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SaleSpotterAI: AI-Driven E-Commerce Sales Aggregation and Visualization Platform

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SaleSpotterAI: AI-Driven E-Commerce Sales Aggregation and Visualization Platform

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Abstract

Why Selecting This Project?

The e-commerce sector has grown rapidly in the current digital era, giving customers a wide range of choices for online product purchases from different brands. Although this gives customers the chance to discover fantastic bargains and savings, it also creates difficulties with navigating many e-commerce platforms, keeping track of sales, and efficiently comparing offers. Additionally, brands struggle to stand out in a crowded market and connect with their target audience. The goal of this platform is to make buying easier for customers and provide them with the knowledge they need to make wise decisions.

What Was Done / How Was It Done?

The frontend development utilized React to ensure both usability and responsivity. We implemented dynamic manifestations together with an advanced state management system (ContextAPI) for better user experience. Our interaction with the system remain smooth because we design the user experience with this in mind. We used the firebase whose databases provides secure management of user sign-ups, logins and data storage that allows for user authentication.

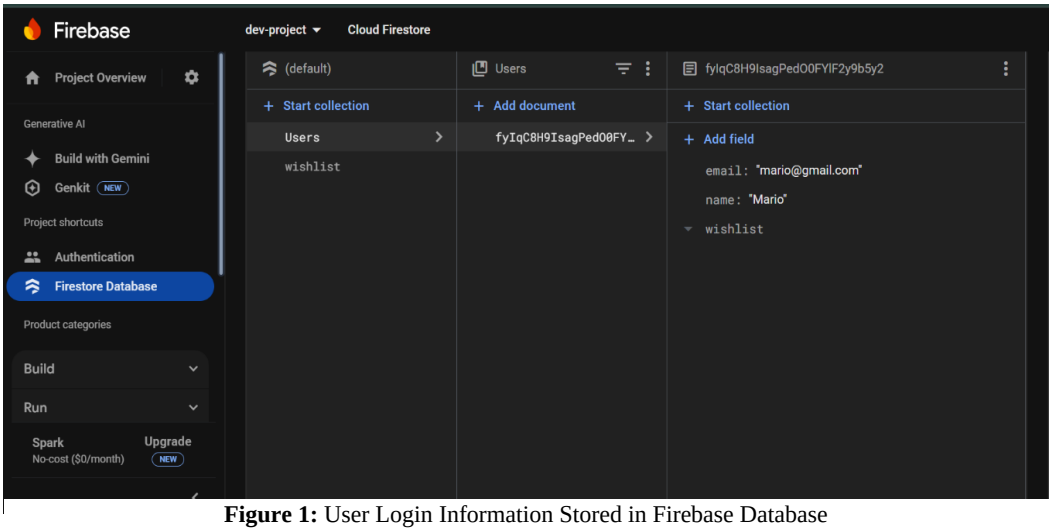
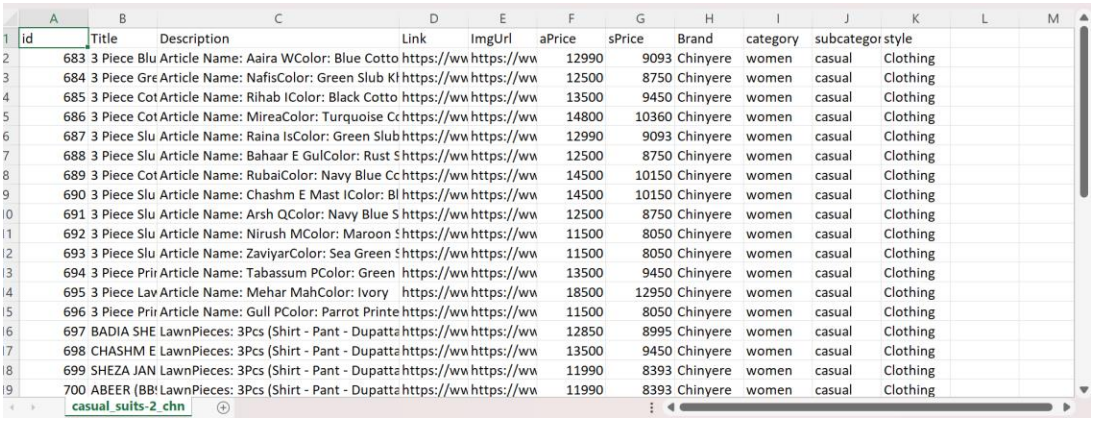


Figure 1: User Login Information Stored in Firebase Database

Through the combination of the web scraping method with Beautiful-Soup and Requests we managed to gather product information effectively. The collection of reliable structured information requires web scraping of the scraped data. The gathered data undergoes cleaning and processing until it is stored as Comma Separated Values (CSV) files. The development of the backend relies on the FASTAPI system provides quick and flexible data handling. The system transmits data to the frontend interface while handling all the operations with minimal hassle.



	id	Title	Description	Link	ImgUrl	aPrice	sPrice	Brand	category	subcategor	style
2	683	3 Piece Blu	Article Name: Aaira WColor: Blue Cotto	https://ww	https://ww	12990	9093	Chinyere	women	casual	Clothing
3	684	3 Piece Gre	Article Name: NafisColor: Green Slub K	https://ww	https://ww	12500	8750	Chinyere	women	casual	Clothing
4	685	3 Piece Cot	Article Name: Rihab IColor: Black Cotto	https://ww	https://ww	13500	9450	Chinyere	women	casual	Clothing
5	686	3 Piece Cot	Article Name: MireaColor: Turquoise Cc	https://ww	https://ww	14800	10360	Chinyere	women	casual	Clothing
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7	688	3 Piece Slu	Article Name: Bahaar E GulColor: Rust S	https://ww	https://ww	12500	8750	Chinyere	women	casual	Clothing
8	689	3 Piece Cot	Article Name: RubaiColor: Navy Blue Cc	https://ww	https://ww	14500	10150	Chinyere	women	casual	Clothing
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11	692	3 Piece Slu	Article Name: Nirush MColor: Maroon S	https://ww	https://ww	11500	8050	Chinyere	women	casual	Clothing
12	693	3 Piece Slu	Article Name: ZaviyarColor: Sea Green S	https://ww	https://ww	11500	8050	Chinyere	women	casual	Clothing
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14	695	3 Piece Lav	Article Name: Mehar MahColor: Ivory	https://ww	https://ww	18500	12950	Chinyere	women	casual	Clothing
15	696	3 Piece Prir	Article Name: Gull PColor: Parrot Printe	https://ww	https://ww	11500	8050	Chinyere	women	casual	Clothing
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18	699	SHEZA JAN	LawnPieces: 3Pcs (Shirt - Pant - Dupatta	https://ww	https://ww	11990	8393	Chinyere	women	casual	Clothing
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Figure 2: Sample scraped data stored in CSV

