A
Project Report
on

Automated Price Comparison and Cheapest Option Finder for Online Grocery Purchase

Submitted to

Sant Gadge Baba Amravati University, Amravati

Submitted in partial fulfilment of
the requirements for the Degree of
Bachelor of Engineering in
Computer Science and Engineering

Submitted by

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Session 2024-2025

SHRI SANT GAJANAN MAHARAJ COLLEGE OF ENGINEERING,

SHEGAON – 444 203 (M.S.)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that **Ms. Apeksha Sanjay Mankhair , Ms. Dnyaneshwari Rajkumar Mhaisne, Ms. Gayatri Pradip Deshmukh and Ms. Palak Yogesh Jasani** students of final year Bachelor of Engineering in the academic year 2024-25 of Computer Science and Engineering Department of this institute have completed the project work entitled "**Automated Price Comparison and Cheapest Option Finder for Online Grocery Purchase**" and submitted a satisfactory work in this report. Hence recommended for the partial fulfilment of degree of Bachelor of Engineering in Computer Science and Engineering.

Dr. P. K. Bharne
Project Guide

Dr. J. M. Patil
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Internal Examiner

Dr. P.K. Bharne

Name and Signature

Date: 9/5/25

External Examiner

A.D. Shah

Name and Signature

Date: 9/5/25

Acknowledgement

It is our utmost duty and desire to express gratitude to various people who have rendered valuable guidance during our project work. We would have never succeeded in completing our task without the cooperation, encouragement and help provided to us by then. There are a number of people who deserve recognition for their unwavering support and guidance throughout this report.

We are highly indebted to our guide **Dr. P. K. Bharne** for his guidance and constant supervision as well as for providing necessary information from time to time. We would like to take this opportunity to express our sincere thanks, for his esteemed guidance and encouragement. His suggestions broaden our vision and guided us to succeed in this work.

We are sincerely thankful to **Dr. J. M. Patil** (HOD, CSE Department, SSGMCE, Shegaon), and to **Dr. S B Somani** (Principal, SSGMCE, Shegaon) who always has been kind to extend their support and help whenever needed.

We would like to thank all teaching and non-teaching staff of the department for their cooperation and help. Our deepest thank to our parents and friends who have consistently assisted us towards successful completion of our work.

Apeksha Sanjay Mankhair (01)
Dnyaneshwari Rajkumar Mhaisne (06)
Gayatri Pradip Deshmukh (08)
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Abstract

The highly price-sensitive Indian market, coupled with the increasing reliance on online grocery shopping, demands innovative solutions to streamline price comparison processes. Today, there are many online vendors that sell groceries, vegetables, and fruits with varying prices, service charges, and promotional discounts. Consumers usually have to spend time comparing them all to figure out the cheapest ones, which is both time-consuming and inefficient. The project introduces an automated price comparison and cheapest option finder website for online grocery purchases. It utilizes Selenium for web scraping, implemented in Java, to extract detailed pricing, and quantity, and offer data from different online grocery platforms. The extracted data is systematically processed and analyzed to generate actionable insights. The output shows the lowest price options for any product for each vendor and customer including all suitable charges and compares the price from different platforms and shows which is cheapest. The process being automated, it enables the user to make informed purchases with suitable savings of time, effort, and money. The project not only streamlines the experience of online shopping but also rectifies the inefficiencies prevailing in comparing prices through manual methods, thus providing a useful and scalable solution for modern consumers.

Keywords: *MySQL, Price Comparison, Selenium, Web Scraping.*

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PROJECT SPONSORSHIP LETTER

SkaleIT

Date: 7th July 2024

To,

Dr. J.M. Patil

Dept of Computer Science Engineering

SSGMCE Shegaon

Dear Mr. Patil,

At SkaleIT Technologies, we are focused on delivering innovative, scalable, and intelligent technology products. As part of our commitment to nurturing future talent and encouraging practical learning, we are keen to sponsor selected final-year student projects from your esteemed department.

We believe that academic-industry collaboration is vital in shaping the future of technology, and we are excited about the opportunity to contribute by providing mentorship and technical support for the following project:

Project Name: Automated price comparison and cheapest option finder for online grocery purchase

Names of students in the group:

1. Dnyaneshwari Rajkumar Mhaisne
2. Palak Yogesh Jasani
3. Gayatri Pradip Deshmukh
4. Apeksha Sanjay Mankhair

Thank you, and I look forward to our collaboration.

Warm regards,

Pankaj Nirale

Managing Partner

SkaleIT Technologies LLP Pune

pankaj.nirale@careermetaverse.in

PROJECT COMPLETION CERTIFICATE

SkaleIT

Project Completion Certificate

This is to certify that the final year project titled:

"Automated price comparison and cheapest option finder for online grocery purchase"

was sponsored by SkaleIT Technologies LLP, Pune, and completed successfully by the following students as part of their academic requirements at the Computer Science and Engineering department, SSGMCE Shegaon, during the academic year 2024-25.

Team Members:

- Dnyaneshwari Rajkumar Mhaisne
- Palak Yogesh Jasani
- Gayatri Pradip Deshmukh
- Apeksha Sanjay Mankhair

The project work was done under the guidance of Prof. Dr. Pankaj K. Bharne.

Project deliverables were found to be satisfactory and met all the objectives set by us.

I wish the team success in all their future endeavors.

Warm regards,

Pankaj Nirale

Managing Partner

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CHAPTER 1

INTRODUCTION

INTRODUCTION

1.1 PREFACE

The Indian online grocery market has seen tremendous growth and is now ranked among the most price-conscious and competitive markets as a result of higher digital penetration and changing consumer behavior towards making purchases over the internet. Today, consumers can access several online grocery platforms dealing in all kinds of products, ranging from staples to fruits and vegetables, dairy products, and household items. But the problem is to determine the optimum deals, since comparing prices on multiple websites manually is time-consuming and inefficient. To solve this, we suggest a web-based automated price comparison system which utilizes Selenium, a web scraping framework in Java, to scrape real-time price information from different e-commerce websites [1][9]. This system systematically stores the data gathered in a structured database [1][7-8][10] and displays it via a user-friendly interface, enabling consumers to effectively compare products and choose the most economical one. The major advantages of this platform are real-time price comparisons, detailed cost analysis, and considerable time savings, as it considers all charges that apply, to show the actual amount payable. Built to be scalable and flexible, the system is capable of adding more vendors, product categories, and future additions such as machine learning-based price forecasts, seasonal discount monitoring, and personal recommendations. By streamlining the price comparison process, this platform transforms online grocery shopping in India, helping consumers make well-informed purchasing decisions while saving money and maximizing convenience.

1.2 BACKGROUND

The swift growth of India's e-grocery market is fueled by growing internet penetration, the emergence of digital payment modes, and shifting consumer lifestyle toward convenience and cost savings. With more online grocery platforms, consumers now have access to several retailers with competitive prices. But the absence of an integrated system for price comparison among vendors is a significant drawback since following price variations manually is tiresome and inefficient. The ever-changing nature of online prices, driven by supply-demand changes, festive offers, and store-specific offers, makes the process even more daunting. Conventional price

comparison involves consumers visiting various websites manually [1][3][5][9], resulting in forgoing savings and exasperation. In response to these challenges, web scraping and real-time processing-based price comparison tools have cropped up as a suitable solution to facilitate decision-making. Through automated tracking and comparison of prices, these systems facilitate improved consumer experience, which allows consumers to make convenient purchasing decisions fast and save the most.

1.3 MOTIVATION

The reason for undertaking this study is the increasing inefficiencies and complexity of online grocery buying, in which the customers struggle with considerable hassles to source the most effective prices on a number of sites. As India's e-grocery websites expand, unstable prices have followed competition, in turn creating uncertainties for consumers regarding identifying the least expensive ones. In contrast to regular retail shopping, where customers get to see the prices in actual stores, Internet shopping involves going to many websites, individually searching for goods, and adding up the ultimate price—a procedure which is both time-consuming and open to human mistakes. Most customers either pay too much for groceries or forfeit discounts offered because they have no easy means of comparing all aspects, such as base price and special offers. With the swift adoption of online payments and digital shopping in India, there is an urgent need for an automated, real-time price comparison platform that not only streamlines the decision-making process but also provides users with up-to-date, accurate pricing information from various vendors on a single, centralized platform.

The work implements a Selenium-based web scraping system in Java, which fetches and processes information from online shopping websites to provide a complete price comparison [1][9]. By doing away with the time-consuming task of price monitoring, this utility allows users to immediately determine the cheapest vendor for their grocery requirements, thus saving time and money.

Moreover, user-specific shopping suggestions based on their shopping history and preferences could also enhance the customer experience further by recommending products that match their purchasing behavior. As the Indian online grocery retailing market develops further, creation of such an automated system will be a game-changer, filling the gap between cost-effectiveness, convenience, and digital retailing.

1.4 PROBLEM STATEMENT

In India's price-conscious marketplace, it takes time and is wasteful to manually compare grocery prices, service fees, and discounts at multiple vendors. Too many price changes and dispersed offers complicate monitoring the most favorable deals, causing missed savings in many cases. An automated price comparison system is required to make decision-making easier and provide better purchasing options.

1.5 AIM & OBJECTVES

Aim: The aim of this project is to create an automated price comparison platform that helps users find the best deals on groceries by comparing prices and offers from different online vendors.

To fulfill the aim of the project, the following are the objectives:

1) To Review existing techniques for price comparison to identify areas for improvement.
2) To develop a web scraping system using Selenium in Java to collect price data from various online sources.
3) To store data in MySQL workbench and pre-process it.
4) To compare the prices and generate a recommendation report highlighting the cheapest options at each online vendor.

CHAPTER 2

LITERATURE REVIEW

LITERATURE REVIEW

The literature survey covers a broad spectrum of topics related to automated price comparison and e-commerce data management. These include web scraping techniques for extracting real-time product prices, Selenium-based automation in Java, structured database management for efficient data retrieval, dynamic pricing strategies in e-grocery platforms, and user-friendly interface design for seamless consumer interaction. Each study offers a unique perspective on the challenges, advancements, and practical applications within the domain of automated price comparison, forming a strong foundation for the development of this system.

Martina D'Souza et.al., 2024, an application for web scraping to automate the process of extracting information of products from other online shops, thereby helping users compare their prices. Beautiful Soup is used for parsing HTML to analyze and extract relevant details from web pages efficiently. Another process used here is selenium with chrome web drivers that helps retrieve dynamic content from websites that are dependent on JavaScript for rendering. To manage the backend operations, Flask is employed, ensuring seamless data processing, API communication, and user request handling. The application is structured into seven key modules, each playing a crucial role in its functionality. First, it collects user input, where customers specify the product they wish to compare. Then, it obtains product URLs from various e-commerce websites, then sets up a Beautiful Soup object to parse and fetch structured data. Setting up the Chrome web driver enables the system to navigate sites dynamically for complete data extraction. The application then continues with extracting required data, such as product prices, descriptions, offers, and availability. Enhances reliability through an error-handling module, which analyzes missing elements or changes in website structure. The system finally displays results in an intuitive, user-friendly format that helps enable a customer to make informed purchasing decisions. The approach automates real-time price comparison, minimizing reliance on manual searches, vastly improving shopping efficiency. Aimed at being scalable and versatile, the system is able to support various e-commerce sites so that users receive the best prices while making internet shopping more convenient and cheaper [1].

