PROJECT REPORT

ON

"SMART SHOPPING TROLLEY WITH AUTOMATED BILLING"

Submitted in partial fulfillment of the requirements for the partial completion of

PROJECT FOR COMMUNITY SERVICE [19EC5PWMP2]

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM

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MPI - 24

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2021-22

Department of Electronics and Communication Engineering

B.M.S COLLEGE OF ENGINEERING

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DECLARATION

We undersigned students of pre-final semester B.E in Electronics and Communication Engineering, BMS College of Engineering, Bangalore, hereby declare that the dissertation entitled "SMART SHOPPING TROLLEY WITH AUTOMATED BILLING", embodies the report of our project work carried out independently by us under the guidance of Suprith Kumar K S, Assistant Professor, E&C Department, BMSCE, Bangalore in partial fulfilment for the award of Bachelor of Engineering in Electronics and Communication from Visvesvaraya Technological University, Belgaum during the academic year 2021-2022.

We also declare that to the best of our knowledge and belief, this project has not been submitted for the award of any other degree on an earlier occasion by any student.

Place: Bangalore

Date: 03-03-2022

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CERTIFICATE

This is to certify that the project entitled **"SMART SHOPPING TROLLEY WITH AUTOMATED BILLING"** is a bonafide work carried out by **Aishwarya.A -** 1BM19EC005, **Chiranjeevi.M** - 1BM19EC035 , **Durga Arpitha P -** 1BM19EC046 and **Varsha.P -** 1BM19EC175 in partial fulfillment for the partial completion of PROJECT FOR COMMUNITY SERVICE [19EC5PWMP2] during the academic year 2021-2022.

Suprith Kumar K S	**Dr.Siddappaji**	**Dr.S.Muralidhara**
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External Examination: **Signature with date:**

1.

2.

ABSTRACT

There has been an emerging demand for quick and easy payment of bills in supermarkets. This project describes how to build an automated and time saving system for the world of retail which will make shopping experience impetuous, customer friendly and secure. In this paper, smart cart is proposed that will be capable of generating a bill from the cart itself. The customer will make the payment in no time through a rechargeable credit card which will help to maintain customer information and balance amount. The designed cart eliminates the effort of self packaging, makes the best use of cart storage space and involves security mechanism in the form of weight module for theft control.

The smart cart uses RFID technology for shopping and payment, weight module for ensuring proper shopping and no malpractice. This innovative system will help the stores to see a rise in their sales along with delighting customers.

ACKNOWLEDGEMENT

Any achievement, be it scholastic or otherwise does not depend solely on the individual efforts but on the guidance, encouragement and cooperation of intellectuals, elders and friends. A number of personalities, in their own capacities have helped us in carrying out this project work. We would like to take this opportunity to thank them all.

We express profound gratitude to respected principal **Dr.S.Muralidhara,** BMS College of Engineering for providing a congenial environment to work in. Our sincere gratitude to **Dr.Siddappaji,** Head of the Department, Electronics and Communication Engineering for encouraging and providing this opportunity to carry out the project in the department.

We would like to thank our guide **Suprith Kumar K S,** Assistant Professor, Department of ECE who helped us in all the ways to carry out the project work. He stood beside and guided us in every step.

We thank all our professors for providing the basic knowledge without which this project wouldn't have been possible. Last but not the least we thank our family and friends, who made their valuable support compelled us to maintain a standard throughout our endeavor.

-

Aishwarya A

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CONTENTS

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION :

Nowadays, if a consumer would like to buy something at a shopping mall, consumers need to take the particular items from the display shelf and then queue up and wait for their turn to make payment. Problem will surely arise when the size of a shopping mall is relatively huge and sometimes consumers don't even know where certain items are placed. Besides, consumers also need to queue for a long time at the cashier to wait for turn to make payment, The time taken for consumers to wait for the consumers in front of the queue to scan every single item and then followed by making payment will definitely take plenty of time. This condition will surely become worst during the season of big sales or if the shopping mall still uses the conventional way to key in the price of every item by hand to the cash register. On the other hand, consumers often have to worry about plenty of things when going to the shopping mall. While doing survey we found that most of the people prefer to leave the shopping mall instead of waiting in long queues to buy a few products. People find it difficult to locate the product they wanted to buy, after selecting product they need to stand in a long queue for billing and payment. To try to solve the problems previously identified, recent years have seen the appearance of several technological solutions for hypermarket assistance. All such solutions share the same objectives to save consumers.

1.2 PROBLEM DEFINITION :

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. 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.

1.3 OBJECTIVE OF THE PROJECT :

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. Customer could either pay their bill by their pre-recharged customer card provided by the shop.

Objectives of our project to achieve the goal:

- This application should be Interactive and robust. The RFID is the connection between virtual world and the reality.
- When products get added or removed from trolley by customer, automatically amount is calculated and displayed.
- At billing section, RFID tag issued to customer is scanned once shopping is completed by customer as he presses shopping end button or switch, it indicates shopping is ended by customer. Automatically bill is generated and amount is paid.
- It has well and effortless user-experience.

CHAPTER 2 : LITERATURE SURVEY

Shopping in the present day usually involves waiting in line to get your items scanned for checkout. This can result in a great deal of wasted time for customers. Furthermore, the technology currently used in checkouts barcodes - is from another era, developed in the 1970s. Today barcodes are found on almost every item. Barcodes are a universal technology in that they are the norm for retail products; stores that own a barcode reader can process barcodes and imprint it on the products. The most important factor that is involved in barcode scanning is that the product should be in the Line of Sight (LOS) of the reader in order to get the barcode imprinted on the product scanned.

2.1 RFID based smart shopping and billing

In [1] this paper explains how to access real time information about the diverse product inside the shopping cart. It included the implementation of smart shelves, which tells when the smart carts enter an aisle and delivered product information to carts. There are many more designs in this area. In all previous designs, customer had to scan the items one-by-one manually, which is not convenient. Difference between RFID and barcode technology is, RFID does not require line of sight reading but barcode depends on it. RFID can achieve distance reading, which intellectually brings the property of IoT.

2.2 Automated Super Trolley Billing System for Super/Hyper Market

In [2] this paper exploited barcode for billing of products, where customer scans the product using barcode technology. The bill will be forwarded to the central billing system where customer will pay them by showing unique id. The limitation of barcode scanning requires line of sight for scanning and it should be fixed within its boundary. Cash register lines optimization system using RFID technology. The RFID is employed for scanning products and the information is stored in the database which could be paid online or in a central bill. It also uses web application to maintain entire shopping details. It requires maintenance of web application server. No necessary steps have been taken for the products that are accidentally dropped into the trolley by the customer.

