A Report

on

ONE CLICK RFID STORE

by

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Under Guidance of -

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BML MUNJAL UNIVERSITY

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CERTIFICATE

This is to certify that Core Project of **SONTU NARENDRA GAUTAM, SUSHRUT GHOKHALE** & **NIKHIL JAIN** titled **ONE – CLICK RFID STORE** is an original work and that this work has not been submitted anywhere in any form. Indebtedness to other works/publications has been duly acknowledged at relevant places. The project work was carried during **3rd AUG 2020** to **3th DEC 2020** in **BML MUNJAL UNIVERSITY, GURGAON**.

Signature of Guide

Name: Dr. Rajiv Dey

Designation: Assistance Professor, SOET

(Seal of the organization with Date)

ABSTRACT

Ever since the debut of wireless technology, electronic commerce has developed to such an extent to provide convenience, comfort and efficiency in our day-to-day life. In this paper, we propose a concept of RFID based smart shopping system in the field of retail merchandise. Our whole shopping experience is often marred by the long checkout lines. Soon we can end this problem by replacing the ubiquitous Universal Product Code (UPC) bar code by smart labels, known as radio frequency identification (RFID) tag and the Internet of Things (IoT) based Smart Shopping Cart is proposed which consists of Radio Frequency Identification (RFID) sensors, NodeMCU, Servers, and Mobile application. RFID sensors depend on wireless communication. One part is the RFID tag attached to each product and the other is RFID reader that reads the product information efficiently. After this, each product information shows in the webpage and the customer easily manages the shopping list displayed on the webpage according to preferences and then after final scanning shopping information sends to the remote server wirelessly and automatically generates billing in the Mobile application. This experimental prototype is designed to eliminate time-consuming shopping process and quality of services issues. The key idea here is to provide assistance in everyday shopping in terms of reduction in time spent, standing in long queues. The primary goal is to provide a technology oriented, reduced cost, time saving, hassle free, commercially oriented system for an enhanced shopping experience.

ACKNOWLEDGMENT

We would like to express our deepest appreciation to all those who provided us the possibility to complete this report. A special gratitude I give to our final year project guide, Dr Dey, whose contribution in stimulating suggestions and encouragement, helped us to coordinate our project especially in writing this report. We have to appreciate the guidance given by other faculty's as well as the panels especially in our project presentation that has improved our presentation skills thanks to their comment and advices. Our thanks and appreciations also go to our university and our dean in developing such a unique program.

Thanking You

Sontu Narendra Gautam
Sushrut Ghokley
Nikhil Jain

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I. OBJECTIVES

To create an environment that makes the shopping experience less hectic and time consuming. We are proposing a system, which runs without a cashier and large manpower. To develop a smart shopping system where we are using a shopping cart with an RFID reader that will display the total amount as per the item added or removed on a webpage. After the final scanning at the gateway by the customer, an e-bill will be sent on the customer's mobile using the server and giving freedom in online payment.

The sub objectives include

    a. Making a webpage for displaying of products in your cart and the amount.
    b. Creating a database for the product information.
    c. Building a mobile application for the customer to get the bill and do payments.
    d. Client and Server communication.
    e. Designing the layout for the sensor implementation.
    f. Hardware implementation.

II. METHODOLOGY

A. REQUIRED SKILLS

    a. Web development.
    b. Database management.
    c. C Programming, JavaScript and MySQL
    d. Client-server communication
    e. Mobile application using block-based coding.
    f. Knowledge of NodeMCU and RC522 reader.

B. DATA COLLECTION AND SURVEY

What's RFID?

Radio-Frequency Identification (RFID) is the use of radio waves to read and capture information stored on a tag attached to an object. A tag can be read from up to several feet away and does not need to be within direct line-of-sight of the reader to be tracked. This is the advantage over Bar-code.

- A RFID reader is a device used to gather information from an RFID tag, which is used to track individual objects. Radio waves are used to transfer data from the tag to a reader.
- A passive tag is an RFID tag that does not contain a battery, the power is supplied by the reader. When radio waves from the reader are encountered by a passive RFID tag, the coiled antenna within the tag forms a magnetic field. The tag draws power from it, energizing the circuits in the tag.

Why RFID over existing barcodes?

In 2009, Arkansas University completed the study to determine the business value of the RFID at the major retailer. That proves the efficiency of RFID is better than the barcode system. According to their survey results, the accuracy of inventory management is improved by 27%, under stock decreased by 21% and overstock decreased by 6%. Because the Barcode scanner scans 10000 items in 53 hours where RFID read in 2 hours. [1]

How are we different from other papers?

- We are using NodeMCU for the transmission of data and send back the data to the smartphone.
- Encrypted data Encryption and Decryption algorithms are used for the symmetric and asymmetric methods. That provides the security techniques based on encryption keys.
- Central server and one-click payments options.
- Displaying cart information in a webpage instead of LCD display.
- The searching and shopping list management modules are added in Mobile Application which helps the consumer to end the location in the supermarket, to remember the shopping list and to manage the shopping list according to preference.

