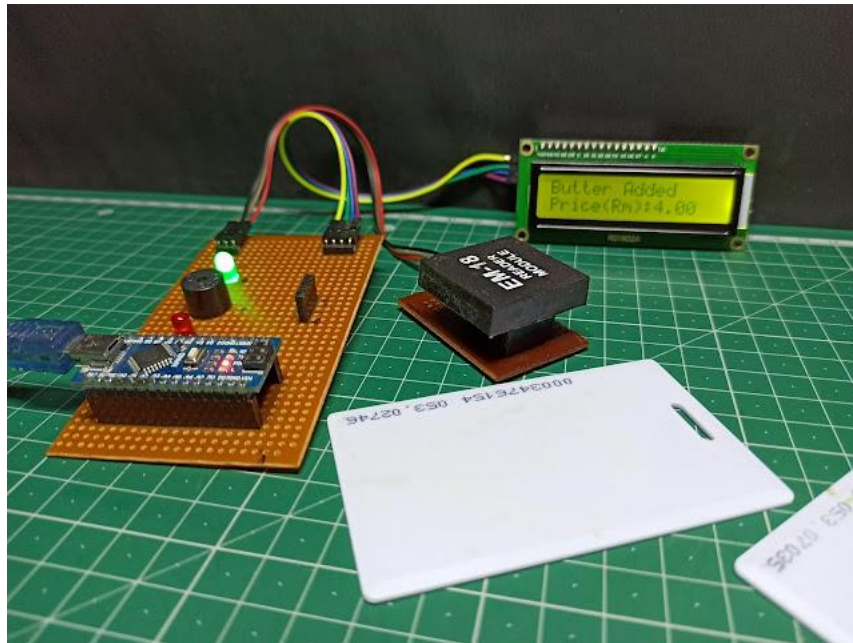


Fig 6.1 Result

Conclusion and Future scope

S-MART is a modern system that offers fast and safe shopping experiences. S-MART supports a bouquet of features that include indoor navigation, fast checkouts, and food tracking.

S-MART interacts with the customers' smart-phone to provide real-time information. The cost associated with offering a premium service to customers is expected to have a high return on investment—with more customers visiting the supermarket for efficient grocery shopping and checkout.

Future works include motorizing and tracking the cart to allow smoother shopping for elderly and kids, and facilitate transportation of heavy items. More over, future work includes accelerating security aspects and database queries using high- performance computing. Many stores have an online presence indicating their type and quantity of goods, but do not indicate an in-store location. Currently the customer must rely on how the products are grouped and employee assistance to locate an item. Imagine if every customer was assigned an employee that knew exactly where everything was, even if it was recently moved.

S-Mart leverages the ideology information retrieval technology to turn the customer's device into a free personal shopping assistant. Our preliminary study has demonstrated the feasibility and promise of the proposed approach.

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