2.3 RFID based Smart Shopping: An Overview

In [4] this paper states that the number of large as well as small shopping malls has increased throughout the global due to the increasing public demand and spending. Constant enhancement is required in the traditional billing system so as to improve the quality of shopping. To improve the existing system this shopping cart will generate the shopping bill on cart itself with the help of RFID reader. This system will save the time of customers and workload of employees in the mall. At the billing desk, the bill which is displayed on the screen will be transferred to the systems memory. This is possible by the module which is present inside the RFID, which transfers the bill wirelessly. The disadvantages of this system model is that once after displaying the total number of products and price, we have to enter a key and after that no addition or deletion of product will happen.

2.4 Automated Billing Cart

In [6] states that RFID technology provides different kind of services and facilities in the business environment. In this the first shelf transistorized with the weight-sensing mat which is integrated with a RFID reader. The second instance is to design a shopping cart which has a tag and a weight-sensing tool, integrated with the RFID reader that can verify the purchase of the items as the items are dropped into the cart. It directly communicates with the database through the server for the purpose of generating bills. Customer prevails the benefits of this particular system as the long queue has been reduced and time efficiency is improved. This system helps retailers to get more additional product details into their mart and track the entire inventory of the mart.

CHAPTER 3 : METHODOLOGY AND IMPLEMENTATION

3.1 METHODOLOGY

The methodology that we propose is based on the idea of creating an automatic billing system while shopping made possible using RFID. All the products in the shopping malls or supermarkets are provided a unique RFID tag instead of a barcode. Each shopping trolley has its own setup which contains an RFID reader, a push button to make payments , buzzer to indicate any malpractice and an LCD screen to display all information related to the item.

- The RFID reader signals are everywhere with it's promity to detect a tag. When a RFID tag comes in the proximity of the RFID reader the tag detects the readers signal through a coil present in it which converts the received RF signal into a electrical signal. This converted signal alone is sufficient to power up the microchip present in the tag. Once the microchip gets powered up, its function is to send the data (unique ID – EPC – Electronic Product Code) which it is stored in it. The same way the signal came in, it is sent out through the same coil into the air.

- The RFID reader also has a transceiver in it. When the signal comes back from the tag through the antenna of RFID reader it is fed to the demodulator and then decoded by a decoder where the original data can be obtained and then further processed by a microcontroller to detect the item and add it to the total bill amount or deduct the cost based on the count of scanning.

3.2 BLOCK DIAGRAM

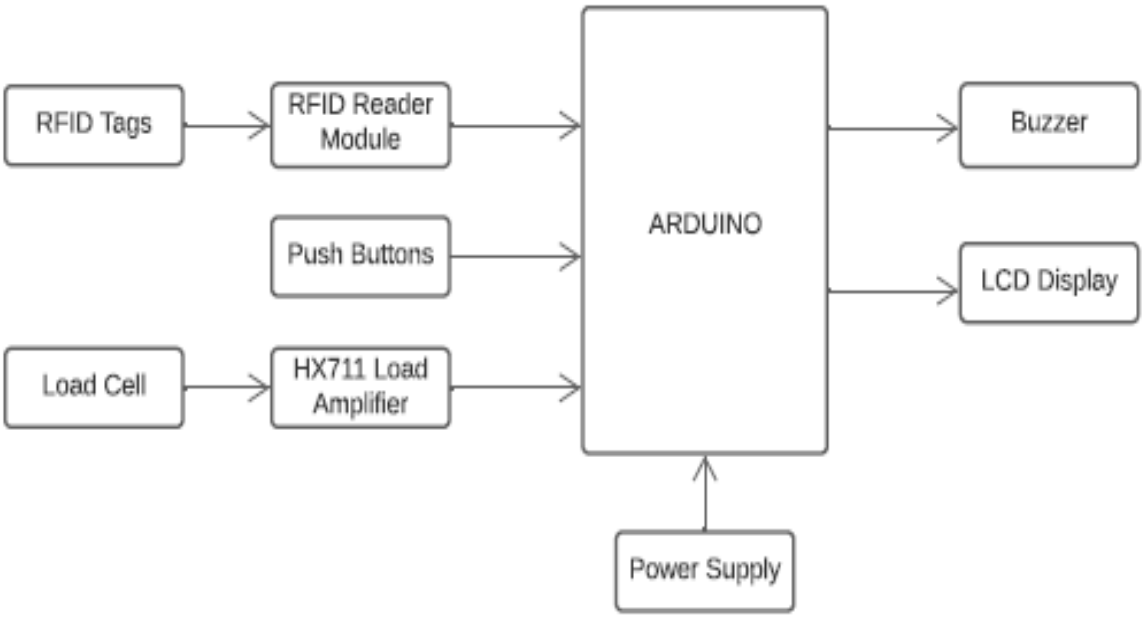

Fig 1. Block Diagram of Automated shopping Trolley

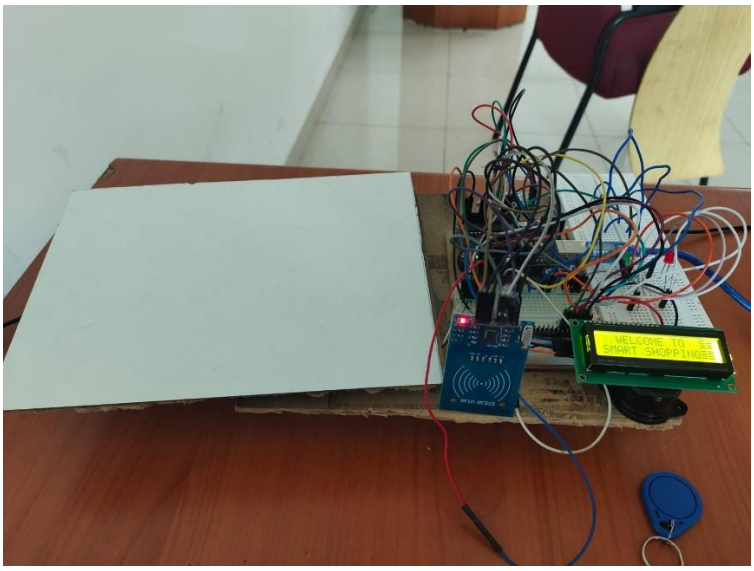

Fig.2 Pictorial Represenation

3.3 HARDWARE DESCRIPTION

3.3.1 Components Description

1. **Arduino :**

Arduino is an open-source AREF stands for Analog Reference. It is sometimes, used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins. electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). Arduino projects can be stand-alone or they can communicate with software on running on a computer (e.g. Flash, Processing, MaxMSP).

ATMEGA microcontroller :

ATMEGA is an 8-bit microcontroller chip that delivers high performance at a low cost. Based on AVR-RISC core for microprocessors, it combines its read-while-write ability with a flash memory that clocks in at 32KB, giving users complete control over the versatile applications of the chip in multiple areas.

