**UIT2511---Software Development Project – II**

**Recommendation System for E-Commerce Products using Sentiment Analysis**

**Software Requirements Specification Document**

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**1. Introduction**

**1.1 Purpose**

The purpose of this document is to provide a detailed Software Requirements Specification (SRS) for the "Best Pick" project. The "Best Pick" application is designed to assist users in finding the top 3 products within a specified budget and product category on Amazon by scraping and analysing user reviews.

**1.2 Scope**

The "Best Pick" application will allow users to input a product category and budget. The system will then search Amazon, scrape reviews of 10 products within that category, analyse the reviews, and rank the top 3 products according to user-defined criteria. The application will provide valuable product recommendations to users based on their preferences.

**1.3 Document Conventions**

- In this document, requirements are stated using the following format: REQ-X, where X is a unique identifier.

* **NLP**: Natural Language Processing, a field of artificial intelligence that focuses on the interaction between computers and human language.
* **UI**: User Interface, the graphical or textual representation of a software application through which users can interact with the system.
* **API**: Application Programming Interface, a set of rules and protocols that allows different software applications to communicate with each other.
* **AWS**: Amazon Web Services, a popular cloud computing platform provided by Amazon.
* **SPA**: Single Page Application, a web application that interacts with the user by dynamically rewriting the current page rather than loading entire new pages from the server.
* **NLTK**: Natural Language Toolkit, a Python library for working with human language data.
* **GPU**: Graphics Processing Unit, a hardware component that accelerates the processing of complex mathematical operations, commonly used in deep learning.

**1.4 Intended Audience**

This document is intended for the development team, stakeholders, and anyone involved in the design, development, and testing of the "Best Pick" application.

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**2. Overall Description**

**2.1 Product Perspective**

The "Best Pick" application is a standalone system that interacts with Amazon's website for data retrieval and analysis. It does not have direct dependencies on other systems.

**2.2 Product Functions**

The "Best Pick" application encompasses a set of core functions that form the backbone of its capabilities, designed to deliver a comprehensive user experience:

* User Input: The application allows users to provide input by specifying their desired product category and budget, ensuring a tailored and personalized search experience.
* Data Retrieval from Amazon: "Best Pick" initiates data retrieval by scraping Amazon's extensive product listings within the specified category, enabling access to a wide array of choices.
* Review Retrieval: The system efficiently retrieves user reviews for the top 10 products within the chosen category, facilitating informed decision-making by providing valuable insights from previous buyers.
* Analysis and Ranking: Utilizing advanced algorithms, the application performs an in-depth analysis of the retrieved reviews, categorizing and ranking the products according to user-defined criteria, which may encompass aspects such as sentiment scores, price, or brand preferences.
* Recommendation Generation: The ultimate goal of "Best Pick" is to present the user with the top 3 product recommendations. These recommendations are meticulously curated based on the analysis, ensuring that users are provided with the most relevant and beneficial product choices within their specified category and budget constraints. This user-centric approach is geared towards simplifying the decision-making process and enhancing the overall shopping experience.

**2.3 User Classes and Characteristics**

Users of the "Best Pick" application are primarily online shoppers who are looking for product recommendations based on specific criteria such as product category and budget.

The diverse user base of the "Best Pick" application is primarily composed of online shoppers hailing from various demographics, each with their unique characteristics and preferences. These user classes include:

* Online Shoppers: The core user group comprises individuals who frequently engage in online shopping activities. They seek recommendations for products across an extensive range of categories, aligning with their evolving needs and preferences.
* Budget-Conscious Shoppers: Among the users are those who prioritize budget constraints when making purchasing decisions. These users place significant importance on recommendations that align with their specified budget, allowing them to make cost-effective choices.
* Tech-Savvy Consumers: Tech-savvy users are well-versed in navigating digital interfaces and utilize the application to harness the power of technology in their shopping endeavors. They appreciate a user-friendly and intuitive platform.
* Data-Driven Shoppers: A segment of users relies on data and analytics to make informed choices. They appreciate the application's data-driven approach in ranking and recommending products based on user-defined criteria.
* Product Enthusiasts: Some users are passionate about specific product categories or brands and are enthusiastic about discovering new and exciting options within their areas of interest.
* Time-Efficient Shoppers: Users who value efficiency seek quick and reliable recommendations to save time during the decision-making process. They appreciate the application's ability to streamline product discovery.
* Demographically Diverse Audience: The user base spans a broad demographic spectrum, including various age groups, genders, and geographical locations, reflecting the application's accessibility and relevance to a wide audience.

