IOT BASED SMART AUTOMATIC SHOPPING CART

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ABSTRACT

Due to the high time consuming for the billing process of the products customers have to wait in the queue for the billing for a considerable time and limits of human working time in the supermarket and hypermarkets are at its limitations of purchasing time, products maintenance and labor rights, so to overcome these problems, This paper suggests the automation of billing, auditing, analyzing products through IoT connected central server for distribution of data to every cart. It is an IoT system and RFID tag that are attached to each product and cart available in the store .So when product is placed into a smart shopping cart, can be automatically read by a cart equipped with an RFID reader and the price of the products that are places into the cart is added, which reduce the human power and saves time.

Web-application that can be connected to every customer through their unique login credentials, which will be a one-time registration. There they can find all the products available in the shop, and more things like discounts, newly arrived products, they can also give feedbacks that can be viewed by the admin. Additionally, an analytical dashboard is created, that can be accessed only by the admin or owner of the shop which has more features for monitoring and analyzing, to improve sales, and more things. With RFID readers attached, and monitoring stock, perhaps also updating a central server is made incredibly easy. Another benefit of this kind of system is that Inventory management becomes much easier, as all items can be automatically read by an RFID reader and indicate whether the products are valid to date and not expired while purchasing. Then it will be updated in IOT and the data is fetched using API and used in webapp for the access of admin and owners for monitoring.

Keywords**:** *IoT server, RFID tags, RFID readers, expiry, Monitoring and Analyzing.*

INTRODUCTION

In this modern world of technology and timeless environment for people, still, people are waiting and wasting their time standing in queue for billing of their purchased products. And in this automated world, supermarkets are still in old age. To make the supermarkets and hypermarkets more productive for the consumer and the owner, They should be automated through embedded systems and IoT.

Customers should be aware of the product they buy and it is the responsibility of the owners to make the customers aware So the web app will help to have complete information about the product they buy along with the details customers can find the location of the product in the shop so that it will be easy to locate the item very soon which will save more time. The app also displays the products available in the shop and the products are categorized. They can also view offers going on, can provide more feedback to owners, and more.

Every management should monitor the performance of the shop and that becomes easy by having a dashboard. This App has a dashboard that can be used by admins and owners. The sales dashboard is a visual representation of a company's sales data and metrics that provides real-time insights into the sales performance of the business. The dashboard typically includes charts, graphs, and tables that display key performance indicators. They can have a watchlist like best-selling products, highly profitable products, targets that need to be achieved, and more. They can also view all the feedback given by customers. Admins can also send emails. Admins can also navigate to the common pages like all users. No need of maintaining stock count and tally information manually, complete information is displayed in the dashboard invested amount will also be displayed so they don't want to worry about anything.

Whenever a product is picked up by the customer backend will take care of decreasing the stock count, increasing the profit, target validation, and updation in charts will be done automatically. These types of web applications can be made by using react js, node js, and database(MySQL databases). React js is built on node.js so installing libraries is very easy and can be learned easily. MySQL and node.js has a very large community so that will be easy to solve any problems. Node.js is the fastest backend framework many of the games are developed using node.js.

A novel, adaptable publishing scheme[1-3] with which privacy requirements can be specified as an arbitrary set of privacy rules over attributes in the micro data table. This is based on the framework that Xin Jin, Mingyang Zhang, Nan Zhang, and Gautam Das developed to model real-world privacy requirements for data publishing. The GuardianNormal Form (GNF), a novel way of publishing numerous sub tables in which each sub-table is anonymized by an existing QI-SA publication algorithm, while the combination of all published tables guarantees all privacy constraints, is introduced to enable versatile publishing. For decomposing a micro data table into GNF, developed two methods: Guardian Decomposition (GD) and Utility-aware Decomposition (UAD).

This research [4-6] suggests an incentive mechanism with privacy protection in mobile crowdsourcing systems to increase the effectiveness and utility of these systems. This research suggests an incentive system that statically chooses worker candidates before selecting winners after bidding, combining the benefits of offline and online incentive systems. An enhanced two-stage auction algorithm (ITA) and an accurate method for updating online reputation are the two algorithms that make up the suggested incentive mechanism (TORU).

Friendships and user profiles are by nature private [7-9]. Sadly, by using data mining techniques, sensitive information hidden in disclosed data can be predicted. As a result, network data must be cleaned before publication. In this article, the launch an inference attack using social networks that combine social interactions and non-sensitive features. It is relate to this challenge to a problem of collective categorization and suggest a model of collective inference. According to this approach, an attacker can anticipate sensitive information about connected victims in a publicly available social network dataset by using user profiles and social connections together. To defend against these assaults, it is provided a data purging technique that affects user profiles and friendship connections all at once. The main innovation is that the suggested strategy can benefit from multiple data-manipulating techniques in addition to cleaning friendship relations. It is demonstrate that by just lowering the adversary's prediction accuracy for sensitive data, it can still maintain relatively high prediction accuracy for non-sensitive data for three social network datasets. To the best of knowledge, this is the first effort that uses collective methods to defend against inference assaults in social networks

that involve a variety of data-manipulating techniques and social interactions.

According to [10-13] users of various context-aware applications that gather users' contexts using sensor- equipped smartphones can benefit from customised services. Meanwhile, the absence of privacy protection methods raises major privacy concerns. The majority of mechanisms currently in use employ passive defence strategies, where the released contexts from a privacy preservation system are always real, increasing the likelihood that an adversary will guess the users' sensitive hidden contexts. In order to demonstrably protect users' privacy, it is implement a deception strategy in this work and introduce the unique approach FAKEMASK, which enables the release of fake circumstances. Untrusted context-aware apps may access the output sequence of contexts from FAKEMASK or use it to respond to questions from those programs. As a result, even if the adversaries are strong enough to have knowledge of the system and the temporal correlations among the contexts, FAKEMASK restricts what they can learn about the user being in sensitive contexts from the output sequence of contexts. A privacy-checking algorithm at the heart of FAKEMASK determines whether to reveal a false context for the user's present context. To speed up the privacy testing process, it is provided a brand-new and effective privacy checking algorithm. Thorough evaluation trials using actual user smartphone context traces show FAKEMASK to perform better than competing products.