**Advantages of using RFID over existing methods:**

- Does not require a direct line of sight.
- Able to be rewritten and reused.
- Tags are durable.
- The reader can read hundreds of tags in seconds.
- The data is encrypted.
- The tags can hold more data than other systems like barcodes.

III. PROJECT DESCRIPTION

We divide our project into two activities:

Trolley Side:

- When the customer enters our store and the customer can do shopping with the help of the cart or without the cart and pick up the products and carry them.
- If he/she chooses to take the RFID implemented cart, then the product description will be displayed on the smart phone(webpage).
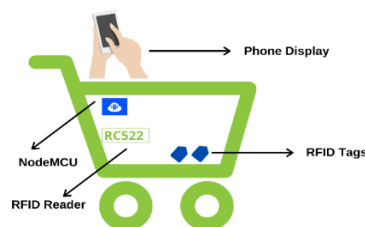
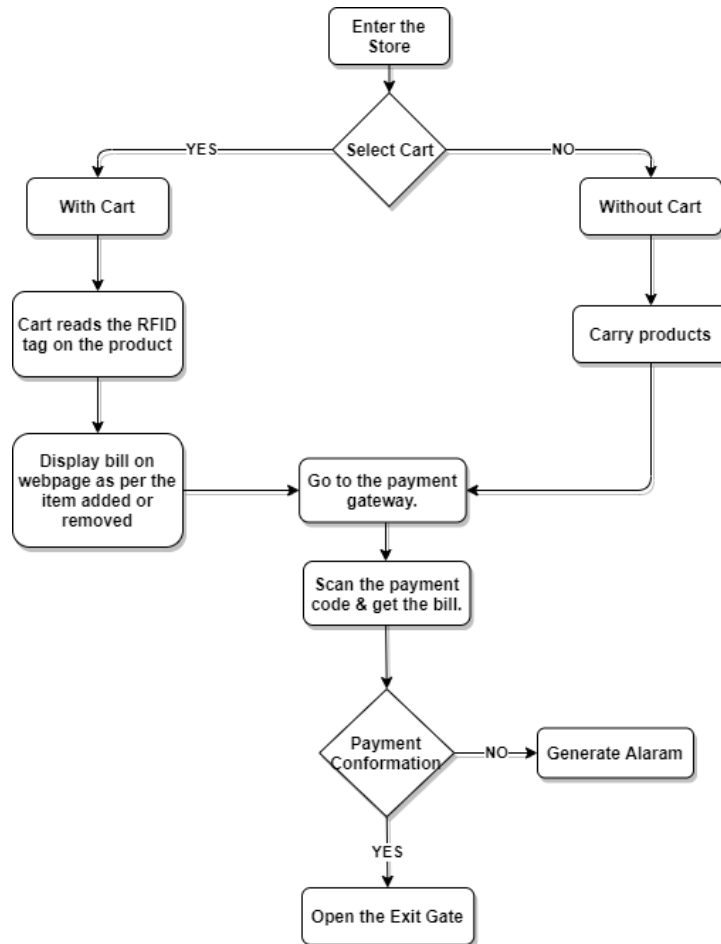(i) Trolley implemented with RFID reader and Node MCU

Gateway Side:

- When the customer reaches with or without the cart at the check-out gateway, the final scan of products will be done.
- After the final scan, the bill will be sent to our app and payments can be done.
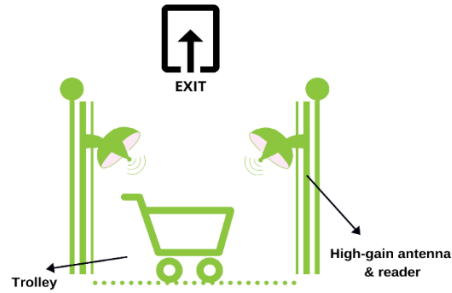
(ii) Checkout gateway with high gain antennas and trolley
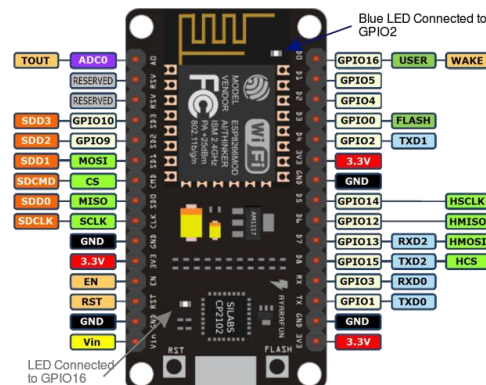
A. Flow Chart