**2.4 Operating Environment**

The "Best Pick" application thrives within a dynamic web-based environment, where it harnesses the power of the internet to provide users with comprehensive product recommendations. Key characteristics of this operating environment include:

* Web-Based Platform: "Best Pick" is designed to be accessed via standard web browsers, ensuring compatibility with a variety of platforms and devices. This web-based approach empowers users with the flexibility to use the application on their preferred desktop computers, laptops, tablets, and mobile devices.
* Internet Connectivity: Central to the application's functionality is its reliance on an active internet connection. Users are required to have continuous access to the internet to enable data retrieval processes from Amazon. This dependence on connectivity is essential for providing users with real-time and up-to-date product information and user reviews.
* Cross-Platform Accessibility: "Best Pick" aims to cater to a wide and diverse audience, making it accessible across multiple operating systems and devices, thus eliminating the barriers of device-specific constraints.
* User-Friendly Interface: The application's web-based interface is intuitively designed, offering a seamless and user-friendly experience. Users can easily input their product preferences, navigate through recommendations, and access historical data, all within an intuitive and visually appealing environment.

**2.5 Design and Implementation Constraints**

The application may be subject to Amazon's terms of service, which need to be adhered to during scraping. Additionally, the application may need to be updated to accommodate changes in Amazon's website structure.

**2. 6 Assumptions and Dependencies**

The application assumes that Amazon's website structure will remain stable, and that the data retrieval process will not be blocked or restricted.

**3. Specific Requirements**

**3.1 External Interface Requirements**

**3.1.1 User Interfaces**

The "Best Pick" application will feature a user-friendly web-based interface where users can easily input their desired product category and budget. Upon submission of their preferences, the application will provide users with the top 3 recommended products tailored to their input, displayed in a clear and intuitive format for easy decision-making.

**3.1.2 Hardware Interfaces**

The "Best Pick" application is designed to run seamlessly on widely used standard web browsers, ensuring compatibility with popular options such as Google Chrome, Mozilla Firefox, Microsoft Edge, and Safari. This cross-browser compatibility enhances user access and experience. Furthermore, the application will necessitate a reliable internet connection, ensuring that users have access to up-to-date product data and reviews. A stable and uninterrupted internet connection is crucial for data retrieval and the timely presentation of product recommendations, thereby guaranteeing a smooth and responsive user experience.

**3.1.3 Software Interfaces**

The "Best Pick" application will establish interfaces with external systems to facilitate its core functionalities. Primarily, it will interact with Amazon's website to retrieve essential data, such as product listings and user reviews. To achieve this, the application may utilize web scraping libraries or Application Programming Interfaces (APIs) that allow it to access and retrieve data from Amazon's platform securely and efficiently. These interfaces ensure that the application remains up to date with the latest product information and user reviews, enabling it to provide users with accurate and valuable recommendations. By seamlessly integrating with external systems, "Best Pick" ensures the quality and relevance of the data it presents to its users, thereby enhancing the overall user experience. The application will interact with Amazon's website for data retrieval, and it may use web scraping libraries or APIs to access and retrieve data.

**3.1.4 Communication Interfaces**

The "Best Pick" application will establish robust communication channels with Amazon's website by utilizing the widely recognized Hypertext Transfer Protocol (HTTP) and its secure counterpart, Hypertext Transfer Protocol Secure (HTTPS). These interfaces will enable the application to initiate secure data retrieval processes, ensuring that product information and user reviews are accessed and retrieved in a reliable and encrypted manner. This secure communication approach not only protects user privacy but also maintains data integrity, which is crucial for providing accurate and timely product recommendations.

**3.2 Functional Requirements**

**Use Case 1: User Input**

* *Primary Actor:* User
* *Precondition:* User has an active internet connection.
* *Main Scenario:*
  + User initiates the product information and budget input process.
  + The system presents a user-friendly interface for entering the desired product category and budget.
  + User enters the product category and budget.
  + The system performs validation checks to ensure the entered data is within acceptable ranges and formats.
  + If the input is valid, the system proceeds to the next step. If not, the system provides clear feedback to the user.
* *Alternate Scenario:* 5(a). If there is a failure in the internet connection during the input process: 5(a)1. The input process is aborted.