A literature survey [14-15] which revealed that various mobile computing applications require the computation of dot-products between two vectors. For instance, in m-Health, the dot-product of an individual's genome data and gene biomarkers from a health center can be used to detect diseases, while the dot-product of two individuals' interests can aid in friend discovery in mobile social networks. However, the computation of dot-products often involves exposing sensitive information about the participants, leading to privacy violations. In this research paper, it is aimed to address this problem by proposing privacy-preserving dot-product computation techniques that are suitable for mobile computing applications where secure channels are not easily established, and computational efficiency is crucial. It is introduced to two basic schemes, followed by advanced versions that enhance privacy-protection strength and improve computational efficiency. The proposed schemes achieve privacy-preservation, non-repudiation, and accountability, as proven theoretically. It is also provide numerical results that

demonstrate the effectiveness of the proposed schemes in terms of communication and computational overheads.

1. OBJECTIVES AND METHODOLOGY

The Bar coder scanner is the existing method to check the amount of the product. It uses ZigBee to transfer the data of the papers to the workstation for the billing process and it is done with human intervention, due to this the queue is followed because the transmission data speed of the system is very slow as it uses ZigBee for communication and tally for billing. A shopping mall or a supermarket is a place where thousands of customers visit every day to purchase many products. Today the trolly is used for different products in the supermarkets or in the shopping. Product procurement represents a complex process. Each time customer has to pull the trolley for getting the items and placing them in the trolley and also he has to take care of expense computation at every product they chose. After purchasing customer has to wait in a long time in a long queue to complete payment and billing process. To Overcome these kinds of problems, this paper is proposed.

In this, a smart and automated way of shopping is developed. Each and every product will be attached to an RFID tag. The smart trolley will consist of an RFID reader, and transmitter. When the customer scans and places any product in the trolley, the cost and the name of the product will be displayed. The sum total cost of all the products will be added to the final bill, which will be stored in the microcontroller memory. It will wirelessly transfer the product information of the items placed in the trolley using a transmitter to the main computer. So, to avoid waiting in the billing queue while constantly thinking about the budget.

2. METHODOLOGY

Below block diagram (Figure 3.1 Methodology chart) gives a glimpse on the end to end process carried out during the entire Paper work.