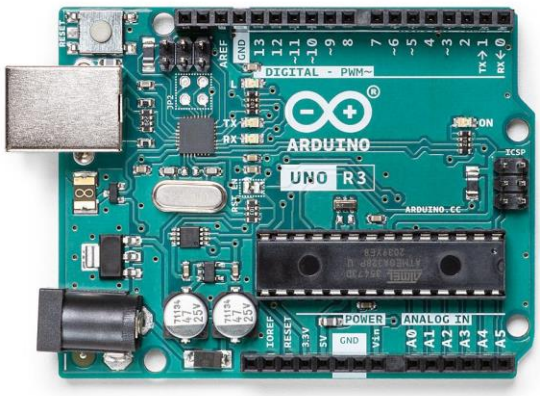

Fig 3. Arduino

2. RFID reader :

An RFID reader is the brain of the RFID system and is necessary for any system to function. Readers, also called interrogators, are devices that transmit and receive radio waves in order to communicate with RFID tags. RFID readers are typically divided into two distinct types – Fixed RFID Readers and Mobile RFID Readers. Fixed readers stay in one location and are typically mounted on walls, on desks, into portals, or other stationary locations. A common subset of fixed readers is integrated readers. An integrated RFID reader is a reader with a built-in antenna that typically includes one additional antenna port for the connection of an optional external antenna as well. Integrated readers are usually aesthetically pleasing and designed to be used for indoor applications without a high traffic of tagged items.

Each trolley is reinforced with an RFID reader, and the type of reader that is used is RFID-RC522. It is a low-cost RFID reader which can also write data into the tags if required and can be directly loaded into the reader module for modulation and demodulation of signals. It operates at 13.6 MHz frequency and can operate wirelessly and handsfree in any environment making it a suitable choice as an RFID reader for a supermarket trolley. It also supports encryption techniques and algorithms and error detection in modules for a reliable experience.

Fig 4. RFID reader module

Fig 5. RC522 with RFID tags

3. RFID Tags :

An RFID tag in its most simplistic form, is comprised of two parts – an antenna for transmitting and receiving signals, and an RFID chip (or integrated circuit, IC) which stores the tag's ID and other information. RFID tags are affixed 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/reader combination. RFID tags typically do not have a battery (unless specified as Active or BAP tags); instead, they receive energy from the radio waves generated by the reader. When the tag receives the transmission from the reader/antenna, the energy runs through the internal antenna to the tag's chip. The energy activates the chip, which modulates the energy with the desired information, and then transmits a signal back toward the antenna/reader.

On each chip, there are four memory banks – EPC, TID, User, and Reserved. Each of these memory banks contains information about the item that is tagged or the tag itself depending on the bank and what has been specified.

Hundreds of different RFID tags are available in many shapes and sizes with features and options specific to certain environments, surface materials, and applications.

Fig 6. RFID Tags

4. LCD display :

LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smartphones, televisions, computer monitors and instrument panels. It is is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. Without the liquid crystals between them, light passing through one would be blocked by the other. The liquid crystal twists the polarization of light entering one filter to allow it to pass through the other.

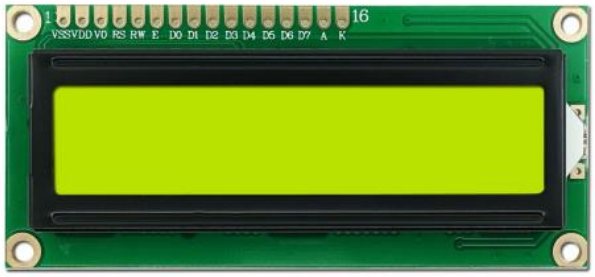

Fig 7. LCD Display

5. I2C [Inter-Integrated Circuit] Driver:

The Inter-Integrated Circuit (I2C) bus is a two wire serial interface originally developed by the Phillips Corporation for use in consumer products. It is a bi-directional bus that is easily implemented in any IC process (NMOS, CMOS, bipolar) and allows for simple inter-IC communication. Connections are minimized by using a serial data line (SDA), a serial clock line (SCL) and a common ground to carry all communications. I2C has gained large acceptance and has even served as a prototype for the System Management Bus (SMBus), which is a subset of I2C. I2C Bus enables 2 devices to communicate with each other in a stable, high-speed, bidirectional way and with the least I/O pins. I2C Bus utilizes 2 lines to communicate, Serial Data Line (SDA) and Serial Clock Line (SCL), so that the protocol I2C uses is also called "bidirectional" protocol.

Fig 8. I2C Driver

5. Push buttons :

A push-button (also spelled pushbutton) or simply button is a simple switch mechanism to control some aspect of a machine or a process. Buttons are typically made out of hard material, usually plastic or metal. The surface is usually flat or shaped to accommodate the human finger or hand, so as to be easily depressed or pushed. It functions as a simple switch that performs a function like payment and reset when it is pressed upon. It sends high voltage electrical signals on feedback generated from the user to set a task in motion.

Fig 9. Push Button

6. Buzzer :

A buzzer is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke. A buzzer is interfaced with the microcontroller to indicate scanning of the product by the RFID reader, and to indicate any kind of malpractice.

Fig 10. Buzzer

7. Load Cell :

A load cell is a force transducer. It converts a force such as tension, compression, pressure, or torque into an electrical signal that can be measured and standardized. As the force applied to the load cell increases, the electrical signal changes proportionally.

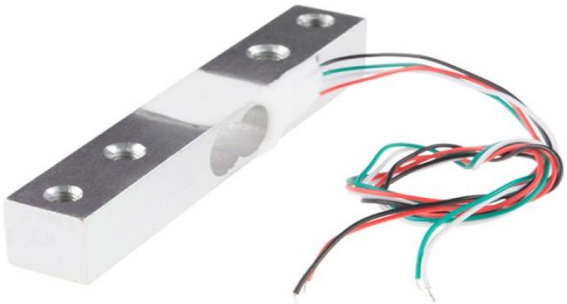

Fig 11. Load Cell

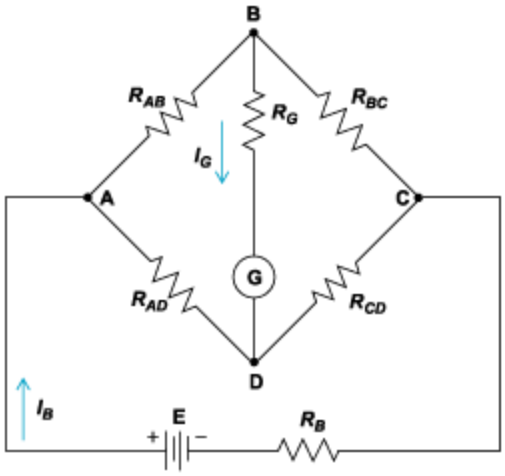

Fig 12. Wheatstone Bridge

The four strain gauges are configured in a Wheatstone Bridge configuration with four separate resistors connected as shown in what is called a Wheatstone Bridge Network.