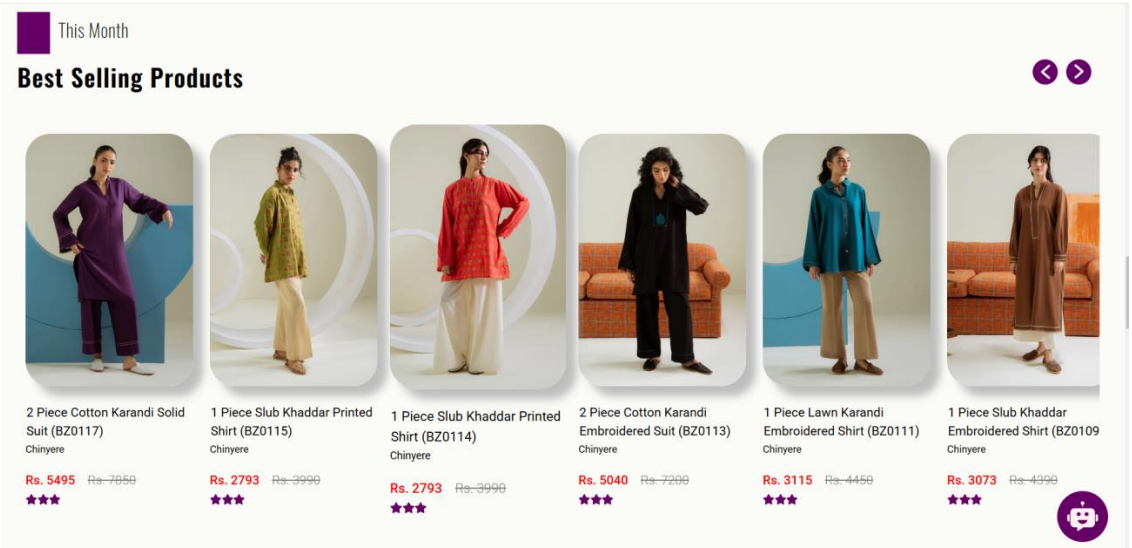


Figure 3: Best Selling Component of Our Website

What Was Found or Learned?

The project served our purposes excellently because we had multiple opportunities to develop our learned skills along our degree and turn them into professional expertise. The development process through various challenges enabled our team to gain expertise with technologies we had not experienced in the past.

The team improved its abilities extensively throughout the quarter relating to frontend and backend programming. The main difficulty during our project development was the process of obtaining data for our website showcasing. To collect this data, we learnt web scraping and discovered how to effectively analyze and store data while making sure that the information that we collected is correct. Our team learned to develop and organize APIs for obtaining data efficiently and mastered linking frontend with backend components. Through our work we developed a Retrieval Augmented Generation chatbot as our major accomplishment. Our team explored the NLP techniques while studying AI integration methods for our website during this project. The experience upgraded our skills for working with Generative-AI while teaching us about integrating AI systems for enhancing user experiences.

Through this project we developed both our technical abilities and our teamwork skills and project collaboration capabilities. These abilities will benefit us in future roles working in software development. Our team achieved better problem-solving capabilities together with enhanced real-time data administration effectiveness because of this project.

What Was Recommended?

The platform requires regular data updates to provide consumers with correct and up-to-date sales statistics for maintaining its long-term effectiveness. Platform relevancy and removal of outdated listings can be achieved through automated web scraping conducted periodically.

Advanced filtering tools improve user experience through their ability to let users define their searches based on categories with set prices and brand preferences and user ratings. User experience improves together with user management when platform offers personalized features such as recommendation system which draws from user preferences and browsing history.

The platform requires continuous feedback collection from users to develop its best possible state. The study of user behavior enables teams to identify function weaknesses for enhancement purposes while developing new features that fulfill the needs of users. A thorough usability testing of the UI/UX design leads to better shopping experience through enhanced user interface and user experience.

A robust performance requires back-end optimization that produces quick data access and secure handling of user data. The platform becomes more efficient when cloud storage integrates with AI-driven chatbot responses while gaining deeper knowledge about user experience.

Chapter 1. Introduction

Motivation

The quick development of e-commerce platforms and the growing necessity for companies to the competitive nature of the fast-changing market environment drives organizations to maintain their competitiveness through this phenomenon concept. Internet shopping preferences among consumers force businesses to deliver more than quality products. Companies offering top-quality products must support their sales displays efficiently for maximizing customer attraction and keep customers.

Our focus was to develop innovative platform which provides assistance to customers during their decision-making processes while enabling company offer sales display effectiveness. Necessity motivated our project to develop an interface which makes possible for customers which can obtain details combined with comparison possibilities for multiple brands via one centralized platform.

The system combines data to create an easy customer buying experience. Our aim was to build an advanced system whose functionality enables both customers to decide better and businesses to exhibit their deals successfully. Therefore, we developed a platform which lets consumers view product information from various brands directly at one site to enable informed purchasing choices. The platform aims to enhance customer relationships through real-time data for providing a streamlined buying process.

Moreover, the project serves our extended business strategy by providing solutions to enhance e-commerce operations for businesses. The aim of our work is to help brands reach higher business growth and enhanced customer satisfaction through the strategic use of brand sales data.

Aims and Objectives

Aim:

Users in the rapidly changing digital marketplace today struggle to manage their shopping choices by reviewing available options across multiple e-commerce stores. Consumers have to waste time looking for optimal deals on several websites because of rising promotional offers that include seasonal sales and limited-time discounts from individual brands.

To resolve this problem “SaleSpotterAI: AI-Driven E-Commerce Sales Aggregation and Visualization Platform created a single web-based platform which obtains sales information from diversified e-commerce websites." Through this platform consumers gain quick smart purchasing abilities by viewing extensive clear layouts of all discounts promotions and brand product information.

Through AI-powered trend mapping and interactive visualization architectures, the platform elevates both consumer experiences and business intelligence capabilities. Core functionalities include:

- The system should observe and present current sales statistics from multiple electronic commerce systems which maintain users with multiple brands data.
- A user-friendly interface should allow smooth search and filter operations to let users easily compare different brand offers.

By bridging the consumer-brand divide, SaleSpotterAI redefines promotional data utilization. Strategic decision-making is enhanced through predictive analytics, while frictionless navigation replaces fragmented browsing—a dual optimization benefiting both enterprise stakeholders and end-users.

Objectives

The following essential aims will help **SaleSpotterAI: AI-Driven E-Commerce Sales Aggregation and Visualization Platform** accomplish its objectives:

1. **User-Friendly Design:**

Every e-commerce platform requires a user-friendly design between seamless user experience (UX) and user interface (UI). Through a well-constructed interface with interactive elements users maintain ease of accessing sales data and making effective discount comparisons leading to well-informed purchasing decisions.

Important Elements of User-Friendly Design:

- **Easy Navigation:** The portal offers a straightforward structure with well-planned navigation that enables effortless customer shopping for brands and sales items and product filtering. Product accessibility will increase by designing careful placements for buttons and by systematically planning filtering features.
- **Efficient Search and Filtering:** Users will be able to examine their search results through various parameters including category selection and brand choices together with discount criteria and product kind together with price level for quick identification of favorable bargains.
- **Minimal Learning Curve:** Users with different technical proficiencies can effortlessly manage the interface because of its basic design layout.

A well-structured design will enhance user engagement, increase platform retention, and establish SaleSpotterAI as the go-to hub for sales tracking and comparison.

2. Data Privacy and Security:

Data protection alongside security functions as a fundamental element for SaleSpotterAI since it processes both real-time selling data and user transactions. Protecting user data leads to brand-user trust formation while meeting marketing legal requirements.

Key Security Measures Implemented:

Secure Authentication & User Access Control:

Firebase Authentication is used for user login and registration, ensuring encrypted user credentials. Also, the user Wishlist is secured with user credentials. No user can view or check other user Wishlist.