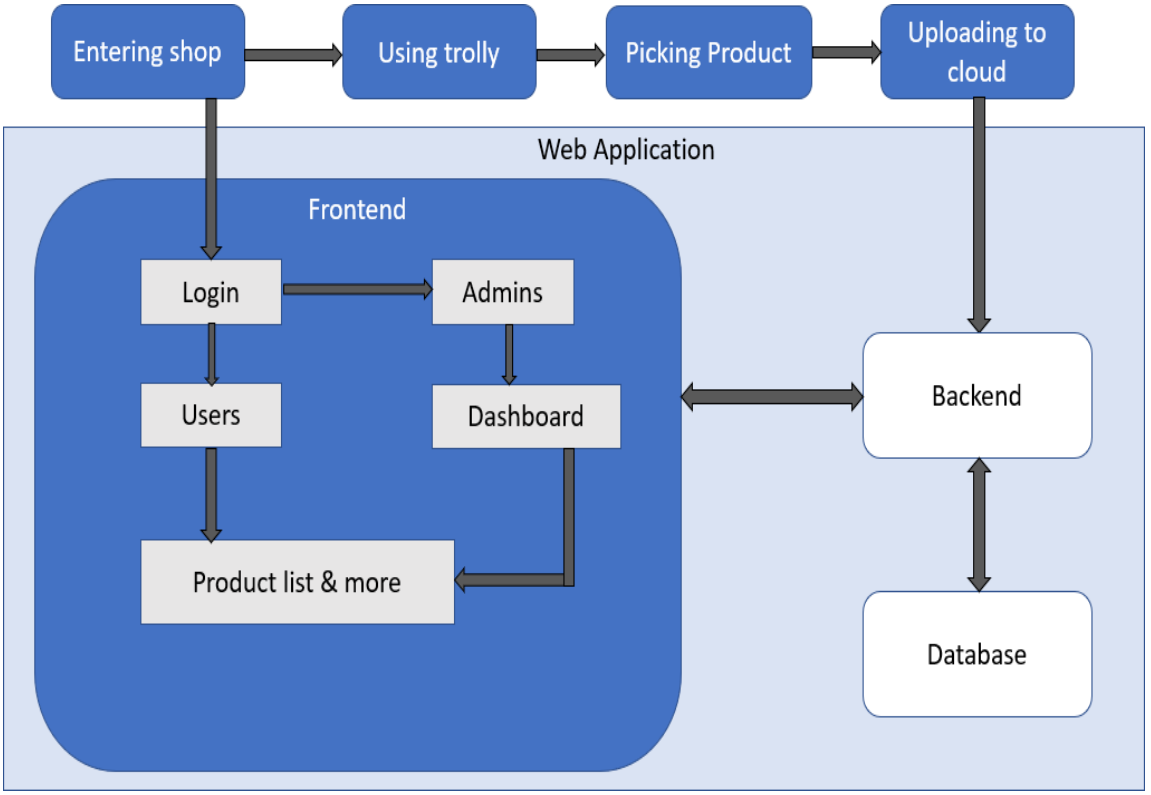


Figure 3.1 Methodology chart

EXPERIMENTAL PROCEDURE

4.1 BLOCK DIAGRAM

4.1.1 TRANSMITTER:

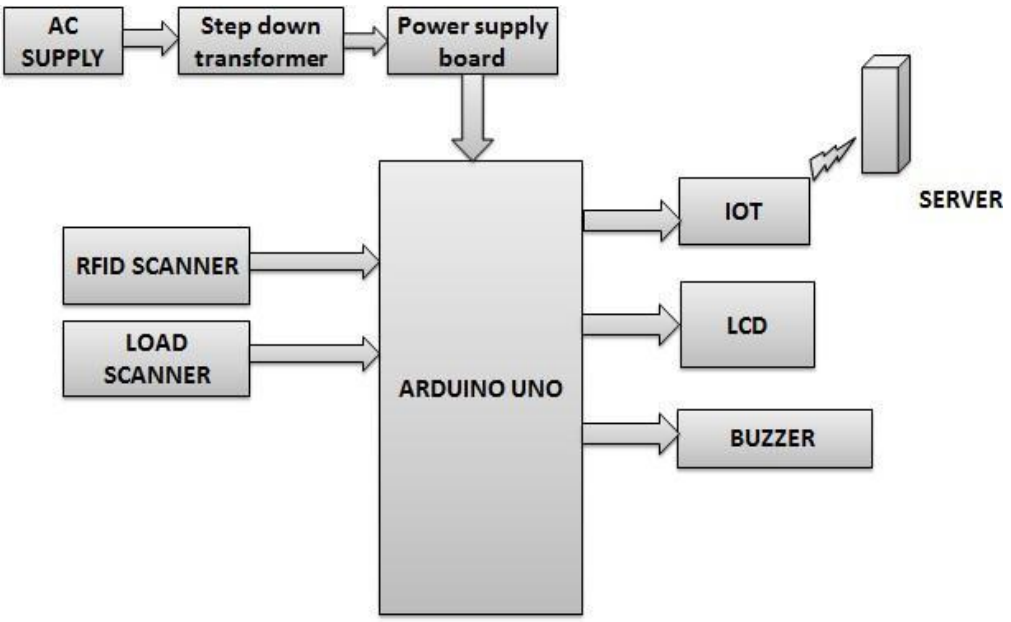


Figure 4.1 Transmitting data

Figure 4.1 shows the overall procedure of the paper. Where the each and every cart is attached with the microprocessor to which the RFID sensor, load scanner, IoT device(i.e ESP) , LCD display and buzzer for alert indication is attached. RFID tag will be attached to the every product available n the store.it works in such a way that whenever the product is placed into the cart the RFID tag attached to the product responds to the RFID readers emitting signal in the way of reflecting those signal back to the RFID reader. Whenever the RFID receives the reflected signal from RFID tag, it gets a unique ID which will get differed to every product available in the store. RFID reader transmits the unique ID received from the tag to the microprocessor to get transferred to the cloud. The data is transferred through the IoT device(esp8266) to cloud server for the extraction of data that ID contains. For this each and every product details will be feeded into the cloud

4.1.2 RECEIVER:

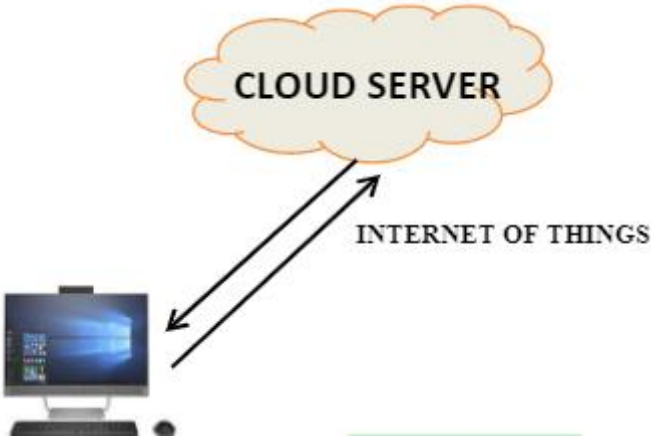


Figure 4.2 Receiving data

Figure 4.2 shows the receving data. When the data of each and every product is stored in the cloud, the data is send back to the IoT device and the microcontroller process the data and displays the received to the LCD display in terms of product name and price for the consumer view. The load scanner always keeps monitoring the weight of the cart. if it exceeds the given weight the power to the buzzer will get triggered.

4.1.3 CIRCUIT DIAGRAM

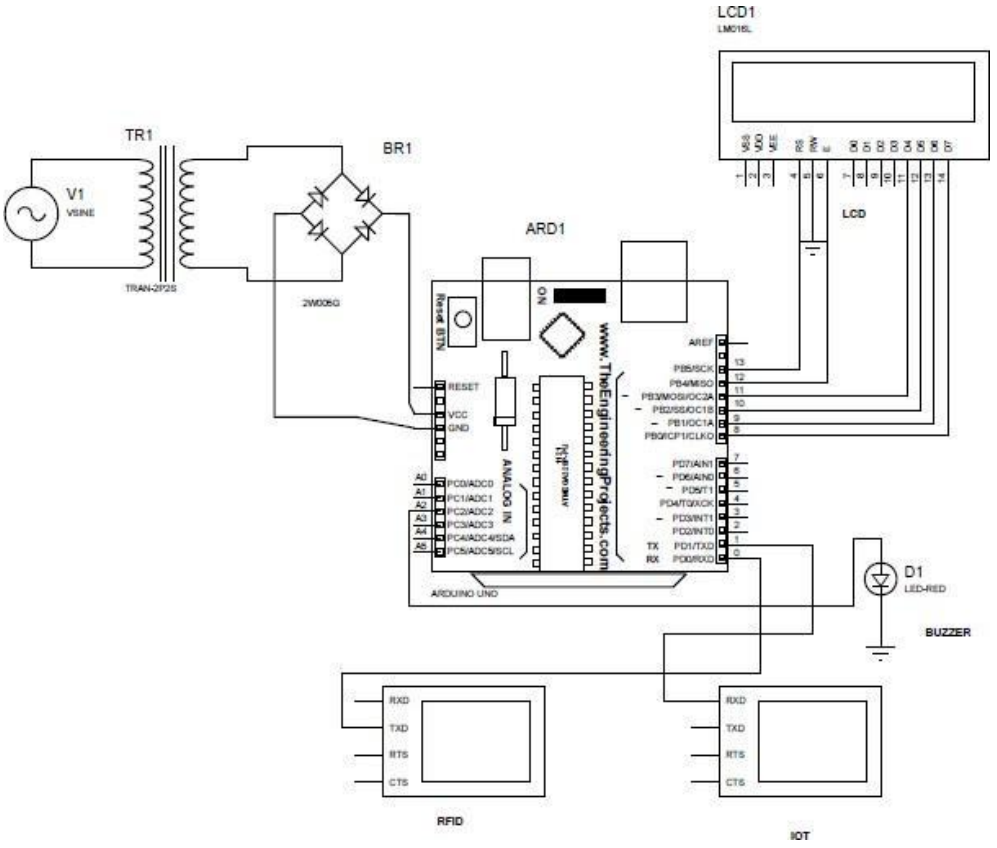


Figure 4.3 Circuit diagram of the proposed system

Figure 4.3 shows the circuit diagram of the proposed system. RFID is connected to the Rx pin of Arduino and IOT is connected to TX pin of Arduino. LCD (rs,En,D4,D5,D6,D7) is connected to the Arduino(13,12,11,10,9,8). buzzer is connected to the A2 pin of Arduino

4.2. WEB-APPLICATION:

Basic understanding of communication between frontend and backend: Frontend technologies like react or angular lies as a middleware between the user and the server.

Backend or server technologies like node js or spring-boot are used to create API that is used to get, store, update and delete the data inside the databases by using sequalize or mongoose. Figure 4.4 explains the application architecture.

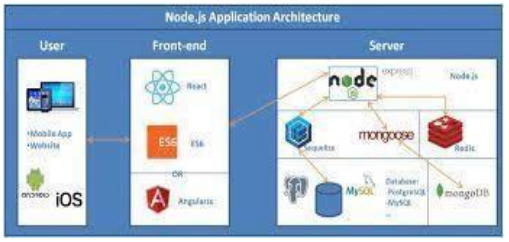


Figure 4.4 working of full stack-application

Technologies used to build the webapp are tabulated below in Table 4.1.