Vaibhavi B Raj et.al., 2024, the smart shopping platform utilizes machine learning, natural language processing (NLP), and web scraping to provide users with personalized suggestions as well as real-time price comparisons. Users are free to start their search via either a chatbot or an online website interface, where they input what they are looking for using Streamlit and NLP processes to gauge their preferences and shopping purpose. Now, the web platform will perform web scraping using BeautifulSoup to collect product prices, availability, and other similar details from different e-commerce websites. Aggregating and analyzing this data, the system effectively compares prices and highlights the best deals, thus giving users the best value for price. Moreover, the chatbot increases user interaction by giving the users personalized product suggestions, answering their queries, and guiding the user through the process of their shopping. The site itself has a login page, homepage, and about page, with all of them hosting real-time price comparison features, making it a user-friendly, wide-ranging platform for more efficient and smarter online shopping. This combination of AI- based recommendations and price tracking automation boosts convenience and assists consumers in saving time and money [2].

S. Rajendar et.al., 2021, web mining methods, such as web crawling and web scraping, are used to collect product information from various e-commerce sites effectively. Using Python libraries like Requests and BeautifulSoup, the system fetches web pages and processes HTML structures to retrieve important information, such as product names, prices, availability, and discounts. The frontend is user-friendly, offering a product search interface to the customers, which easily look up their desired items. After a user submits a search query, the system retrieves relevant results from the local SQLite3 database and enables quick price comparisons on different platforms. This approach saves online shoppers' time, money, and effort through best-informed decisions without surfeiting on various websites. Also, the system is constructed with the Django web framework to provide scalability, security, and effective data management. Important features like real-time price comparison and auto alerts assist users in remaining informed regarding price reductions and promotions so that they can make informed buying decisions. Through the incorporation of automated data retrieval, structured storage, and intelligent price analysis, the system makes the general online shopping experience more efficient, cost-effective, and convenient for users [3].

E. Uzun, 2020, the UzunExt method is a very fast web content extraction method that far surpasses DOM-based methods in speed and performance. While the DOM parsing technique takes as long as 140 days to execute large-scale web scraping operations, UzunExt does the same thing in a single day. Moreover, its use of string-based methods makes it 60 times faster than other standard techniques. The technique also improves extraction performance by leveraging extra information that is gathered while the web is crawled, resulting in a 2.35x increase in efficiency over relying on string-based techniques alone. In contrast to DOM-based scraping, which requires walking and processing a full tree structure, UzunExt focuses on specific elements of interest without having to execute intricate DOM tree processing. This optimized method makes it an ideal choice for web scraping projects on a large scale, guaranteeing quicker, more precise, and resource-friendly data extraction for numerous sectors depending on web data mining [4].

N. Singh, A. Rana, and A. Chaudhary, 2023, an user-friendly web scraping-based price comparison tool designed to help consumers compare product prices across multiple e-commerce websites efficiently. It utilizes Python's BeautifulSoup to extract real-time pricing information from various online stores, ensuring users receive the most up-to-date cost comparisons. Before analysis, the extracted data undergoes preprocessing, which involves cleaning and normalizing the information to ensure consistency and accuracy. This phase is significant in reducing duplicates, formatting irregularities, and extraneous data, ensuring a more credible comparison process. The system then utilizes descriptive statistics and bar graphs to provide analysis and visual representations of price fluctuations on various platforms, allowing users to make an informed buying decision. It facilitates easy accessibility and a lot more convenience through the use of Python's Tkinter library and develops a GUI. This enables users to input product details easily and view price comparisons in a user-friendly format. With automation, data visualization, and an interactive interface, the system has streamlined the shopping experience for consumers while saving them a lot of time and money and ensuring that they receive the best deals available online [5].

K. Harikirshnan et.al., 2023, an intelligent online shopping platform that maximizes user satisfaction through the incorporation of a Machine Learning-based product comparison engine. It employs web scraping techniques to gather vital product information, such as prices, reviews, and specifications, from various e-commerce websites. To ensure accurate product classification and comparison, the system applies the Support Vector Machine (SVM) algorithm, which has demonstrated a remarkable accuracy of 94.71%, outperforming other classification models such as Decision Tree, Naïve Bayes, and Random Forest. This machine learning approach enables the system to categorize products effectively based on their features, ensuring precise matching across different platforms. The site offers a common interface through which users are able to easily compare prices of products and make informed buying decisions, ultimately cutting time and costs. The SVM classifier also has a vital role in paralleling and correlating product prices across various e-commerce websites for consistency and eradicating inconsistencies. Aside from serving consumers, this site also helps e-commerce merchants by providing them with information on competitive pricing strategies, allowing them to dynamically adjust their prices based on market trends. With the integration of machine learning, automation, and web scraping, the system redefines the experience of online shopping as efficient, precise, and highly consumer-oriented [6].

Arman Shaikh et al., 2023, price comparison sites employ web scraping methods to effectively capture and analyze product information from various online shopping websites. With the use of PHP libraries, such sites capture important information like product titles, prices, ratings, and stock levels, offering consumers real-time intelligence about the best prices online. The core intention of such sites is to empower buyers by helping them make informed buying decisions and at the same time facilitate product visibility for merchants and potential buyers. Such websites are an interactive platform connecting buyers with sellers, making it easy for the customers to compare prices while the businesses can streamline their marketing efforts. Additionally, the implementation of a trade show feature is suggested, where businesses can showcase their products and services for free, benefiting from increased exposure while the platform generates revenue through advertisements and commission-based sales. Through the integration of web automation, focused marketing, and revenue-building strategies, cost comparison websites not only

simplify the shopping process but also provide a viable business model for consumers and merchants alike in a competitive online marketplace [7].

P Nagaraj et al., 2023, A price comparison website that is meant to retrieve real-time product prices of Amazon and Flipkart via web scraping technology. The system is built upon PHP as the main programming language and deployed in the XAMPP environment, which consists of critical components like MySQL, Apache Web Server, Perl, FTP Server, PHP, and phpMyAdmin for effective backend management. MongoDB is used for storing the extracted product data, ensuring scalability and fast retrieval of information. To implement web scraping, the system integrates PHP-CURL and PHP Simple DOM, which allow it to parse and extract product details such as price, name, and availability directly from e-commerce websites. The site gives consumers a convenient interface through which they can search for a product and immediately fetch its price on various platforms, aiding them in making informed buying decisions. Through automation of the price-fetching function, the system avoids the need for manual searches, provides greater user convenience, and allows consumers to locate the best offers effectively. The incorporation of XAMPP and MongoDB ensures smooth data management, making the platform scalable, robust, and well- equipped to manage large datasets, which is a prerequisite for a changing e-commerce environment [8].

J. Viba Mary, and N. Blessy Benitta, 2023, the web application will facilitate cross-product price comparison in various shopping centers, thus saving time and making the purchase choice easier. In general, the system modules constitute the user interface, admin functions, product information retrieval, fake comment detection, and price updating as well as cart management. The price comparison module allows users to search for an item, put it into a list, and compare prices among various shopping malls in real time. Through the use of Java with Selenium, the program conducts automated web scraping, pulling product information like prices, availability, and promotions from various e- commerce websites. It also comparatively analyzes the overall cost of the product, taking into account several elements like taxes, discounts, and delivery costs, and determines the lowest price shopping center. Users are subsequently presented with a comprehensive comparison report, allowing them to make the best cost-saving decision. The system also has a fake comment detection feature in place to ensure the credibility of product reviews,

as it prevents users from being misled by counterfeit feedback. Combination of real-time pricing information and smart comparison logic makes this site an awesome resource for online consumers, simplifying the choice process and getting them the best available prices [9].

Piyush Rawal et.al., 2020, The website aims to facilitate effective product price comparison by using web scraping technologies and API integration to obtain live product information from retailers. The system works by posting API queries to numerous e-commerce platforms, gathering current product details like prices, specifications, and stock status, and storing it in a centralized database that automatically updates. Further, a web crawler automatically explores pre-defined sites to fetch critical product information, providing users with the most up-to-date and precise price information. The site is coded with latest web technologies like HTML, CSS, and responsive templates, providing glitch-free user experience across different devices. It abides by the Software Development Life Cycle (SDLC) guidelines, applying robust testing mechanisms to optimize performance and reliability. By comparing prices automatically, the system greatly saves time and effort users incur in surfing manually for the most favorable bargains. In addition, the project offers practical experience in web development with exposures to web site structure, database handling, API interaction, and real-time data fetching. Finally, this site is a strong consumer tool, which enables the consumers to save time and money by offering instant access to the top product offers from various online stores [10].

CHAPTER 3

METHODOLOGY

METHODOLOGY

The diagram below shows the project workflow—from extracting data with Selenium to storing it in a MySQL database. After validating and transforming the data (e.g., standardizing names, converting units), operations like sorting and price comparison are performed. Node.js retrieves data from the backend, and results are visualized using HTML, CSS, and JavaScript for easy user comparison and insights.

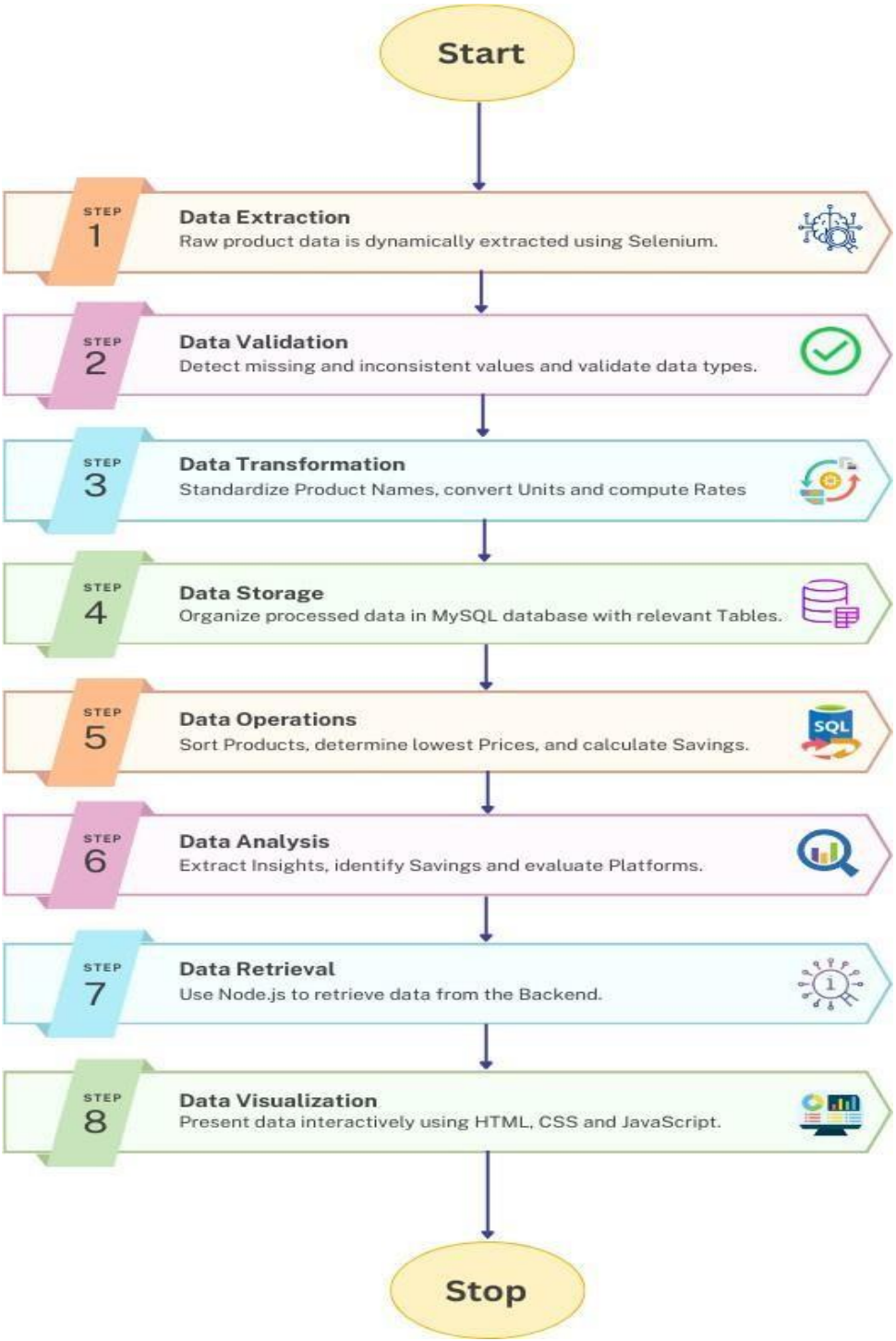

Figure 3.1 Data Processing Workflow

3.1 Data Extraction

Data extraction is an essential part of this project as it involves dynamically gathering real-time product-related data from various e-commerce websites. The extraction process is carried out by Selenium in Java, which simulates browsing processes and navigates through formatted and unformatted web pages to fetch required product information. The most important features extracted in the process are Product Name, Price, Quantity, and the source of the Website. In order to make the data available for future processing and transformation, it is first saved in an Excel file, which is an intermediate dataset. This way, the system keeps fetching the latest product information from various vendors, allowing the users to make informed buying decisions based on live price comparisons.