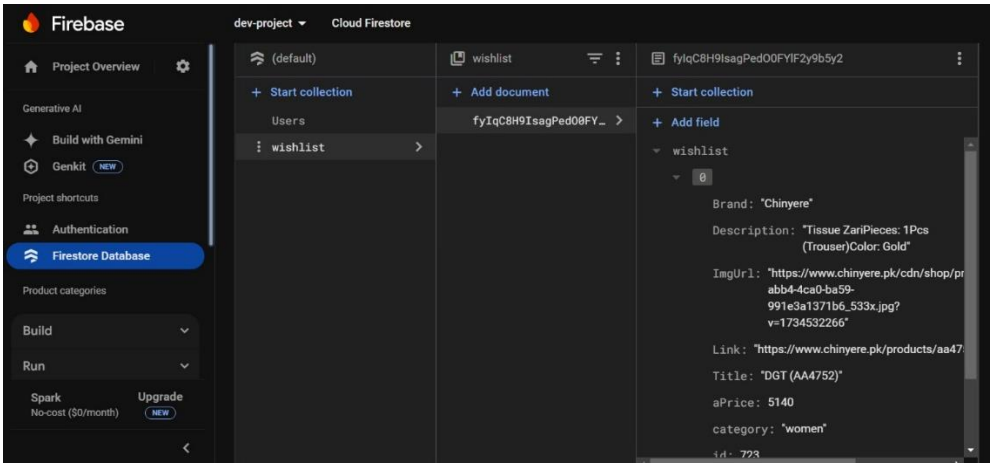


Figure 4: User's Wishlist Data Stored in Firebase

Secure Data Storage:

Firebase Database is used to save user's information and to detect unauthorized access.

Organization of The Dissertation

This dissertation consists of multiple parts that focues on essential emements related to developing “SaleSpotterAI”. The following section provides a summary of each chapter in the document.

Chapter 1: Introduction

This chapter defines the project motivation together with its goals and objectives. The section outlines both the identified problem and all expected research outcomes.

Chapter 2: Literature Review

This part provides a review of modern research together with technological advances regarding sales aggregation methods alongside AI analytics applications as well as e-commerce systems and interface design practices. The proposed platform requires development because the existing solutions present critical missing pieces according to this section.

Chapter 3: Methodology

The present chapter provides comprehensive details about every technique and resource and technology used to build the platform. The chapter explains how the system functions through its structure design for data collection and development operations.

Chapter 4: Results and Evaluation

The project results are introduced and major platform aspects are described within this chapter. The platform evaluation includes a usability assessment alongside scalability analysis and testing evaluation which relies on user feedback.

Chapter 5: Conclusion and Future Work

This final chapter includes project contributions followed by limitation assessments and proposals for next-stage research and developments.

References

This section lists all the academic papers, books, and resources referenced during the research and development of the project.

Chapter 2. Literature Review

E-Commerce Trends and Consumer Behavior:

Success of E-Commerce platforms depends heavily on understanding customer conduct in digital markets because online shopping momentum is expanding globally (Kumar & Reinartz, 2016). Research shows that modern online consumers prioritize quick and affordable shopping with customized services according to Pappas (2016).[9]

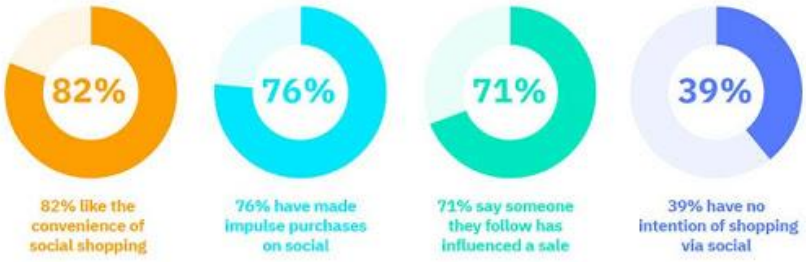


Figure 5: E-commerce Trends

Web scraping and API integration techniques allow platforms to collect and maintain current pricing details from multiple information sources on a continuous basis (Huang et al., 2019). These methodologies maintain vital positions in guaranteeing both accurate and up-to-date product data available to consumers.

Price Comparison Websites and Aggregators:

Various retailers benefit greatly from price comparison websites and aggregators which serve as indispensable shopping tools for consumers trying to find the best deals (Chen et al., 2018). Studies demonstrate that price comparison sites improves market transparency and consumer rights along with fostering marketing competition[3].

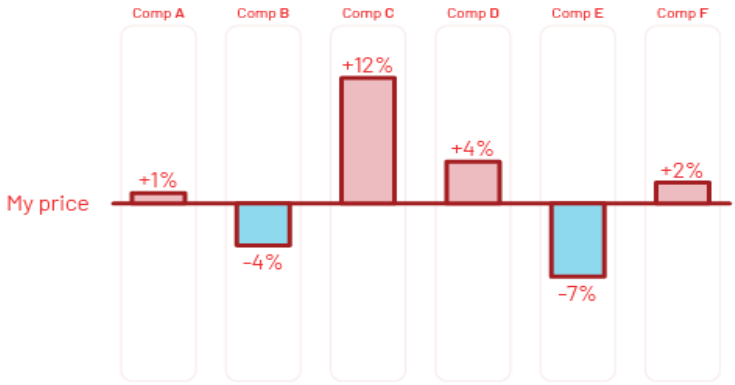


Figure 6: Price comparison

User Experience (UX) Design:

The design of E-Commerce websites determines how much users stay involved and how satisfied they become. User experience enhancement depends on intuitive search tools and filter systems with personal recommendation features and smooth checkout flows according to Chaffey et al. (2019).[5]

Technological Innovations:

Innovation in E-Commerce advances continuously through technology. Internet transactions benefit from blockchain technology according to Swan (2015) since it boosts security together with transparency (Swan, 2015). Artificial intelligence offers customized recommendations and chatbot assistance as shown by Verhoef et al., (2021).

Case Studies and Success Stories:

The evaluation of successful E-Commerce websites along with their exiting case studies helps identify proven successful approaches in the industry. Amazon along with eBay maximizes their sales figures through real-time data aggregation while providing personalized recommendations that boost both customer loyalty and revenue(Chen et al., 2018).[3]

Future Directions and Opportunities:

The upcoming period will bring advanced innovations that enhance the growth potential of E-Commerce. The online shopping experience will undergo a transformative change because of emerging technologies which implement features of augmented reality and virtual reality (Böhm et al., 2018).[1]

Chapter 3. Materials and Methods

The project will implement Scrum Software Development Life Cycle as its development framework. The development of SaleSpotterAI will utilize (Sprints) iterative approach to combine Front-end and Back-end Technologies and API Integration and web scraping and data visualization elements in the system. The Scrum-Software Development Life Cycle model starts by processing minimal requirements before moving through all development stages of these needs. Our team will utilize sprints that keep adding requirements until SaleSpotterAI reaches its production stage.

Why using Scrum?

We implemented the Scrum approach, an agile framework that encourages collaborative and iterative software development, to guarantee an effective and adaptable development process. By dividing the project into smaller, more manageable tasks called Sprints, Scrum enables our team to make immediate adjustments in response to input and ensure ongoing improvements.