Table 4.1 Technologies used for web app

TECHNOLOGIES	SOFTWARE
Client/Frontend	
React Js	Visual studio code
UI/UX design	Figma
CSS and its frameworks	Visual studio code
Server/Backend	
Node Js	Visual studio code
MySQL Database	Terminal (command prompt)

Here the View part can be majorly classified into two parts,

- Product list and Marketing page for customers and admin.
- Analytic or Monitoring Dashboard only for admins or owner.

4.2.1 FRONT-END:

Library or Dependencies used:

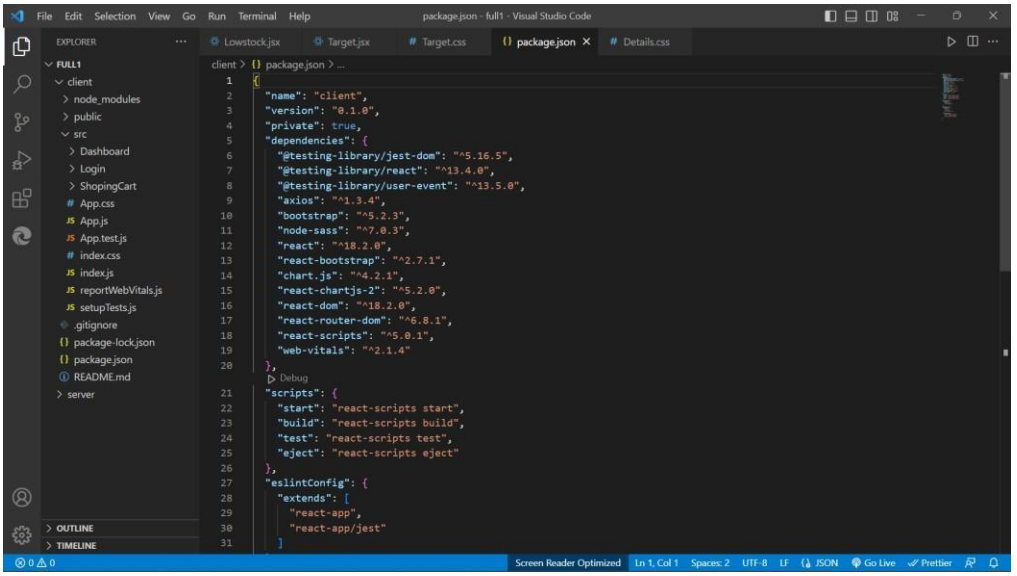


Figure 4.5 Dependencies for client

Front-end or client-side contains 3 main components namely login, Dashboard, Shopping-Cart.

The paper starts with the login page, new users can register, and existing users can log in as shown in the figure 4.5. Once the login is completed they will be automatically navigated to the respective page, if he is a normal user then he will be navigated to the shopping page. If he is an admin he will be navigated to the dashboard. This is achieved using role-based routing. Figure 4.6 shows the Authentication flow.

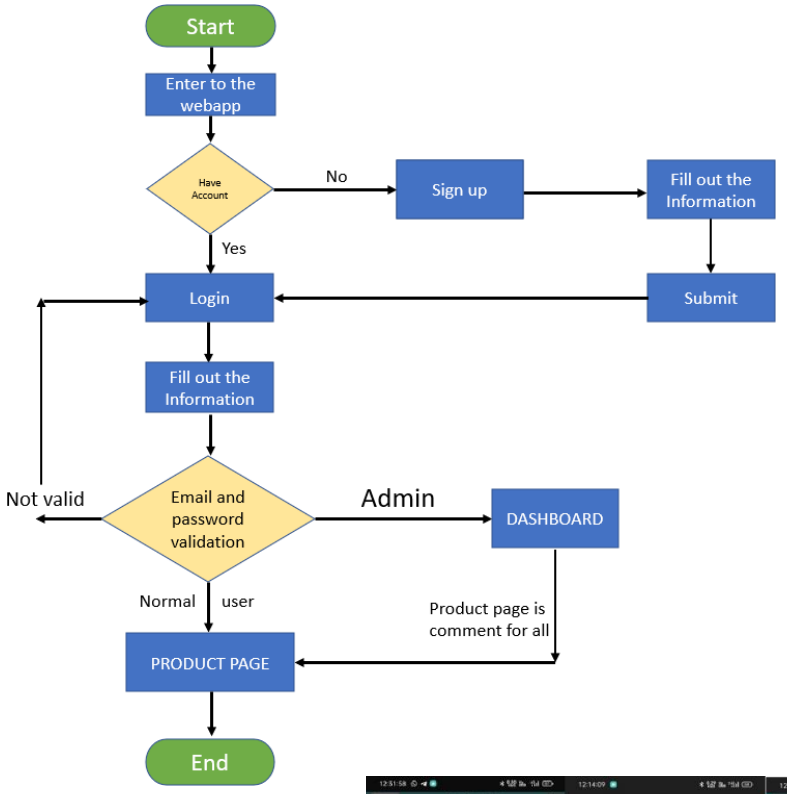


Figure 4.6 Authentication flow

Figure 4.7 Login Page

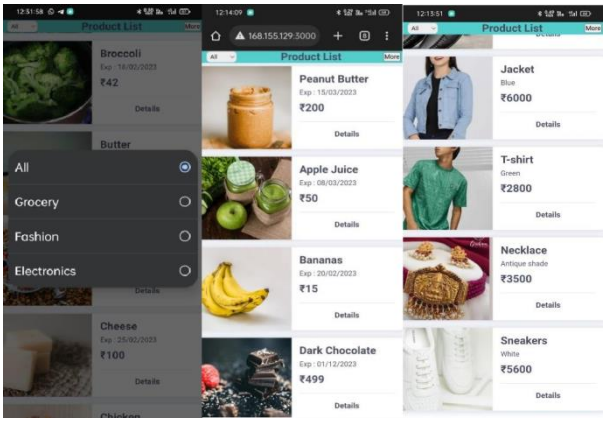


Figure 4.8 Product List Page

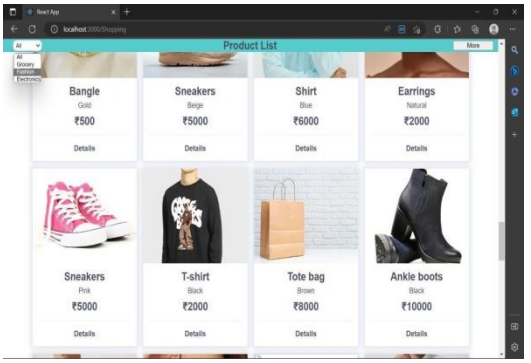


Figure 4.9 Sort by categories in mobile view

Shopping page:

Here the customers can see all the products available in the shop, they can able to see them using any device like mobile phones, tablets, laptops, and more as shown in the figure 4.8 and 4.9. The react app will start running in port number 3000 which is the default port number used.

