A

PROJECT PHASE-II REPORT ON

"Smart Trolley and Billing System"

SUBMITTED TOWARDS THE
FULFILLMENT OF THE REQUIREMENTS

BACHELOR OF ENGINEERING

(COMPUTER ENGINEERING)

SUBMITTED BY

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CERTIFICATE

This is to certify that the project report entitled

"Smart Trolley and Billing System"

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is a bonafide work has been carried out by students under the supervision of **Prof Kohakade P.S.** and it is submitted towards the fulfillment of the requirements of Bachelor of Engineering (Computer Engineering) Project.

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ABSTRACT

In this project, the scope of this study focuses on developing and improvising current existing sell and purchase process that uses grocery cart to be quicker and more efficient for both seller and customers. Nowadays, consumers at local grocery store are facing long queues at the payment counter, standing and waiting for a long period at the counter during payment session especially during peak hours. This has been very troublesome to consumers especially those elderly who have health issues, are in a rush or those who are carrying toddler. To solve this problem, a grocery cart attached with an RFID Scanning System Device is created.

This product is fully designed and created to make consumers shopping and payments process faster hence, reducing time consumed by consumers at the payment counter. In this study, feasibility study which is intending to be a preliminary review of the facts to see if it is worthy of proceeding to the analysis phase are done. Further, the system programming is designed using Arduino IDE. As for its system, the system is implemented into two sections which are customer section and the retailer section. The result of experiment emphasized that RFID Grocery Cart reduce time consumed by consumer during shopping and payment process. Also, to improve this product there are some future plan recommendation, one of it is to make the device more user friendly especially toward elderly.

Keywords: Develop, Customer, RFID, Grocery Cart, Shopping, NodeMCU, etc.

CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

Grocery trolley, also called as shopping cart, shopping trolley might as well being called as carriages, baggies or wagon (depending on particular region), is a wheeled cart supplied by a shop or store, especially supermarkets, for use by customers inside the premises for transport purposes of merchandise as they move around the premises, while shopping, prior to heading to the checkout counter or cashiers.

They're used everywhere in almost every grocery store, department store, and bulk item superstore. The used of grocery cart nowadays is very crucial as it lessen consumers burden while carrying huge amount of goods while moving around premises and allow consumers to purchase more amount, bigger size and heavier load of item at once.

1.1.1 MOTIVATION

RFID Grocery Cart are applicable to all kind of store and supermarket and are most compatible to be used in busy supermarket during peak hours, weekends and festive season where the number of people visiting supermarket during this period are extremely huge. It is compatible as RFID Grocery Cart with the aid of radio frequency identification (RFID) technology are able to reduce time used by consumer during purchasing activity (particularly during payment/checkout session), get rid of long queues at checkout counter issue and making shopping process easier, faster and also systematically better.

RFID Grocery Cart are also specifically design to operate as durable, convenient and flexible as current conventional grocery cart. Only slight modification are added in order to have a better grocery cart handling and movement. In addition, as people are entering the Industrial Revolution 4.0 (IR4.0) era, having a grocery cart with a RFID Technology and system fulfil the requirement of IR 4.0 component where it consist 2 out of 4 IR4.0 major components which is Internet of Things (IoT) and Cloud Computing.

1.1.2 OBJECTIVES

The objectives to this research are:

i. To create a grocery cart with RFID system, install in it to solve long queues at paying counter issues.

ii. To create a grocery cart with a RFID price scanner to make consumer shopping process faster.

1.2 PROBLEM STATEMENT

Main issue that are being confront by consumer all over the country is that they need to face a very long queues and wait for a long period during the checkout session at the payment counter. This is due to the number of people who went to grocery store and supermarket per day are extremely huge. This can witness clearly in our country where grocery stores and supermarket in Malaysia are relentlessly being crowded by civilian per day and this number get enormous during festive season. This has been very troublesome to a lot of consumer especially those elderly who have health issues, those who are in a rush and family who are carrying toddler.

1.3 SCOPE

RFID Grocery Cart is specifically fabricated to help to make customers shopping session faster and get rid of long queues and long period of waiting during the checkout session of the payment counter.

The scope of this project are:

i. The grocery cart is able to reduce time used during payment and checkout session.
ii. This grocery cart is able to eliminate long queues at payment counter issues during items payment session.
iii. The grocery cart is able to fulfill the IR 4.0 trend requirement.

CHAPTER 2

LITERATURE SURVEY

SR. NO.	TITLE	AUTHOR	YEAR	SUMMARY
1.	IoT based Smart Shopping Trolley with Mobile Cart Application	Kowshika S, Madhu Mitha S.	2021	In this, it focuses on the generating a bill using IOT along with mobile cart application and trolley, customer can make payment bill in less time. The smart cart uses the RFID tags and receive to scan the product, load cell to prevent theft , LCD display and the Raspberry pi.
2.	Shopping System with an RFID Interface for Human Assistance	S. Lakshmanachari, G. Avanthi, V. Vijay	2020	In this, it focuses on generating a bill for the shopping. The main idea is to save customers time by providing digital billing system with which the customers can get the bill through their registered email. A compartment of all products will be attached with RFID tags and the purchasing product information will get stored in the database.
3.	IOT- based Smart Shopping Cart using Radio Frequency Identification	M. Shahroz M. F., M. Ahmad	2020	In this, the IOT based smart shopping cart is proposed which consists of RFID sensors, Arduino microcontroller, Bluetooth module, and mobile application. RFID sensors depend on wireless communication. The customer easily manages the shopping list in Mobile application according to preferences. Then shopping information sends to server wirelessly and automatically generates billing.

4.	Fast and Low-Cost, Wireless Controlled Smart Shopping Cart with Raspberry pi and RFID Technology	Z. Ali, M. Waqas	2022	This paper presents the RFID based smart shopping cart, which helps people to avoid standing in queues for checkout at counter. It is more advanced technology system than a bar code reader and allows users to scan their desired items themselves with RFID. Testing of the smart shopping cart shows that RFID scans the product, and the message is displayed on the screen.

CHAPTER 3

SOFTWARE REQUIREMENT SPECIFICATION

3.1 INTRODUCTION

3.1.1 SCOPE

In this chapter, the progress of producing RFID System for Grocery Cart will be explain with more detail. The programming of the system was designed by using Arduino IDE Software. As the component and all material needed for the project is also explained briefly.

3.1.2 ASSUMPTIONS & DEPENDENCIES

The aims of the RFID System for Grocery cart are:

1. Will solve long queues issue at checkout counter.
2. To be user friendly and safe to use.
3. Convenience for the consumer.
4. To add up RFID technology to the process of shopping.

3.2 EXTERNAL INTERFACE REQUIREMENT

3.2.1 USER INTERFACE

Application Based Smart shopping cart system.

3.2.2 HARDWARE INTERFACE

To ensure an effective product are being made, the study of every part and material used need to be done. This is so that the best solution to the main problem can be develop and so that other kind of product error that can lead to new kind of problem can be avoided. The components of the RFID System Device for Grocery Cart are as follows:

i. RFID EM-18 Reader Module

ii. NodeMCU ESP8266

iii. Breadboard 800 Holes

iv. Dupont Jumper Wires M/M

v. RFID Cards

vi. Adapter

vii. Converter

viii. IR Sensor

3.2.3 SOFTWARE INTERFACE

1) Arduino IDE Software

3.3 NON FUNCTIONAL REQUIREMENT

3.3.1 PERFORMANCE REQUIREMENTS

The performance of the functions and every module must be well. The overall performance of the software will enable the users to work efficiently. Performance of encryption of data should be fast. Performance of the providing virtual environment should be fast Safety Requirement. The application is designed in modules where errors can be detected easily. This makes it easier to install and update new functionality if required.

3.3.2 SAFETY REQUIREMENT

The application is designed in modules where errors can be detected and fixed easily. This makes it easier to install and update new functionality if required.

Software quality attributes

Our software has many quality attribute that are given below:-

Adaptability: This software is adaptable by all users.

Availability: This software is freely available to all users. The availability of the software is easy for everyone.

Maintainability: After the deployment of the project if any error occurs then it can be easily maintained by the software developer.

Reliability: The performance of the software is better which will increase the reliability of the Software.

User Friendliness: Since, the software is a GUI application; the output generated is much user friendly in its behavior.

Integrity: Integrity refers to the extent to which access to software or data by unauthorized persons can be controlled.

Testability: The software will be tested considering all the aspects.

CHAPTER 4

SYSTEM DESIGN

4.1 SYSTEM ARCHITECTURE

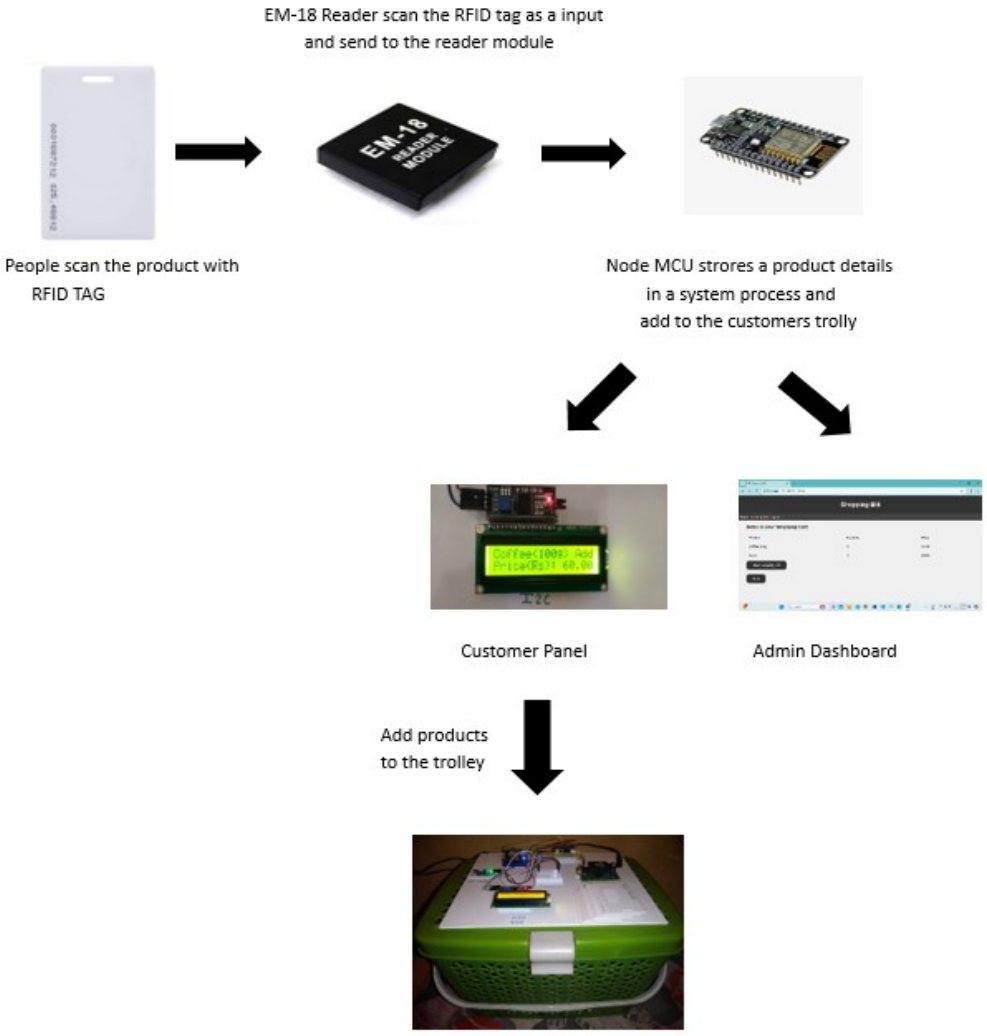


Figure 4.1: System Architecture

4.2 ANALYSIS MODELS

Waterfall approach was the first Software Development Life Cycle (SDLC) model to be used widely in Software Engineering to ensure the success of the project. In the Waterfall Approach, the whole process of software development is divided into separate phases. In this model, typically the outcome of one phase acts as the input for the next phase sequentially.