(iii) Flow chart of the shopping process

B. Experimental Setup

Materials Used

1. NodeMCU

(iv) Pinout of NodeMCU

NodeMCU is an open-source Lua based firmware for the ESP8266 Wi-Fi SOC from Espressif and uses an on-module flash-based SPIFFS file system. NodeMCU is implemented in C and is layered on the Espress if NON-OS SDK. The node MCU is used to read the value from RC522, display the webpage, and connect to the server and database. It is used because it is an Arduino board with integrated Wi-Fi. We integrate NodeMCU in our project as a server and as a client. we can use our NodeMCU as a server in two ways. This functionality came because our NodeMCU connects to any wi-fi network as a client or it can create a network to which other wi-fi enabled devices can connect. [2]

- NodeMCU as HTTP Server using Wi-Fi AP mode: NodeMCU wi-fi as Access Point (AP) mode through which it can create Wireless LAN to which any wi-fi enabled device can connect.

- NodeMCU as HTTP Server using Wi-Fi STA mode: NodeMCU has Station (STA) mode using which it can connect to the existing wi-fi network and can act as an HTTP server with an IP address assigned by that network.

- We use NodeMCU as http server using Wi-Fi STA mode in our project.

2. Rc522 Reader
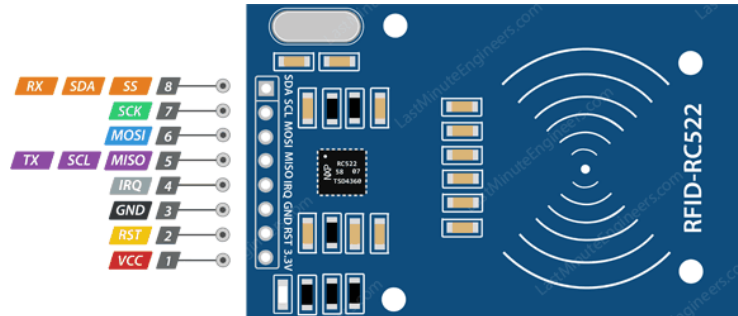
(v) Pin out of RC522 RFID module

The RC522 RFID module based on MFRC522 IC from NXP is one of the most inexpensive RFID options that you can get online for less than four dollars. It usually comes with a RFID card tag and key fob tag having 1KB memory. And best of all, it can write a tag, so you can store some sort of secret message in it. The RC522 RFID Reader module is designed to create a 13.56MHz electromagnetic field that it uses to communicate with the RFID tags (ISO 14443A standard tags). The reader can communicate with a microcontroller over a 4-pin Serial Peripheral Interface (SPI) with a maximum data rate of 10Mbps. It also supports communication over I2C and UART protocols. RC522 allows us to read HF RFID tags attached on products. [3]

Setup
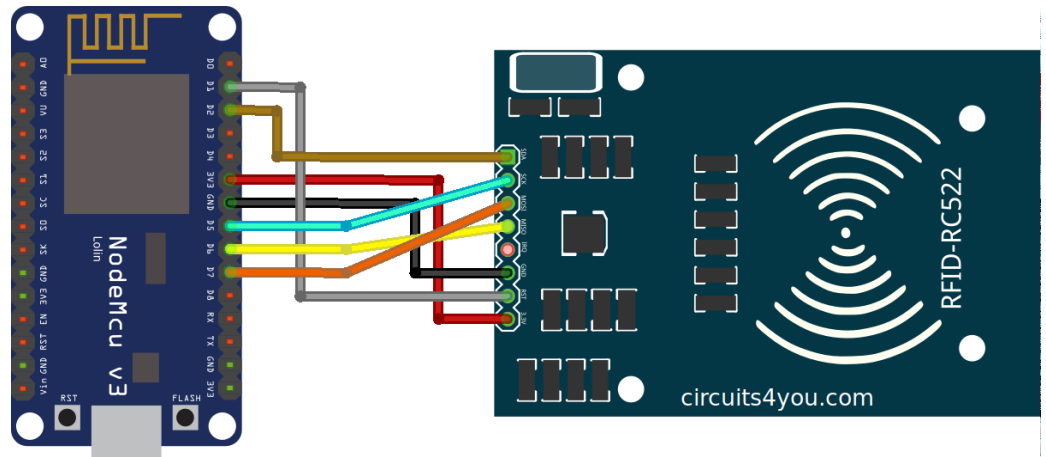
NODEMCU PIN	RC522 PIN
SDA	10
SCK	13
MOSI	11
MISO	12
GND	GND
RST	9
3.3V	3.3V

(vi) Connection of RC522 with NodeMCU

The RFID reader and the NodeMCU are connected in this configuration. We use SPI communication for communication between them. The NodeMCU is capable of I2c communication too.

Database building

For building the database the software prerequisites are.