3.2 Data Validation

After data extraction, the information is subject to an exhaustive validation routine to make sure the data are accurate, clean, and complete. The validation procedure starts with identifying missing and inconsistent data for important attributes like price and quantity. If a product record does not contain salient details, corrective actions are applied to either fill in the gaps by applying the right heuristics or exclude incomplete records from further consideration. For instance, If the price of an item is not available on the website, replace it with '0'. Furthermore, duplicate entries are recognized and removed to ensure accuracy because multiple scrapes may produce redundant product listings. Data type checking is also undertaken in order to ensure numerical properties like price and quantity are saved in the correct manner to avoid computational issues in later processing. This validation process is important in order to fine-tune the dataset to make sure it is structured, correct, and prepared for effective price comparisons.

3.3 Data Transformation

Following validation, the data extracted is transformed to normalize naming conventions, units of measurement, and format consistency in general. One of the most important transformations is the extraction of standardized product names from long descriptions to remove naming inconsistencies across platforms. For instance, "Apple - Royal Gala 1kg" is transformed to "Apple," which ensures consistency in product presentation. Unit conversion is also carried out to reduce all measurements to a standard base, for instance, converting kilograms to grams or liters to milliliters

based on established conversion factors. This makes it easier for various product quantity formats not to interfere with price comparisons in an absolute manner. Another key conversion is the calculation of price per unit quantity using the Rate = Price / Quantity formula. This facilitates effective and meaningful comparison of prices from various vendors. Additionally, products are classified under standardized names to enable easy filtering, sorting, and significant analysis. Such transformations allow for the simplification of the dataset, as they ensure uniformity and consistency in all records for effective price analysis.

3.4 Data Storage

For effective storage and management of the transformed data, a structured MySQL database is created, with guaranteed organized and swift access to product information. The database schema is composed of several tables, each used for a unique purpose. The All_Products table stores all the extracted product information, such as product name, quantity, unit, rate, price, and web information. Only the cheapest available product per category is stored in the Cheapest_Products table to reduce the cost of retrieving effective products. User authentication information is stored in the User_Data table to provide a secure system access. The Cart table also stores products picked by customers for checkout to ensure an easy shopping process. This organized database method allows for rapid query execution, effective data retrieval, and seamless integration with other system elements.

3.5 Data Operation

Once the data is safely stored in the database, various operations are carried out to extract meaningful information. Products are initially alphabetized by their standardized names so that it becomes convenient to browse and analyze similar products. For every category, items are then sorted within the category in ascending order of price, finding the lowest price platform selling each item. Furthermore, for each item, the potential savings is calculated with the formula Amount Saved = Highest Price - Lowest Price, pointing out the economic advantage of making the most affordable vendor choice. These calculations make users able to find well-organized and meaningful product comparisons to make wise purchase decisions.

3.6 Data Analysis

There is an extensive data analysis stage to glean useful information from the gathered and processed data. The system compares price fluctuations between various platforms so that users know how product prices change between vendors. The analysis also determines the most sought-after products with the greatest potential savings, directing users towards cost-saving purchasing options. Furthermore, vendor performance is analyzed by determining which platforms tend to provide competitive prices. This data-driven strategy adds sophistication to the entire decision-making process by breaking down pricing trends as well as vendor competitiveness in detail.

3.7 Data Retrieval

Having real-time access to processed data is paramount for a smooth user experience. A Node.js server is utilized to serve as middleware between the frontend and backend, processing data retrieval operations with efficiency. The server makes use of asynchronous JavaScript methods for handling user requests in real time, causing the most current pricing data to be shown with little lag. This configuration allows for immediate retrieval of the lowest price for search products, fast response to show comparison results, and a safe, scalable data retrieving system that helps ensure system stability and performance.

3.8 Data Visualization

The processed information is finally served to users via an interactive and intuitive interface. A Comparison View has been made available by the system, wherein users are allowed to compare product prices side by side across various e-commerce sites. Through a Lowest Price Highlight feature, the best offer for each product is highlighted clearly so that users can easily spot the most affordable options. In addition, a Cart Summary gives a summary of chosen products, categorized by platform, and includes total savings calculations. These visualization components improve usability by allowing users to make well-informed purchasing decisions easily through an intuitive and interactive interface.

CHAPTER 4

IMPLEMENTATION

IMPLEMENTATION

The image illustrates the system architecture of the project, showcasing the interaction between the frontend, backend, and API layer. It highlights the complete flow—from user activities like sign-up, login, comparing products, and placing orders on the frontend, to backend processes like web scraping, data storage, and optimization. Node.js serves as the bridge for API requests, handling data transfer for price analysis, user credentials, and product comparisons, ensuring smooth communication between the interface and the database.

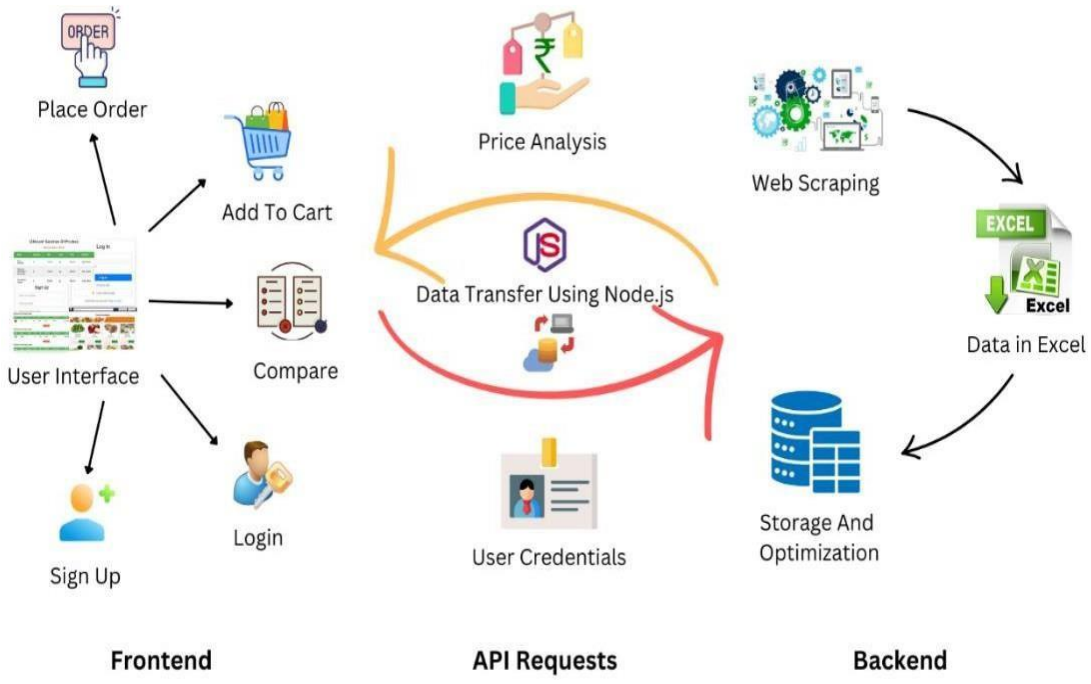

Figure 4.1 Grocery Price Comparison system

4.1 Web Scraping:

Product details are dynamically scraped from various e-commerce sites using Selenium with Java. The scraped information contains vital attributes like product name, price, quantity, and platform information. This information is first saved in an Excel sheet as an interim step for preprocessing. At this step, a 'Standardized Name' column is obtained from the product name to maintain consistency across various platforms. In the same way, the 'Unit' column is derived from the quantity field to make comparisons easier. A new column, 'Rate,' is also created by dividing the price by the unit, which assists in identifying the best bargains. This organized method ensures that product information is cleaned and optimized prior to being moved to the database for processing.

4.2 Storage and Optimization

After being preprocessed, the data is warehoused in a MySQL database, and there are structured tables for product management, cheapest choice, user information, and cart items. SQL queries organize the products in their standardized names by grouping, alphabetical order, and then in further order by rate to find out the lowest possible price. The lowest-priced platform is saved in a special "Cheapest Product" table. Moreover, the system determines the difference in price between the most expensive and cheapest available option to ascertain the possible savings, which is titled as 'amount_saved.' This method allows consumers to immediately know the optimal offers and, at the same time, monitor price fluctuations to make an informed decision.

4.3 Interactive UI:

The user interface is made such that it presents an optimal shopping experience. A sign-up page enables new users to sign up by filling in their information, which is stored securely in the database. Existing users can log in via an authentication system, providing them with access to personalized information. The home page shows a list of standardized products and their images, names, and input fields for filling in the quantity to be entered. Each product comes with two main features: a "Compare" button and an "Add to Cart" button. The "Compare" button gives a comprehensive price comparison by detailing rates from various e-commerce websites in order from lowest to highest, enabling users to tell the most affordable option. The "Add to Cart" button makes shopping easy by directly picking the cheapest available product and putting it in the cart. When the customers choose to order, they are directed to the original e-commerce site where the item is available, so the transaction process continues smoothly.

4.4 Functionality:

The platform offers two core functionalities—product comparison and shopping cart management. When users click the "Compare" button, they receive a list of price comparisons for the selected product, displaying rates from different platforms in ascending order. This helps users make informed purchasing decisions by selecting the most affordable option. The "Add to Cart" button also facilitates the process further by automatically checking for the product with the least price and putting it in

the user's cart. After the users make their choices, they can go through the "Place Order" feature, which opens the respective e-commerce website in order to make the purchase complete. This feature helps the user compare, choose, and buy products effectively without added complexity.

4.5 Connectivity:

In order to maintain communication between the frontend and backend seamlessly, Node.js services as middleware. When actions like "Compare" or "Add to Cart" are taken by users, an asynchronous call from JavaScript is made to the Node.js server. The requests are handled by the server, accessed the MySQL database using MySQL2, and fetched or updated the required data. The results are then passed through processing and returned as JSON so that the frontend can dynamically update the UI in real time. This kind of architecture allows for a fast and responsive user experience with minimized delays and optimized overall performance.

4.6 Real-Time Data Transfer:

Real-time data management and security are the most important features of the system. In sign-up, user information is securely hashed via bcrypt and stored in the database to maintain data privacy. On the client side, product details are dynamically fetched from the database every time "Compare" or "Add to Cart" option is selected. Products are grouped by platform, and there are independent tables in both UI and database for each platform. Only platforms with purchases made are active tables, and this maximizes data storage and retrieval. This organized method increases efficiency while providing users with constant access to the most current product and price information.

CHAPTER 5

RESULT AND DISCUSSION

RESULT AND DISCUSSION

The online grocery shopping price comparison tool has also been very convenient and effective, as it enables users to compare the prices of different products among different sellers within a single interface. This is no longer necessary to do manually by visiting numerous websites, sparing shoppers their precious time while it ensures cost-effectiveness through finding the cheapest options for all products. Because of this, users can easily make cost-saving choices. Additionally, the device features a user-friendly and fluid interface, making it easy for repeat customers to navigate and find the best current offers. The platform also takes care of numerous prevalent issues online grocery shopping brings about, including price inconsistencies, mismatched sales, and mixed offers, and finally makes shopping more transparent, effective, and economical.