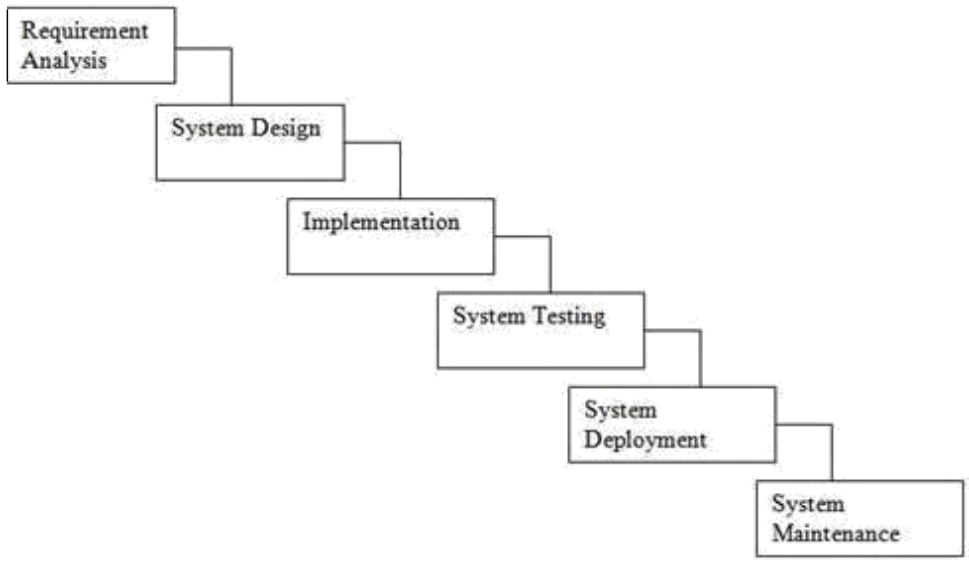


Figure 4.9: Waterfall Model

4.2.1. MODULES

Customer Section:

1. Customer enter premises with RFID tags (can also be provide by store retailer).

2. Whilst taking grocery cart before begin with shopping activity, customer scan their RFID tag through RFID reader that is attached to the grocery cart.

3. RFID Reader scan information embedded in the tags and send this information to NodeMCU Microcontroller.

4. NodeMCU Microcontroller translate the information and send this information to System Software.

5. This set up an item purchased database site which is set up exclusively for that particular customer only.

6. While moving around premises during shopping activity, customer can scan the item they wish to purchase (that have been attached with RFID adhesive tags) through the same RFID reader attached at the grocery cart.

7. Data of customers purchased item will be collected in the items purchased section and is organize and also sum up with a total price.

8. As customer are done with their shopping activity, customer can head to the cashier counter directly.

Retailer Section:

1. Customer reaches cashier counter and hand-over their RFID tags to the cashier.

2. Cashier will scan the RFID tags through a RFID reader located at the cashier counter.

3. This will command the supermarket central billing system to receive input of database from the customer's Item purchased Database.