Scrum in Project Management — How Does It Work?

Here's a summary of how Scrum works in practice during a project:

- The project starts with a general vision and a set of product features, ordered from most to least important ones. All these features will land in the Product Backlog, which will be maintained by the Product Owner (in this case it is our group).
- Product Owner will forecast the features to be completed during a time box which in Scrum is called a Sprint. A Sprint can last from one to four weeks. Software development teams usually set sprints to two weeks.
- At the end of every Sprint, the Development Team shows a demo of the completed work to all the relevant stakeholders (in this case it is the advisors) and gathers feedback to use it during the following Sprint. The team also takes time to reflect on their workflow with the aim of improving it in the next sprint.

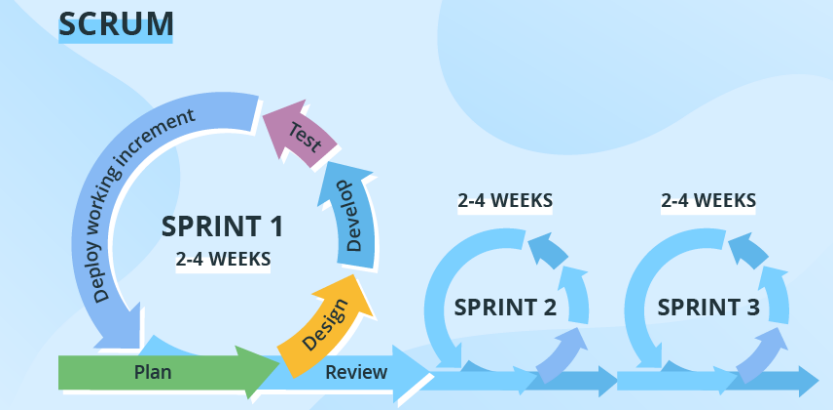


Figure 7: Scrum Model

Key Benefits of Scrum for Our Project:

- **Incremental Development:** Each sprint focuses on completing a small, functional part of the platform.
- **Faster Iterations:** Regular updates allow for quick identification and resolution of issues.
- **User-Centered Approach:** Constant testing ensures the platform meets user expectations.

Methodology

"SaleSpotterAI" aims to develop an innovative E-Commerce platform powered by Artificial Intelligence (AI) for real-time sales aggregation and visualization. This methodology plan outlines the step-by-step approach for the development of "SaleSpotterAI" using the Scrum-SDLC model, incorporating the necessary technologies at each phase.

1. Requirement Analysis and Planning

Activities:

- Conduct stakeholder interviews to gather requirements.
- Analyze existing e-commerce aggregation platforms.
- Define features, functionalities, and project scope.
- Create a detailed project plan with timelines, milestones, and resource allocation.

2. Data Collection and Aggregation

Activities:

- Identify target e-commerce websites for data collection.
- Develop web scraping python scripts to extract sales data.
- Implement data validation and cleaning processes.

3. Gen-AI and Large Language Models (LLM's)

Activities:

- LLMs are used to power a conversational assistant on our platform
- By integrating GenAI, we also generate concise product summaries and insights from the aggregated e-commerce data, enabling users to make informed decisions effortlessly.

4. User Experience (UX) and User Interface (UI) design

Activities:

- Design wireframes, prototypes, and mock-ups.
- Incorporate User Experience/User Interface best practices and feedback from usability testing.
- Develop a user-friendly interface with intuitive navigation, interactive elements, and clear visualizations.

5. Platform Development

Activities:

- Develop front-end and back-end using React and FASTAPI.
- Save and implement real-time data aggregation, visualization, and search, filter, and comparison features.
- Ensure responsive design, cross-browser compatibility, and accessibility.

6. Security and Compliance

Activities:

- Implement authentication, and authorization mechanisms using Firebase.
- Comply with relevant data protection regulations (e.g., GDPR, CCPA).
- Conduct security audits and vulnerability assessments to identify and mitigate potential risks.

7. Deployment and Launch

Activities:

- Set up hosting, configure servers, and deploy application code on GitHub or any free platform.
- Develop a launch plan, including marketing and promotion strategies, to attract initial users and gather feedback for continuous improvement.

8. Monitoring, Maintenance and Continuous Improvement

Activities:

- Implement monitoring tools to track platform usage, user engagement, and performance metrics.
- Provide ongoing maintenance and support, address user feedback and feature requests, and iterate on the platform to enhance functionality, usability, and value proposition.

By following this comprehensive methodology, the "SaleSpotterAI" project aims to systematically address the identified problem, achieve the defined objectives, and will deliver a robust, innovative, and user-centric e-commerce sales aggregation and visualization platform that meets the needs and expectations of modern consumers and brands in the digital marketplace.

Chapter 4. Results and Discussions

Results:

Technical Implementation:

Data Sources Integrated:

We scraped data from various brands to ensure a diverse range of sales information. The extracted data was initially stored in CSV files due to their structured format, making it easy to manage and analyze. While CSV files typically requires conversion to JSON format for integration with the backend, FastAPI simplifies this process by directly handling CSV files without conversion. The backend efficiently processes and serves the data, ensuring smooth and automated management.

Data Storage and Processing Methods:

To display real-time sales data on our platform, we used our local system hard drive. Each time new data is scraped, it replaces outdated data to ensure users receive the most accurate and up-to-date information. Instead of relying on a static database, we chose to store the data in our local system and then providing it to the backend server, enabling efficient retrieval, scalability, and reliability. This approach ensures that the website remains responsive while handling large datasets dynamically.

Programming Languages Used:

Frontend: We implemented React.js to build a frontend that provides users with powerful yet adaptable and convenient screen design. The React component-based structure allowed developers to update the user interface without impedance while offering improved UX experience. The application employs React.js along with Context-API to transfer data between its internal components back and forth.

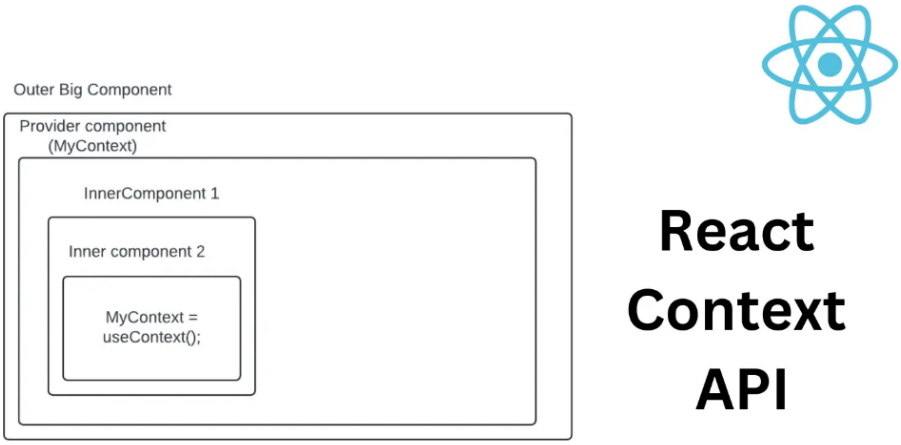


Figure 8: React Context API

Data Processing & Conversion: The use of Python with its libraries such as Beautiful-Soup and Requests allowed data extraction and conversion.