XAMPP-- it is an open-source software that gives us the functionality to connect to a live server from our local host machine. It is developed by the Apache Friends community and it is free to use. We use Xampp mainly for connecting to our database that we created for our project, giving the idea to the customer about the product's details.

Apache -- provides the functionality to work on HTTP server, it is an absolutely free and open-source platform. We connect to the Apache server from our local host machine and we created a database with the help of Apache server. In the below picture we have shown our database which contains essential information regarding our products.

MySQL server-- we use MySQL relational database management system (RDBMS), which is also free and open-source software. A relational database management is used to make our database less complicated and easy to use.

phpMyAdmin-- phpMyAdmin is a free software tool written in PHP, intended to handle the administration of MySQL over the Web. Provide functionality like managing databases, tables, columns, relations, indexes, users, permissions, etc, can be performed via the user interface, or we can write and execute SQL query statements.

Step1 We use XAMPP software to initiate Apache Friends server and MySQL web server, on our local machine. [4]
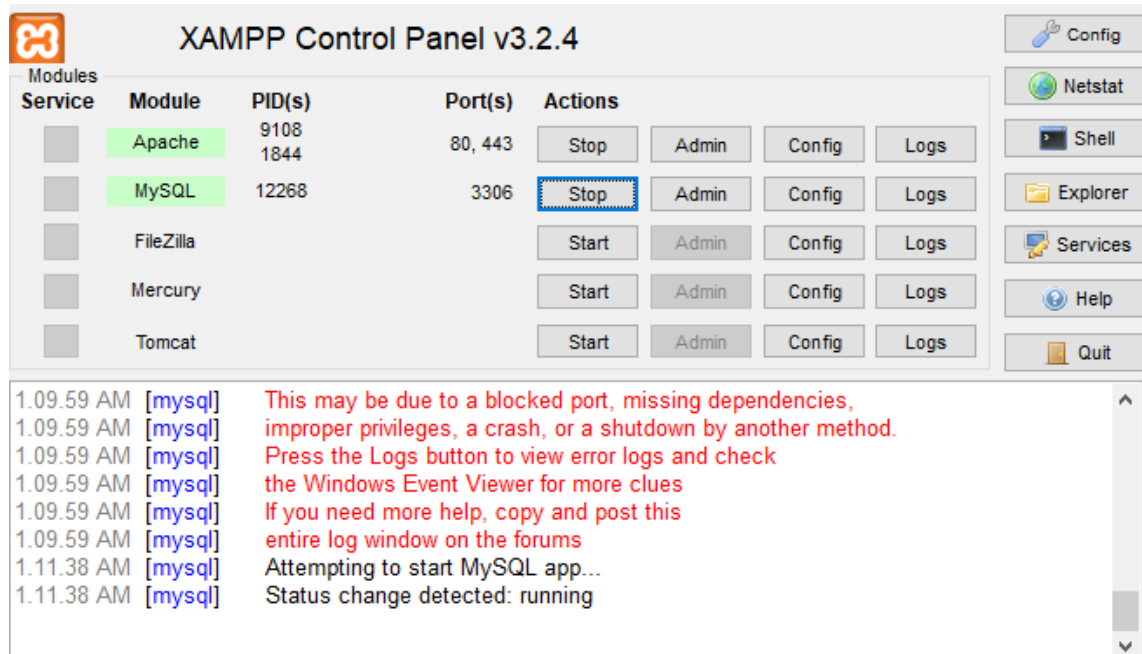
(vii) XAMPP Control Panel
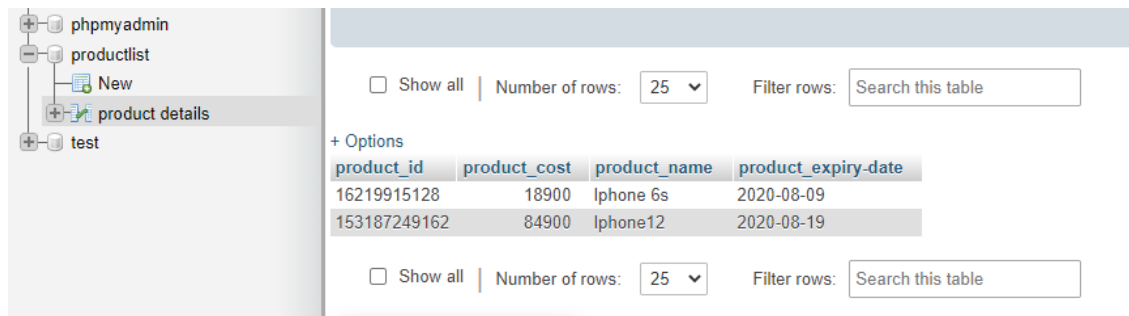
Step2 Connect to phpMyAdmin
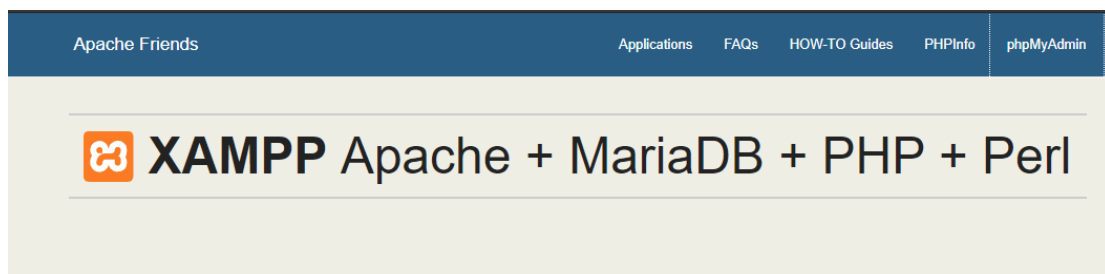
(viii) phpMyAdmin page