An excitation voltage – usually 10V is applied to one set of corners and the voltage difference is measured between the other two corners. At equilibrium with no applied load, the voltage output is zero or very close to zero when the four resistors are closely matched in value. That is why it is referred to as a balanced bridge circuit.

When the metallic member to which the strain gauges are attached, is stressed by the application of a force, the resulting strain – leads to a change in resistance in one (or more) of the resistors. This change in resistance results in a change in output voltage. This small change in output voltage (usually about 20 mVolt of total change in response to full load) can be measured and digitized after careful amplification of the small milli-volt level signals to a higher amplitude 0-5V or 0-10V signal.

These load cells have been in use for many decades now, and can provide very accurate readings but require many tedious steps during the manufacturing process.

8. HX711 Load Amplifier :

The HX711 is a precision 24-bit analog-to-digital converter (ADC) that is designed for weighing scales and industrial control applications to interface directly with a bridge sensor.It is specially made for amplifying signals from cells and reporting them to another microcontroller.

The HX711 chip integrates a regulated power supply, an on-chip clock oscillator, and other peripheral circuits, which have the advantages of high integration, fast response, and strong anti-interference.

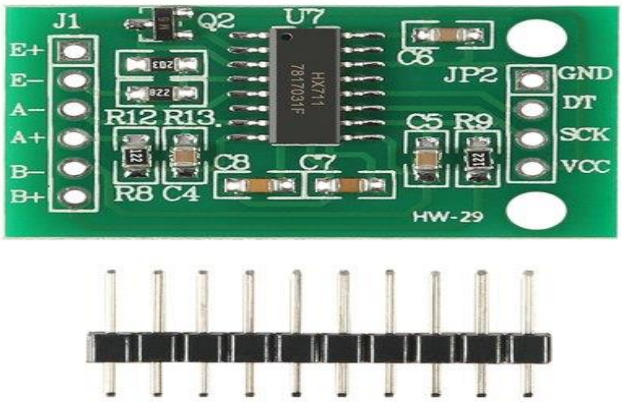

Fig 13. HX711 Load Amplifier

9. Master card :

It is a card used by individual customers to make payments based on their purchase. It contains information like unique identification number, name of the customer and the available balance in his/her card. It can be used as rechargeable debit card for shopping.

3.4 FLOWCHART

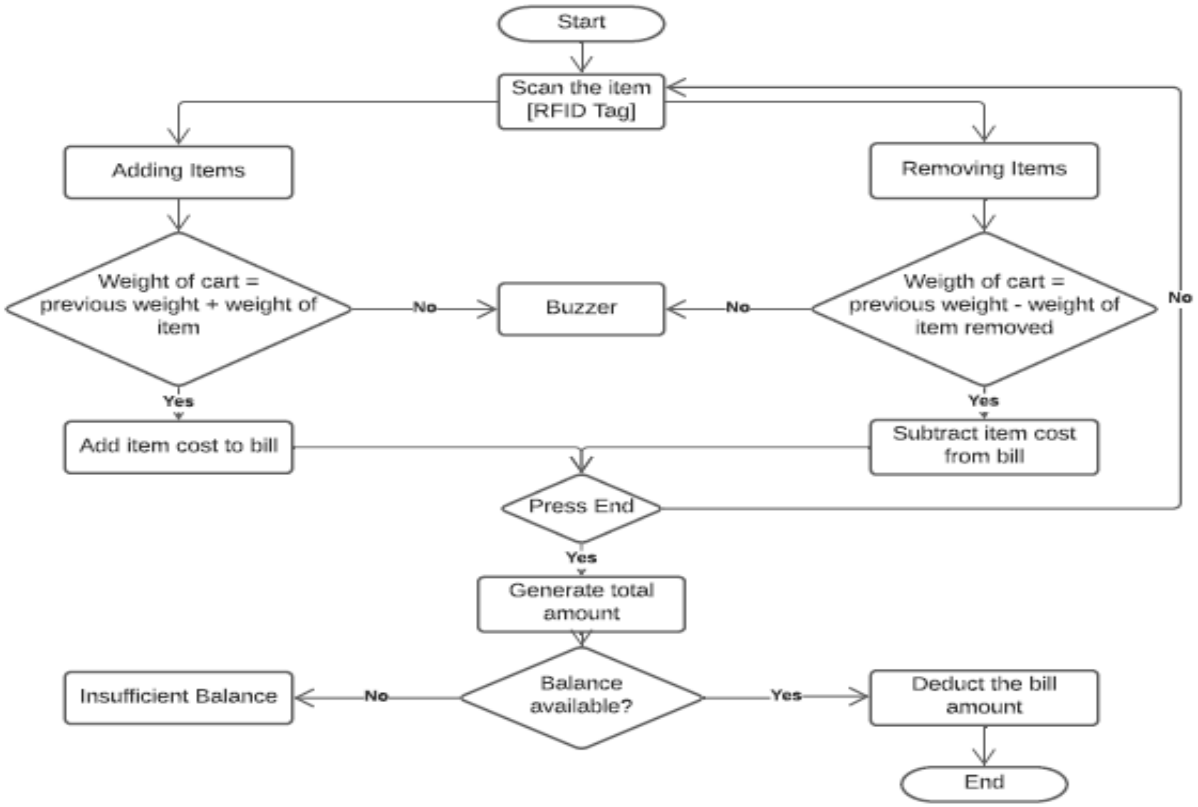

Fig 14. Flowchart of Automated Shopping Trolley

3.5 WORKING

- An RFID tag (of frequency 13.56MHz) is attached to every product in the mall and the reader is attached to the trolley. At the time of purchase, the tag attached to the product is scanned by the reader. Each tag has a unique EPC. Based on the EPC received by the Arduino, the information of the product is displayed on the LCD along with the updated cost

- Weights of each product will also be considered simultaneously after scanning. If the weight of the current item scanned and the previous weight is equal to the weight of the trolley the process continues, else the buzzer is turned on indicating that the customer is cheating.

- 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.

- Now again the weight is checked. If the total weight of the cart is equal to the previous weight – the weight of removed item, the process continues else the buzzer is turned on.

- The push button is provided at the trolley to indicate the end of the shopping. On pressing of push button, the final bill is displayed on the LCD

- The payment through pre charged card can be done which is a master card. Master cards are unique RFID tags provided for each customer. These cards contain the information such as the customer identification number and the balance available in the card. by scanning master cards, payment is done at the trolley itself.

- If the customer doesn't have enough balance in his master card then the buzzer is turned on indicating that he has to recharge his card.