4. Sum up of collective data with a total price that the customer need to pay will pop out at the counter screen.

5. Customer pay total amount of purchased item through cash or online services.

4.2.1 USE CASE DIAGRAM

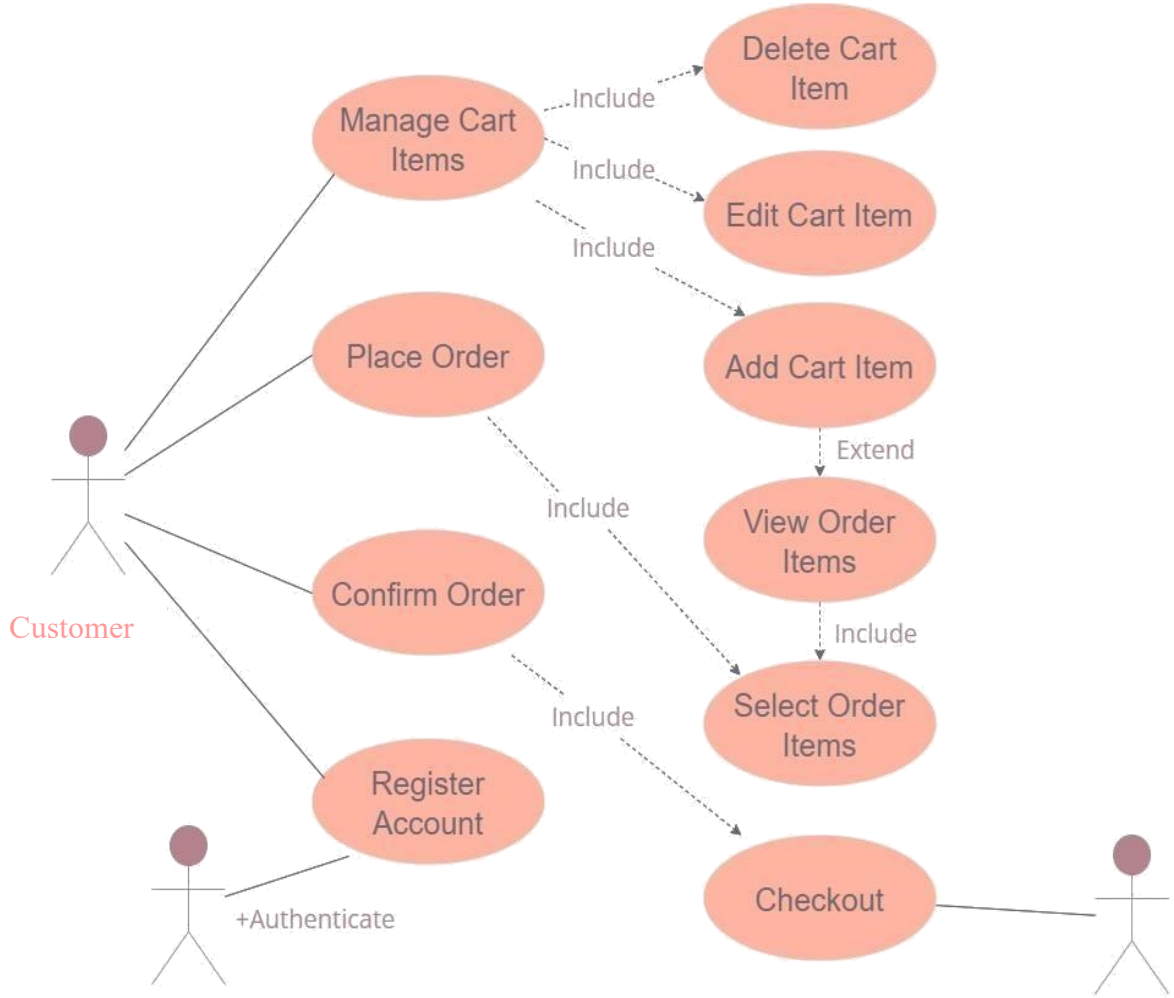


Figure 4.2: Use case Diagram

4.2.2 DATA FLOW DIAGRAMS

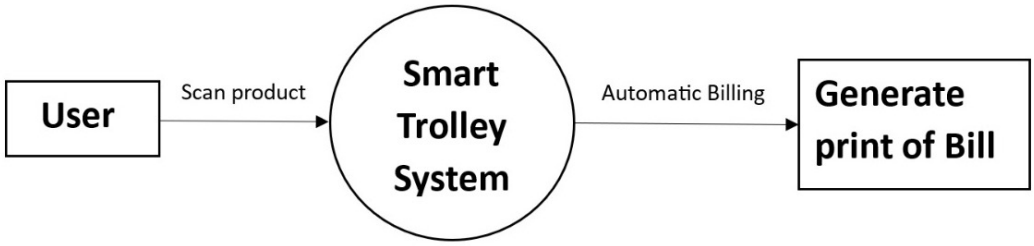


Figure 4.3: DFD Level 0 Diagram

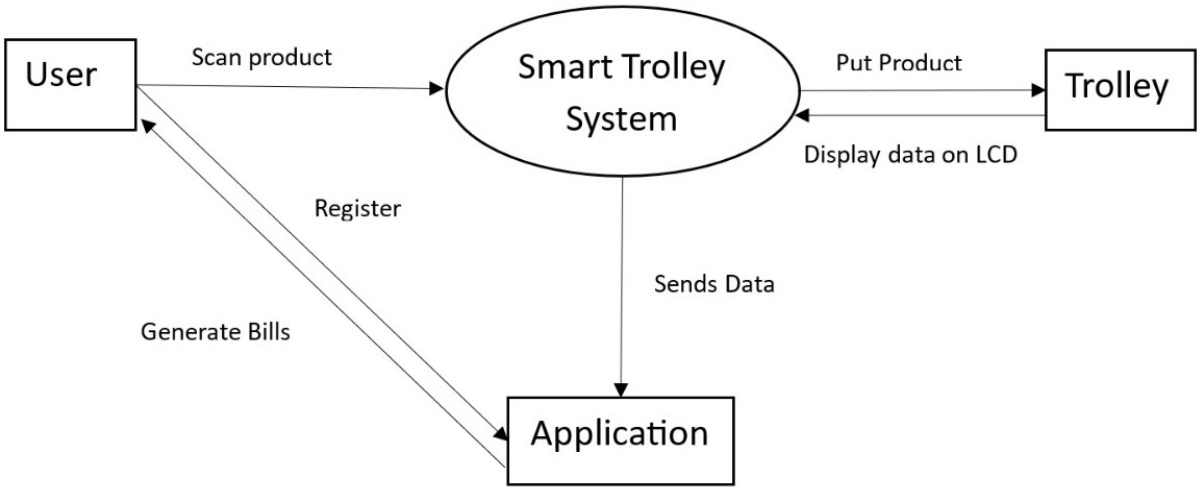


Figure 4.4: DFD Level 1 Diagram

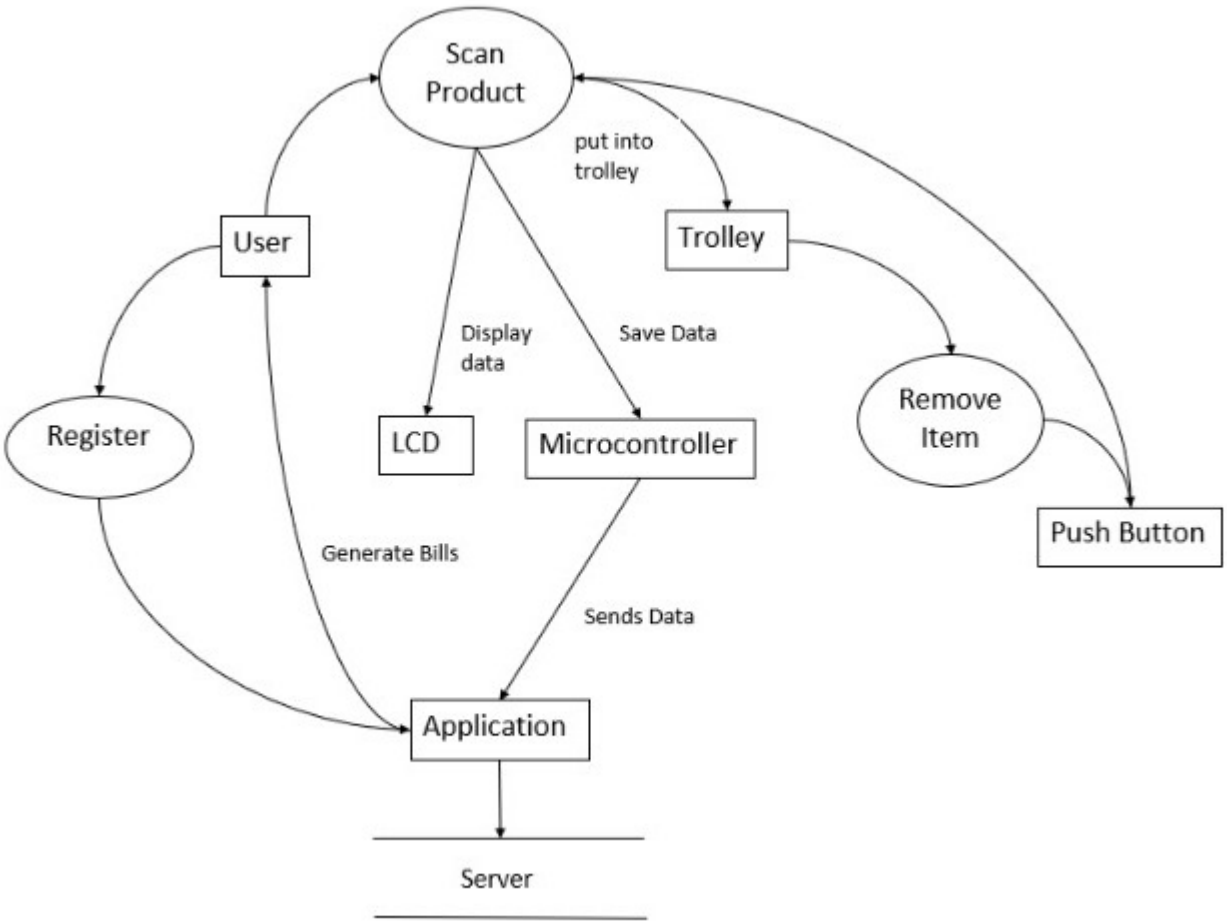


Figure 4.5: DFD Level 2 Diagram

4.2.3 CLASS DIAGRAM

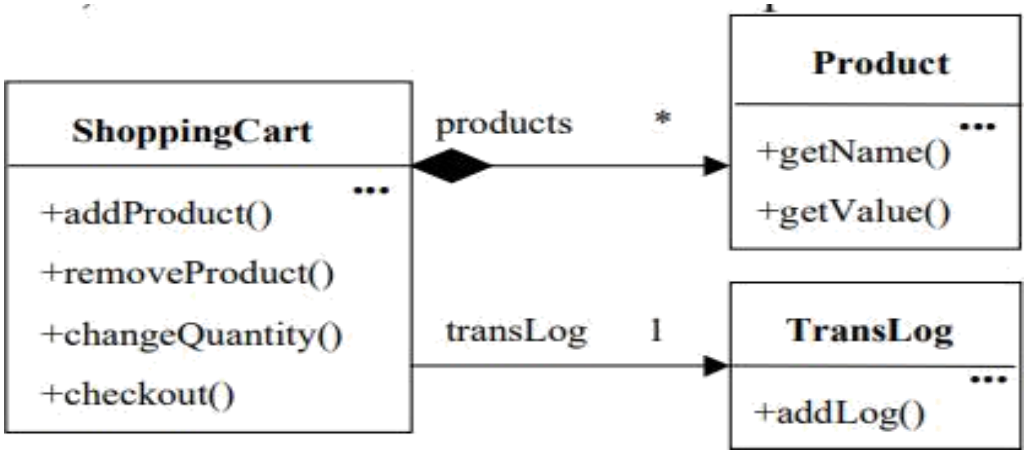
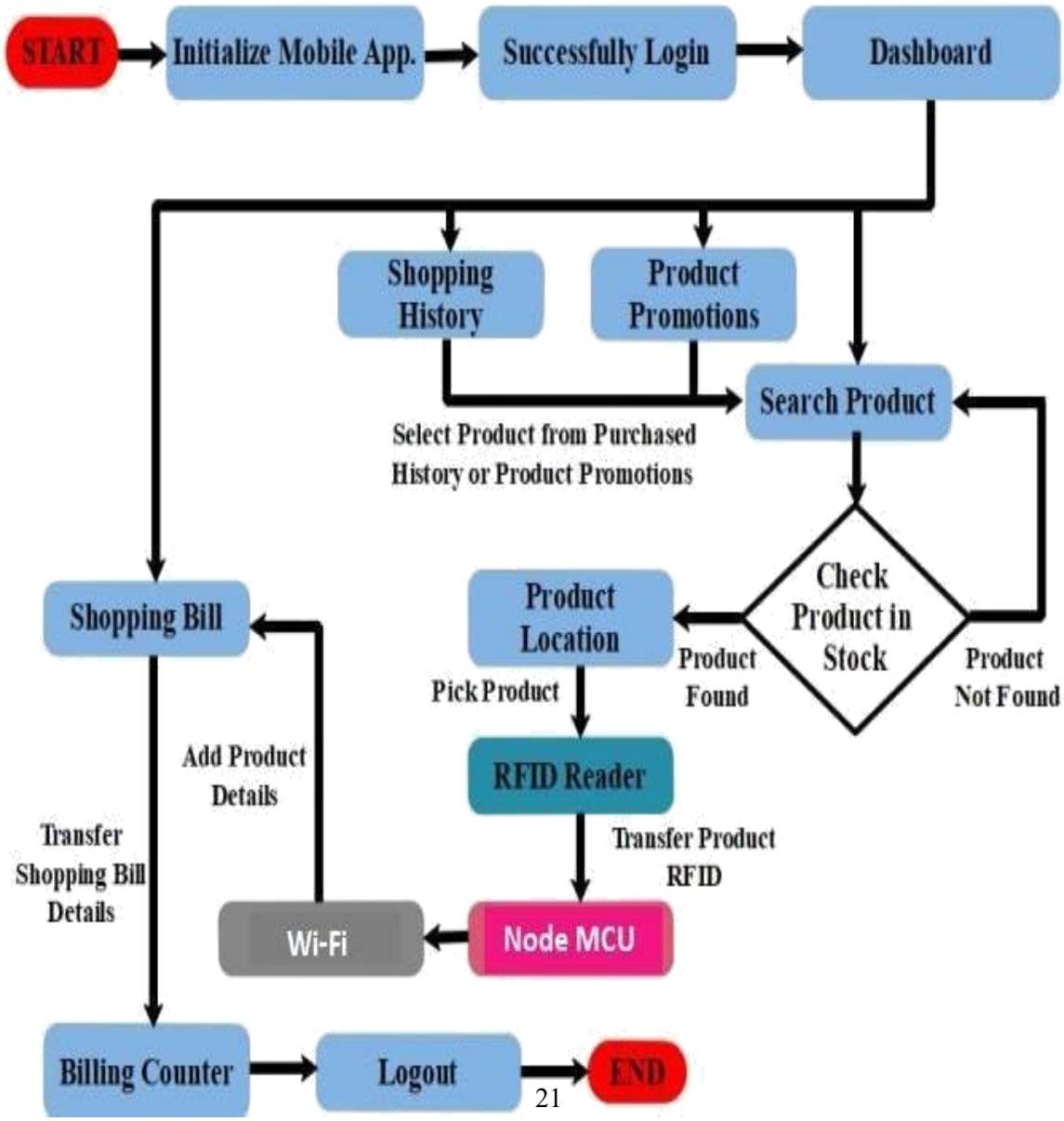


Figure 4.6: Class Diagram

4.2.4 ACTIVITY DIAGRAM



4.2.5 SEQUENCE DIAGRAM

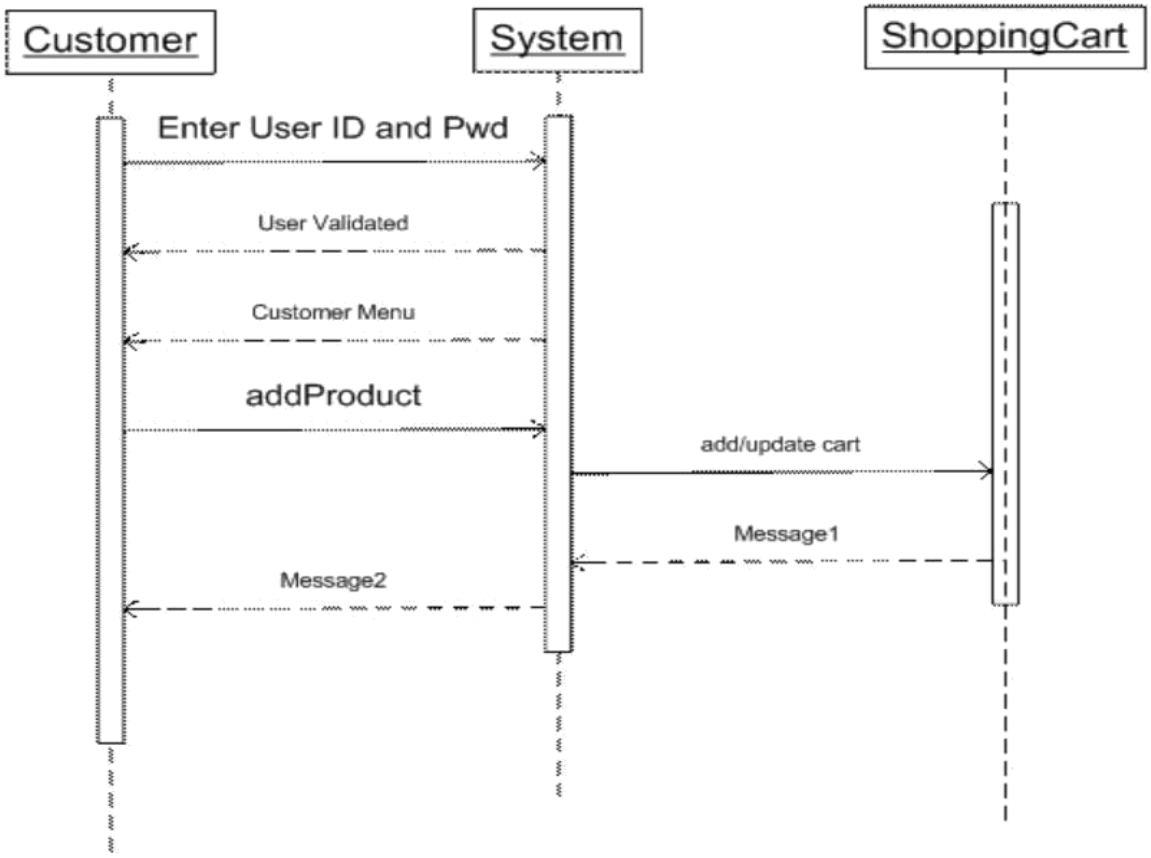


Figure 4.8: Sequence Diagram

CHAPTER 5

PROJECT PLAN

5.1 SYSTEM IMPLEMENTATION PLAN

Sr. No.	Reporting Date	Project Activity	Guide changes And Suggestions
1.	01/07/2023	Decide Project Group Members	Group should be of 4 members.
2.	05/07/2023	Search and submit 3 project topics with IEEE papers.	Search another different papers.
3.	08/07/2023	Discuss 5 PPT analysis of IEEE papers	Detailed more study
4.	15/07/2023	3 IEEE papers presentation and select the paper	Change in topic name
5.	22/07/2023	Create and submit the synopsis of project	Focus on literature
6.	05/08/2023	Literature survey and information gathering of selected topic paper	Details literature with comparison
7.	12/08/2023	30% project completion and presentation	Hardware and Software PPT discussion

Sr. No.	Reporting Date	Project Activity	Guide Changes and Suggestions
8.	19/ 08/2023	Draw UML Diagrams of Project	Some changes in sequence and class diagram
9.	26/08/2023	50% project completion and presentation	Changes in System architecture
10.	02/09/2023	Making Journal Paper	Changes in Introduction, Literature and plagiarism
11.	03/10/2023	Make Project report in Word	Changes in Introduction, Literature and plagiarism
12.	05/11/2023	Check Project report and made changes in that	Changes in project plan, plagiarism
13.	08/01/2024	Finally made project report	Completed
14.	08/02/2024	Project report submission	Completed
15.	11/03/2024	Finally submitted hard copy of project report	Completed