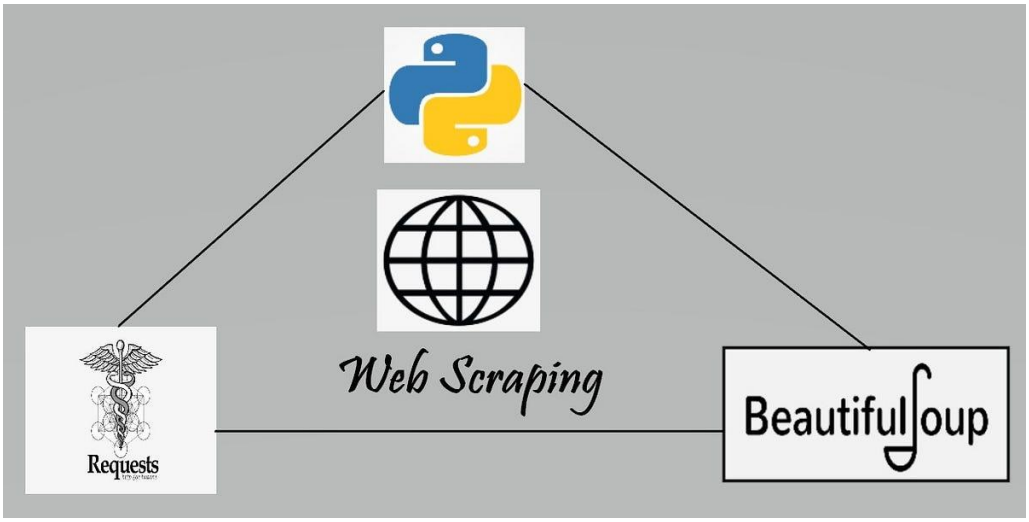


Figure 9: Web Scraping Using Python, BeautifulSoup and Requests

Backend: The system uses FastAPI for processing data while establishing API connections and enabling live communication between frontend and backend controls. The project selected

FastAPI because it offered efficient synchronization during asynchronous requests combined with easy scalability and high performance.