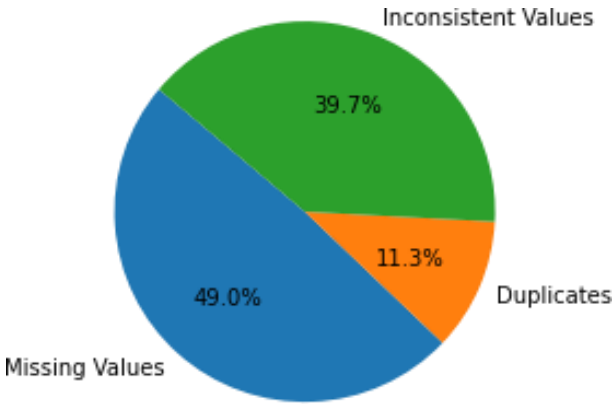

Figure 5.1 Percentage of issues resolved during preprocessing

The preprocessing process was an essential step in making the data reliable and of high quality. Figure 5.1 presents the percentage distribution of the types of issues encountered and solved during this process, with three major data issues being Missing Values, Inconsistent Values, and Duplicates. Among these, Missing Values constituted the largest portion, accounting for 49.0% of the total issues, indicating that a significant portion of preprocessing efforts focused on handling gaps in the dataset. Inconsistent Values made up 39.7%, which reflects efforts to standardize and harmonize the data to ensure uniformity. Duplicates represented 11.3% of the issues, showing that part of the preprocessing involved identifying and eliminating redundant records. These preprocessing activities were instrumental in ensuring data integrity, enabling proper analysis and useful insights.

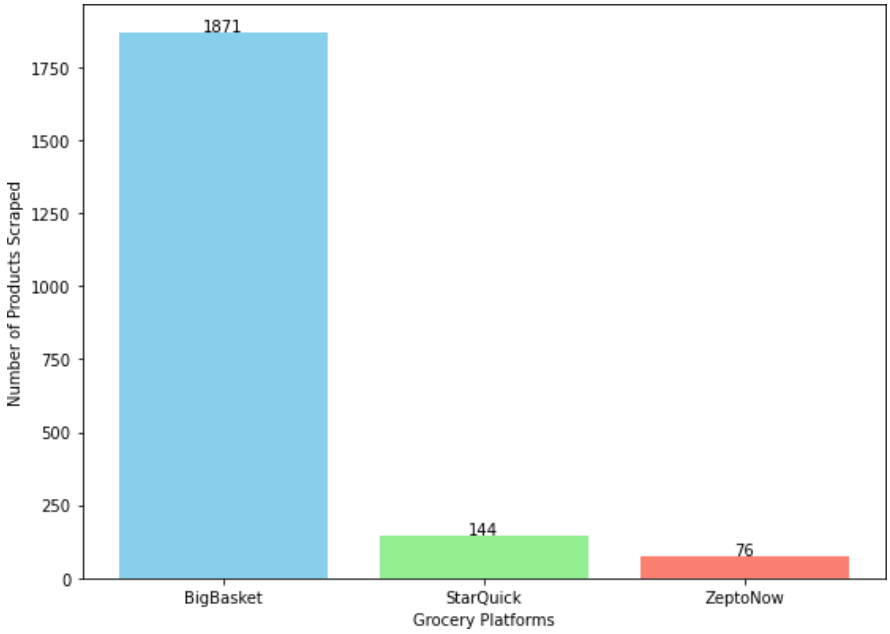

Figure 5.2 Number of products scrapped from grocery platforms

Moreover, the tool made it easy to collect useful data from grocery platforms such as product names, prices, and availability for thorough comparative analysis. Figure 5.2 shows the number of products scraped from various grocery platforms with a high degree of variation in data availability on different platforms. BigBasket scraped the maximum number of products, at 1,871 products, which is probably because its website was well-structured and web scraping tools had easy access. On the other hand, StarQuik and ZeptoNow scraped relatively fewer products, at 144 and 76 products, respectively. This disparity in coverage of data suggests that certain sites are easier to gather data from than others, perhaps as a result of differences in website architecture or data protection policies. Generally speaking, the capabilities of collecting comprehensive product data make the price comparison tool more effective, and thus a useful tool for internet-based grocery shoppers who wish to make educated buying decisions.

Table I: Raw Data

Name	Price	Quantity
Cherry Tomatoes	**20.00**	**About 200 Gm**
Papaya Raw	**39.00**	**About 1 Kg**
Garlic Peeled	**86.00**	**100 Gm**
Cucumber – English(Loose)	**10.00**	**250Gm**
Baby Banana - Robusta	**47.00**	**1 kg –(9-12 pcs)**
Banana – Robusta, Small	**19.00**	**About 250 Gm**

Table II: Clean Processed Data

Name	Standard Name	Price	Quantity	Calibrated Quantity	Unit
Cherry Tomatoes	Cherry	20.00	About 200 Gm	0.20	Kg
Papaya Raw	Papaya	39.00	About 1 Kg	1.00	Kg
Garlic Peeled	Garlic	86.00	100 Gm	0.10	Kg
Cucumber – English(Loose)	Cucumber	10.00	250Gm	0.25	Kg
Baby Banana - Robusta	Banana	47.00	1 kg –(9-12 pcs)	1.00	Kg
Banana – Robusta, Small	Coconut	19.00	About 250 Gm	1.00	Pcs

The raw data as shown in Table I is from online store websites that experience challenges in product naming, quantity, or units. Ongoing mismatch of Quantity Descriptions and product naming makes it a hard nut to compare various products among the vendors. There were numerous steps involved in cleaning and transforming the raw data into a structured and consistent format as in Table II. Preprocessing involved several important steps to aid in reducing the vagueness of the comparisons.

Firstly, in Table I, product names which were devoid of the needed similarity from the original name to the descriptive type names were made standardized by replacing excess descriptors and deviations. The consequence of which was the whole range of products were collated under a single name only that rendered comparison quite easy-peasy for vendors to make.

Third, the "Quantity" column in Table I was set to have uniform measurements. A condition of non-uniformity arises when the weight is described in different styles like "About 200 Gm" or "250 g." These were translated into a base unit (kilograms) using code logic as weights are in both directions. For instance, "200 Gm" was translated as "0.20 kg," while "250 g" became "0.25 kg." The opposite happened in "1kg - (9-12 pcs)," where "1.00 kg" substituted, and when dealing with items that were not weight-based, such as "1 pc," the initial figure was maintained while the appropriate unit was added. A measure is categorized as such in the "Calibrated Quantity" column of Table II.

In addition, separation of measurement units ensures unambiguity and facilitates straightforward computation of mathematical operations like price per unit or overall price without any confusion. The above pre-processing has a number of significant benefits in product comparison across vendors. Standardized names eliminate redundancies and enable meaningful grouping of the same product. Standard amounts measured to the same unit enable simple direct comparison of price per unit regardless of how the vendors are displaying their quantities. Additionally, isolating the "Calibrated Quantity" and "Unit" further makes the calculations simple and precise. Comparing the raw data presented in Table I to the neat and organized format in Table II makes the process itself highly efficient and of high accuracy.

Figure 5.3 Heatmap of cheapest products across platforms

The comparison of grocery price differences across platforms provides useful information for budget-conscious consumers looking for the best value. Figure 5.3 gives a clear indication of which platform has the lowest prices, showing that BigBasket leads the market by offering most of the cheapest products, with more than 80% of the lowest-priced items among the compared platforms. ZeptoNow ranks second, while StarQuik has the minimum share of the lowest-priced products. This information is helpful to users looking to make sound judgments while purchasing grocery items online. Knowing which platforms often provide the lowest prices, users can strategically plan their shopping, thereby achieving maximum savings without the inconvenience of comparing multiple websites' prices manually. In addition, this analysis makes the process of decision-making easier by providing an integrated picture of price patterns across platforms, not just enabling consumers to make budget-friendly decisions but also encouraging consumers to trust particular vendors because of their prices. Moreover, this data-based analysis acts as a guide for vendors, making it easier for them to realize competitive pricing measures and encouraging

platforms such as StarQuik to lower their prices to maintain competitiveness in the market.

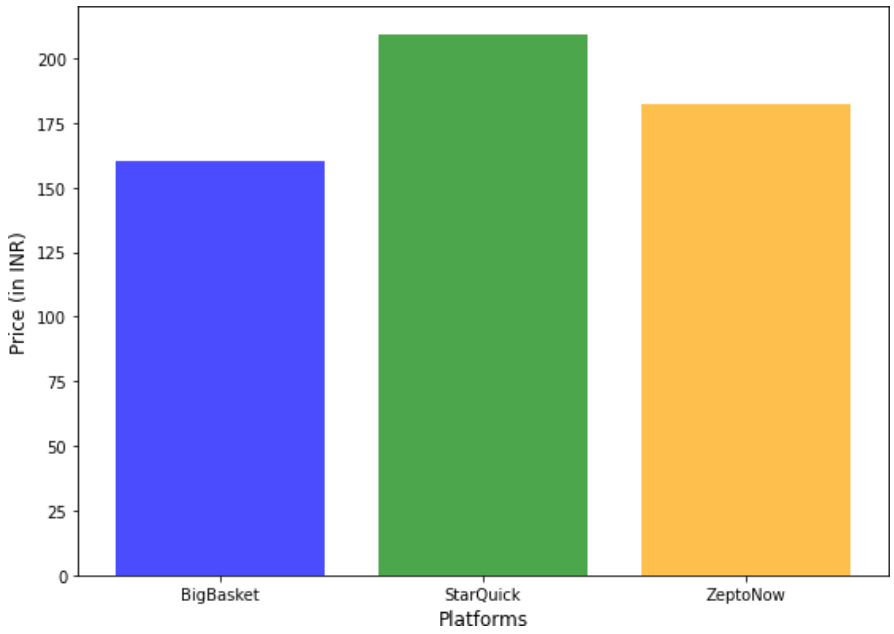

Figure 5.4 Price comparison for mango raw across platforms

The price comparison of individual grocery items across platforms further narrows down shopping strategies. Figure 5.4 shows a comparative study of raw mango prices on three grocery platforms, showing the price differences and allowing users to decide which platform provides the best value. For instance, the customer can simply know which one is most affordable without necessarily having to check the price by themselves, hence saving effort and time. This efficient process of comparison not only saves the users money but also enhances their shopping experience in general by enabling them to quickly discover the best deals. By showing evident price differences, customers can easily determine the cheapest choice, thereby saving time and effort. This effective comparison process not only assists consumers in saving costs but also improves their shopping experience by facilitating easier access to the best deals available.