They can also sort based on the categories in which they are interested. The UI is designed in a responsive manner so that they can see comfortably on any device they like as shown in the figure 4.10.

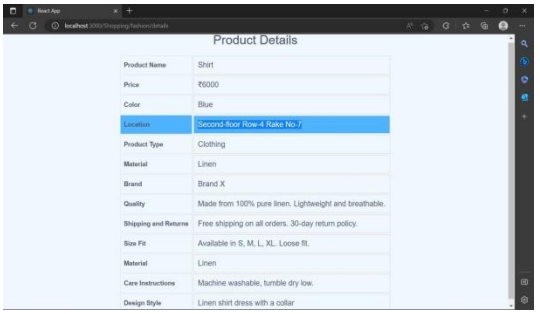
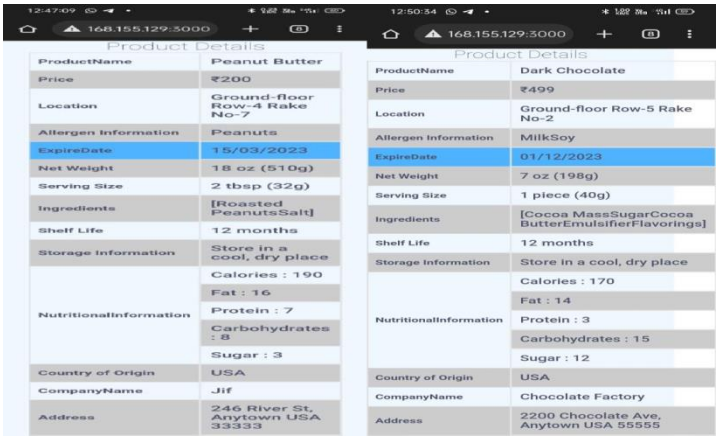


Figure 4.10 Location details

Customers can see the location of the product available in the shop as shown



in the figure 4.10 on seeing the location they can locate the product very easily this saves more time in searching the products.

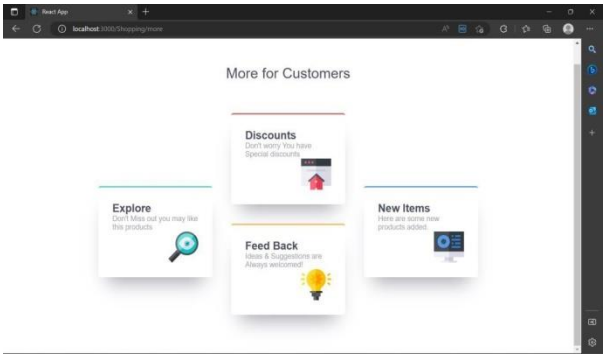
Figure 4.11 Complete details

On clicking on the card or the details button they are able to view complete information about the product as shown in the figure 4.11. So that the customer will be aware of the product they buy which will be very helpful for them. And the most important thing is, nowadays people are not aware of the expire date of the product as part of the product information this expire date is also displayed in a noticeable

manner. So can buy accordingly. This navigation is achieved using routing and the library used is react- router-dom while routing the router link takes the id of the specific product along with it so the information related to that product is displayed.

More Options:

On-clicking the more button on the top-right of the shopping will route to a new page that contains small components like discounts, newly arrived products, some interesting products figure 4.12, and also the customers can give their feedback and that can be viewed by the admin or owner in the dashboard.



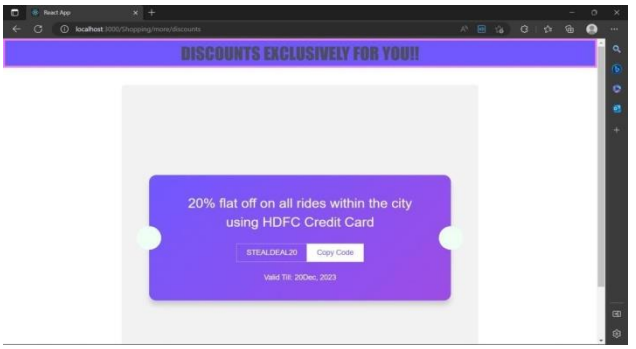


Figure 4.12 More options **Figure 4.13 Discounts page**

By clicking on the different components it will route a new page, and each component will route the respective page. Clicking on the discount component he/she can see all the discounts available in the shop as shown in figure 4.13.

Clicking on the Feedback component he/she can give feedback to the admin or owner. Autocorrect can also be enabled just by adding an extension which will help to improve their writing skills as shown in figure 4.14.

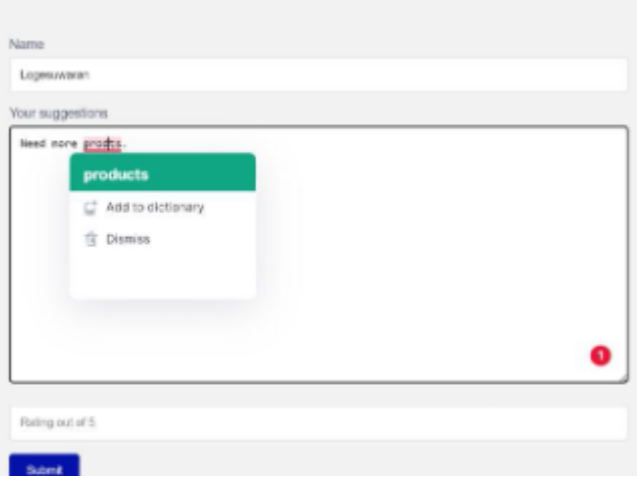


Figure 4.14 Feedback page

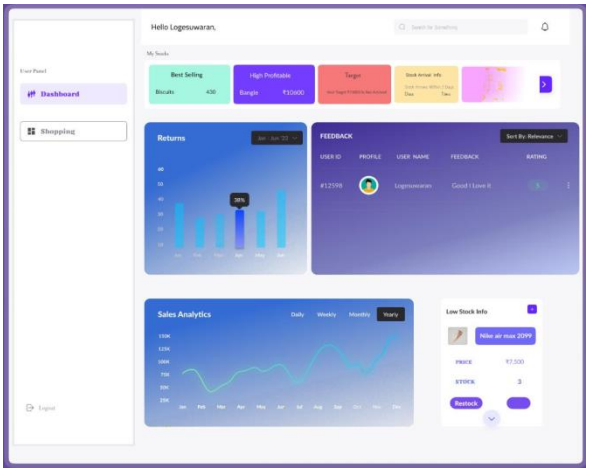


Figure 4.15 Admin Dashboard

Dashboard:

This dashboard is only for admin and owner, Here they monitor stock available, best-selling products, highly profitable products, and more. A visual representation is made for returns and sales using chart-js and react chart-js. Figure 4.15 shows the admin dashboard.