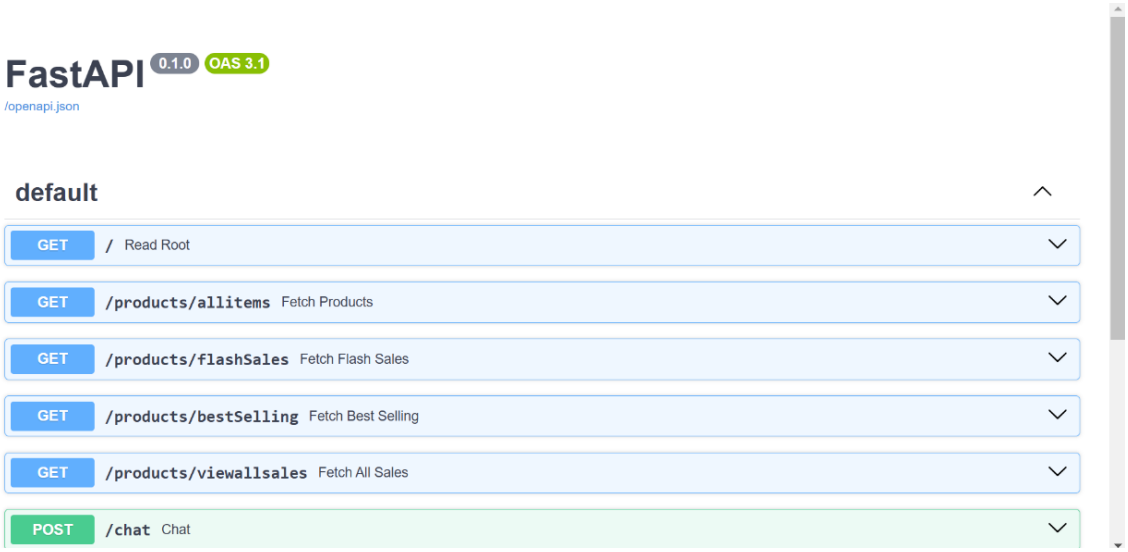


Figure 10: FastAPI End Points

Figure 11: Sample Endpoint showing data in JSON

Website Design Overview / Demo Pictures

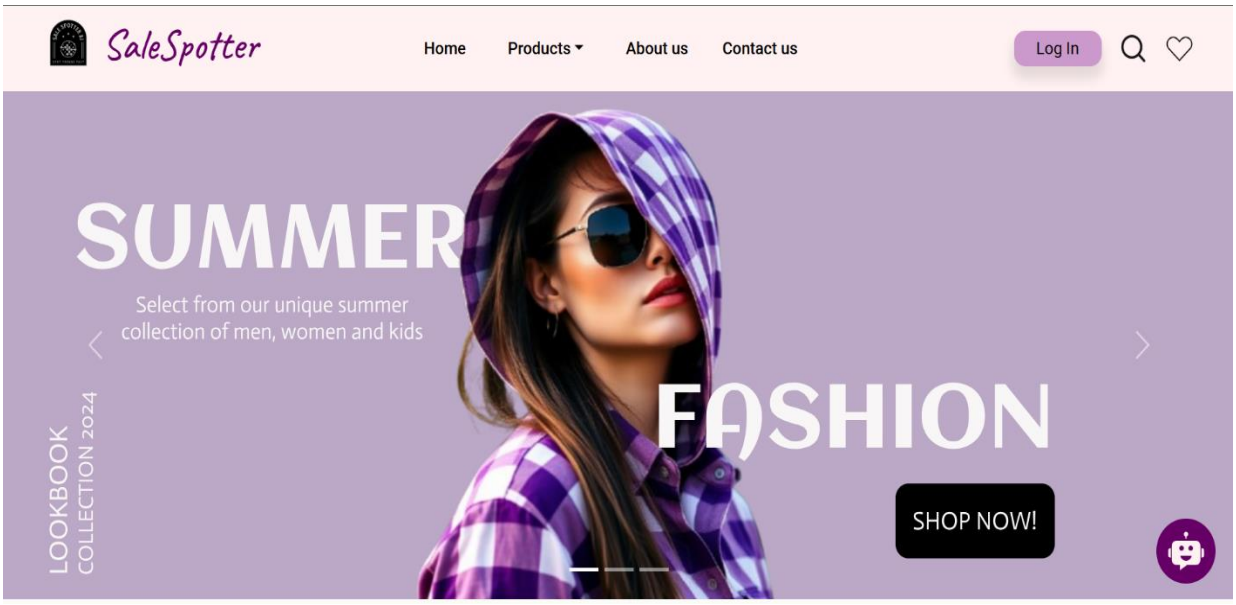


Figure 12: Front-end Design of Our Website

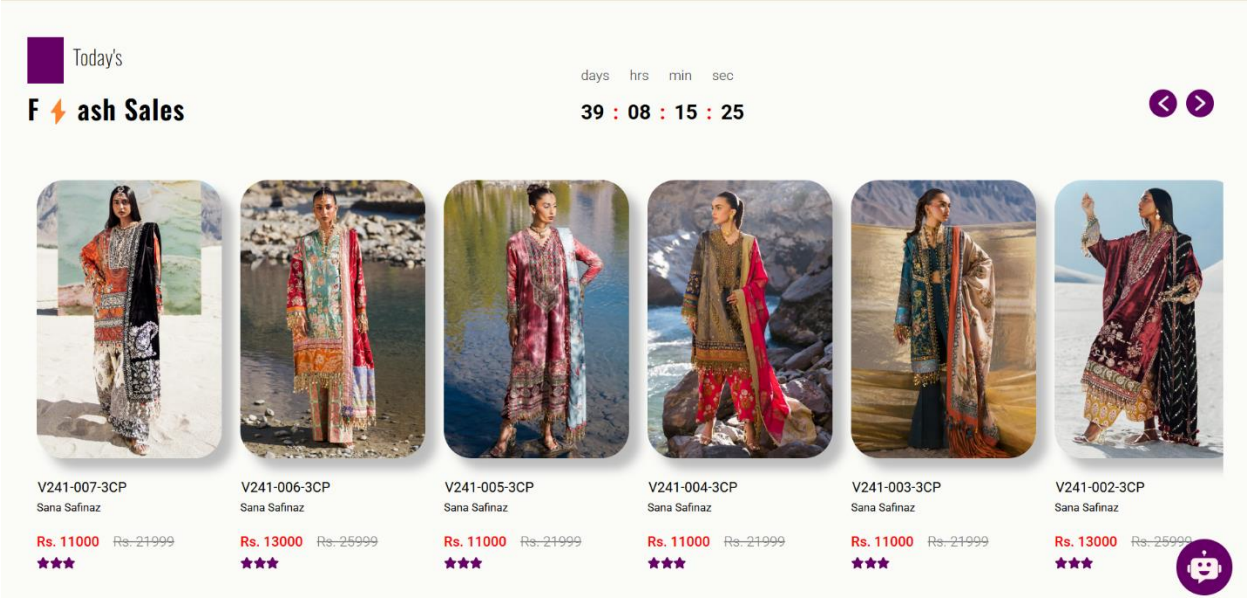


Figure 13: Flash Sales Component of Our Website