5.2 TIMELINE CHART

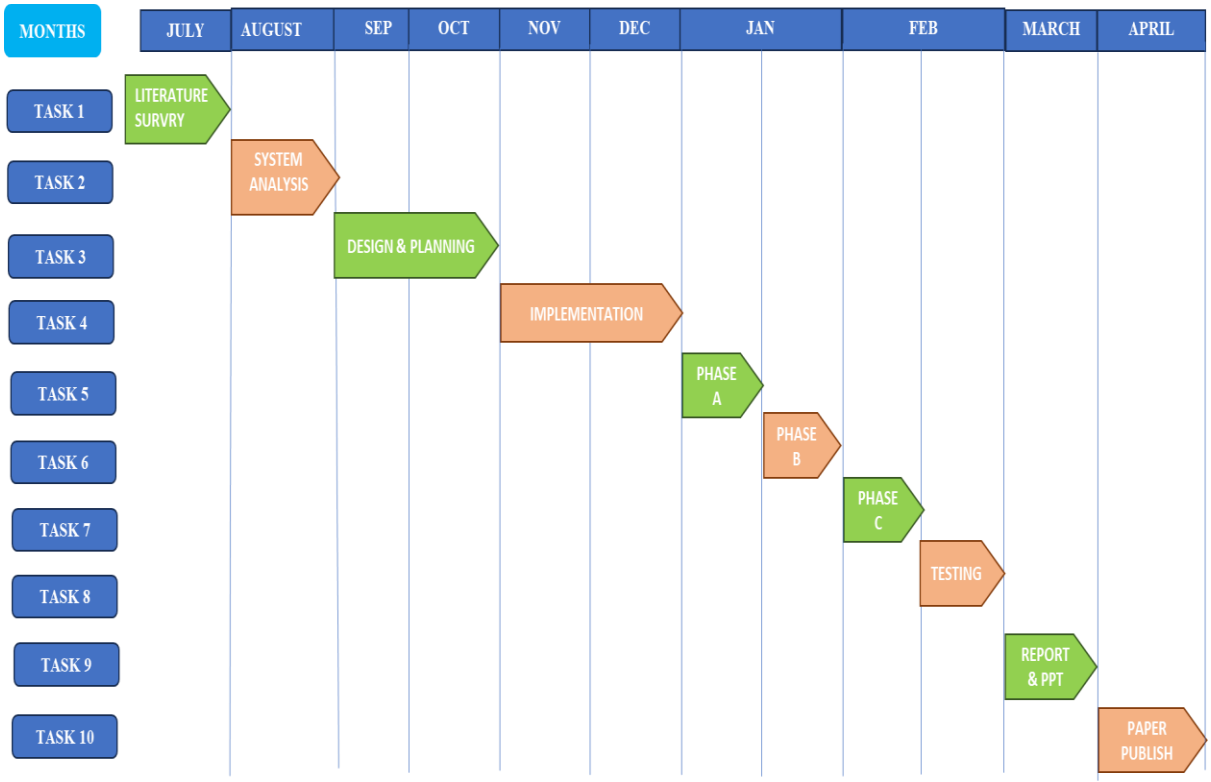


Figure 5.1 Timeline chart

CHAPTER 6

PROJECT IMPLEMENTATION

6.1 TOOLS AND TECHNOLOGIES

6.1.1 LIBRARIES USED

1) Wificlient.h

It is used to create a client that can connect to to a specified internet IP address and port as defined in client.connect().
Syntax : WiFiClient()

2) ESP8266WebServer.h

ESP8266WebServer is an easy-to-use library to set up a web server on ESP8266. It is quite minimal, nowhere near other perfect production-ready web servers like esp-httpd or WebBase. It serves only one client at a time. It is however very easy to set up and use.

3) Liquid Crystal_I2C.h

The LiquidCrystal_I2C library allows you to program an Arduino to print messages to an LCD screen using an I2C backpack. I2C is a communication protocol that allows you to communicate with multiple devices using only a few pins.

4) Wire.h

This library allows you to communicate with I2C / TWI devices. On the Arduino boards with the R3 layout (1.0 pinout), the SDA (data line) and SCL (clock line) are on the pin headers close to the AREF pin. The Arduino Due has two I2C / TWI interfaces SDA1 and SCL1 are near to the AREF pin and the additional one is on pins 20 and 21.

6.1.2 ARDUINO IDE

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment.

The program or code written in the Arduino IDE is often called as sketching. We need to connect the Genuino and Arduino board with the IDE to upload the sketch written in the Arduino IDE software. The sketch is saved with the extension '.ino.'

6.1.3 C PROGRAMMING

C Programming for Arduino will show you how to harness powerful capabilities like sensing, feedbacks, programming and even wiring and developing your own autonomous systems. C Programming for Arduino contains everything you need to directly start wiring and coding the electronic project.