In the above picture we use phpMyAdmin, for supporting our MySQL database.

Step3 Creating database with database table and details of products.


(ix) Database

Our database contains four columns, contains product_id, product_cost, product_name, product expiry_date.

Information for our database-

1. Table name -- product details

2. Divided into 4 columns

   a) product_id

   b) product_cost

   c) product_name

   d) product_expiry_date

3. Given 2 product details e.g., Iphone6s and Iphone12. [5]

Application Development

We created an app using the MIT app inventor. This app will be used by the customer to make their profile, generate the QR code and pay for their products.
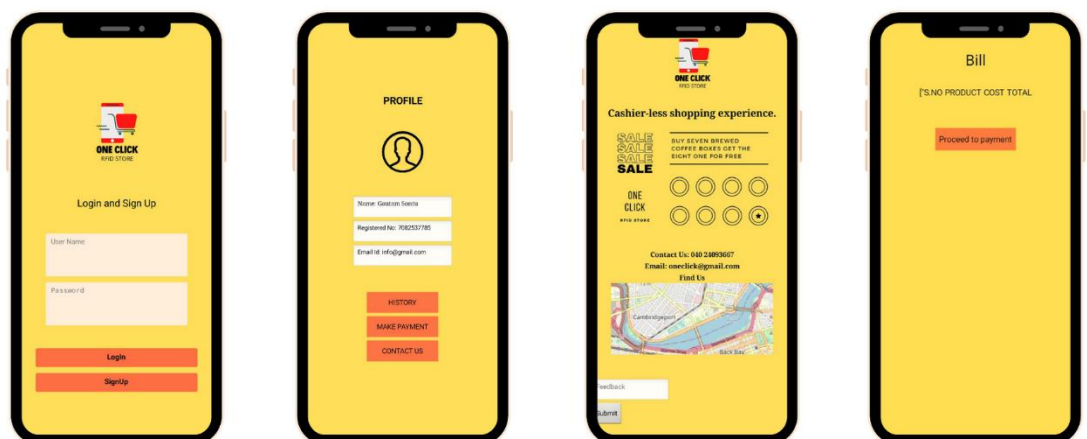
(x) App interface

For further development we plan to add a search functionality where people can search the availability of the products. We also want a history function where people can look at past bills.

Webpage development
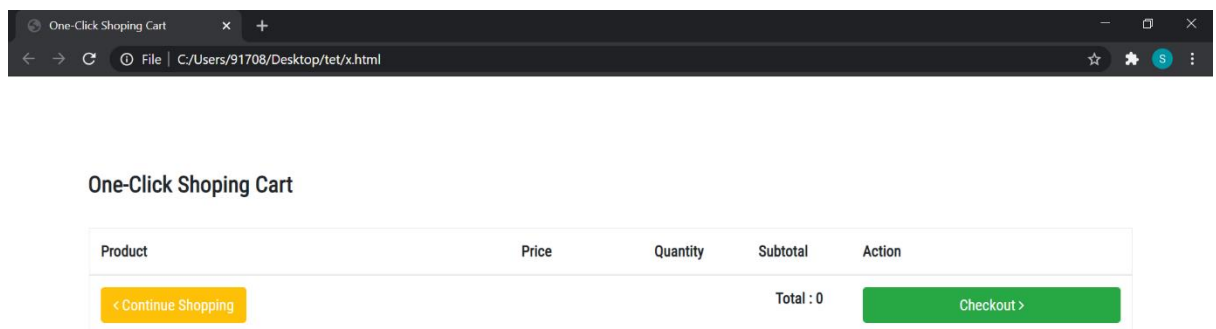
(xi) Product information on NodeMCU hosted page