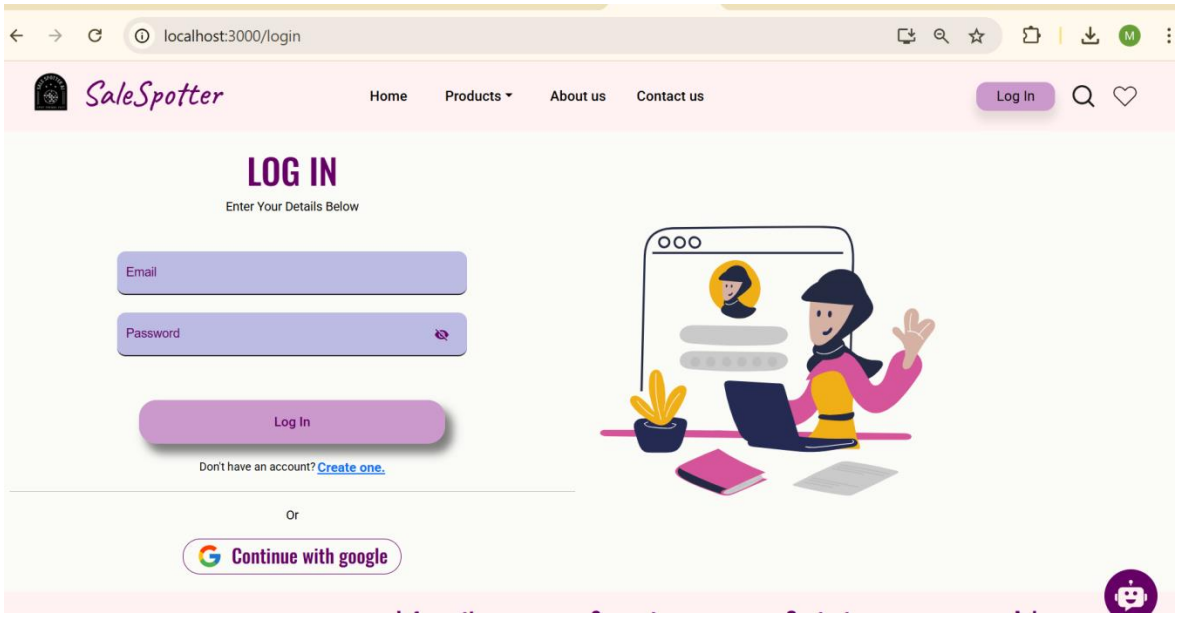


Figure 14: Login Page

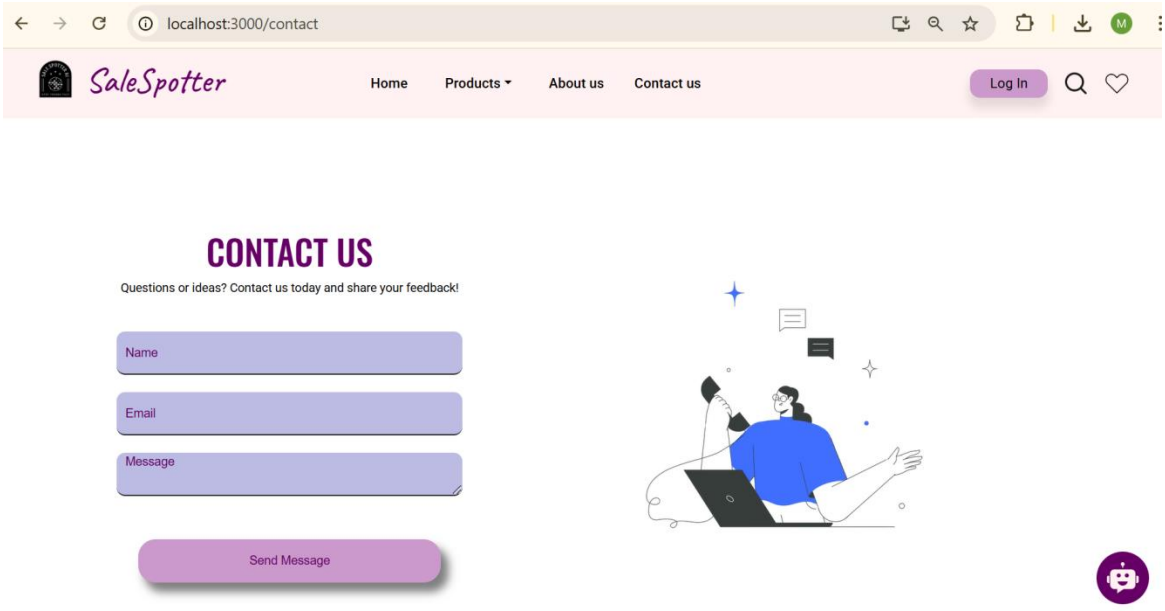


Figure 15: Contact Us Component

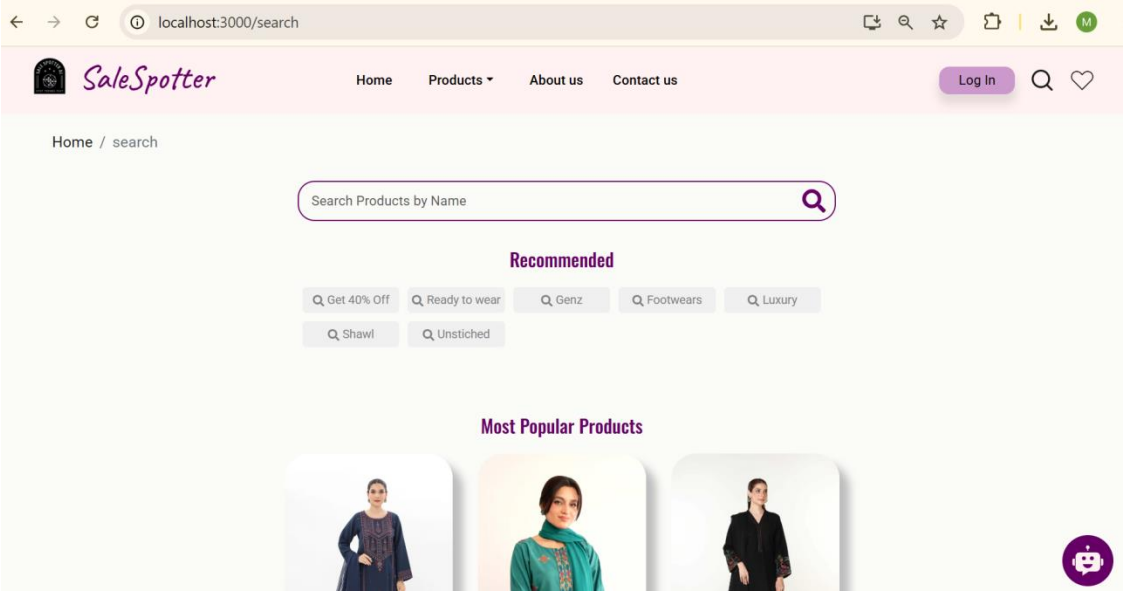


Figure 16: Search Component

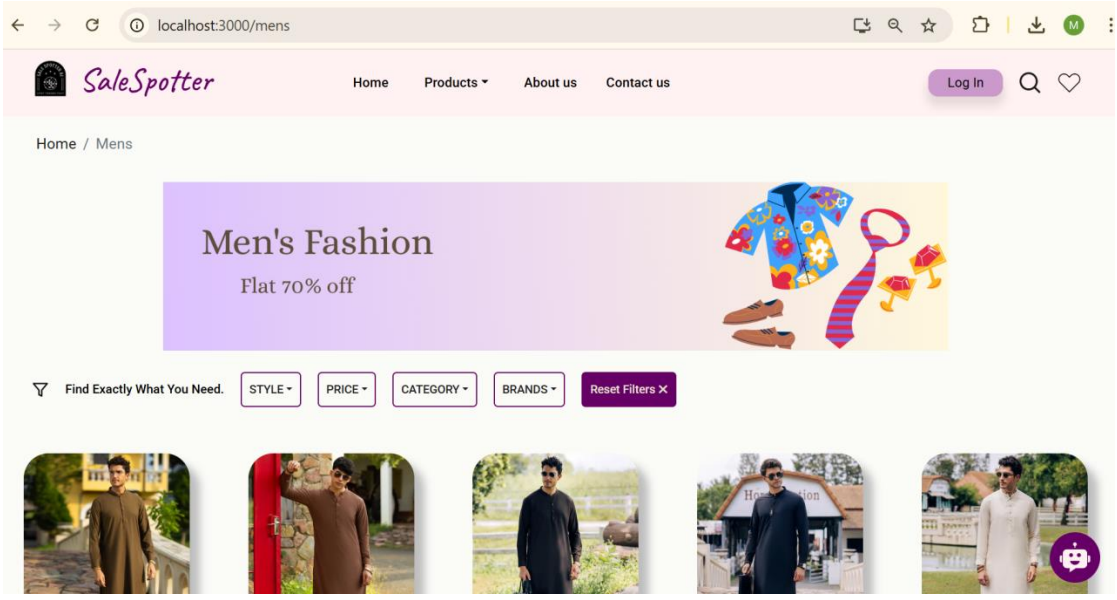


Figure 17: Product Category - Men's

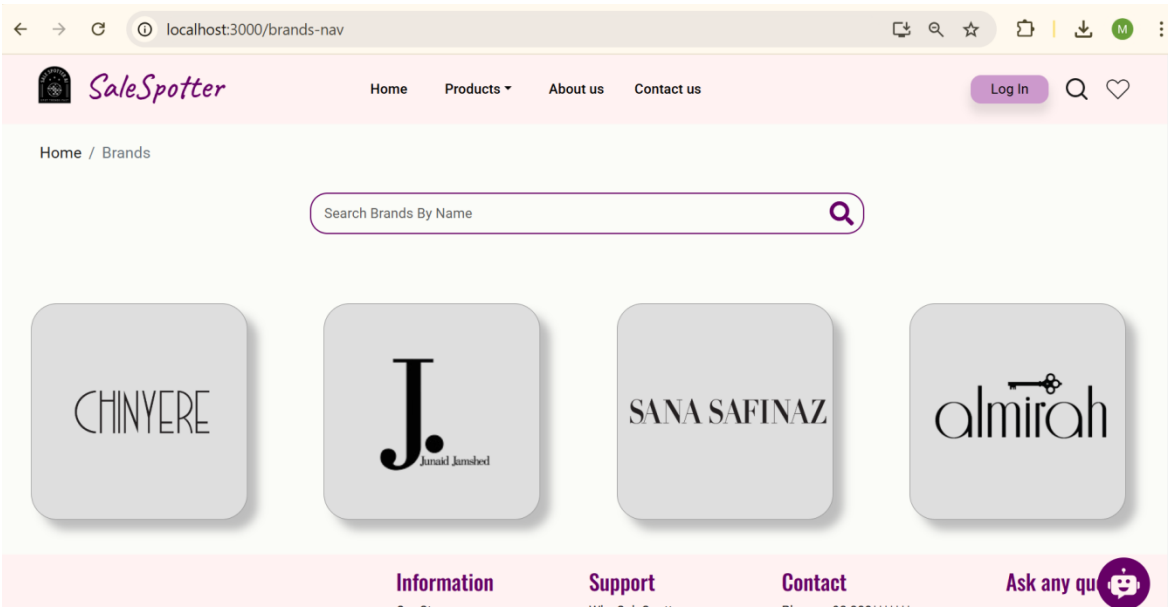
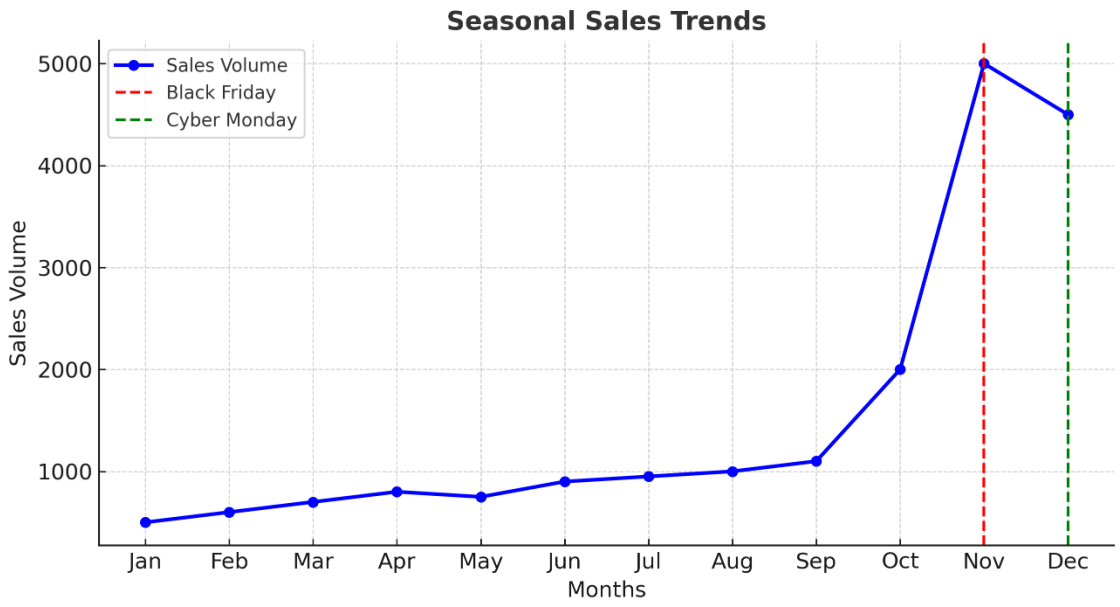