**Use Case 2: Data Retrieval**

* *Primary Actor:* System
* *Precondition:* User has successfully provided the product category and budget.
* *Main Scenario:*
  + The system initiates the web scraping process to retrieve information on products within the specified category.
  + The system accesses Amazon's product listings and retrieves relevant data.
  + The data retrieval process is robust to handle various page structures and website changes.
  + The system ensures data retrieval complies with Amazon's terms of service.
* *Alternate Scenario:* 4(a). If there is a violation of Amazon's terms of service: 4(a)1. The data retrieval process is halted.

**Use Case 3: Review Retrieval**

* *Primary Actor:* System
* *Precondition:* Product data has been successfully retrieved.
* *Main Scenario:*
  + The system identifies the top 10 products based on user-defined criteria.
  + The system retrieves user reviews for the top 10 products.
  + User reviews are extracted and stored for these top products, ensuring that review data is kept up to date.
* *Alternate Scenario:* 3(a). If there is a failure in retrieving user reviews: 3(a)1. The system proceeds without user reviews.

**Use Case 4: Analysis and Ranking**

* *Primary Actor:* System
* *Precondition:* User reviews have been successfully retrieved.
* *Main Scenario:*
  + The system analyzes the reviews using sentiment analysis algorithms.
  + The top 3 products are ranked based on user-defined criteria such as sentiment scores, product attributes, or user preferences.
  + The ranking process is transparent, providing insights into how the top 3 products are selected.
* *Alternate Scenario:* 3(a). If there is a failure in the analysis or ranking process: 3(a)1. The system proceeds with a default ranking.

**Use Case 5: Recommendation**

* *Primary Actor:* System
* *Precondition:* Top 3 products have been successfully ranked.
* *Main Scenario:*
  + The system presents the top 3 recommended products to the user.
  + Clear and concise recommendations are displayed, including product name, image, price, and a link to the product page on Amazon.
* *Alternate Scenario:* 2(a). If there is a failure in presenting recommendations: 2(a)1. The system proceeds without displaying recommendations.

**Use Case 6: User Preferences**

* *Primary Actor:* User
* *Precondition:* User is logged into the system.
* *Main Scenario:*
  + User accesses the preference settings.
  + User sets and saves product preferences, including brand preferences, price range, and specific product features.
  + User can update their preferences at any time.
* *Alternate Scenario:* 3(a). If there is a failure in saving or updating preferences: 3(a)1. The system continues with the existing preferences.

**Use Case 7: Mobile Accessibility**

* *Primary Actor:* User
* *Precondition:* User has a mobile device with the application installed.
* *Main Scenario:*
  + User accesses the system through a mobile application.
  + The mobile app provides a user-friendly interface with feature parity with the web version.
* *Alternate Scenario:* 2(a). If there is a failure in accessing the system through the mobile app: 2(a)1. The user switches to the web version.

**Use Case 8: User Feedback**

* *Primary Actor:* User
* *Precondition:* User has used the system.
* *Main Scenario:*
  + User provides feedback through the system's feedback mechanism.
  + User can report issues, suggest improvements, and rate the quality of recommendations.
* *Alternate Scenario:* 2(a). If there is a failure in collecting user feedback: 2(a)1. User feedback is not collected for that session.

**Use Case 9: Multilingual Support**

* *Primary Actor:* User
* *Precondition:* User accesses the system.
* *Main Scenario:*
  + User selects the preferred language for the user interface.
  + The system provides multilingual support for both the user interface and sentiment analysis.
* *Alternate Scenario:* 2(a). If there is a failure in providing multilingual support: 2(a)1. The system defaults to a default language.

**Use Case 10: Data Security**

* *Primary Actor:* System
* *Precondition:* User data is being stored or accessed.
* *Main Scenario:*
  + User data and preferences are securely stored and encrypted.
  + The system complies with data protection regulations and industry standards.
* *Alternate Scenario:* 2(a). If there is a breach in data security: 2(a)1. The system takes immediate measures to secure user data.

**Use Case 11: Customizable Recommendation Criteria**

* *Primary Actor:* User
* *Precondition:* User is logged into the system.
* *Main Scenario:*
  + User accesses the system's customization settings.
  + User customizes the criteria for product recommendations, such as weighting sentiment analysis, price, or brand preferences.
  + User fine-tunes recommendations to align with their specific needs.
* *Alternate Scenario:* 3(a). If there is a failure in customizing recommendation criteria: 3(a)1. The system continues with the default recommendation criteria.