We have used HTML, CSS, and JavaScript for making this webpage. This webpage is imported into NodeMCU and hosted by it. NodeMCU is configured as a server and connected to the reader which is attached to the shopping cart, whenever the customer puts the products in cart, we see the amount and the product information on the webpage.
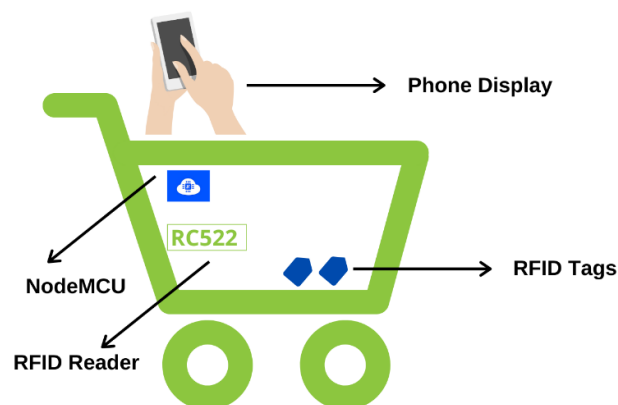
Google sheets
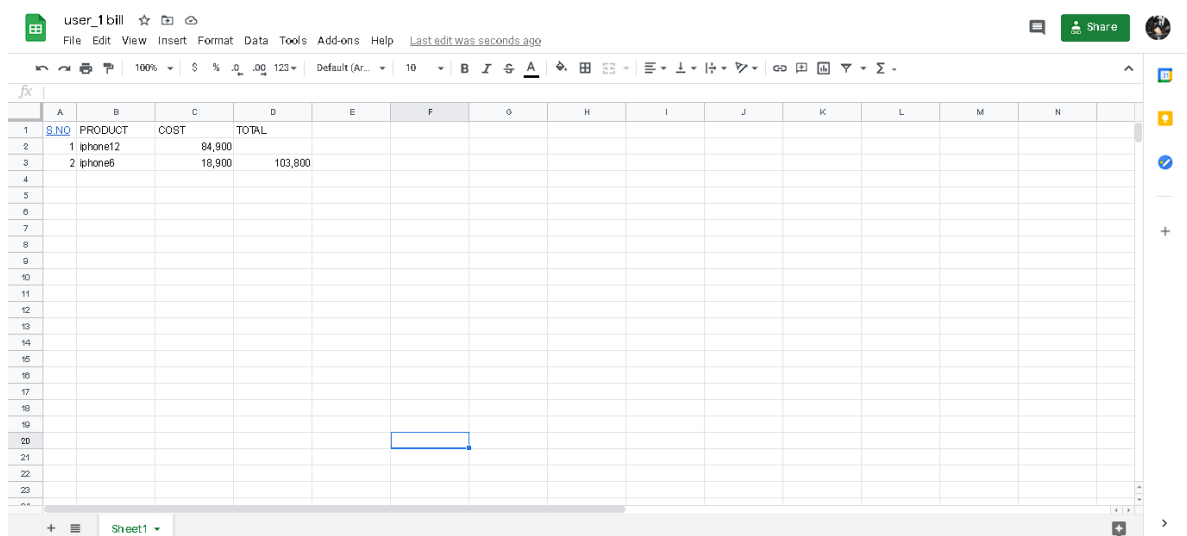
(xii) Google sheet bill

There is a functionality in google sheets which allows us to add scripts and deploy it as a web app. We use this functionality to edit the sheet by sending URL requests. then the script reads the URL and edits the sheets accordingly. [6]
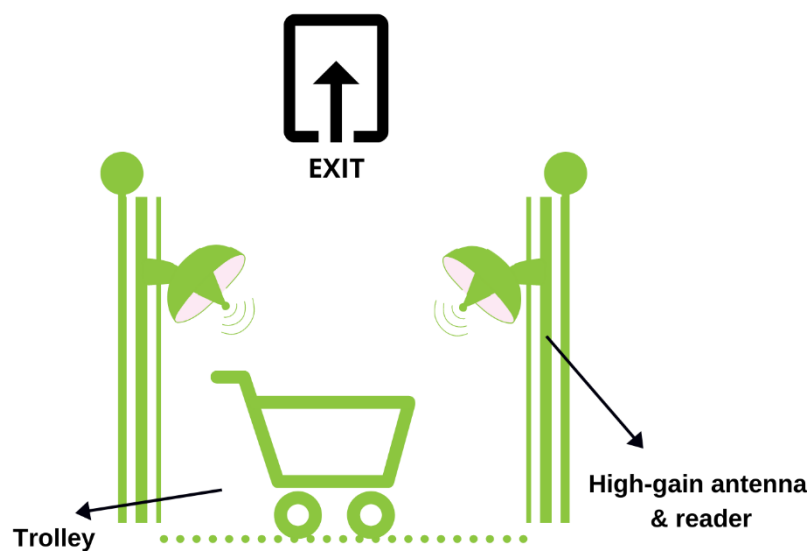
Systems

Trolly:

(xiii) Trolley implemented with RFID reader and NodeMCU

In the trolley there is a RFID reader connected to a NodeMCU. The reader reads the tags on the products and then the NodeMCU fetches their information and displays it on a webpage which is hosted on the NodeMCU.
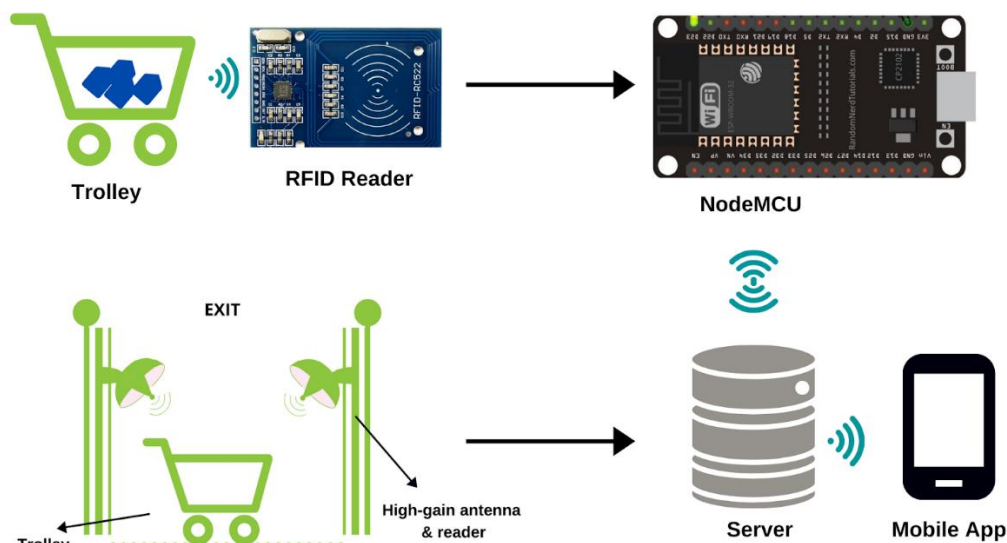
Gateway:

(xiv) Checkout gateway with high gain antennas and trolley

At the exit gateway the customer can scan a QR code which is unique to their profile, this lets the gateway know which profile to send the bill to. Once the person passes through the gateway their products are detected by high gain RFID antenna and communicated to the NodeMCU then the NodeMCU fetches the relevant information and sends it to the server which generates the bill and sends it to the person's profile.
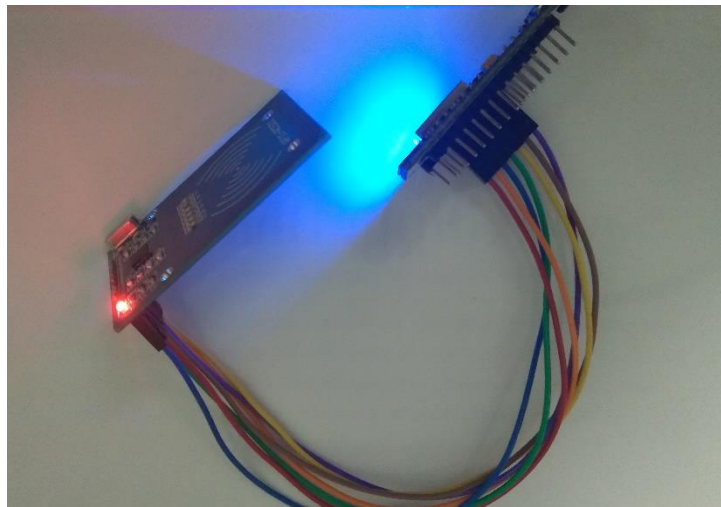
IV. WORKING

The customer has to install an app and make their profile on it. Their bill will be sent directly to their profile and the payment will also be done online. The store will have RFID tags on the products and the RFID readers will be able to detect the tag and then fetch the product information from a database.

(xv) Working of the project

The customer can choose to either use a trolley or not use one. In the trolley there will be a NodeMCU and RFID reader which will read the tags when the person adds the items into the cart and the information will be displayed on our webpage which is hosted on NodeMCU.

(xvi) Connections & working

Once the customer is done with the shopping, they can proceed to the exit gateway. At the exit gateway the customer has to scan a QR code which is unique to their profile, this lets the gateway know which profile to send the bill to. Once the person passes through the gateway their products are detected by high gain RFID antenna and communicated to the NodeMCU then the NodeMCU fetches the relevant information from our database. our database stores the additional information for our product. This data is communicated with our webpage through the server-side scripting language, we use PHP language as it is easy to use. After sending data that has been requested by the NodeMCU. The data is sent to google sheet in the form of a URL (get request method). The sheet is deployed as a web app There is a script in that web app that checks the URL and fills the sheet with the information that is sent from the NodeMCU. The app accesses the bill by using a specialized URL which automatically exports that google sheet in CSV format and then formats the data to make it presentable.
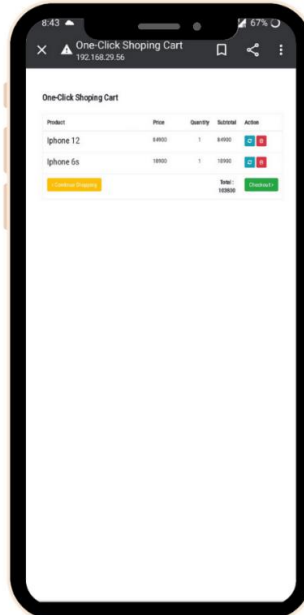
V. RESULTS