CHAPTER 7

RESULTS

Figure 7.1 Trolley Model

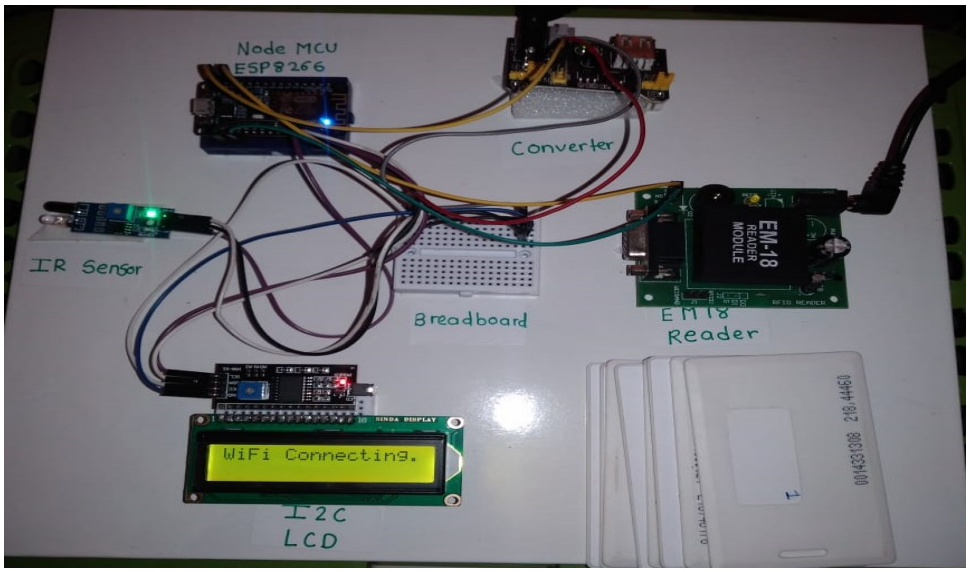


Figure 7.2 IOT circuit with RFID Tags

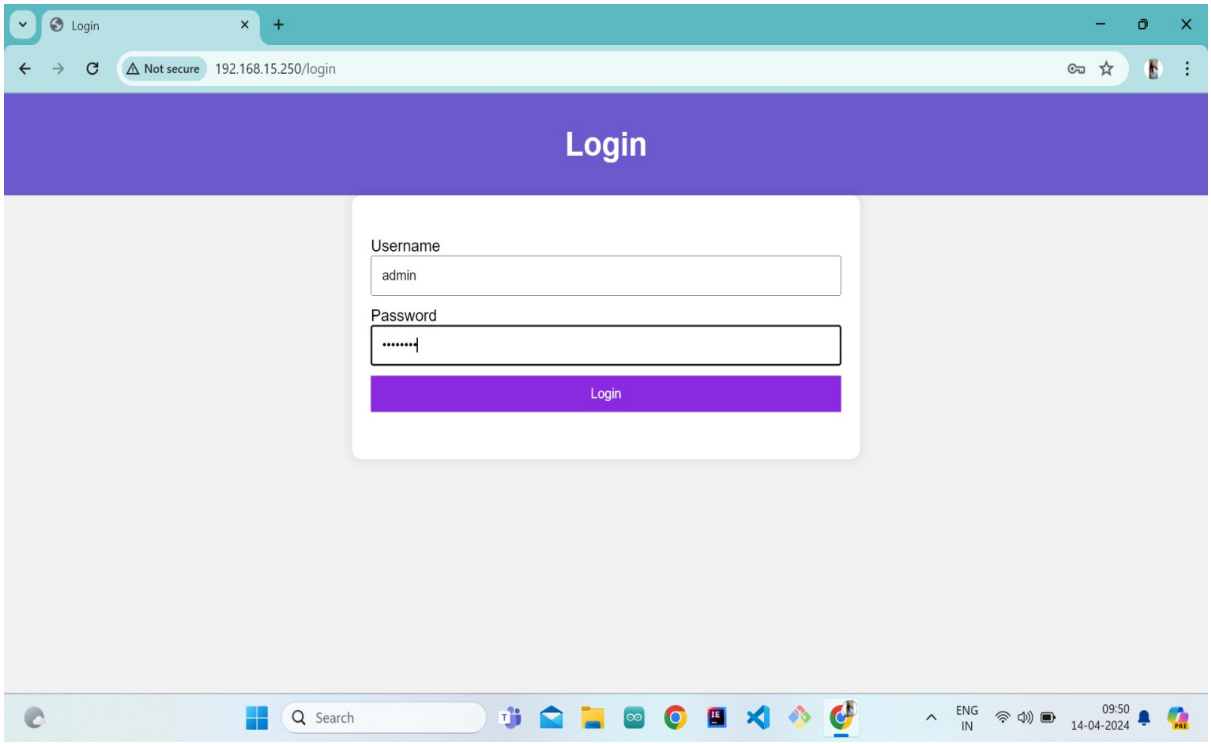


Figure 7.3 Admin Login

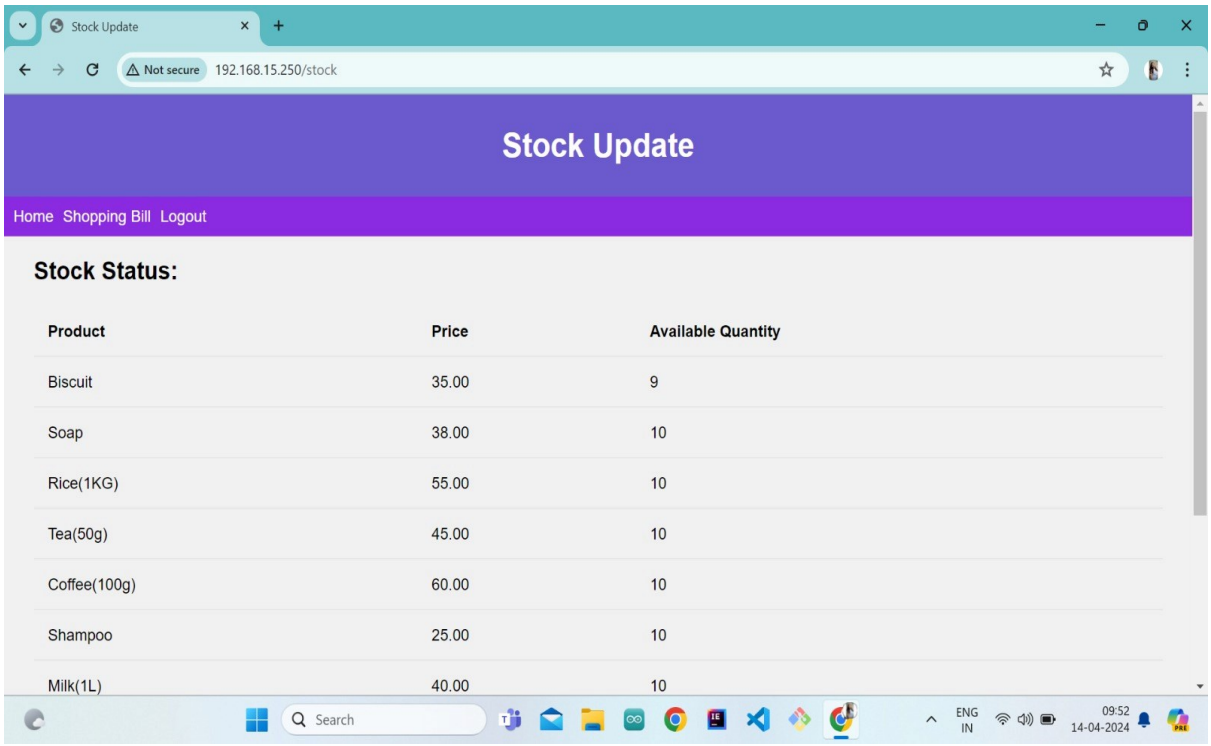


Figure 7.4 Stock Status

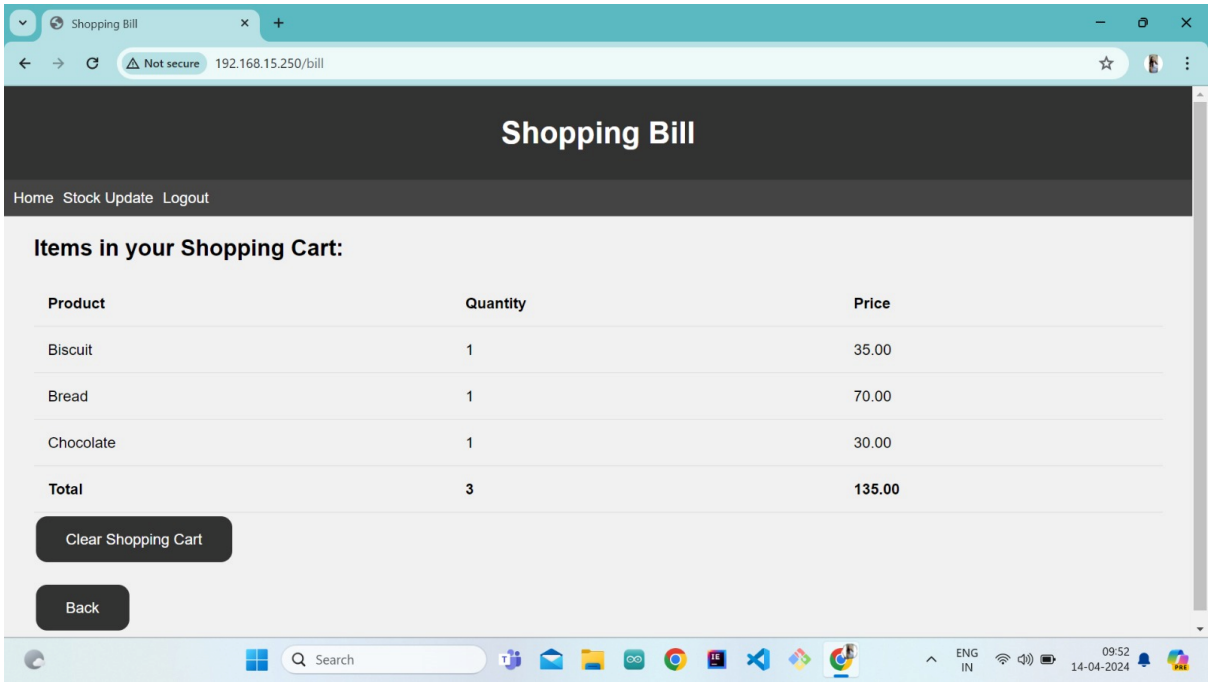


Figure 7.5 Bill Generation

CHAPTER 8
SOFTWARE TESTING

8.1 TYPE OF TESTING

8.1.1 UNIT TESTING

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program inputs produce valid outputs. All decision branches and internal code flow should be validated. Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

8.1.2 INTEGRATION TESTING

Integration tests are designed to test integrated software components to determine if they actually run as one program. Testing is event driven and is more concerned with the basic outcome of screens or fields. Integration testing is specifically aimed at exposing the problems that arise from the Combination of components.

8.1.3 REGRESSION TESTING

Regression testing is a type of software testing that ensures that previously developed and tested software still performs the same way after it is changed or interfaced with other software. Changes may include software enhancements, patches, configuration changes, etc.

8.1.4 ALPHA TESTING

Alpha testing is a type of acceptance testing; performed to identify all possible issues/bugs before releasing the product to everyday users or public. The focus of this testing is to simulate real users by using black box and white box techniques. The aim is to carry out the tasks that a typical user might perform. It is carried out in a lab environment and usually testers are internal employees of organization.

8.2 RECONCILED ESTIMATES

8.2.1 Line of Code (LoC):

KLOC (thousands of lines of code) is a traditional measure of how large a computer program is or how long or how many people it will take to write it. The code measured is usually source code. Estimating LOC for this project is difficult at estimation stages this project is of research or innovative type project.

8.3 RISK MANAGEMENT W.R.T. NP HARD ANALYSIS

8.3.1 Risk Identification

For risks identification, review of scope document, requirements specifications and schedule are done. Answers to questionnaire revealed some risks. Each risk is categorized as per the categories mentioned in [?]. You can refer following risk identification questionnaire.

1. Have top software and customer managers formally committed to support the project?

Answer: Yes

2. Are end-users enthusiastically committed to the project and the system/product to be built?

Answer: Yes

3. Are requirements fully understood by the software engineering team and its customers?

Answer: Yes

4. Have customers been involved fully in the definition of requirements?

Answer: Yes

5. Do end-users have realistic expectations?

Answer: Yes

6. Does the software engineering team have the right mix of skills?

Answer: Yes

8.4 RISK ANALYSIS

1. Technical Risk:

The probability of loss incurred through the execution of a technical process in which the outcome is uncertain. Untested engineering, technological or manufacturing procedures entail some level technical risk that can result in the loss of time, resources, and possibly harm to individuals and facilities. Like mobile phone battery off, network error in user and server, multiple requests at time.

2. Operational Risk:

Operational risk is the prospect of loss resulting from inadequate or failed procedures, systems or policies. Employee errors. Systems failures. Fraud or other criminal activity. Any event that disrupts business processes. Like user registration, login, send request to service provider.

3. Schedule Risk:

Schedule risk is the risk that the project takes longer than scheduled. It can lead to cost risks, as longer projects always cost more, and to performance risk, if the project is completed too late to perform its intended tasks fully.

4. Business Risk:

Business risk is the possibilities a company will have lower than anticipated profits or experience a loss rather than taking a profit. Business risk is influenced by numerous factors, including sales volume, per-unit price, input costs, competition, and the overall economic climate and government regulations.

CHAPTER 9

ADVANTAGES, DISADVANTAGES AND APPLICATION

7.1 ADVANTAGES

1) Smart Trolley system is time saving and avoids standing in long queues.
2) This system provides the feature of automatic billing.
3) It also helps to reduces manual efforts.

7.2 DISADVANTAGES

1) For this system, the initial setup cost is high.
2) It requires software update regularly.

7.3 APPLICATIONS

1) In malls it will help to creates an automated central billing system. The product information is directly sent to billing system.
2) In stores we can easily integrate with shopping list and automatically checking off items as we pick them.

CHAPTER 10

CONCLUSION

10.1 CONCLUSION

In conclusion, the main idea behind this project is to help the society by cutting short the time spent on queuing when making grocery shopping. The usual grocery cart at other related supermarkets/ hypermarkets is mainly used to store goods in the cart after shopping. By having RFID technology applied on the grocery cart, it can help both the customer and cashier when making payment, thus making the checkout process faster.

10.2 FUTURE WORK

We can make the system more advanced so that the shopping trolley will be able to move in a crowded environment and follows the user automatically in any direction. Lastly, an improved Android application that can remind the users of the items they need to purchase when they are unintentionally passing by the goods location. In addition, it can also remind the users who have health problems about the nutrition of products. Besides that, the locations of shopping trolleys are tracked and can be displayed to allow supermarket staff and users to know the shopping trolley current locations.

CHAPTER 11

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Smart Trolley and Billing System

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ABSTRACT: The goal of this project is to improve and enhance the present supermarket cart-based sell and purchase procedure such that it is faster and more effective for both the seller and the customer. Customers now have to wait in lengthy lines at the payment counter during peak hours at their neighbourhood grocery store, standing and waiting for extended periods of time. Customers have found this to be quite problematic, particularly the elderly, people with health concerns, people in a haste, and people who are carrying little children. An RFID scanning system device was mounted to a grocery cart in order to address this issue. This solution is entirely made to speed up the purchasing and checkout processes for customers, saving them time at the payment counter. This study includes a feasibility study, which aims to be an initial assessment of the data to see whether it merits moving further to the analysis stage. Furthermore, Laragon, Node.js, and the Arduino IDE were used to design the system programming. Next, Autodesk Inventor Professional 2019 software was used to create the gadget housing. Regarding its system, it is divided into two sections: one for customers and the other for retailers. The experiment's findings demonstrated how RFID grocery carts shorten customers' shopping and payment processes.

KEYWORDS: **Customer,Development, NodeJs, Recommendation. RFID.**

I. INTRODUCTION

A grocery trolley, also known as a shopping cart, is a wheeled vehicle provided by a store, particularly a supermarket, for customers to use inside the establishment to move goods as they shop and make their way to the checkout counter or cashiers. Depending on the area, the term "wagon," "buggies," or "chariot" may also be used to describe this type of vehicle. They are widely utilized in practically all department stores, superstores that sell bulk goods, and grocery stores. The use of shopping carts is becoming increasingly important since they relieve customers of the stress of carrying large loads of items while navigating the store and enable them to make several, larger-sized, and heavier purchases at once. RFID grocery carts can be utilized in any type of store or supermarket, but they work best in crowded supermarkets at peak hours, on weekends, and during the holiday season when there are a lot of people shopping. It is compatible because RFID grocery carts, which use radio frequency identification (RFID) technology, can cut down on the amount of time customers spend making purchases (especially when paying and checking out), eliminate lengthy lines at checkout counters, and improve the overall shopping experience.

RFID grocery carts are made with the same precise design to function as the modern, traditional shopping carts—that is, to be as strong, practical, and adaptable. To improve the control and mobility of the grocery cart, only minor adjustments are made. Furthermore, as society moves into the Industrial Revolution 4.0 (IR4.0) age, a shopping cart equipped with an RFID technology and system satisfies the requirements for an IR 4.0 component, as it consists of two of the four primary components of IR4.0: cloud computing and the Internet of Things (IoT).

II. RELATED WORK

The literature survey phase is crucial to the system development life cycle because it gathers and gathers the data needed to manage or build a project during this stage. A description of the literature that is pertinent to a given field or topic is called a literature review. It provides a summary of the main points made, the identities of the important authors, the theories and hypotheses that are now in circulation, and the methods and approaches that are

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acceptable and beneficial. Research is done in this portion before beginning the project and comprehending the many approaches that have been employed in the past. A thorough examination of the current systems was carried out. The advantages and disadvantages of the current systems were identified with the aid of this investigation.

Given that the project is an application of RFID technology, a review of the literature has been conducted on a few articles pertaining to various components and procedures or techniques. Data has been gathered from these papers in accordance with the project requirements.

People visit supermarkets to make payments and buy the goods they need on a regular basis. Therefore, the total products and total amount must be calculated. Here, self-service is used using RFID tags to cut down on labor costs and wait times. Utilizing Zigbee technology lowers low power consumption, low cost, and low data rate[1].

The goal of this study is to design a system that uses RFID reader antennas to scan both static and dynamic objects in a retail environment. Aisle-level scanning is used in place of performing RFID observations at the level of individual carts [2].

Instead of a barcode scanner, every product in this paper had an RFID tag. An LCD monitor, a Zigbee transmitter, and an RFID reader will be included in the smart trolley. When a goods is placed in the trolley, a scanner scans it and displays the product's pricing on the LCD. Radio frequency identification, or RFID, recognizes and tracks tags affixed to items automatically [3].

Problem Statement: Create a solution that will be economical and shorten the supermarket's billing process. A novel product that improves everyday comfort, ease, and efficiency is one that the public finds acceptable. In large cities, shopping and making purchases at malls has become a daily routine. Individuals buy various goods and load them into the cart. Once purchases are made, payments must be made at the billing counter. There is a lengthy line at the billing counter because the cashier prepares the bill using a bar code reader, which takes a lot of time. Time spent standing and waiting for individual turns can be better spent doing something useful. Finding the goods they need is another issue that the majority of people have. The majority of people are also having trouble learning about the current promotions that are offered for a given product. Shop owners are also quite concerned about potential theft or product take-out, which would result in additional losses.