**3.3 Performance Requirements**

**Use Case 12: Response Time**

* *Primary Actor:* System
* *Precondition:* The system is operational.
* *Main Scenario:*
  + The system responds to user queries within 10 seconds.
  + Response time for user queries, including input, data retrieval, analysis, and recommendation generation, does not exceed 10 seconds.
* *Alternate Scenario:* 2(a). If there is a delay in responding to user queries: 2(a)1. The system provides a notification about the delay.

**Use Case 13: Scalability**

* *Primary Actor:* System
* *Precondition:* The system is operational.
* *Main Scenario:*
  + The system is designed to handle an increasing number of users without a significant decrease in performance.
  + The system architecture allows for additional hardware resources or distributed computing to accommodate a growing user base.
* *Alternate Scenario:* 2(a). If there is a decrease in performance due to increased user load: 2(a)1. The system optimizes resources or undergoes maintenance to restore performance.

**Use Case 14: Data Freshness**

* *Primary Actor:* System
* *Precondition:* The system is operational.
* *Main Scenario:*
  + The system ensures that product data and reviews are updated at least once every 24 hours.
* *Alternate Scenario:* 1(a). If there is a failure in updating product data and reviews: 1(a)1. The system proceeds with the latest available data.

**Use Case 15: High Traffic Handling**

* *Primary Actor:* System
* *Precondition:* The system is operational.
* *Main Scenario:*
  + The system is able to handle a surge in user traffic during peak shopping seasons, with a minimum of a 50% increase in user load.
* *Alternate Scenario:* 1(a). If there is a failure in handling high traffic: 1(a)1. The system implements measures to handle the increased load.

**Use Case 16: Availability**

* *Primary Actor:* System
* *Precondition:* The system is operational during normal hours.
* *Main Scenario:*
  + The system maintains an availability rate of at least 99% during normal operation hours.
* *Alternate Scenario:* 1(a). If there is scheduled maintenance or downtime: 1(a)1. Users are notified in advance, and downtime is minimized.

**Use Case 17: Load Testing**

* *Primary Actor:* System
* *Precondition:* The system is operational.
* *Main Scenario:*
  + The system undergoes load testing to ensure it can handle concurrent user requests without performance degradation.
* *Alternate Scenario:* 1(a). If limitations are identified during load testing: 1(a)1. The system undergoes optimization based on load testing results.

**Use Case 18: Error Handling**

* *Primary Actor:* System
* *Precondition:* The system is operational.
* *Main Scenario:*
  + The system provides informative error messages to users in case of issues or failures.
  + Errors are logged for debugging and system improvement.
* *Alternate Scenario:* 2(a). If there is a failure in logging errors: 2(a)1. The system continues without detailed error logs.

**Use Case 19: Usability Testing**

* *Primary Actor:* User
* *Precondition:* The system is operational.
* *Main Scenario:*
  + Usability testing is conducted to ensure that the user interface is intuitive.
  + Users can easily navigate, input data, and understand recommendations.
* *Alternate Scenario:* 2(a). If there are identified usability issues: 2(a)1. The system undergoes updates to improve usability.

**3.4 Design Constraints**

**Use Case 20: E-commerce Website Compatibility**

* *Primary Actor:* System
* *Precondition:* The system is operational.
* *Main Scenario:*
  + The application remains compatible with Amazon's website and potentially with other e-commerce websites in the future.
* *Alternate Scenario:* 1(a). If there are changes in the structure of e-commerce websites: 1(a)1. The system adapts to changes in website structure for continued data retrieval.

**Use Case 21: Legal Compliance**

* *Primary Actor:* System
* *Precondition:* The system is operational.
* *Main Scenario:*
  + The system adheres to all relevant data protection laws, privacy regulations, and copyright laws.
* *Alternate Scenario:* 1(a). If there is a violation of legal compliance: 1(a)1. The system takes immediate corrective action to ensure compliance.

**Use Case 22: Web Structure Changes**

* *Primary Actor:* System
* *Precondition:* The system is operational.
* *Main Scenario:*
  + The application is designed to accommodate changes in the structure of e-commerce websites.
* *Alternate Scenario:* 1(a). If there are unexpected changes in the website structure: 1(a)1. The system undergoes updates to adapt to the new structure.