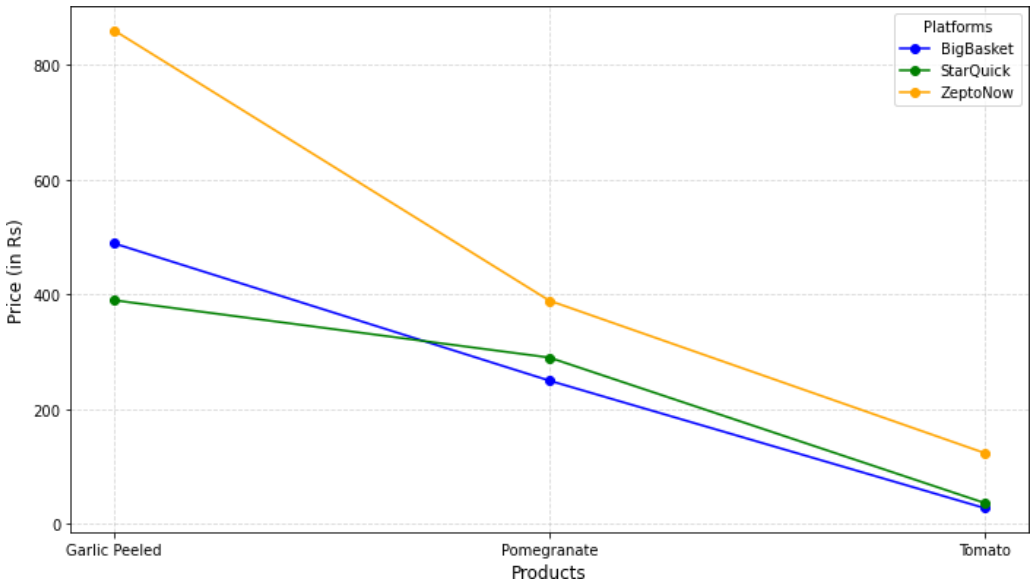

Figure 5.5 Price comparison for multiple products across platforms

Figure 5.5 highlights the price differences of three various products—Pomegranate, Garlic Peeled, and Tomato—on BigBasket, as well as StarQuik and ZeptoNow, for an equivalent amount of one kilogram. This comparison again highlights the need to choose the appropriate platform to reap maximum cost benefits. For example, BigBasket is the most cost-effective platform for purchasing Pomegranates, while Garlic Peeled is cheaper on StarQuik and ZeptoNow. Likewise, StarQuik is the ideal choice for buying Tomatoes at a cheaper price. By emphasizing such differences, this analysis shows how customers can substantially lower their supermarket bills by making smart decisions according to platform-related prices. It makes the process of shopping simpler by providing a straightforward and understandable comparison so that users can easily decide where they can get the best deal for their money. This data-driven form of grocery shopping not only works to the benefit of individual customers by allowing low-cost purchasing, but it also gives a big picture view on market price trends, promoting competitiveness among grocery websites to provide attractive offers to compete for customers.

This comparison will clearly indicate the amount of money the user can save if he or she selects the proper platform for a specific product. This will simply describe the price difference so that one can easily determine where to shop and save money on groceries.

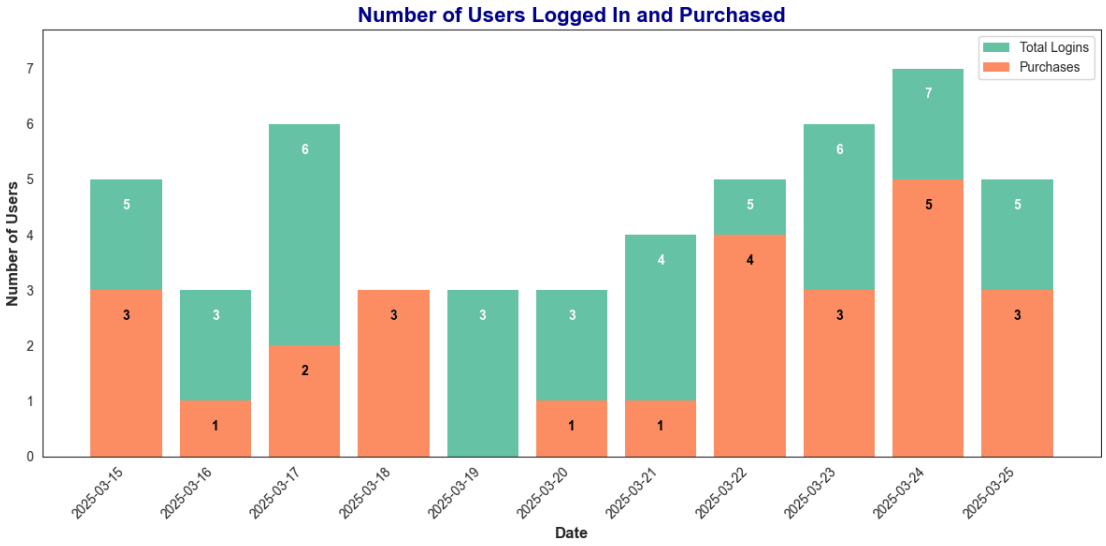

Figure 5.6 Purchase Rate

The above figure 5.6 represents user activity over a period of eleven days, from March 15 to March 25, 2025. It visualizes two key metrics: the number of users who logged into the platform (shown in green) and those who made purchases (shown in orange) on each respective day. The chart uses a stacked format to clearly compare login and purchase counts, with values labeled on each bar for easy reference. The data indicates that March 24 had the highest overall activity, with 7 logins and 5 purchases. In contrast, some days like March 19 and 20 showed user logins but no purchases, pointing to potential disengagement. Towards the end of the observed period, specifically from March 22 to March 24, there is a noticeable upward trend in both logins and purchases, suggesting increased user interaction and successful conversions. It helps identify patterns in user behavior over time.

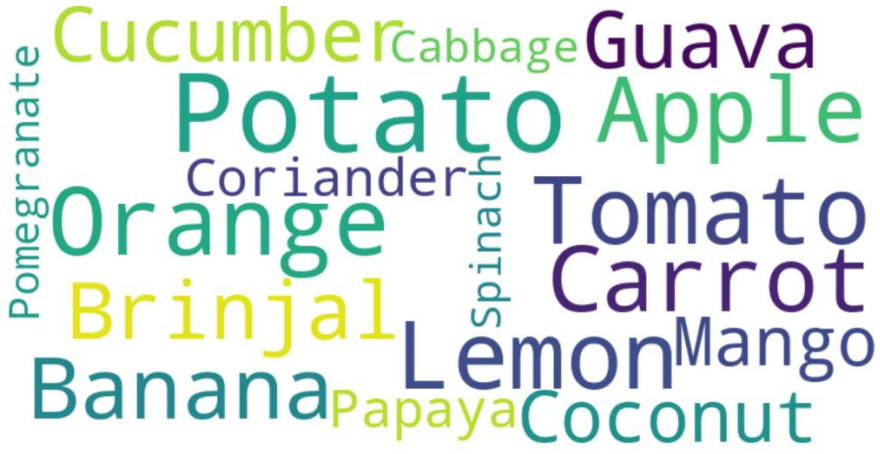

Figure 5.7 High-Demand Products

The figure 5.7 displays a word cloud representing the names of various fruits and vegetables frequently found in the dataset. In a word cloud, the size of each word indicates its frequency or importance—larger words like Potato, Tomato, Apple, and Orange appear more frequently in the data, while smaller words like Spinach, Mango, and Cabbage occur less often.

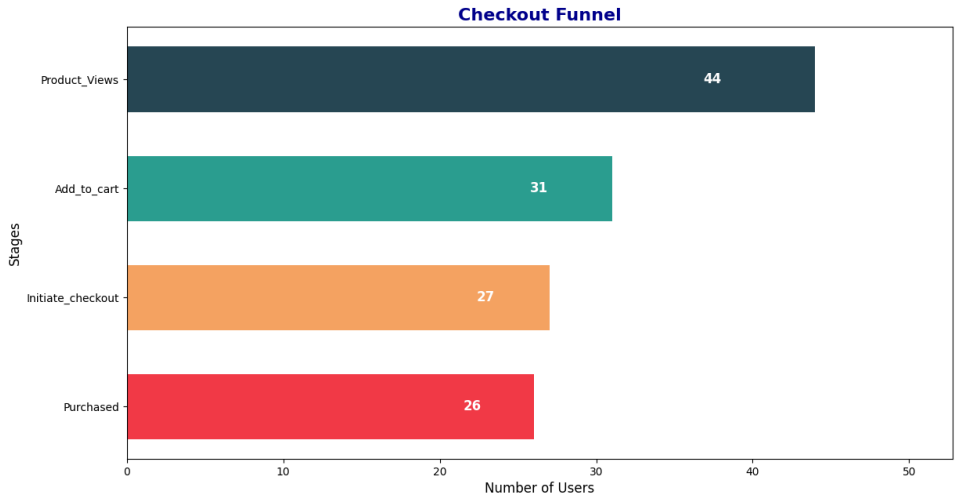

Figure 5.8 Purchase Funnel

The figure 5.8 represents a Checkout Funnel visualization, which helps track user behavior through different stages of the purchasing process. The funnel is divided into four key stages: Product Views, Add to Cart, Initiate Checkout, and Purchased. It begins with 44 users viewing products, indicating initial user interest. Out of those, 31 users proceeded to add products to their cart, showing a significant level of purchase intent. The next stage, initiating the checkout process, was performed by 27 users, indicating a minor drop-off. Finally, 26 users completed their purchases, reflecting a strong conversion rate from the initial product view to final purchase.

This analysis is crucial for identifying at which stage users are most likely to drop off and provides insights into improving the user experience and conversion strategy. The minimal drop between the checkout and purchase stages suggests that the platform's checkout process is user-friendly and effective, whereas the drop from views to cart indicates a potential area for improvement in terms of product presentation or pricing.

CHAPTER 6

CONCLUSION

CONCLUSION

6.1 CONCLUSION

The designed website is an extremely useful utility for the consumers to make better buy decisions through comparing prices across stores. Such a price comparison platform is more suitable for busy people who would require checking the price before they make a purchase but might not find time to compare manually. The platform combines different online retailers' pricing, deals, and promotions and brings a significant effort reduction and saving on time involved in shopping.

Furthermore, the site is of benefit to vendors as it assists them in establishing fair prices and attracting more clients. Through market analysis, vendors are able to provide the best offer and enhance their pricing models. The system ensures that users have constant access to the cheapest alternatives, which enhances the overall shopping experience in the grocery store.

This study enriches the literature of e-commerce and online retailing by overcoming the current shortfalls in price comparison solutions. By providing a seamless, automatic, and friendly platform, the site enables wiser grocery shopping and a better and more competitive online market.

6.2 CONTRIBUTIONS

The project brings substantial value to price comparison through its provision of an automated, easy-to-use, and effective platform for grocery shopping. The system simplifies the price comparison process by gathering, processing, and presenting real-time pricing information from various vendors to enable users to make cost-efficient purchasing decisions with minimal effort. It improves the shopping experience by giving users a unified platform to compare prices and find the best offers available. The platform also assists vendors by enabling them to analyze market trends and price competitively, hence creating a more dynamic and competitive online marketplace. The system also brings a data-driven decision- making process, enabling users and vendors to make use of insights on pricing trends, discounts, and promotions.

6.3 SCOPE FOR FUTURE WORK

Future development of the platform will focus on making the shopping experience smarter and more personalized. Users will receive product recommendations based on their shopping history and preferences. Real-time price tracking will highlight discounts, offers, and price changes as they happen. The platform will expand its product range by adding more grocery categories. Advanced web crawling techniques will enhance data collection and accuracy. Machine learning will be used to forecast future prices based on market trends, helping users decide the best time to buy. Automated email alerts will notify users when prices drop on their favorite items. Additionally, the website will be converted into a personalized mobile application, allowing users to access features more easily, receive real-time notifications, and enjoy a seamless, on-the-go shopping experience tailored to their needs.

CHAPTER 7

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REFERENCES

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DISSEMINATION
OF WORK

Automated Price Monitoring and Comparison for E-Grocery Markets Using Selenium and Java

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Abstract*— The highly price-sensitive Indian market, coupled with the increasing reliance on online grocery shopping, demands innovative solutions to streamline price comparison processes. Today, there are many online vendors that sell groceries, vegetables, and fruits with varying prices, service charges, and promotional discounts. Consumers usually have to spend time comparing them all to figure out the cheapest ones, which is both time-consuming and inefficient. This study introduces an automated price comparison and cheapest option finder website for online grocery purchases. It utilizes Selenium for web scraping, implemented in Java, to extract detailed pricing, and quantity, and offer data from different online grocery platforms. The extracted data is systematically processed and analyzed to generate actionable insights. The output shows the lowest price options for any commodity for each vendor and customer including all suitable charges and discounts and compares the price from different platforms and shows which is cheapest. This being automated, the website enables the user to make informed purchases with suitable savings of time, effort, and money. This study not only streamlines the experience of online shopping but also rectifies the inefficiencies prevailing in comparing prices through manual methods, thus providing a useful and scalable solution for modern consumers.