III. METHODOLOGY

This chapter will provide a more thorough explanation of the steps involved in creating an RFID system for a grocery cart. Software from Laragon, Node.js, and the Arduino IDE were used to design the system's programming. Next, Autodesk Inventor Professional 2019 software was used to design the system enclosure. The project's component and all necessary materials will also be briefly outlined.

A) Assumptions and Dependencies

The objectives of the grocery cart RFID system are:

i. Will address long lines at the counter,

ii. To ensure ease of use and safety,

iii. The consumer's convenience,

iv. To include RFID technology into the purchasing process.

B) User Interface

Application Based Smart shopping cart system.

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C) Hardware Interfaces:

A thorough analysis of each component and material utilized is necessary to guarantee the production of high-quality products. This is to prevent other types of product errors that could result in new problems and to help design the best solution to the primary issue. The goal of the study in this section is to learn more about the fundamental part of the apparatus that will enable the RFID System Device to function as intended. The following are the parts of the RFID System Device for Grocery Cart:

i. RFID RC522 Module for Arduino
ii. Node MCU Microcontroller
iii. Breadboard 800 Holes
iv. Dupont Jumper Wires M/M
v. RFID Passive Tags
vi. Rechargeable Battery

D) Software Interfaces

1) Arduino IDE Software,
2) Laragon Software and
3) NodeJs Software

E) System Architecture

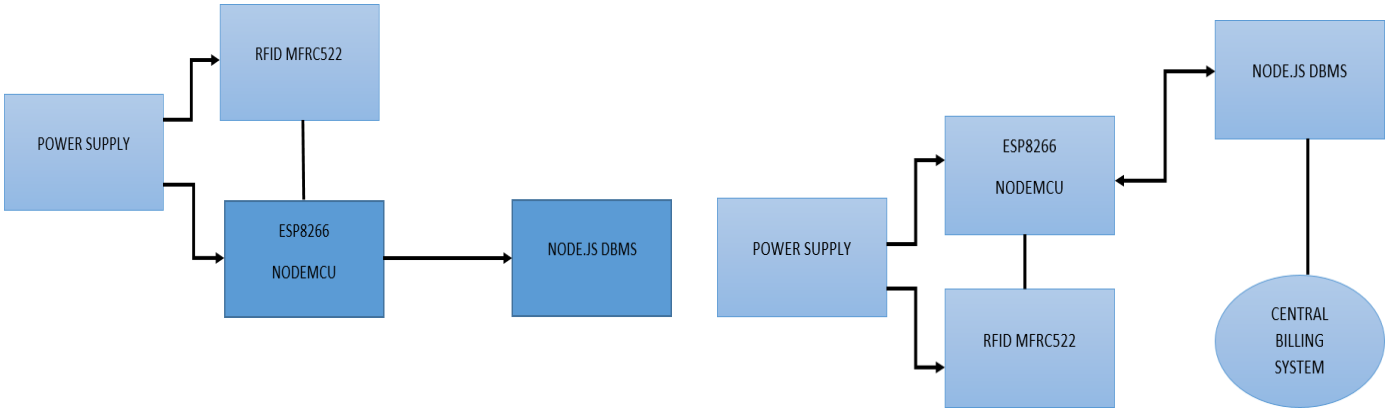

Fig 1 System Architecture: (a) Customer Section (b) Retailer Section

Operational Procedure of RFID System Device for Grocery Cart

Customer Section;

1. Customer enter premises with RFID tags (can also be provide by store retailer).

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2. Whilst taking grocery cart before begin with shopping activity, customer scan their RFID tag through RFID scanner that is attached to the grocery cart.

3. RFID Reader scan information embedded in the tags and send this information to NodeMcu Microcontroller.

4. NodeMcu Microcontroller translate the information and send this information to Node.Js Database Management System Software.

5. This set up an item purchased database site which is set up exclusively for that particular customer only.

6. While moving around premises during shopping activity, customer can scan the item they wish to purchase (that have been attached with RFID adhesive tags) through the same RFID reader attached at the grocery cart.

7. Data of customers purchased item will be collected in the items purchased database and is organize and also sum up with a total price.

8. As customer are done with their shopping activity, customer can head to the cashier counter directly.

Retailer Section;

1. Customer reaches cashier counter and hand-over their RFID tags to the cashier.

2. Cashier will scan the RFID tags through a RFID reader located at the cashier counter.

3. This will command the supermarket central billing system to receive input of database from the customer's Item purchased Database.

4. Sum up of collective data with a total price that the customer need to pay will pop out at the counter screen.

5. Customer pay total amount of purchased item through cash or online services.

IV. EXPECTED RESULT

The main basic working operation of this system consist of three main part which is a purchase database management system software, a microcontroller and a RFID Reader Module, interfacing with each other.

A microcontroller is a computer present in a single integrated circuit which is dedicated to perform one task and execute one specific application. It contains memory, programmable input/output peripherals as well a processor. They run one specific program and are dedicated to a single task. They are low power devices with dedicated input devices and small LED or LCD display outputs. Microcontrollers can take inputs from the device they controlling and retain control by sending the device signals to different parts of the device. A good example is a TV's microcontroller. It takes input from a remote control and delivers its output on the TV screen.

Next, a RFID reader is Radio Frequency module and an antenna which generates high frequency electromagnetic field. It read code which is embedded in a passive generates an electromagnetic field which causes electrons to move through the tag's antenna and subsequently power the chip. The powered chip inside the tag then responds by sending its stored information back to the reader in the form of another radio signal. This is called backscatter. The backscatter, or change in the electromagnetic/RF wave, is detected and interpreted by the reader which then sends the data out to a computer or microcontroller. In this project, the module that will be used is RFID RC522 Module.

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Finally, a database management system software. A database is an organized collection of data, generally stored and accessed electronically from a computer system. This collection data will be managed by a management system software that interacts with end users, applications, and the database itself to capture and analyse the data.The DBMS software additionally encompasses the core facilities provided to administer the database. The sum total of the database, the DBMS and the associated applications can be referred to as a "database system". Often the term "database" is also used to loosely refer to any of the DBMS, the database system or an application associated with the database. In this project, the database management system that will be used are Node.JS Software as it is an open-source, cross-platform, JavaScript runtime environment that executes JavaScript code outside of a browser and is easier to use.

To make things short, to make the whole system work it require all three components to interface with each other by;

1. RFID reader read information embedded in passive RFID tags then send signal of information to NodeMCU Microcontroller.
2. NodeMCU Microcontoller receive input of information, translate this information and send them to Database Management System Software.
3. Node.Js Database Management System collect these inputs and organize these data and sum up the total of these database wirelessly.

A) Advantages

1) Real Time solution
2) Saves Time
3) Reduces manual efforts

B) Disadvantages

1) Initial setup cost is high
2) Require software update regularly

C) Application

1) In mall
2) At airport

V. CONCLUSION

In conclusion, the main idea behind this project is to help the society by cutting short the time spent on queuing when making grocery shopping. The usual grocery cart at other related supermarkets/ hypermarkets is mainly used to store goods in the cert after shopping. By having RFID technology applied on the grocery cart, it can help both the customer and cashier when making payment, thus making the checkout process faster.

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Smart Trolley and Billing System

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Abstract— The goal of this project is to improve and enhance the present supermarket cart-based sell and purchase procedure such that it is faster and more effective for both the seller and the customer. Customers now have to wait in lengthy lines at the payment counter during peak hours at their neighbourhood grocery store, standing and waiting for extended periods of time. Customers have found this to be quite problematic, particularly the elderly, people with health concerns, people in a haste, and people who are carrying little children. An RFID scanning system device was mounted to a grocery cart in order to address this issue. This product is entirely made to speed up the purchasing and payment processes for customers, so cutting down on the amount of time they must customers in front of the payment counter. This study includes a feasibility study, which aims to be an initial assessment of the data to see whether it merits moving further to the analysis stage. Furthermore, Laragon, Node.js, and the Arduino IDE were used to design the system programming. Next, Autodesk Inventor Professional 2019 software was used to create the gadget housing. Regarding its system, it is divided into two sections: one for customers and the other for retailers. The experiment's findings demonstrated how RFID grocery carts shorten customers' shopping and payment processes. Additionally, there are some suggestions for future plans to improve this product. One of them is to make the device more user-friendly, particularly for the elderly.

I. INTRODUCTION

A grocery trolley, also known as a shopping cart, is a wheeled vehicle provided by a store, particularly a supermarket, for customers to use inside the establishment to move goods as they shop and make their way to the checkout counter or cashiers. Depending on the area, the term "wagon," "buggies," or "chariot" may also be used to describe this type of vehicle. They are widely utilized in practically all department stores, superstores that sell bulk goods, and grocery stores. The use of shopping carts is becoming increasingly important since they relieve customers of the stress of carrying large loads of items while navigating the store and enable them to make several, larger-sized, and heavier purchases at once.

II. LITERATURE SURVEY

Sure, here's the same information presented in a point-wise format:

1. Suraj. S, Vishal Guruprasad, Udayagiri R Pranava, Preetham S Nag developed an RFID-based wireless intelligent cart using ARM7, focusing on improving retailers' service quality through automatic identification.

2. Akshay Kumar, Abhinav Gupta, S. Balamurugan, S. Balaji, R Marimuthu designed a smart shopping cart using Arduino and Xbee modules to reduce queues at billing counters.

3. Harpreet Singh Bedi*, Nikhil Goyal, Sunil Kumar, and Avinash Gupta's system utilized Arduino and smartphones for a smart trolley, emphasizing RFID for customer security and membership card integration.

4. Renjini Jose, Saleh Musallam Abdullah Al Harthi, Ahmed Abdullah Awadh Koofan, Aida Khamis Ahmed Al Raiisi surveyed traditional shopping challenges and proposed a smart trolley solution to reduce waiting times.

5. Karpagam V, Balapriya S, Kalairubini G, Kalaivani A designed a unique system with RFID tags on products, enabling automatic billing within the shopping cart and LCD display of product details and prices.

6. Gade A, Bhatt N, Thakare N innovatively used barcode scanning in a smart trolley system but noted a distance barrier due to Zigbee limitations.

7. Chandrasekar P, Sangeetha T introduced a multifaceted system using ARM7, RFID, barcode readers, and Visual Basics for billing, allowing diverse payment modes but increasing system complexity.

8. Ms. Rupali Sawant, Kripa Krishnan, Shweta Bhokre, Priyanka Bhosale developed an advanced RFID-based shopping trolley with features like displaying product information on LCD screens and alerting weight mismatches.

9. Karpagam V, Balapriya S, Kalairubini G, Kalaivani A contributed to smart billing by updating customer bills in real-time as products were added to the cart.

10. Ambekar K, Dhole V, Sharma S, Wadekar T's RFID-Cloud smart cart system integrated RFID for billing alongside PCB, Wi-Fi, and power supply components, aiming for centralized and automatic billing directly from the shopping cart.