- Finally, LCD shows the balance available in their card after deducting the total bill amount .This whole information is available on the serial monitor of central PC.

3.6 PROJECT PLANNING

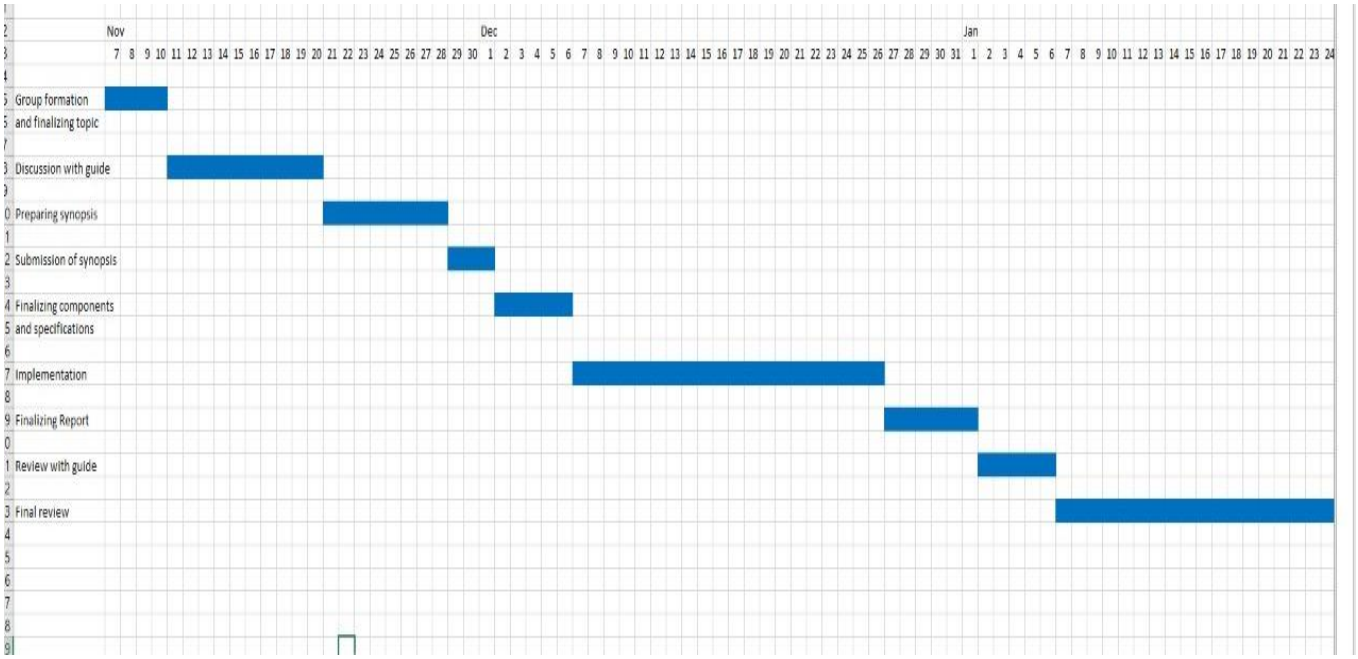

Fig 15. Project Planning Chart

3.7 BUDGET :

1. Arduino	700
2. RFID reader	250
3. RFID Tags and Master card	100
4. LCD display – 16X2	170
5. I2C Driver	100
6. Push buttons	5
7. Buzzer	25
8. Load Cell + HX711 Load Amplifier	400
9. Products	50
TOTAL	1800

CHAPTER 4 : RESULTS AND DISCUSSION

4.1 Results

The proposed model is easy accessible and convenient to use. It does not require special training. The manpower is decreased and will save time that the user spends in billing queue. Many users can be attended in same time which is useful for retailers and customers. Time efficiency and cost efficiency are guaranteed by this smart billing system.

The customer starts shopping by reading his master card. Then he starts adding items which is simultaneously detected by the reader and weights are verified by the reader. If any malpractice is found, the buzzer starts beeping and red LED glows indicating error in shopping.

Results are represented using different scenarios.

1 : Customer starts shopping.

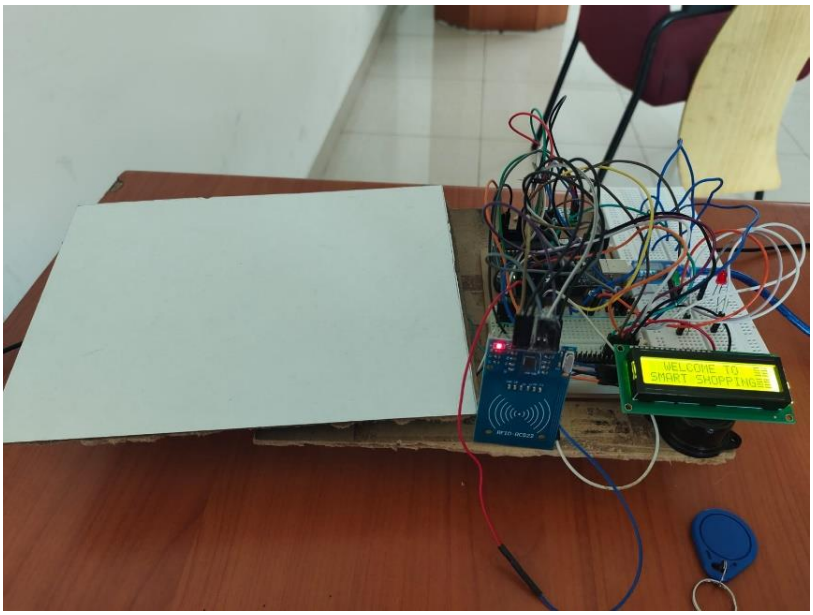

Fig 16. Setup

2 : Master card is scanned, customer information and the balance amount in his master card is displayed.