Index Terms—*MySQL, Price Comparison, Selenium, Web Scraping.*

I. INTRODUCTION

Indian e-grocery has witnessed tremendous growth, which ranks it among the most vibrant and price-sensitive categories in the country. Increased use of online services for grocery purchase has offered various choices of retailers selling groceries, vegetables, fruits, and related items at competitive prices with their service charges and promotional offers. However, it is precisely the freedom of options offered to the consumers that throws an important challenge-the right options and the right price. Normally, the procedure followed to make price comparisons along with service charges, offers among the various vendors had been rather long and tiresome. This is a difficult job that people usually done manually [1], [3], [5], [9] making it inefficient for today's consumers who want both convenience and savings.

We introduces a new automated price comparison and cheapest option finder website for online grocery shopping. This website utilizes Selenium, a robust web scraping framework implemented in Java, to extract detailed and real-time data on prices, quantities, and offers from different e-commerce platforms [1], [9]. After extracting the data, Store the processed data in an organized database that is easy to query and handle [1], [7], [8], [10]. It is systematically processed and analyzed to provide actionable insights to consumers. This website displays the cheapest price for any product across different websites, [1], [2], [5], [9], [10] taking into account all applicable charges, such as delivery costs and discounts. This alone automatically mechanizes the process which, otherwise inundated with inefficiencies in terms of manual price comparison, has saved consumers many hours of hassle in identifying the best deals.

Here, we focuses on making online shopping easier and more affordable for consumers [1], [3]. Scalability is another emphasis, thereby meaning the tool can be used to include more vendors and product categories apart from groceries. The adaptability extends the tool's relevance to a wider spectrum of online shopping needs. Further, the project provides a platform for future advancements like incorporating machine learning algorithms to predict price trends, seasonal discounts, or even personalized recommendations based on user preferences and shopping history. With these major needs addressed, the tool spans a huge lacuna in the online shopping value chain with an actionable, ready-to-use, user-friendly approach tailored to uniquely address the need of the Indian market [5].

This research paper goes far beyond just offering price comparisons and represents a transformational approach to changing how Indian shoppers, especially grocers, buy online. This website equips users with the right and updated information by combining dynamic web scraping with real-time data analysis, thus making purchasing decisions wiser [1]. It reduces the inefficiencies of manual processes, ensuring consumers save not only money but also precious time and energy. Additionally, the scope of expansion potential in the tool will always keep it relevant within the market's constantly shifting landscape as it can quickly adapt and add new functionalities in relation to shifting consumer needs.

This paper has illustrated how technology increasingly shapes consumer experiences and market problems get resolved. This has underscored efficiency, automation, and scalability in modern applications among consumers. This website is a game-changer for the Indian online grocery market, which is characterized by intense competition and high price sensitivity. It provides significant savings to consumers while streamlining the overall shopping

experience, making it an indispensable asset for navigating the complexities of online grocery shopping in India [2], [6], [9].

II. LITERATURE REVIEW

Martina D'Souza, Soham Desai, Dhruv Agrawal, and Falguni Joshi, 2024, describes an application that gathers product information from online stores using Beautiful Soup, analyzing the structures of HTML. Flask is used as the backend for managing data processing and API communication, and the Python bs4 module is used to handle the data extraction. Selenium along with Chrome web drivers supports the web scraping process. The application is divided into seven main modules: collecting user input, retrieving product URLs, creating a Beautiful Soup object, initializing the Chrome web driver, extracting necessary data, handling errors, and displaying the results to the user [1].

Vaibhavi B Raj, A S Sushmitha Urs, Abhishek Kumar Pandey, Jagruthi G, Archana VR, and Deepthi Das, 2024, display an intelligently shopping stage based on machine learning, NLP, and web scratching to produce personalized proposals and cost comparisons. Clients start their look through either a chatbot or an online site interface, with the input being deciphered utilizing Streamlit and NLP methods. The stage at that point rub e-commerce websites utilizing BeautifulSoup and demands to bring item prices and compare them, eventually exhibiting the finest bargains. The chatbot moreover offers personalized proposals and answers client inquiries. The site incorporates a login page, domestic page, and approximately page, all including real-time cost comparisons [2].

S. Rajendar, K. Manikanta, M. Mahendar, and K. Madhavi, 2021, describe a system that uses web mining techniques like web crawling and web scraping to retrieve product details from several e-commerce websites. Web pages are loaded using Python modules like requests and BeautifulSoup, which also parse HTML to extract the necessary data. The frontend gives users access to the product search interface. To compare prices across different sites, the query is executed in the local database (SQLite3). It aims to save the online shopper time, money, and effort by helping them find the greatest deals. The Django web framework was used in its construction, and features like price comparison and alerts are included to assist the customer in making an informed purchase [3].

E. Uzun, 2020, presents a fast web content extraction technique outperforming the traditional DOM-based methods. In contrast to DOM, taking up to 140 days, the UzunExt method will complete the task within one day, and string methods are 60 times faster compared with those. Furthermore, the use of additional data from the crawling process also boosts the extraction performance to 2.35 times that of the string methods alone. The technique is more efficient since it directly points out the elements of interest, avoiding the need for a DOM tree and offering a faster solution to web scraping [4].

N. Singh, A. Rana, and A. Chaudhary, 2023, designs a user-friendly web scraping-based price comparison system for e-commerce websites. Python's BeautifulSoup will be used in the system for scraping product prices from various online stores. Preprocessing of data is done in order to clean and normalize the information so that consistency is guaranteed. The results of price comparisons are analyzed and visualized with the help of descriptive statistics and bar graphs. A user-friendly interface is built by using Python's Tkinter library, providing users with an easy-to-use platform to input products and then view price comparisons [5].

K. Harikirshnan, R. Nagavigneshwar, R. Vignesh, R. Santhosh, and R. Reshma, 2023, develop an intelligent online shopping platform that improves the satisfaction of its users by applying a Machine Learning-based product comparison engine. It will scrape the web to get information such as price, reviews, and other product details from e-commerce websites. The SVM algorithm classifies products according to the features chosen, resulting in the highest accuracy at 94.71% compared to other algorithms like Decision Tree, Naïve Bayes, and Random Forest. The platform streamlines the shopping process by providing a unified interface for comparing products, allowing users to find the best deals and helping e-commerce sites with competitive pricing. Additionally, the SVM classifier is applied for matching and linking product prices between different websites [6].

Arman Shaikh, Raihan Khan, Komal Panokher, Mritunjay Kr. Ranjan, and Vaibhav Sonaje, 2023, discuss how cost comparison websites use web scraping techniques to gather and analyze information related to items from various sources. By utilizing PHP libraries, such websites extract details like item names, prices, and ratings. The focus is on helping customers make informed purchasing decisions while enabling merchants to effectively promote their products. Additionally, they suggest the creation of a trade show that offers free services to clients, generating revenue through advertisements and commissions [7].

P Nagaraj et al., 2023, describes the designing of a website that fetches the price of products from Amazon and Flipkart using PHP, XAMPP, and MongoDB. The system uses web scraping technology to give the price of the desired product on these e-commerce websites. For implementation, XAMPP was used that includes MySQL, Apache web server, Perl, FTP server, PHP, and phpMyAdmin. The primary programming language used in the XAMPP environment was PHP. The PHP-CURL library and PHP Simple DOM were also used for web scraping to obtain product data. [8].

J. Viba Mary, and N. Blessy Benitta, 2023, introduce a web application that assists consumers in comparing product prices between different shopping centers to save time and make better decisions. Key modules of the application include the user interface, admin functions, retrieval of product information, updating of price, fake comment detection, and addition to cart. The price comparison module allows the user to select a product, add it to a list, and compare prices between various shopping centers by extracting data from e-commerce websites using Java with Selenium. It analyzes the total price of the product and identifies which shopping center is offering it at its minimum price, providing the user with a detailed result of the comparison [9].

Piyush Rawal, Priyansh Gupta, Shubham Gaur, and Faraj Chishti, 2020, describes the development of a website that

enables the comparison of product prices by scraping data from various websites and connecting APIs to fetch real-time product details directly from retailers. The system sends API requests and stores data in a database so that it gets automatically updated. A crawler visits predefined websites with the intention of collecting essential information such as price and features. The work provides insight into web development in terms of HTML, CSS, responsive templates, and SDLC and also offers hands-on experience for testing features and creating a site that helps users save time and money [10].

III. RESEARCH METHODOLOGY

A. Data Extraction

Raw product data is dynamically extracted from various e-commerce websites using Selenium in Java [1]. The captured attributes include Product Name, Price, Quantity and Website which is then saved in an Excel file for further processing [1].

B. Data Validation

The scraped data is validated for cleanliness and completeness. Missing and inconsistent values for key attributes such as price and quantity are detected [5]. Duplicate entries and inconsistent data are eliminated in order to ensure integrity. Data types are validated, such as numeric for prices and quantities.

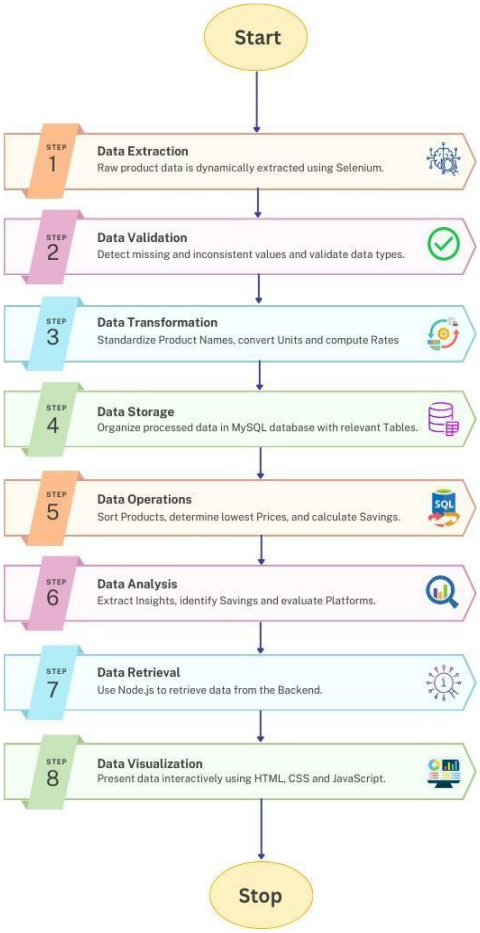

Fig. 1 Data Processing Workflow

C. Data Transformation

Extracts standardized product names, for example:

"Apple - Royal Gala 1kg" → "Apple".

Converts measurements to standard units (e.g., grams to kilograms) by applying pre-established conversion factors.

Computes the rate per unit to facilitate comparison by:

$$\text{Rate} = \text{Price}/\ \text{Quantity} \quad (1)$$

D. Data Storage

Store the processed data in an organized database that is easy to query and handle [1], [7], [8], [10]. A MySQL database schema is designed, comprising the tables: All_Products (Holds all products with product name, quantity, unit, rate, price and website information), Cheapest_Products (Holds only the cheapest category product), User_Data (Enables authentication and holds user information) and Cart (Holds products chosen by users at checkout).

E. Data Operations

Products are sorted alphabetically by their standard names. Under each category, they are further screened according to their prices in ascending order to determine the lowest price and the platform offering it. The value of 'savings' is calculated as:

$$\text{savings} = \text{highest price} - \text{lowest price} \quad (2)$$

F. Data Analysis

Determine insights based on the organized data by understanding the products that exist and the price within the different platforms [1]. Identify the most popular products with the maximum savings and assess the platforms that offer the lowest price [2], [6].