III. PROPOSED WORK

A. Block Diagram

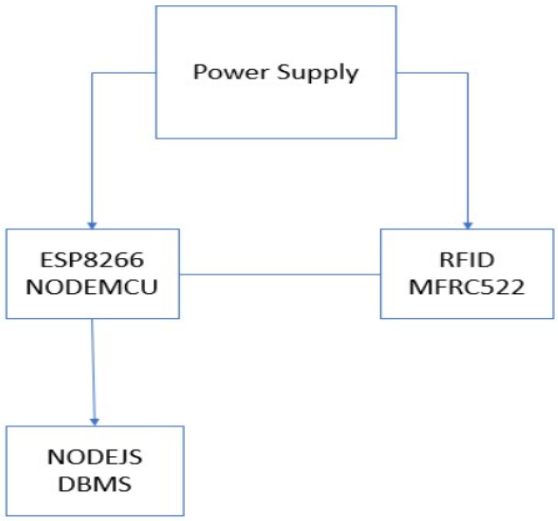


Fig 1

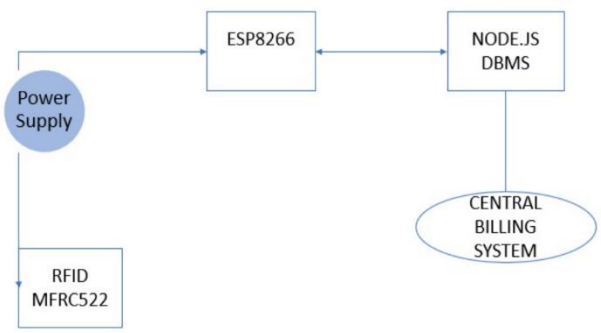


Fig 2

B. Hardware Specifications

1)

FID:

Radio-frequency identification, or RFID, is a useful technology for a variety of applications where an identifying mechanism is needed. This article demonstrates how to use the Arduino Uno with the RFID-RC522 module. An RFID reader that can read RFID tags at close range is the RFID-RC522 module. An RFID tag cannot be read unless both the reader and the tag are operating at the same frequency. Only tags that emit high radio frequency, traveling at 13.56 MHz, can be read by the RFID-RC522 module. A basic application that recognizes a user based on an RFID tag is created to illustrate the RFID-RC522 module.

Fig 3 RFID RC522 Module with a RFID tag

2) ***E***

SP8266*:*

An eLua-based firmware called NodeMCU is available for Espressif's ESP8266 WiFi SOC. The firmware employs a spiff-based file system and is based on the Espressif NON-OS SDK. 98.1% of the code in the repository is C-code. The well-liked NodeMCU dev kits, which are ready-made, open-source development boards containing ESP8266-12E processors, include a companion project called NodeMCU firmware.

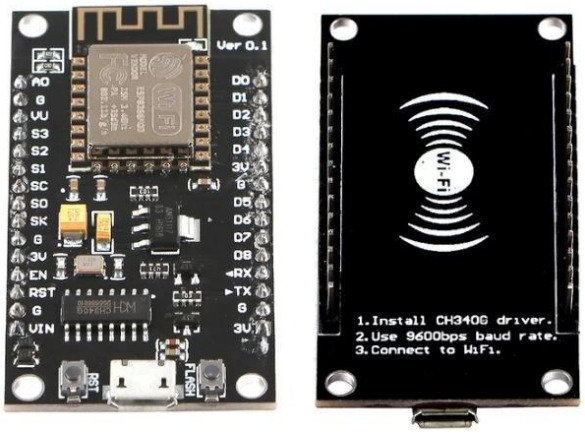


Fig 4 ESP8266

3) ***B***

readboard 800 Holes:

A contemporary solderless breadboard socket is made of a plastic block that has holes in it, beneath which are several spring clips made of nickel silver alloy or phosphor bronze that have been plated with tin. The clips are frequently referred to as contact points or tie points. The breadboard's specification frequently includes the number of tie points. Lead pitch, or the distance between the clips, is usually 0.1 inches (2.54 mm). It is possible to place integrated circuits (ICs) in dual in-line packages (DIPs) so that they cross the block's centre line. To finish the circuit, insert connecting wires and discrete component leads (such as those from capacitors, resistors, and inductors) into the remaining open holes. Discrete parts and related wires can use any of the holes if integrated circuits are not being used. Usually, the

R

ratings for spring clips are 0.333 amperes at 15 volts (5 watts) and 1 ampere at 5 volts. Male and female dovetail notches are located on the board's edge, allowing boards to be clipped together to create a larger breadboard.

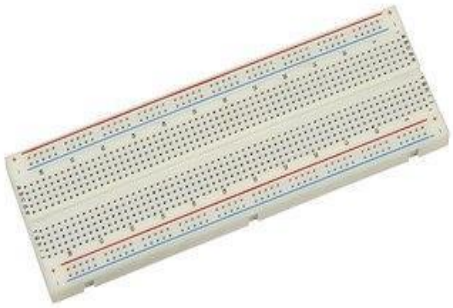


Fig 5 Breadboard

4)

FID Passive Tags:

An RFID tag that is passive is one that is battery-free. The reader provides the power. A passive RFID tag's coiled antenna creates a magnetic field when it comes into contact with radio waves from the reader. It provides energy to the tag, supplying energy to the circuits within the tag. Subsequently, the data stored in the tag's memory is transmitted.

Fig 6 RFID Passive Tag

5)

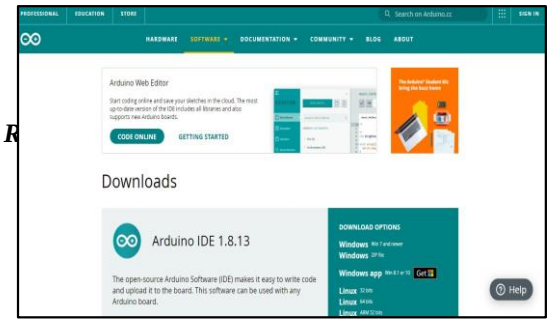
echargeable Battery:

Unlike a disposable or main battery, which is supplied fully charged and disposed of after use, a rechargeable battery is an electrical battery type that may be charged, discharged into a load, and recharged numerous times. One or more electrochemical cells make up this structure. Because it stores and accumulates energy through a reversible electrochemical reaction, it is referred to as a "accumulator". Rechargeable batteries come in a wide variety of sizes and forms, from button cells to megawatt systems linked to maintain the stability of an electrical distribution system. There are numerous combinations of electrode materials and electrolytes that are employed, such as lead-acid, lithium-ion (Li-ion), nickel-cadmium (NiCd), nickel-metal hydride (NiMH), and lithium-ion polymer (Li-ion polymer).

Fig 7 Rechargeable Battery

C. Software Requirement

a) Arduino IDE Software:



Link: https://www.arduino.cc/en/software

Fig 8 Arduino Ide Software webpage

b) Laragon Software:

Link: https://laragon.org/download/index.html

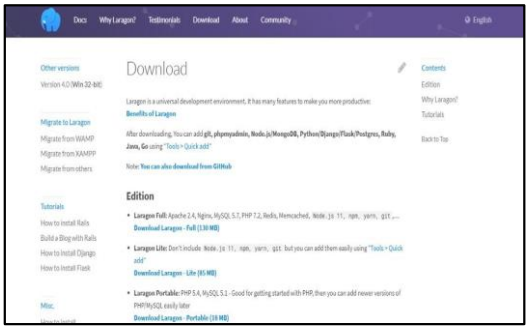
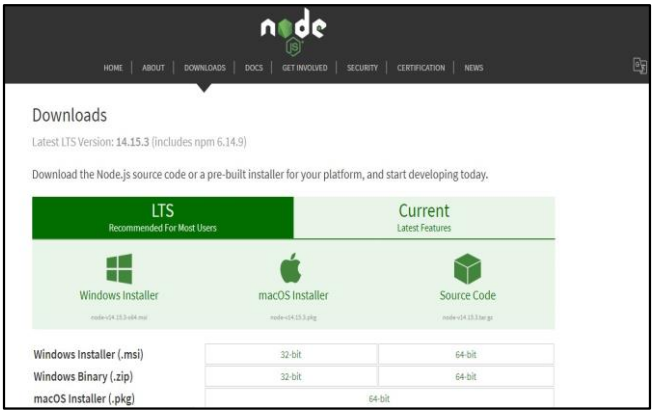


Figure 9 Laragon Software webpage.

c) NodeJs Software:

Link : https://nodejs.org/en/download/



IV. Result Discussion

A. Advantages

- Easy to use
- Low cost
- Robust operation.

B. Applications

- Used as shopping trolley
- Used as load carrier at airport or bus stations

V. Conclusion

This study shows how to install an RFID-based human-following load carrier successfully. This robot can follow and track objects in addition to being able to identify them. The tag is used to identify the owner, and the robot moves in accordance with that identification. The purpose of the robot's numerous sensors was to increase detection precision. Furthermore, the "following" skills of the robot were supposed to be optimized for maximum efficiency. The experiments were run under a variety of conditions to find and fix algorithmic errors.

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Smart Trolley and Billing System

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Abstract :

The goal of this project is to improve and enhance the present supermarket cart-based sell and purchase procedure such that it is faster and more effective for both the seller and the customer. Customers now have to wait in lengthy lines at the payment counter during peak hours at their neighborhood grocery store, standing and waiting for extended periods of time. Customers have found this to be quite problematic, particularly the elderly, people with health concerns, people in a haste, and people who are carrying little children. An RFID scanning system device was mounted to a grocery cart in order to address this issue. This solution is entirely made to speed up the purchasing and checkout processes for customers, saving them time at the payment counter. This study includes a feasibility study, which aims to be an initial assessment of the data to see whether it merits moving further to the analysis stage. Furthermore, Arduino IDE were used to design the system programming. Next, Autodesk Inventor Professional 2019 software was used to create the gadget housing. Regarding its system, it is divided into two sections: one for customers and the other for retailers. The experiment's findings demonstrated how RFID grocery carts shorten customers' shopping and payment processes.

Key Words: **Customer, Development, Grocery Cart, Recommendation, RFID.**

I. INTRODUCTION

A grocery trolley, also known as a shopping cart, is a wheeled vehicle provided by a store, particularly a supermarket, for customers to use inside the establishment to move goods as they shop and make their way to the checkout counter or cashiers. Depending on the area, the term "wagon," "buggies," or "chariot" may also be used to describe this type of vehicle. They are widely utilized in practically all department stores, superstores that sell bulk goods, and grocery stores. The use of shopping carts is becoming increasingly important since they relieve customers of the stress of carrying large loads of items while navigating the store and enable them to make several, larger-sized, and heavier purchases at once. RFID grocery carts can be utilized in any type of store or supermarket, but they work best in crowded supermarkets at peak hours, on weekends, and during the holiday season when there are a lot of people shopping. It is compatible because RFID grocery carts, which use radio frequency identification (RFID) technology, can cut down on the amount of time customers spend making purchases (especially when paying and checking out), eliminate lengthy lines at checkout counters, and improve the overall shopping experience.

RFID grocery carts are made with the same precise design to function as the modern, traditional shopping carts—that is, to be as strong, practical, and adaptable. To improve the control and mobility of the grocery cart, only minor adjustments are made. Furthermore, as society moves into the Industrial Revolution 4.0 (IR4.0) age, a shopping cart equipped with an RFID technology and system satisfies the requirements for an IR 4.0 component, as it consists of two of the four primary components of IR4.0: cloud computing and the Internet of Things (IoT).

II. RELATED WORK

The literature survey phase is crucial to the system development life cycle because it gathers and gathers the data needed to manage or build a project during this stage. A description of the literature that is pertinent to a given field or topic is called a literature review. It provides a summary of the main points made, the identities of the important authors, the theories and hypotheses that are now in circulation, and the methods and approaches that are acceptable and beneficial. Research is done in this portion before beginning the project and

comprehending the many approaches that have been employed in the past. A thorough examination of the current systems was carried out. The advantages and disadvantages of the current systems were identified with the aid of this investigation.

Given that the project is an application of RFID technology, a review of the literature has been conducted on a few articles pertaining to various components and procedures or techniques. Data has been gathered from these papers in accordance with the project requirements.

People visit supermarkets to make payments and buy the goods they need on a regular basis. Therefore, the total products and total amount must be calculated. Here, self-service is used using RFID tags to cut down on labor costs and wait times. Utilizing Zigbee technology lowers low power consumption, low cost, and low data rate [1].

The goal of this study is to design a system that uses RFID reader antennas to scan both static and dynamic objects in a retail environment. Aisle-level scanning is used in place of performing RFID observations at the level of individual carts [2].

Instead of a barcode scanner, every product in this paper had an RFID tag. An LCD monitor, a Zigbee transmitter, and an RFID reader will be included in the smart trolley. When a goods is placed in the trolley, a scanner scans it and displays the product's pricing on the LCD. Radio frequency identification, or RFID, recognizes and tracks tags affixed to items automatically [3].