Figure 18: All available Brands

Overall Sales Trends

Seasonal Discounts: According to data analysis brands benefit from generous discount promotions that occur during Black Friday, Cyber Monday and seasonal sales periods.



Graph 1: Seasonal Sales Trends Showing Sales Spikes During Black Friday and Cyber Monday.

Pricing Strategies: Some brands consistently offer small discounts throughout the year, while others provide large discounts only during peak sales periods.

Category-Based Discounts: Certain product categories, such as electronics and fashion, tend to have the highest discount rates compared to other categories.

Comparison of Brand Sales Strategies:

Some brands rely on **flash sales** and limited-time deals to attract customers.

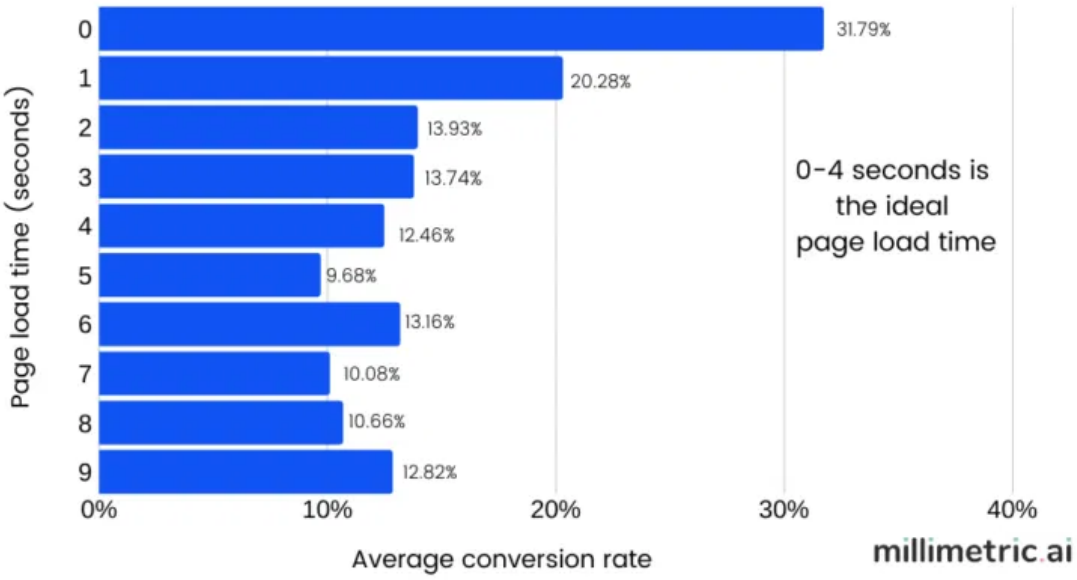
Others maintain steady pricing but introduce exclusive coupon codes for loyal shoppers.

Brands offering bundle discounts (e.g., "Buy 1 Get 1 Free") tend to have higher promotional activity throughout the year.

Identification of Anomalies

High page loading times can cause anomalies and impact your customers. Here is the impact of page loading times on e-commerce. These anomalies result in significant drop in page views

According to a survey by Invesp, 11% of people who abandoned their cart did so because the website was too slow, and 5% reported it was because the website crashed.



Graph 2: Impact of Page Loading Times on E-commerce Conversions

Discussions:

Technical Implementation Overview:

After implementing the core functionalities, we evaluated the system's efficiency, scalability, and usability.

Data Processing Performance:

- Our backend efficiently handled **sales data** from various brands, ensuring minimal delay in fetching sales data.
- Our Backend is able to handle large data with minimal delays and processing time.

Intuitive Interface:

- Tested the interface to ensure all buttons and components function correctly.
- Verified the Wishlist and login functionality to provide a seamless user experience.
- Ensured intuitive navigation for a smooth and user-friendly interface.

Chapter 5. Conclusions and Future Work

Conclusion

The creation of a centralized, intuitive, and effective e-commerce sales aggregation and visualization system has advanced significantly with the creation of the SaleSpotterAI platform. SaleSpotterAI offers a thorough understanding of discounts, promotions, and pricing trends by combining real-time sales data from several e-commerce platforms, assisting both customers and businesses in making wise decisions.

The platform delivers business intelligence help to organizations wanting to make their sales approach stronger. The platform delivers its business intelligence platform through a sturdy backend structure merged with optimized front-end design implemented.

This project has delivered three main outcomes which are:

Effective Data Collection: The platform successfully collets sales data from multiple sources, ensuring the information is current and relevant.

User-Friendly Interface: The platform's design ensures easy navigation and comparison, making it simple for users to find the best deals.

Scalable Backend: The backend, powered by FastAPI, has been optimized for performance and scalability to handle large datasets and growing user traffic through its asynchronous capabilities.

The project has successfully laid the foundation for a tool that offers both customers and businesses a seamless, data-driven shopping experience.

Future Work:

The SaleSpotterAI platform has reached its core purposes but multiple functionalities could be optimized in future development stages and expanded upon in future developments:

1. **AI-Powered Recommendations:**
   The system needs an AI-powered recommendations engine which suggests products correctly. SaleSpotterAI uses user browsing habits to recommend products which delivers improved shopping platforms.
2. **Expanded Data Sources:**
   The expansion of e-commerce websites through SaleSpotterAI will deliver more products combined with additional deals. The system would offer users a more extensive comparison tool for their needs.
3. **Making chatbot more effective and accurate:**
   We aim to enhance the Chatbots performance by training it on a larger and more diverse dataset. This will enable the chatbot to provide more accurate and contextually relevant responses, improving its overall effectiveness in addressing user queries.
4. **Website Hosting:**
   We are considering hosting our website with a web hosting provider.
5. **Dynamic Data Scraping:**
   We plan to use a service to schedule and automate our data scraping, making the process more efficient and dynamic.
6. **Store Data to Cloud:**
   In the future, we may move our data from local storage to a cloud storage solution just like AWS to enhance scalability, security and accessibility.

The SaleSpotterAI platform may develop further and provide even more benefits to companies and customers by concentrating on these areas. Long-term objectives include developing a fully integrated, AI-powered e-commerce ecosystem that optimizes business sales, simplifies the buying experience, and offers actionable information to help make better decisions..