G. Data Retrieval

Ensures that processed data is made available in real-time to the frontend for visualization. Sets up a Node.js [1] server to act as middleware between the frontend and the backend by utilizing asynchronous JavaScript functions to handle retrieval operations fetching the cheapest price and the corresponding platforms and savings.

H. Data Visualization

The processed data is then presented through an interactive interface with the use of HTML, CSS, [6] and JavaScript [4, 6] including a 'Comparison View' that shows prices across platforms, a 'Lowest Price Highlight' for the best deal, and a 'Cart Summary' that groups products by platform with total savings.

IV. IMPLEMENTATION

A. Web Scraping

Product information is dynamically scraped from multiple e-commerce websites using Selenium in Java. The extracted data includes product name, price, quantity, and platform details. The scraped data is stored in an Excel file as an intermediate form for preprocessing where 'Standardized Name' column is derived from 'Name' and 'Unit' from 'Quantity'. Units are chosen such that they are easily

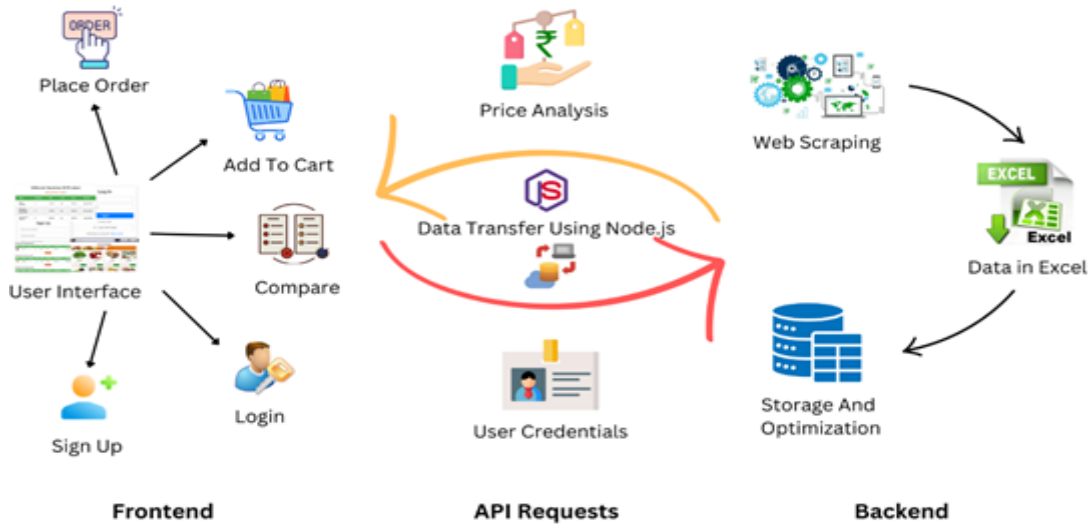

Fig. 2 Grocery Price Comparison System

compared. Additionally, a new column for 'Rate' (price/quantity) is created.

B. Storage and Optimization

The preprocessed data is transferred to a MySQL database with tables for products, cheapest options, user details, and cart items. SQL queries group products by standardized names, sort them alphabetically, and further sort by rates to find the lowest price. The platform with the lowest price is stored in the "Cheapest Product" table, and the price difference between the highest and lowest is calculated to determine the 'savings'.

C. Interactive UI

A sign-up page allows new users to register by inputting their details, which are securely stored in the database. A login page authenticates existing users, granting access to their personalized data. Main Page displays standard products available with images, names, and placeholders for entering desired quantities. Each of the products include "Compare" and "Add to Cart" buttons which allows users to compare between platforms and select the cheapest option.

D. Functionality

The "Compare" button gives a list of price comparison for the desired product by providing the rates charged by different websites in ascending order, thus determining the cheapest way to buy that product. "Add to Cart" simplifies the shopping by automatically selecting a product from the lowest price website, adding it to their cart. Once the user has decided to order, they can click on the "Place Order" button, which leads them to the original e-commerce website where the product is sold, thus facilitating a seamless continuation of the transaction process.

E. Connectivity

Node.js acts as middleware between the frontend and backend, ensuring smooth data transfer. The user action "Compare" or "Add to Cart" sends an asynchronous request from JavaScript to the Node.js server. The server processes these requests, interact with the MySQL database using MySQL2, and retrieve or update data. Results are sent back as JSON, allowing the frontend to update the UI dynamically and in real time, ensuring fast, responsive performance and a smooth user experience.

F. Real Time Data Transfer

User details are hashed using bcrypt and stored safely in the database at the time of sign-up. On the client side, the product details are fetched from the database when the "Compare" or "Add to Cart" option is selected. Products are grouped by platform, with separate tables created in both the UI and database for each platform. Only platforms with purchased products have active tables.

V. RESULTS

It has become a convenient and effective price comparison tool for the online grocery shopper. Through it, prices of various items across different vendors are compared in one place; therefore, all that time, which would be otherwise spent comparing on different websites manually, is saved. Cost efficiency is maintained as the cheapest alternative is identified by the system for every product. It helps a shopper make more budget-friendly choices. Above, the tool enables a smooth user-friendly interface where frequent buyers could easily make selections by quickly getting an idea to find the best available deals. Also, this vast approach addresses those common problems encountered in online shopping, such as price disparities, incongruent offers, and most importantly, inconsistent offers, with online grocery shopping becoming more understandable, efficient, and affordable for customers.

Fig. 3 shows the percentage distribution for discrepanc resolved. It indicates three main types of data problems: Missing Values, Inconsistent Values, and Duplicates. Of these, Missing Values represented the largest share at 49.0%, meaning that much of the preprocessing efforts involved filling or dealing with missing entries in the data set. Inconsistent Values stood at 39.7%, which showed an effort

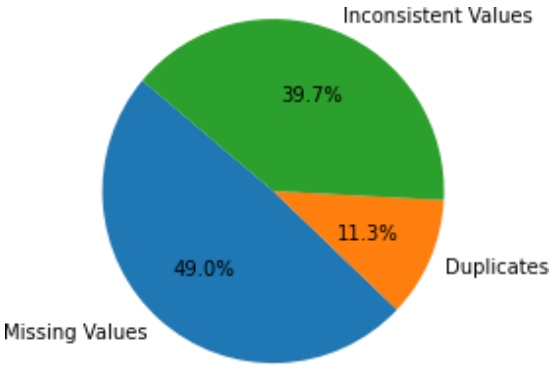

Fig. 3 Percentage of discrepancies resolved during preprocessing

to normalize and make the data consistent and uniform. Lastly, Duplicates accounted for 11.3%, showing that the procedure was to identify and eliminate the duplicate records. Fig. 3 underscores the importance of proper preprocessing that ensures the quality and reliability of data so that appropriate analysis and results can be obtained from the project.

In the context of grocery platforms, it enables us to collect very valuable data in terms of names, prices, and availability, allowing comparative analysis and insights. Fig. 4 indicates the number of products scraped from three platforms, namely BigBasket (1,871 products), StarQuick (144 products), and ZeptoNow (76 products). The disparity is significant as BigBasket appears to offer the most extensive coverage of data probably because of the structured website or better accessibility for scraping tools.

The raw data reflected in Table. I comes from online retailer sites that have difficulties regarding product naming, quantities, or units. Constant mismatch of Quantity Descriptions and product naming makes it a tough nut to compare different products among the vendors. Here many steps were taken to clean up and convert the raw data into a structured and uniform format as is seen in Table. II. Such preprocessing included several crucial steps to support cutting down on the ambiguity of the comparisons.

Initially, in Table. I, the product names that lacked the necessary resemblance from the original names to descriptive name types were standardized by replacing unnecessary descriptors and variations. The effect of which was the entire set of products were gathered together according to a single name only which made comparison very trouble-free for vendors to undertake.

The "Quantity" column in Table. I was calibrated to represent uniform measurements. A situation of non-uniformity occurs if the weight is explained in various formats such as "About 200 Gm" or "250 g." These were converted into a base unit (Kilograms) with the help of code logic since weights vary in both directions. For example, "200 Gm" was rendered as "0.20 kg," and "250 g" as "0.25 kg." Conversely, "1kg - (9-12 pcs)" was replaced with "1.00 kg," and in the case of non-weight-based items, like "1 pc," the original value was kept and the correct unit was indicated. A measurement is classified this way in the “Calibrated Quantity” column of Table. II.

Moreover, measurement unit separation guarantees clarity and allows for easy performance of mathematical operations such as price per unit or total price without any ambiguity. The foregoing pre-processing has several crucial advantages in comparing products from different vendors. Standardized names remove redundancies and allow meaningful grouping of the same products. Uniform quantities calibrated to a common unit allow for easy direct comparison of price per unit, irrespective of how vendors are presenting their quantities. Further separating the "Calibrated Quantity" and "Unit" makes calculations straightforward and accurate. Comparing the raw data in Table. I to the clean and structured format in Table. II transforms the process itself into that

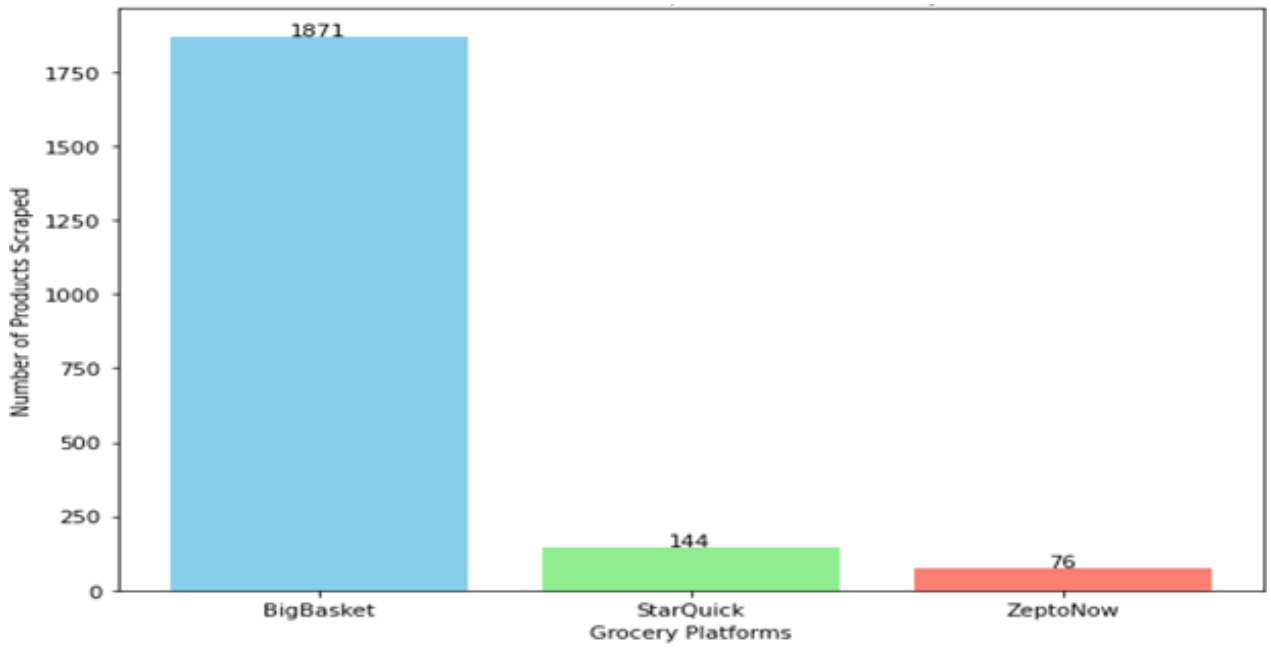

Fig. 4 Number of products scrapped from grocery

Table. I Raw Data

Name	Price	Quantity
Cherry Tomatoes	20.00	About 200 Gm
Papaya Raw	39.00	About 1 Kg
Garlic Peeled	86.00	100 g
Cucumber - English (Loose)	10.00	250 g
Baby Banana - Robusta	47.00	1 kg - (9-12 pcs)
Banana - Robusta, Small	19.00	About 250 Gm

Table. II Clean Processed Data

Name	Standard Name	Price	Quantity	Calibrated Quantity	Unit
Cherry Tomatoes	Cherry	20.00	About 200 Gm	0.20	kg
Papaya Raw	Papaya	39.00	About 1 Kg	1.00	kg
Garlic Peeled	Garlic	86.00	100 g	0.10	kg
Cucumber - English (Loose)	Cucumber	10.00	250 g	0.25	kg
Baby Banana - Robusta	Banana	47.00	1 kg - (9-12 pcs)	1.00	kg
Coconut	Coconut	34.00	1 pc	1.00	pcs

which is highly efficient and of great accuracy.