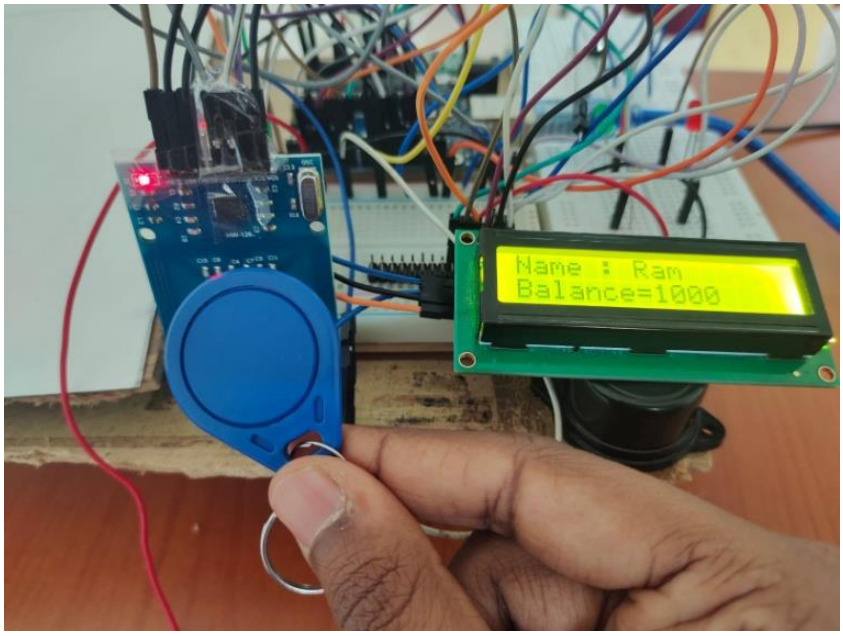

Fig 17. Inserting master card

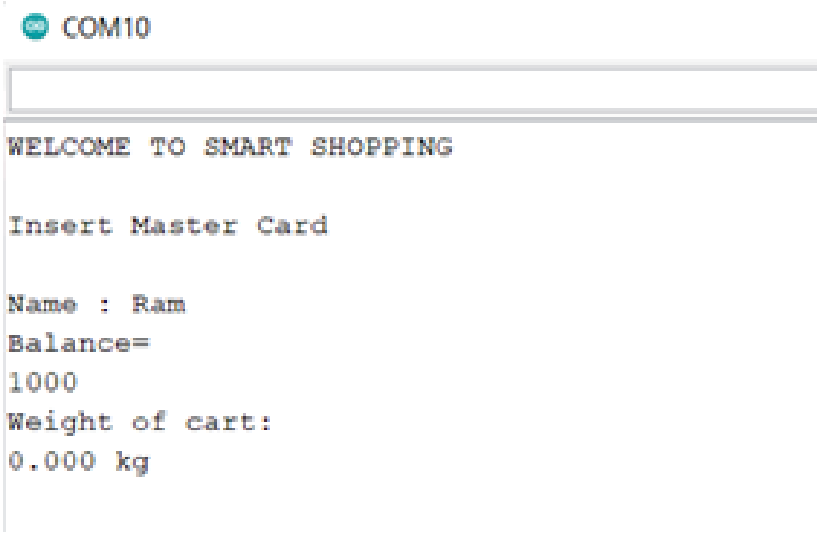

Fig 18. Serial Monitor output during setup

3 : Items is scanned. Its details are displayed and weight is checked.

Fig 19. Item is added

COM10

```
WELCOME TO SMART SHOPPING

Insert Master Card

Name : Ram
Balance=
1000
Weight of cart:
0.000 kg


Soap Added
Price = Rs.50


Weight of cart:
0.083 kg


Weight matched
Total:
50

Continue
```

Fig 20. Serial Monitor output

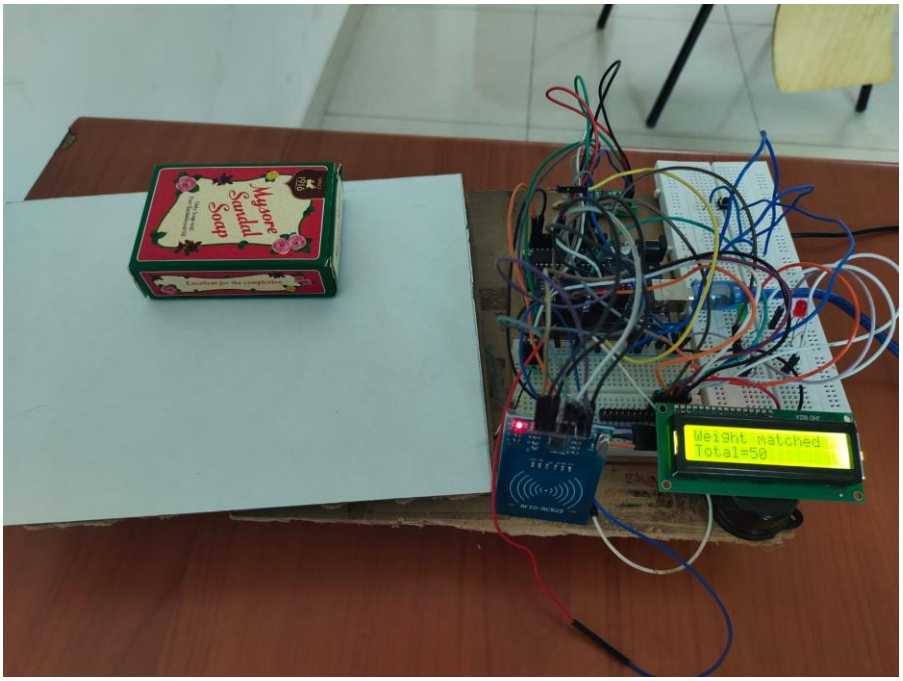

Fig 21. Shopping Cart showing total amount

Fig 22. Adding 1 more item

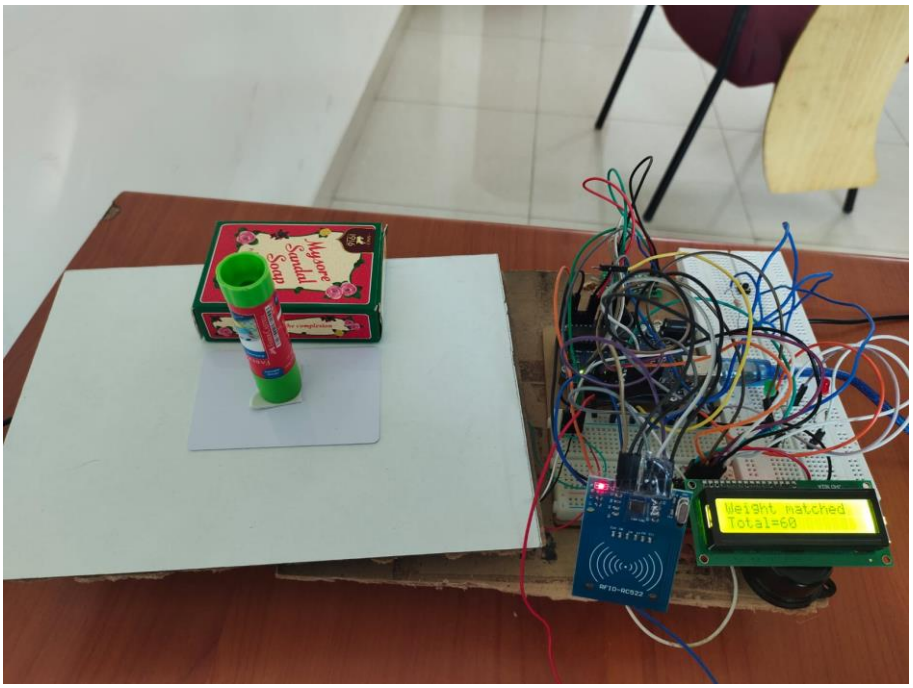

Fig 23. Shopping cart showing total amount

```
WELCOME TO SMART SHOPPING

Insert Master Card

Name : Ram
Balance=
1000
Weight of cart:
0.000 kg


Soap Added
Price = Rs.50


Weight of cart:
0.085 kg


Weight matched
Total:
50

Continue
Glue Added
Price = Rs.10


Weight of cart:
0.107 kg


Weight matched
Total:
60

Continue
```

Fig 24. Serial Monitor Output

4 : Item is removed. Its details are displayed and weight is checked.