After integration of the above model, we could deploy the following outputs,

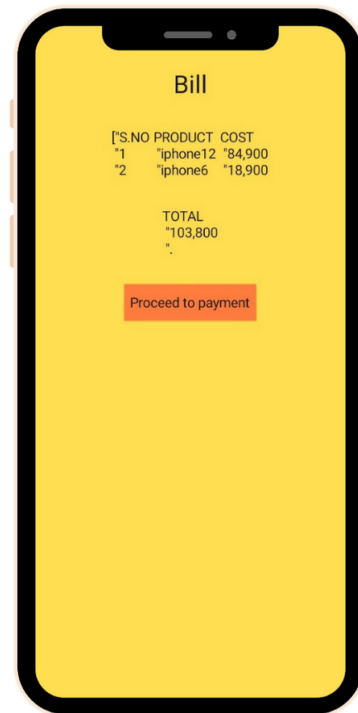1. Product information in the cart in desktop and mobile view.
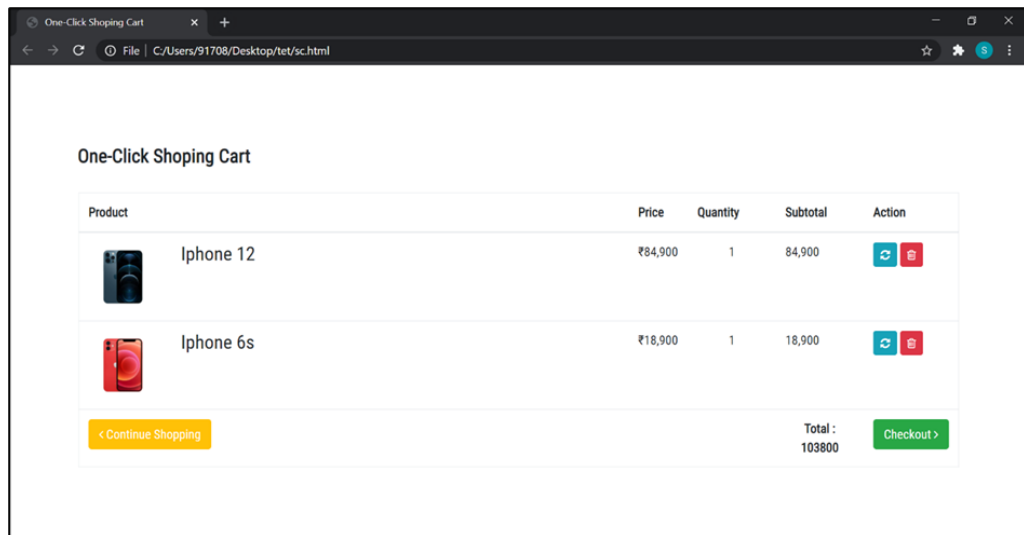
(xvii) Desktop view of product information webpage hosted on NodeMCU

(xviii) Mobile view of product information webpage hosted on NodeMCU

2. Generated bill to One-Click mobile app

(xix)Generated bill to One-Click mobile app

VI. CONCLUSION & FUTURE WORK

In this report, as you can see the shopping experience that we created is not only technologically advanced and state of the art but is also extremely convenient and will make physical shopping easier and give the user a better experience. We took the advantage of IOT to allow us to exchange our information between clients and servers. This allows us to build a network of RFID sensors that can detect the products information and automate the shopping process. This makes the whole process less time consuming.

It was a wonderful learning experience for us while working on this project. This project took us through the various phases of project development and gave us real insight into the world of software engineering. The joy of working and the thrill involved while tackling the various problems and challenges gave us a feel of the developers' industry. It was due to this project we came to know how IOT can change industry and lives.

In future we can use enhanced RFID readers that operate in high frequency which can read multiple tags simultaneously. Mobile applications can be developed to avoid smart cards and GSM. Inventory management can be incorporated using IOT which in turn helps in automation of stock management. The proposed smart shopping trolley system can reduce the customer's time in searching the location of the product. The customer just types the name of the product he/she wants to purchase on an android device. The trolley will automatically guide them to the location of the product.

VII. REFERENCES

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