The Fig. 5 provides insights into which platforms consistently offer the most affordable prices for groceries. As evident from Fig. 5, BigBasket dominates, accounting for the highest percentage (over 88%) of the cheapest products among the platforms compared. ZeptoNow holds the second position, while StarQuick contributes a smaller share. It helps to assist users in finding the best grocery deals. By identifying platforms that frequently offer the lowest prices, users can make informed purchasing decisions, maximizing savings.

For instance, Fig. 5 clearly highlights that BigBasket is the go-to platform for budget-conscious shoppers for most products.

This simplifies the decision-making process by presenting an aggregated view of price trends across platforms. It helps users not only choose a cost-effective platform but also build trust in specific vendors for their affordability. Furthermore, it can guide vendors to understand competitive pricing strategies and encourage platforms like StarQuick to improve their pricing to stay competitive.

Fig. 5 Heatmap of cheapest products across platforms

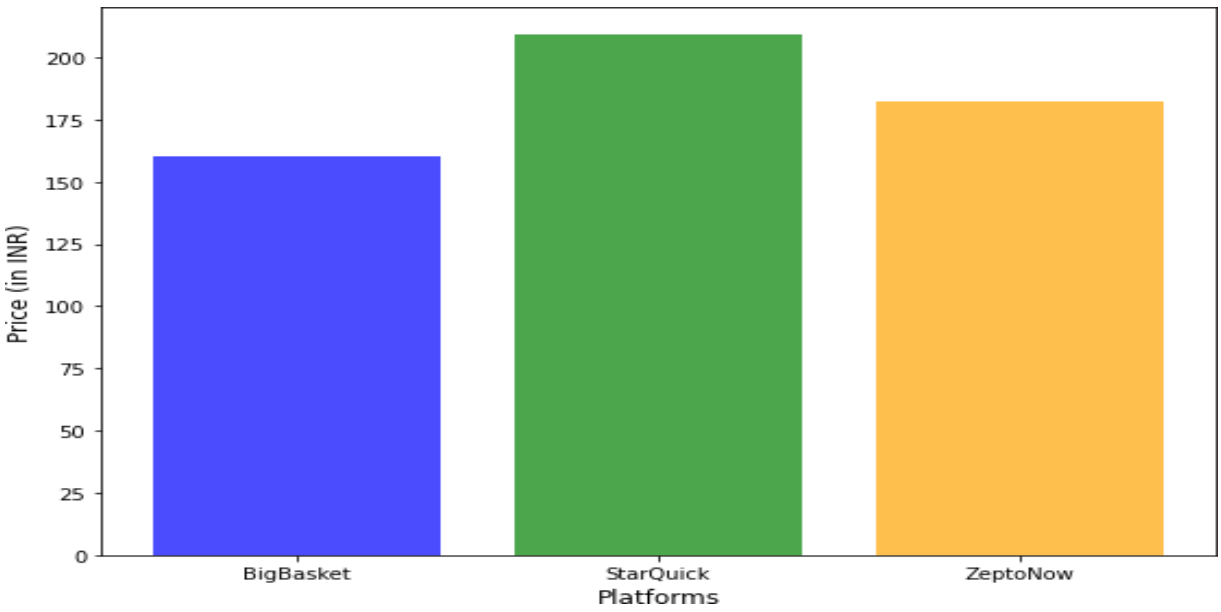

Fig 6. Price comparison for mango raw across platforms

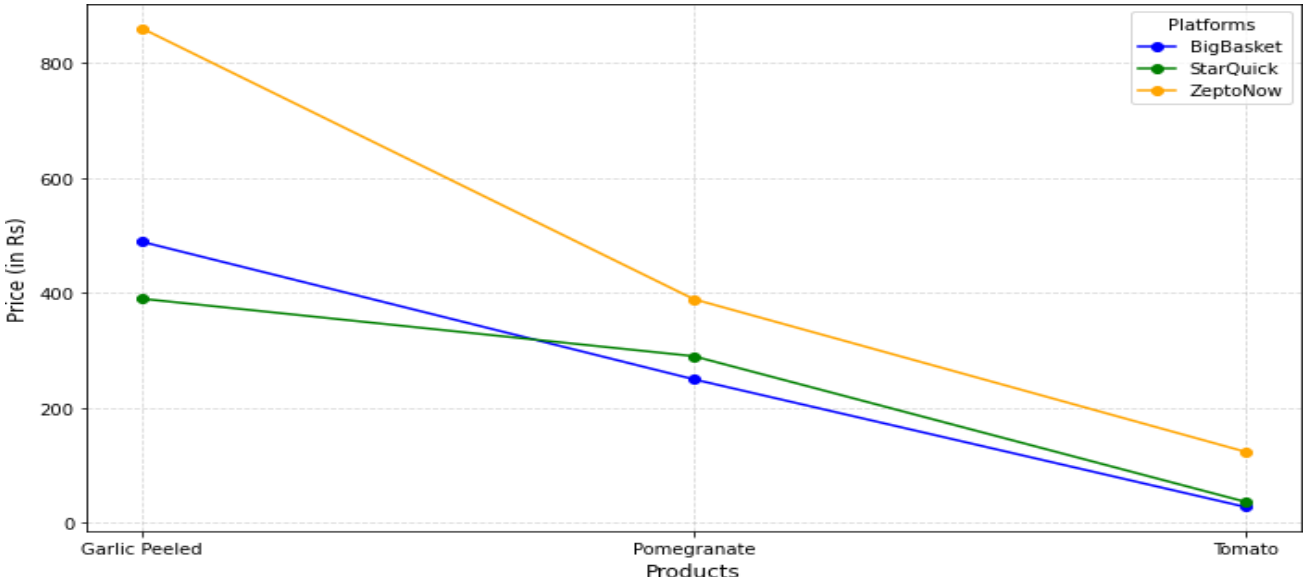

Fig 7. Price comparison for multiple products across platforms

Fig. 6 illustrates the price comparison of mangoes across three platforms. This will enable the user to make the most cost-effective decision as it clearly indicates which platform is offering the lowest price. For example, the user can easily find out which one is the cheapest without having to check the price manually, saving time and effort. This streamlined comparison process not only helps users save money but also improves their overall shopping experience by making it easier for them to find the best deals.

Fig. 7 displays the comparison of prices of three different items: Garlic Peeled, Pomegranate, and Tomato, across three grocery platforms, namely BigBasket, StarQuick, and ZeptoNow for the equal quantity of "1 Kg". It highlights the place where the user could save the most money. For instance, Pomegranate is the cheapest on BigBasket, whereas Starquick and ZeptoNow were much cheaper for Garlic, and StarQuick will provide the user with the best value for Tomatoes.

This comparison will clearly show how much the user can save if he or she chooses the right platform for each product. This will simply tell about the differences in prices so that one can easily decide where to shop and save money on groceries.

VI. FUTURE WORK

Future enhancements to the website include providing personalized suggestions to users depending on their preferences, offering dynamic price tracking for real-time updates on promotions and other offers, and expanding to other grocery categories to give it more coverage. Additional web crawlers will enhance the efficiency of data collection by distributing the load. Machine learning can also be applied to forecast the future price of grocery products based on trends and provide insights to the users. The users will also be automatically updated, by email, whenever the prices drop so that they will never miss an offer. These improvements shall strive to create a far more user-friendly and intelligent model in price monitoring and comparison for groceries.

VII. CONCLUSION

The website assists the users with relevant data requisite to enable them to make reasonable judgments. Offering this price comparison website, the concern of working individuals who are required to check prices before buying the products is addressed. This site aids the users in searching through several grocery stores by comparing their prices and finding out the cheapest and best offers. This not only reduces the buyers' effort significantly but also the amount of their precious time. Finally, it combines all strategies, proposals, and promotions of the best internet shops and this means a user-friendly and time-saving online shopping experience.

The website assists the vendors in determining the most competitive prices for various goods and services by enabling them to discount vendors' offers, and automatically place purchases showing on the website the best vendor offer price which enables users to make a more rational use of their money. It significantly enhances the ease of grocery shopping and does more in the sphere of e-grocery activities. It offers a great opportunity for services and systems to triangulate their platforms and price comparison and merger algorithms to build balance.

This research paper, through filling the gaps in the solutions already existing, provides a seamless, automated, and user-friendly price comparison experience that opens doors to smarter grocery shopping through data.

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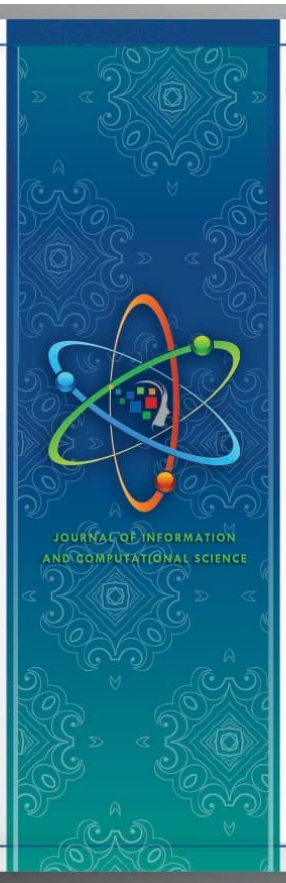

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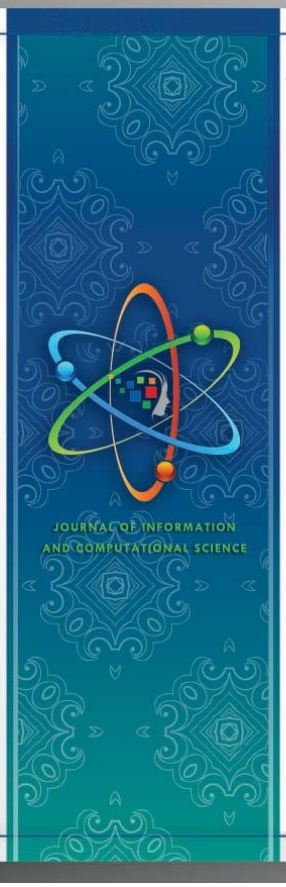

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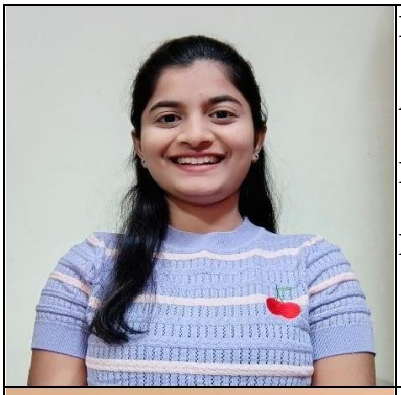	**Name: Apeksha Sanjay Mankhair** **Address: Warkari Nagar, Shegaon** **Mobile No: 9322143019** **Email ID: apeksha.mankhair08@gmail.com**
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