Admin can also set a target value and internally some mathematical logic is implemented that will show whether the target value is achieved or not continuously. They can also view the feedback given by the customers. The low Stock info component is used to display low stock available and he can enter a number and that number will be the stock quantity to restore. After entering by just clicking the restore button the mail will be sent to the respective dealer with a template message. This will be handled by nodemailer in the backend.

API and Axios:

Data for the above dashboard components will be given by API which will be generated in the backend. Axios are used to get and send data from API. Data from thingspeak cloud is fetched by using Axios, it makes HTTP requests from web browsers Not only that Axios are the main part of CRUD applications.

Some APIs and Axios example

'https://api.thingspeak.com/channels/2053365/feeds.json?api_key=0PU6PZX4M6D9T4YQ'
-- API from thingspeak cloud.

Axios.get("https://api.thingspeak.com/channels/2053365/feeds.json?api_key=0PU6

PZX4M 6D9T4YQ '); -- Axios request for Thingspeak data.

Axios.get('http://localhost:8080/grocery/highprofit'); -- this api gives high-profitable product details from database through backend.

4.4.1. SIMULATION

Proteus is a software tool for electronics design automation (EDA). It is widely used by engineers and students for designing, simulating, and testing electronic circuits and microcontroller-based systems. Proteus allows users to create schematic diagrams and printed circuit board (PCB) layouts for their papers and provides a suite of simulation tools to test the circuit's performance. The software also has a built-in microcontroller simulation environment, which allows users to develop, test, and debug firmware code for microcontroller-based papers. Proteus is a powerful tool for electronics design and simulation and is widely used in academic and professional settings. Proteus works by creating a virtual environment where electronic circuits can be designed and tested. Users can create a circuit schematic by adding various electronic components such as resistors, capacitors, and transistors, and connect them together using wires. The software also includes a wide range of microcontrollers, sensors, and other devices that can be used to build complex circuits.

Once the circuit is designed, Proteus allows users to simulate its operation in real-time. This includes the ability to simulate the behavior of microcontrollers, displays, and other devices in the circuit. Users can also test the circuit's response to different inputs and signals, helping to ensure that it will function correctly when built. Proteus also includes a range of debugging tools that allow users to identify and fix problems in their circuit design. This includes the ability to trace signals through the circuit and monitor the behavior of individual components. Overall, Proteus is a powerful tool that enables electronics designers and hobbyists to create and test electronic circuits in a virtual environment, reducing the time and cost required for prototyping.

Proteus supports integer numbers, floating point numbers, and strings as its data types. The language has hundreds of built-in functions for accessing the file system, sorting data, manipulating dates and strings, and calculating logical and mathematical expressions.

Proteus has two types of regular expressions: extended and basic, and it also

supports associative arrays and AVL trees. Programs written in Proteus are loaded into memory and pre-compiled before running, and the execution speed is usually fast.

One of the most interesting features of Proteus is the ability to run scripts as services or ISAPI scripts. This allows scripts to be started as soon as the operating system has finished loading, which is useful for critical processes in industrial environments or to prevent accidental closure of utilities. Proteus also has an ISAPI version that can be used to create scripts run through Internet Information Services and is equipped with specific functions to cooperate with the web server Figure 4.16 – 4.19 shows the output of simulation.

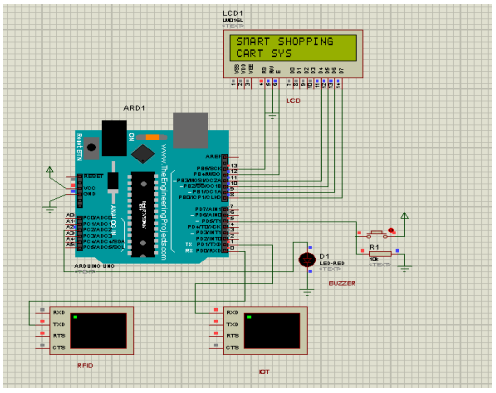


Figure 4.16 output-1

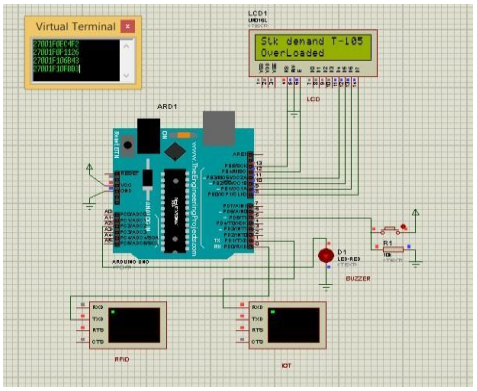


Figure 4.17 output-2

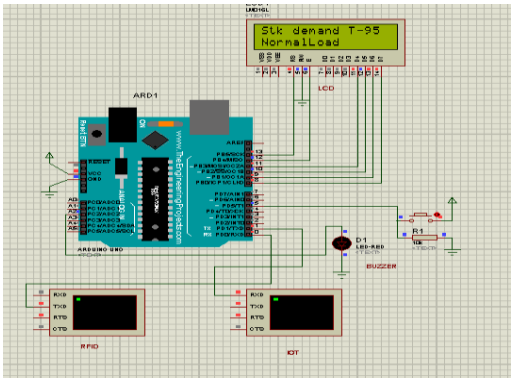


Figure 4.18 output-3

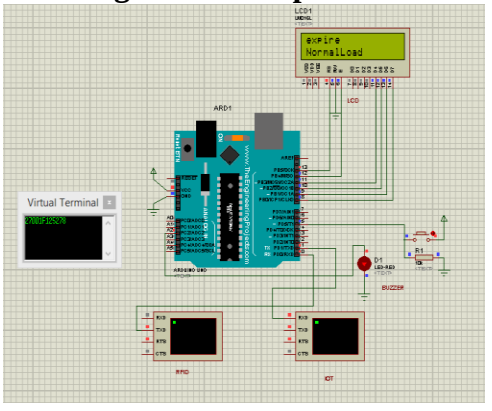


Figure 4.19 output-4

5. RESULTS AND DISCUSSION

This chapter deals the outcome of the paper

5.1 Hardware:

The product picked up is detected and displayed in the LCD display load scanner continuously checks the load of the trolly and gives a buzzer alert successfully. When a customer unfortunately picks an expired product again the buzzer makes a sound and also displayed in the LCD screen. When the product is removed from the trolly price of the respected product will be reduced Figure 5.1 – 5.6 shows the final results. And finally, the Total amount they want to pay is displayed on the screen successfully by this testing it can conclude that the hardware works fine.