Problem Statement: Create a solution that will be economical and shorten the supermarket's billing process. A novel product that improves everyday comfort, ease, and efficiency is one that the public finds acceptable. In large cities, shopping and making purchases at malls has become a daily routine. Individuals buy various goods and load them into the cart. Once purchases are made, payments must be made at the billing counter. There is a lengthy line at the billing counter because the cashier prepares the bill using a bar code reader, which takes a lot of time. Time spent standing and waiting for individual turns can be better spent doing something useful. Finding the goods they need is another issue that the majority of people have. The majority of people are also having trouble learning about the current promotions that are offered for a given product. Shop owners are also quite concerned about potential theft or product take-out, which would result in additional losses.

III. RESEARCH METHODOLOGY

This chapter will provide a more thorough explanation of the steps involved in creating an RFID system for a grocery cart. Software the Arduino IDE were used to design the system's programming. The project's component and all necessary materials will also be briefly outlined.

A) Assumptions &Dependencies

The objectives of the grocery cart RFID system are:

i. Will address long lines at the counter
ii. To ensure ease of use and safety
iii. The consumer's convenience
iv. To include RFID technology into the purchasing process.

B) User Interface

Application Based Smart shopping cart system.

C) Hardware Interfaces:

A thorough analysis of each component and material utilized is necessary to guarantee the production of high-quality products. This is to prevent other types of product errors that could result in new problems and to help design the best solution to the primary issue. The goal of the study in this section is to learn more about the fundamental part of the apparatus that will enable the RFID System Device to function as intended. The following are the parts of the RFID System Device for Grocery Cart:

i. RFID RC522 Module for Arduino
ii. Node MCU Microcontroller
iii. Breadboard 800 Holes
iv. Dupont Jumper Wires M/M
v. RFID Passive Tags
vi. Rechargeable Battery

D) Software Interfaces:

1) Arduino IDE Software,

IV. ARCHITECTURE

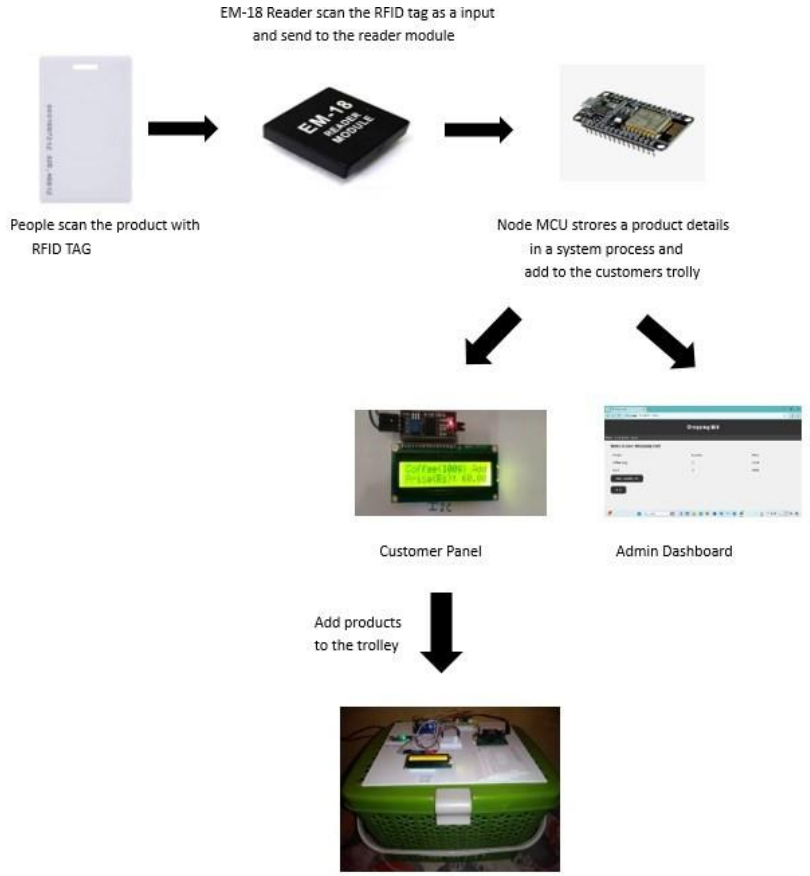

Figure 1. System Architecture

Operational Procedure of RFID System Device for Grocery Cart

1. Customer enter premises with RFID tags (can also be provide by store retailer).
2. While taking grocery cart before begin with shopping activity, customer scan their RFID tag through RFID scanner that is attached to the grocery cart.
3. RFID Reader scan information embedded in the tags and send this information to NodeMcu Microcontroller.
4. NodeMcu Microcontroller translate the information and send this information to Node.Js Database Management System Software.
5. This set up an item purchased database site which is set up exclusively for that particular customer only.

6. While moving around premises during shopping activity, customer can scan the item they wish to purchase (that have been attached with RFID adhesive tags) through the same RFID reader attached at the grocery cart.
7. Data of customers purchased item will be collected in the items purchased database and is organize and also sum up with a total price.
8. As customer are done with their shopping activity, customer can head to the cashier counter directly.

Retailer Section :

1. Customer reaches cashier counter and hand-over their RFID tags to the cashier.
2. Cashier will scan the RFID tags through a RFID reader located at the cashier counter.
3. This will command the supermarket central billing system to receive input of database from the customer's Item purchased Database.
4. Sum up of collective data with a total price that the customer need to pay will pop out at the counter screen.
5. Customer pay total amount of purchased item through cash or online services.

IV. RESULT AND DISCUSSION :

The main basic working operation of this system consist of three main part which is a purchase database management system software, a microcontroller and a RFID Reader Module, interfacing with each other.

A microcontroller is a computer present in a single integrated circuit which is dedicated to perform one task and execute one specific application. It contains memory, programmable input/output peripherals as well a processor. They run one specific program and are dedicated to a single task. They are low power devices with dedicated input devices and small LED or LCD display outputs. Microcontrollers can take inputs from the device they controlling and retain control by sending the device signals to different parts of the device. A good example is a TV's microcontroller. It takes input from a remote control and delivers its output on the TV screen.

Next, a RFID reader is Radio Frequency module and an antenna which generates high frequency electromagnetic field. It read code which is embedded in a passive generates an electromagnetic field which causes electrons to move through the tag's antenna and subsequently power the chip. The powered chip inside the tag then responds by sending its stored information back to the reader in the form of another radio signal. This is called backscatter. The backscatter, or change in the electromagnetic/RF wave, is detected and interpreted by the reader which then sends the data out to a computer or microcontroller. In this project, the module that will be used is RFID RC522 Module.

Finally, a database management system software. A database is an organized collection of data, generally stored and accessed electronically from a computer system. This collection data will be managed by a management system software that interacts with end users, applications, and the database itself to capture and analyse the data. The DBMS software additionally encompasses the core facilities provided to administer the database. The sum total of the database, the DBMS and the associated applications can be referred to as a "database system". Often the term "database" is also used to loosely refer to any of the DBMS, the database system or an application associated with the database. In this project, the database management system that will be used are Node.JS Software as it is an open-source, cross-platform, JavaScript runtime environment that executes JavaScript code outside of a browser and is easier to use.

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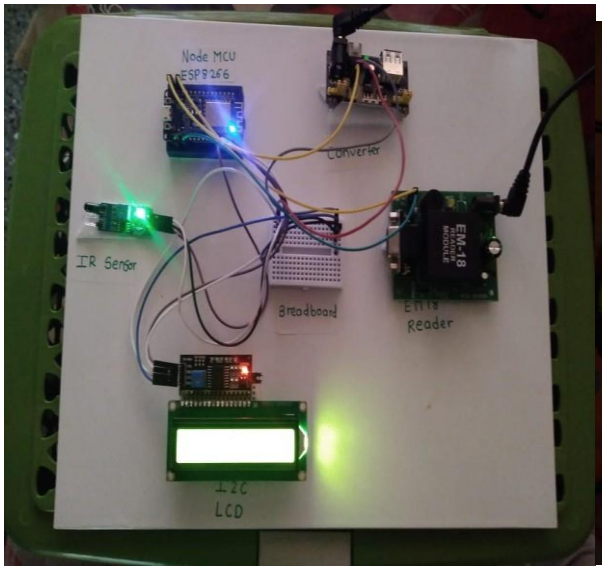

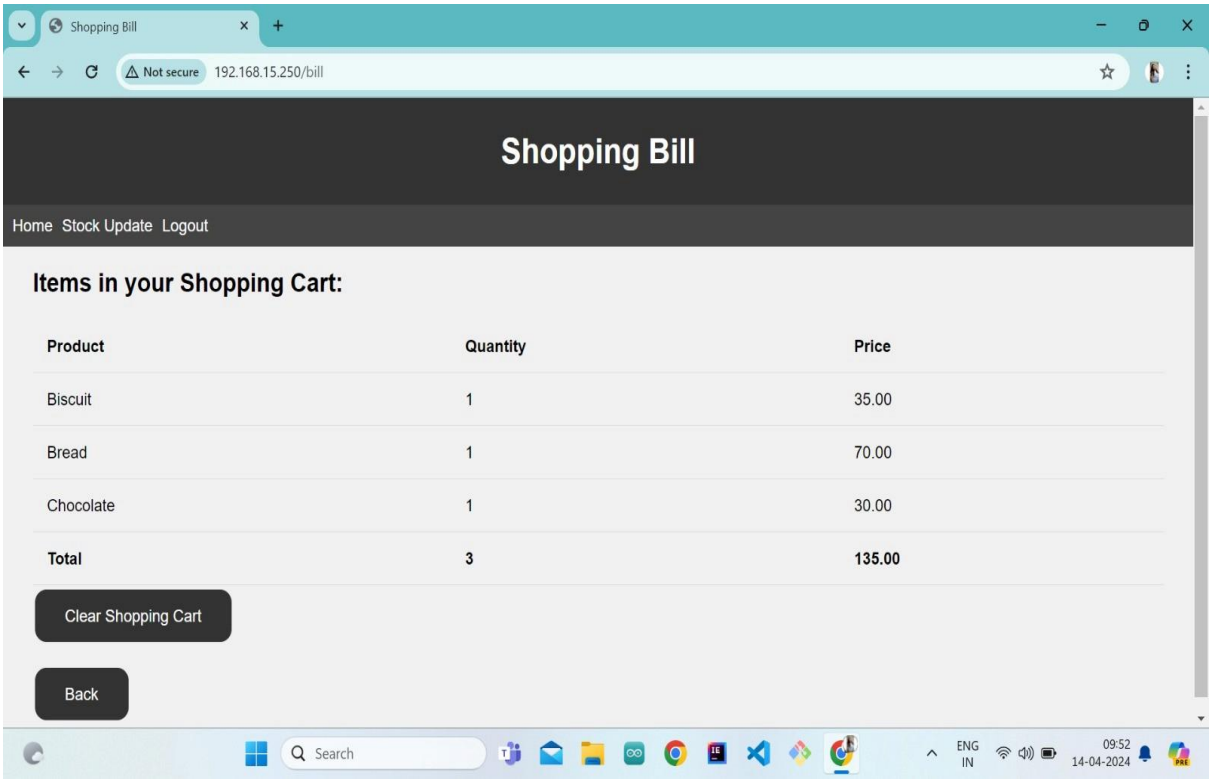

To make things short, to make the whole system work it require all three components to interface with each other by;

1. RFID reader read information embedded in passive RFID tags then send signal of information to NodeMCU Microcontroller.
2. NodeMCU Microcontoller receive input of information, translate this information and send them to Database Management System Software.
3. System collect these inputs and organize these data and sum up the total of these database wirelessly.

V. CONCLUSION

In conclusion, the main idea behind this project is to help the society by cutting short the time spent on queuing when making grocery shopping. The usual grocery cart at other related supermarkets/ hypermarkets is mainly used to store goods in the cert after shopping. By having RFID technology applied on the grocery cart, it can help both the customer and cashier when making payment, thus making the checkout process faster.

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