**Use Case 23: Data Storage Limits**

* *Primary Actor:* System
* *Precondition:* The system is operational.
* *Main Scenario:*
  + The system adheres to data storage limits set by the hosting infrastructure.
* *Alternate Scenario:* 1(a). If there is a risk of exceeding data storage limits: 1(a)1. The system optimizes data storage to remain within constraints.

**Use Case 24: Technology Stack**

* *Primary Actor:* System
* *Precondition:* The system is operational.
* *Main Scenario:*
  + The application is built using a technology stack currently supported and maintained by the development team.
* *Alternate Scenario:* 1(a). If there are changes in technology stack support: 1(a)1. The system undergoes updates to align with the current technology stack.

**Use Case 25: Third-Party Service Availability**

* *Primary Actor:* System
* *Precondition:* The system is operational.
* *Main Scenario:*
  + The system's functionality may depend on third-party services.
  + Alternatives are provided or the system gracefully handles service unavailability to avoid critical failures.
* *Alternate Scenario:* 2(a). If there is prolonged unavailability of third-party services: 2(a)1. The system notifies users and seeks alternatives.

**3.5 Software System Attributes**

**Use Case 26: Performance Optimization**

* *Primary Actor:* System
* *Precondition:* The system is operational.
* *Main Scenario:*
  + The system continuously monitors performance metrics.
  + Performance optimization efforts are applied as needed to maintain response time requirements and scalability.

**Use Case 27: Error Handling and Logging**

* *Primary Actor:* System
* *Precondition:* The system is operational.
* *Main Scenario:*
  + The application has a robust error-handling mechanism.
  + Errors are logged for debugging purposes and for making improvements.

**Use Case 28: User Authentication and Authorization**

* *Primary Actor:* User
* *Precondition:* The user attempts to access the system.
* *Main Scenario:*
  + Users are authenticated and authorized to access their own accounts and data.
  + User data and preferences are secured to prevent unauthorized access.

**Use Case 29: Redundancy and Backup**

* *Primary Actor:* System
* *Precondition:* The system is operational.
* *Main Scenario:*
  + The system implements redundancy measures to ensure data integrity and availability.
  + Regular automated backups are conducted for disaster recovery.

**Use Case 30: Internationalization and Localization**

* *Primary Actor:* User
* *Precondition:* The user wants to access the system in a different language.
* *Main Scenario:*
  + The application supports internationalization, allowing adaptation to different languages, currencies, and regional preferences.

**Use Case 31: User Support and Feedback**

* *Primary Actor:* User
* *Precondition:* The user encounters an issue or wants to provide feedback.
* *Main Scenario:*
  + User support channels and mechanisms are provided for reporting issues, giving feedback, and requesting assistance or clarification.

**Use Case 32: Accessibility**

* *Primary Actor:* User
* *Precondition:* The user accesses the system.
* *Main Scenario:*
  + The user interface adheres to accessibility standards (e.g., WCAG) to ensure that the application is accessible to users with disabilities.

**Use Case 33: Integration with External Systems**

* *Primary Actor:* System
* *Precondition:* The system is operational.
* *Main Scenario:*
  + The system is designed to integrate with other external systems, such as customer relationship management (CRM) tools or email marketing platforms, to enhance user engagement and support.

**4. Future Extension**

4.1 Multi-User Support:

Currently, "Best Pick" is designed for individual users. A potential future extension could involve implementing multi-user support, allowing multiple users to create accounts, access the system simultaneously, and save their own product preferences and review analyses. This would require user authentication and role management to ensure data privacy and security.

4.2 Integration with More E-Commerce Platforms:

Expanding the system's compatibility with a wider range of e-commerce websites, including international platforms and niche markets, would make "Best Pick" even more versatile and appealing to users. This extension would involve adapting web scraping and data extraction components to different site structures.

4.3 Mobile Application:

Develop a mobile application for "Best Pick" to provide users with on-the-go access to product reviews and recommendations. The app could include features like barcode scanning for in-store product analysis and quick access to saved preferences and reviews.

4.4 Social Media Integration:

Allow users to link their social media accounts to "Best Pick" to gain insights from social network data, such as product recommendations from friends and influencers. This could involve integrating with social media APIs to extract relevant data and trends.