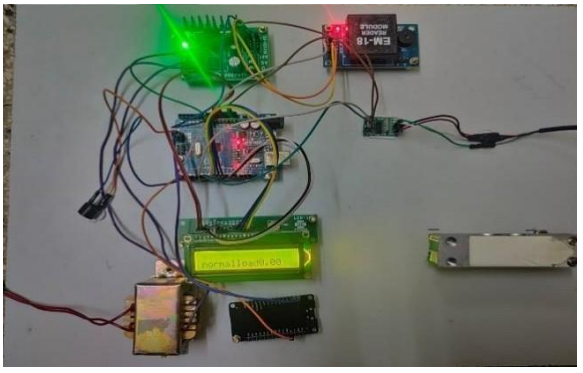


Figure 5.1 Under normal load

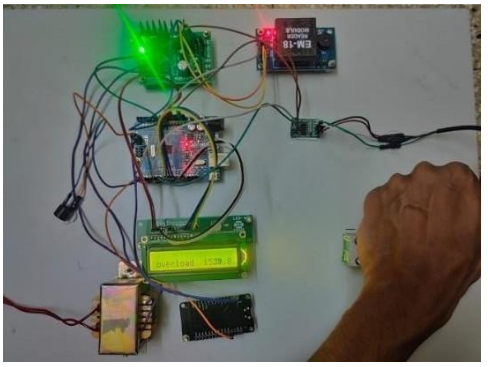


Figure 5.2 Under overload

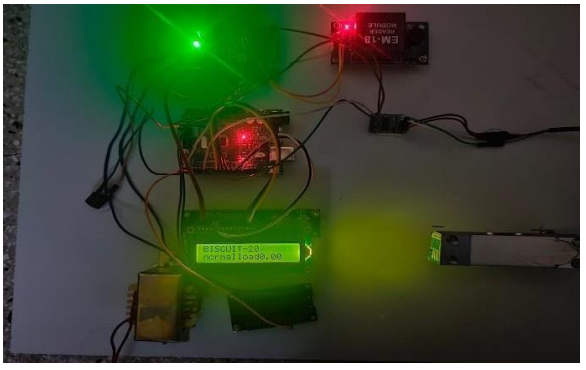


Figure 5.3 Picking up products

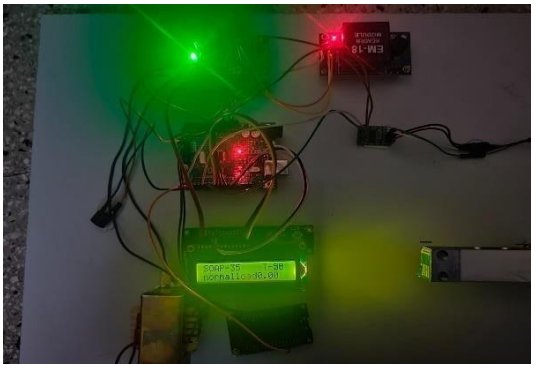
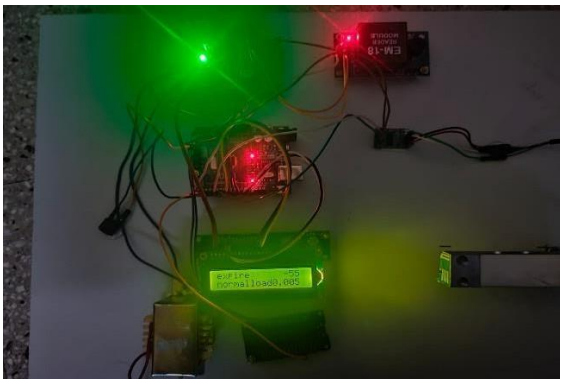


Figure 5.4 Total price displayed



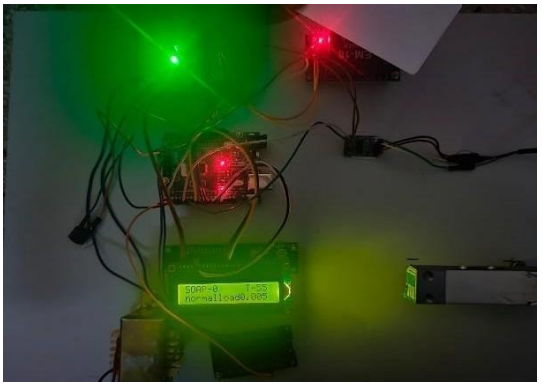
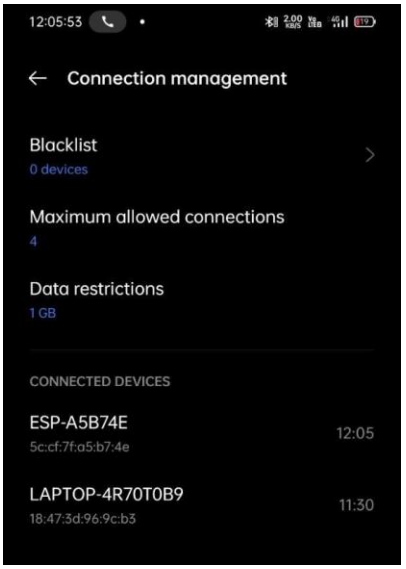


Figure 5.5 Picking expired product

Figure 5.6 Product is Remove

5.2 Data to cloud:

The data is uploaded to thingspeak cloud using the ESP module. First, the connection between the ESP module and hotspot or wifi is verified. Here it is connected Figure 5.7–5.8 shows the connection of cloud using wifi.