Fig 25. Displaying Removed item

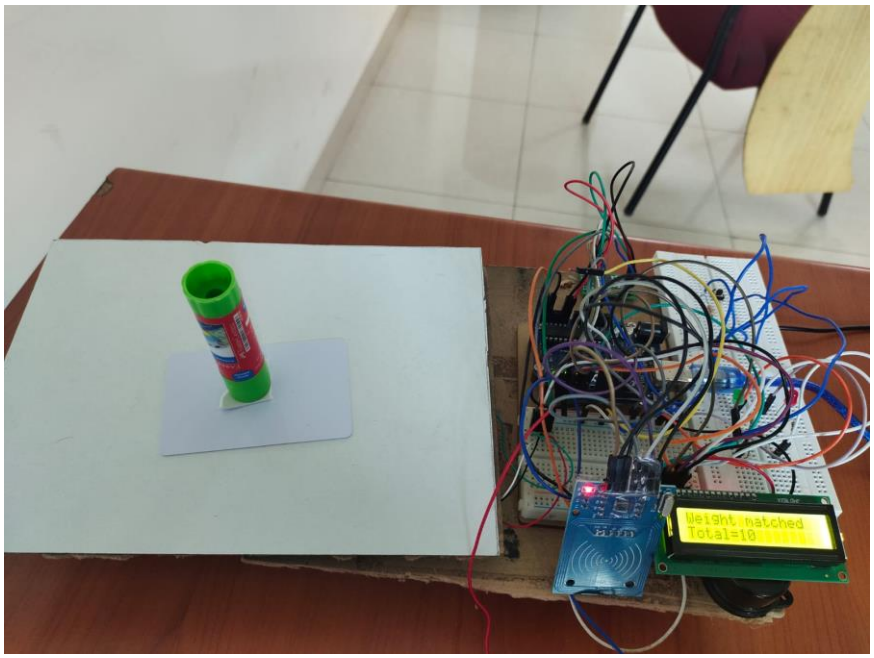

Fig 26. Cart showing total amount after removing an item

```
Continue
Soap Removed
Price = Rs.50


Weight of cart:
0.023 kg


Weight matched
Total:
10

Continue
```

Fig 27. Serial Monitor Output

5 : If item 1 is scanned and Item 2 is removed. Weight is imbalanced, buzzer starts beeping and red LED turns ON.

Fig 28. Indicating malpractice

```
Weight of cart:
0.022 kg


Weight matched
Total:
10

Continue
Soap Added
Price = Rs.50


Weight of cart:
0.155 kg


Weight not matched
```

Fig 29. Checking weight and detecting malpractice

6 : After customer is done shopping, he presses push button. Ending message is displayed and total amount, balance is displayed.