**5. Appendix**

**5.1 Appendix A:**

Formula for Sentiment Analysis Score: The sentiment analysis score (SA) for a given product review is calculated using a sentiment analysis model. This model assigns a numerical score to the sentiment of the text, which can be positive, negative, or neutral. The formula for calculating the sentiment analysis score for a review is as follows:

SA = (Positive Words - Negative Words) / Total Words

Where:

* Positive Words: The count of positive words in the review.
* Negative Words: The count of negative words in the review.
* Total Words: The total number of words in the review.

The sentiment analysis score indicates the overall sentiment of the review, with positive scores suggesting a positive sentiment, negative scores indicating a negative sentiment, and scores close to zero representing a neutral sentiment.

**5.2 Appendix B:**

Collaborative Filtering Recommendation Score:

In the collaborative filtering recommendation system, a recommendation score (RS) is calculated to suggest products to users based on their preferences and behaviour. The formula for the recommendation score is as follows:

RS = ∑ (Sim (u, v) \* R (v, p)) / ∑ |Sim (u, v) |

Where:

* Sim (u, v): The similarity score between user u and user v.
* R (v, p): The rating of user v for product p.

The recommendation score RS provides a weighted average of the ratings given by similar users for a particular product. This score is used to suggest products to the user, with higher RS indicating a stronger recommendation.

**5.3 Appendix C:**

Real-time Data Monitoring Update Interval:

To keep the product database and sentiment analysis models up to date, a real-time data monitoring system is implemented. The update interval (UI) defines how frequently the data is refreshed. The formula for calculating the update interval is as follows:

UI = 1 / (Number of Updates per Day)

Where:

Number of Updates per Day: The desired frequency of data updates per day.

A shorter update interval results in more real-time data, but it may increase the computational load on the system. The choice of the update interval depends on the project's requirements and resources.

Including these formulas and explanations in the project's appendix helps users and stakeholders understand the underlying calculations and algorithms used in the "Best Pick" project.

This Software Requirements Specification outlines the functionality, interfaces, and performance requirements for the "Best Pick" application. It serves as a foundation for the development and testing of the system.

**6.Supporting Information:**

The "Best Pick" project is fortified by leveraging key insights and methodologies from reputable research and industry practices. These references provide a robust foundation for the development and implementation of the sentiment analysis system, user interface, and overall functionality of the application.

**Sentiment Analysis Model:**

The sentiment analysis module in "Best Pick" is designed based on advanced Natural Language Processing (NLP) techniques. This approach is influenced by state-of-the-art sentiment analysis models used in contemporary e-commerce applications.

**Real-Time Sentiment Analysis:**

The real-time sentiment analysis capability of "Best Pick" is inspired by cutting-edge methodologies discussed in the field. Real-time insights are crucial for users in the dynamic environment of e-commerce, ensuring timely and relevant recommendations.

**User Interface Design:**

Content: The user interface of "Best Pick" draws inspiration from modern design principles that prioritize user experience. Elements such as intuitive navigation, clear input forms, and visually appealing displays are influenced by industry best practices.

**Mobile Application Development:**

Content: The decision to develop a mobile application for "Best Pick" is driven by the industry trend of providing on-the-go access to users. Cloud-based text processing services play a role in shaping the mobile application's features for efficient sentiment analysis.

**Integration with social media:**

Content: The concept of integrating social media for additional sentiment insights is driven by industry examples where social networks provide valuable data for opinion mining. This integration aims to enhance the depth of sentiment analysis in product recommendations.

**Multi-User Support:**

Content: The potential extension for multi-user support in "Best Pick" is motivated by the need to accommodate diverse user interactions. Learning from industry practices, the system envisions a future where multiple users can create accounts and personalize their experiences.

**Security and Legal Compliance:**

Content: The emphasis on legal compliance and data protection in "Best Pick" aligns with established best practices within the technology industry. Adherence to data protection laws, privacyregulations, and copyright laws is essential for user trust and ethical operation.

By incorporating these industry-driven insights, the "Best Pick" project ensures a well-rounded, contemporary, and ethical approach to the development of a sentiment analysis system for e-commerce product recommendations. The amalgamation of research findings and industry best practices contributes to the project's effectiveness and relevance in the rapidly evolving landscape of online shopping and sentiment analysis.