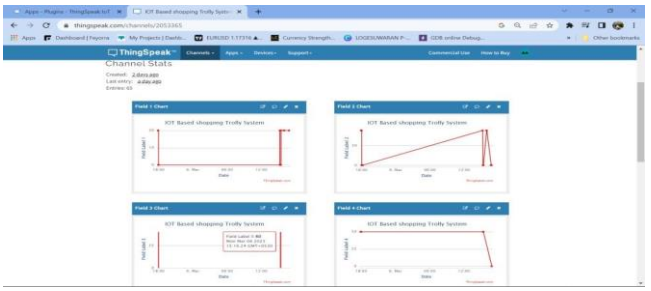


Figure 5.7 ESP wifi connection check Figure 5.8 Movements in charts in things peak cloud

Once after confirming, checked for the update in my channel in thingspeak like a movement in the chart, the last entry by downloading the excel data sheet, and an update in the plugin was made. A confirmation after seeing it Figure 5.9 shows the Data downloaded from cloud.

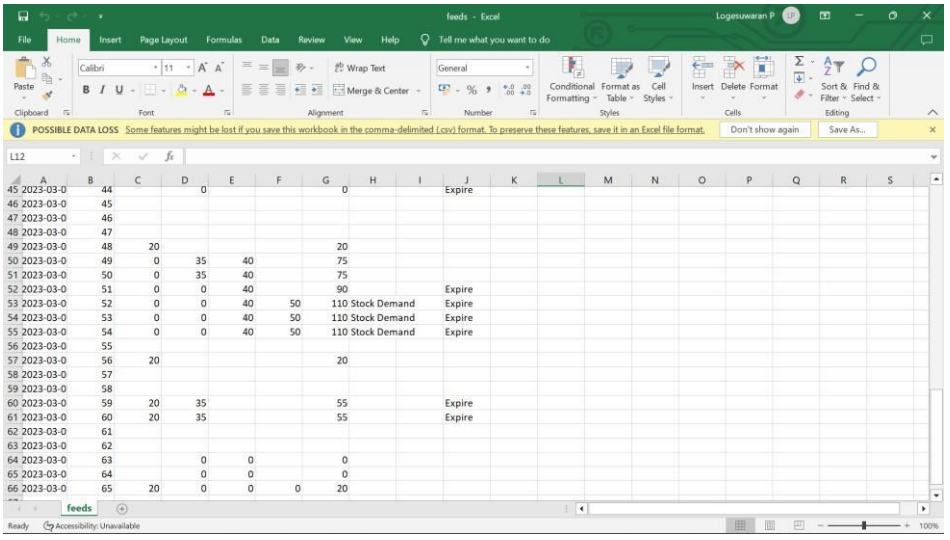


Figure 5.9 Data downloaded from in thingspeak cloud

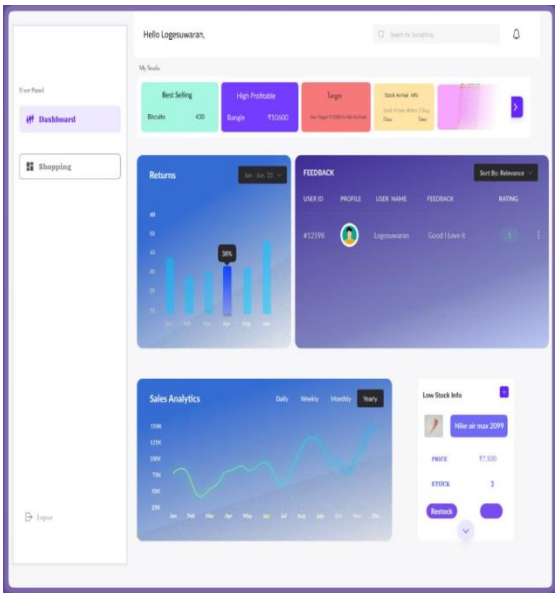
Login

Here there are two types of users Normal users and Admins. For a normal user, it is routing to the product list page successfully. For an Admin user, it is routing to the dashboard page successfully. And admin is not restricted only with the dashboard he can also navigate to the other pages which are common for all. For additional confirmation, checking the response from the backend/server in postman

stating the user role (Admin/User)

Admin Dashboard

Here in the dashboard admin is able to see best-selling products, highly profitable products, he is able to set the target levels and check whether it is achieved or not, and also he can see the stock arrival information. Visual charts are updated accordingly to the values in the database based on profits and sales Figure 5.10 – 5.11 shows the final result of dashboard for admin. Feedbacks are updated live in the feedback component which is in the dashboard



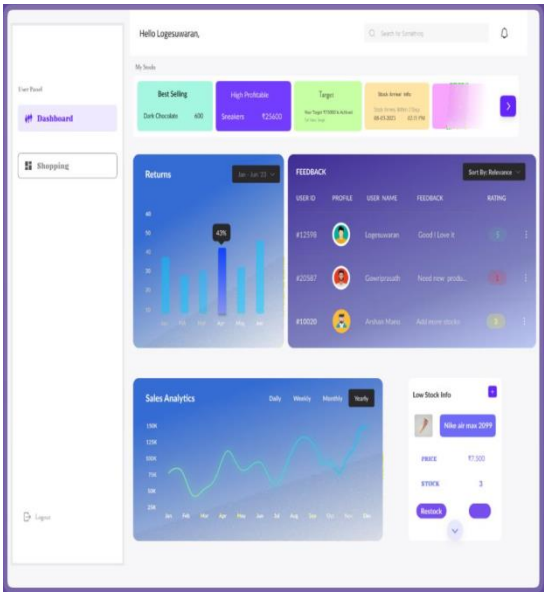


Figure 5.10 Dashboard before updating **Figure 5.11 Dashboard after updating**

CONCLUSION

Now a days everything became automated and everyone runs out of time this paper will help to automate the complete process and saves very more time and reduce manpower. Customers can also be aware of the product they buy. Customers' suggestions can be considered to improve the facilities and sales. and more than that customers can view all the products along with the location of the product available in the shop and discounts available in the shop.

With this dashboard owners or admins can monitor everything going on in

the shop, there is no need for manual stock maintenance or an analysis team. Owner/Admin can view everything and from wherever by just logging in and clicking buttons this makes everything simple. This will help to save more money and improves sales enormously. The customers will gain more trust in the shop.

The advantages of this paper are

- Easy to implement
- User-friendly
- Easily customizable
- Interactive
- Responsive
- Adaptable for all device
- Low cost.

FUTURE WORKS & SCOPES

Since it is a web application it can keep on adding new features and customization options. The most important feature that can be implemented is adding a payment system and Personalized recommendations using machine learning that will help to suggest new products based on their interests.

In the future, most cities will be converted into smart cities and smart houses so Integration with smart home devices will create a very big advantage. Consider integrating the Smart Shopping Cart system with smart home devices, such as voice assistants or smart refrigerators. This would allow customers to add items to their shopping cart via voice commands or by scanning items with a smart refrigerator. This could help to streamline the shopping process even further and make it even more convenient for customers.

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