Fig 30. Displaying message after shopping ends

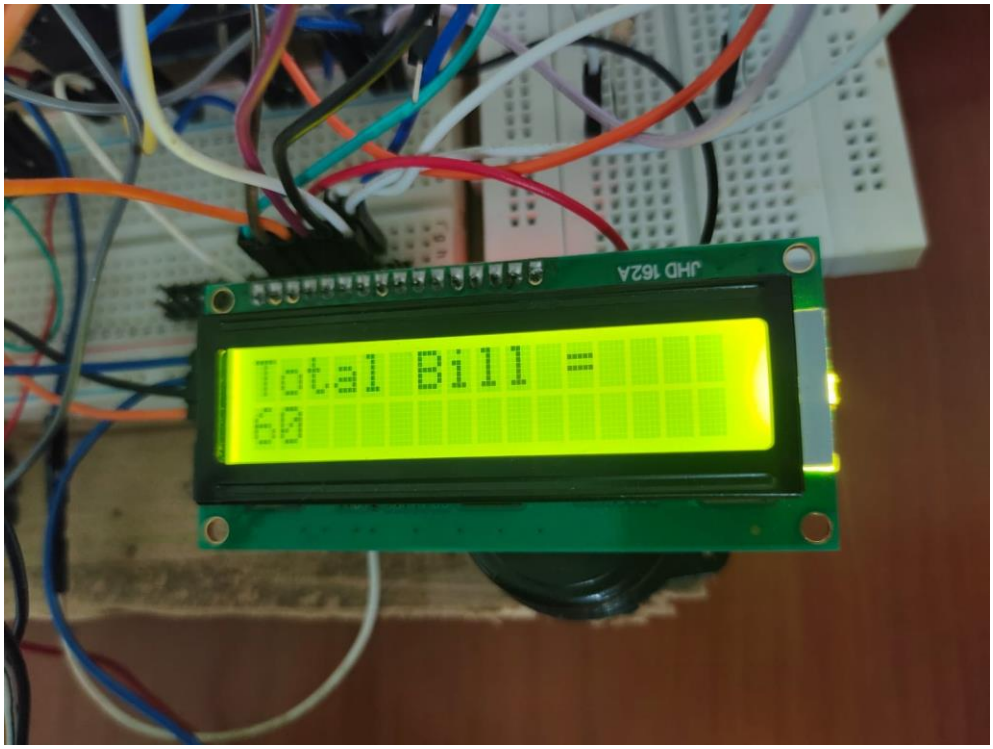

Fig 31. Display total bill after pressing finish button

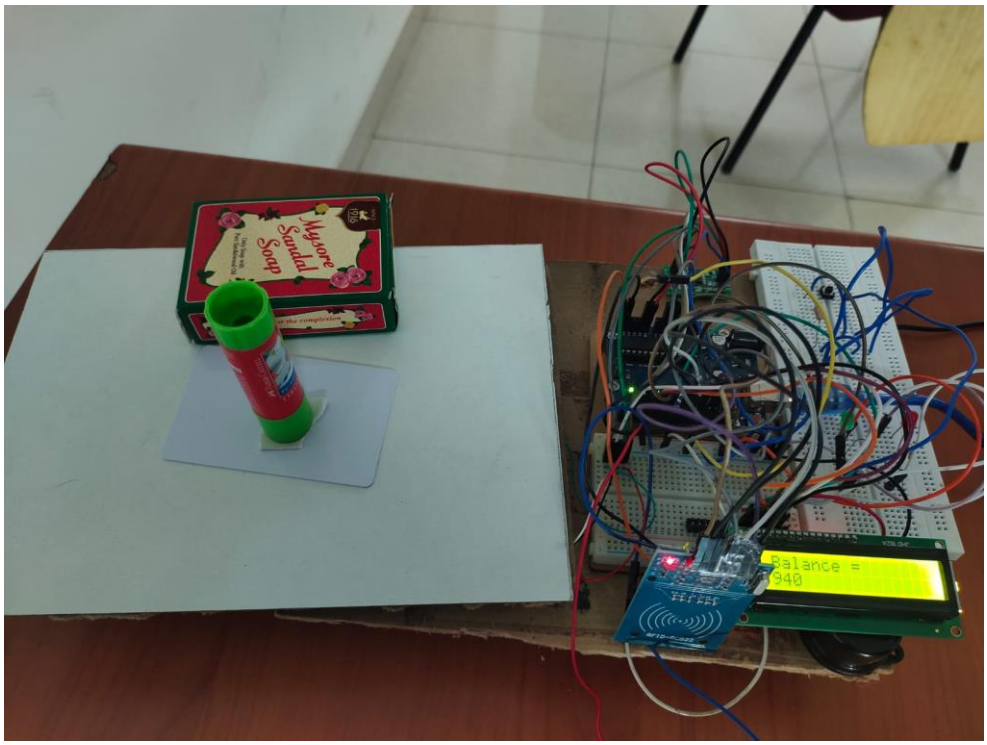

Fig 32. All shopped items and balance in master card is displayed

```
Weight of cart:
0.107 kg


Weight matched
Total:
60

Continue
THANKS FOR SHOPPING


TOTAL BILL AMOUNT =
60

BALANCE AMOUNT =
940
```

Fig 33. Serial Monitor output after shopping is completed

7 : If balance is insufficient, error message is displayed.

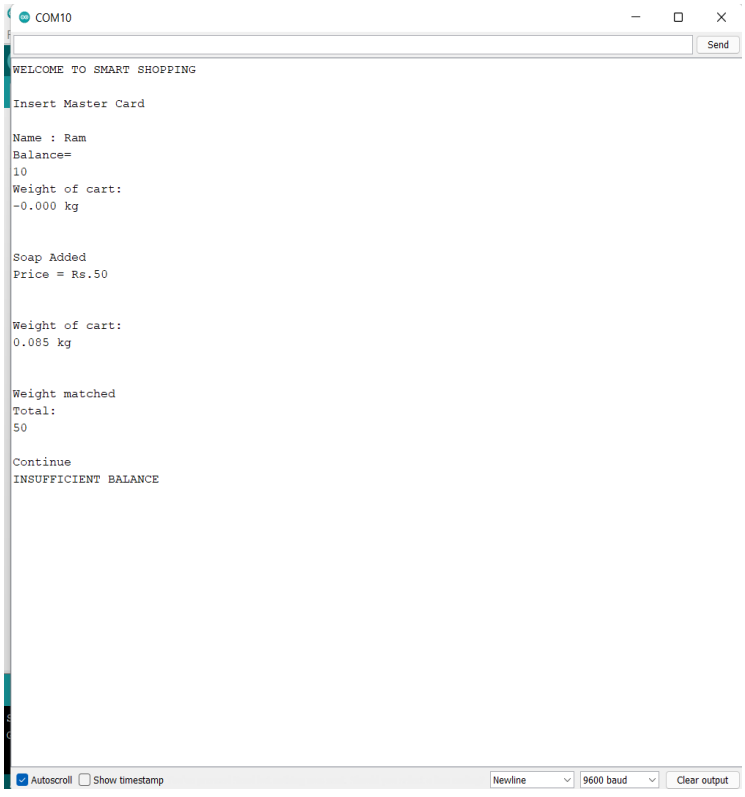

Fig 34. Displaying insufficient balance

4.2 Advantages

- This system helps in achieving a faster billing system.
- It helps buyer to know the bill details in advance so that they can plan accordingly in affordable prices.
- Helps in business promotions for the supermarkets by gaining more customers providing quick service.
- Easy to use and does not need any special training.
- Introduction of artificial intelligence increases profit for sellers

RFID advantages over barcodes:

1.No line of sight required for reading

2. Multiple items can be read with a single scan

3.Each tag can carry a lot of data (read/write)

4.Individual items identified and not just the category.

5.Passive tags have a virtually unlimited lifetime.

4.3 Applications

There are two main area of applications, defined broadly as proximity (short range) and vicinity (long range). Long range or vicinity applications can generally be described as track and trace applications, but the technology provides additional functionality and benefits for product authentication.

- RFID enables greater automation of data collection process. Most companies spend considerable effort in knowing what's in their warehouse. RFID will help them dig deeper and much more easily, tracking to the detail of even each unit, long after it has left the factory or warehouse.
- RFID allows all this data to be transferred securely. Companies use independent suppliers, data from each of them can be carried on tags and uploaded to the Company's central system.

Some other areas where passive RFID has been applied in recent past are:

- Person Identification
- Food Production Control
- Vehicle Parking Monitoring
- Toxic Waste Monitoring
- Valuable Objects Insurance Identification
- Asset Management
- Access Control

CHAPTER 5 : CONCLUSION AND FUTURE WORK

5.1 Conclusion

The work done with the help of RFID technology, RC522 reader and Arduino. It's aim is to reduce the time of billing in long queues so that the customers gets benefited and the same time inventory management becomes so easy. It can be implemented in shopping malls where there is a large crowd and huge rush into malls.

In the world of Automation, This automatic billing system plays a major role in the upliftment of technology. This technology will replace the present barcode system which is present being followed. Hence this technology can help people to make their life's easy and time saving too.

5.2 Future Work

There is improvement in tag life expectancy and durability in past few years. The RFID technology brings new opportunities as well as challenges to the AIDC infrastructure. Although RFID suffers from many limitations but still demand for RFID systems is increasing day by day. RFID tags can combine with sensors of different kinds. This would allow the tag to report not simply the same information over and over but identifying information along with current data picked up by sensors.

Smart cart can be interfaced with wireless technologies to make it completely portable in the near future. Payment of bills using mobile can be implemented. A low cost RFID scanner can be manufactured and used which can scan multiple tags (products) simultaneously for faster processing and lesser resources. Automatic scanning & availability of products can be introduced. Pay scheduling feature will be the latest trend in upcoming years due to the boost in the e-commerce industry.

Cameras with image processing techniques can be used for more increased theft control and efficient shopping.

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