

Enhancing Online Food Delivery Systems through Comprehensive Text Analytics and Strategic Data Integration

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Abstract

Addressing challenges in the online food delivery system involves employing various data analytics techniques. Text Analytics, encompassing web analytics, social media analytics, stream analytics, and geospatial analytics, plays a pivotal role in managing and extracting valuable insights. The use of third-party systems by many companies to meet the demand for online food delivery presents issues related to control. Furthermore, information overload and poorly organized data contribute to observed problems. This research proposes effective data integration as a solution, facilitating strategic analytics for optimal system performance. Proper data sorting enables adaptive planning and priority shifts tailored to customer satisfaction. The framework of data integration is crucial in illustrating the comprehensive analysis of online food delivery systems. The report also delves into the challenges associated with implementing text analytics.

Keywords—data analytics, text analytics, data integration, customer satisfaction, implementation challenges.

1 Introduction

Numerous companies, irrespective of their size, have faced significant repercussions due to the COVID-19 pandemic. Huang and Siao [1] demonstrated that the online restaurant delivery sector experienced a twofold increase compared to conventional restaurant sales, reaching approximately seven to eight percent in the United States. This surge was a direct consequence of the pandemic's immediate impact on the restaurant industry. ABC Company, a fast-food establishment, is among the businesses grappling with the consequences of the pandemic. Adapting to the circumstances, the fast-food company has shifted its focus from dine-in services to online food delivery to align with customer preferences for home dining as a precautionary measure against COVID-19. Consequently, the company must ensure the efficiency of its online food delivery services to meet customer needs during these challenging times. This strategic move is aimed at retaining its customer base even after the pandemic is brought under control.

Recognizing the paramount importance of customer reviews and satisfaction in the success of an online delivery system, ABC Company has embraced analytics methods to enhance its online delivery orders. Studies indicate that 90% of customers make purchasing decisions based on online reviews, and 88% trust reviews and recommendations from bloggers or influencers [2]. To gain a comprehensive understanding and maximize the performance of the online delivery system, various analytics approaches can be employed. These include text analytics, web analytics, social media analytics, stream analytics, geospatial analytics, and addressing management challenges associated with analytics.

2 Literature Review

2.1 Text Analytics, Web Analytics, Social Media Analytics

According to Panigrahi and Singh [3], web mining analytics serves as a convenient method for merchants to gain insights into real customer preferences by analyzing metrics such as bounce rate and average user time spent on a website. Some online food delivery (OFD) systems have web-based versions, making it straightforward to

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acquire customer data through web mining methods for analytical purposes. Hristov and Chirico [4] earlier study emphasized that key performance indicators (KPIs) play a crucial role in shaping the reputation of online food delivery systems.

The interest of restaurant owners in engaging with customers via social media is evident in their use of platforms like Facebook. Through web analytics, companies can track website user activity, browsing habits, identify popular websites, and engage with users to analyze online behaviors. Social media platforms such as Instagram and Facebook provide a means for individuals to share experiences, opinions, and thoughts, enabling the collection of data related to consumer preferences [5].

Research by Yigitcanlar and Kankanamge [5] highlights the significance of consumers' online feedback and reviews as promising sources of unstructured data, influencing nearly half of all purchase decisions. Applying text mining to analyze customer textual reviews and quantify them through star ratings based on predetermined decision factors has proven beneficial. This approach helps manage the overload of customer reviews and ratings, facilitating decision-making [1], [5], [6].

2.2 Stream Analytics, Geospatial Analytics

Drawing from Lo [7], stream analysis offers a comprehensive view of the entire delivery process, enhancing customer interest as they await their orders. Real-time information transmitted from the merchant to customers allows them to track their order status. However, it's crucial to note that the effectiveness of stream analytics is contingent on connectivity speed [8]. A robust stream analytics system ensures timely delivery information without delays in customer acknowledgment.

In the online food delivery industry, accuracy takes precedence over route optimization, ensuring on-time delivery, a critical factor for customer satisfaction. Traditionally, delivery estimates were based on distance, considering how long or far customers had to wait. Sebastian and Findawati [9] research suggests that many customers may not be familiar with the store's location and desire a model to suggest a location based on data inputs. Additionally, Liu et al. [10] found that Foodpanda prioritizes customer satisfaction by leveraging location and data, consistently achieving delivery times within 20 minutes. Harnessing data science and machine learning enables predicting the optimal route, considering customers' locations, and optimizing the selection of drivers and restaurants.

2.3 Other technological perspectives

As illustrated in figure 1, ABC Company is tasked with acquiring customer feedback and reviews from various channels to inform decision-making and enhance its services. To achieve this, the company gathers these inputs from diverse sources, including Excel, the web, and social media, constituting unstructured data or text. This initial phase is referred to as data collection or gathering.

Subsequently, the crucial step involves cleaning and transforming these unstructured data sources along the pipelines to facilitate migration to OLTP (Online Transaction Processing). This process is known as data migration or data transformation. Once the data resides in OLTP, the next stage involves the ETL (Extract, Transform, Load) process, completing the cycle of extracting, transforming, and loading the data for further analysis and utilization.

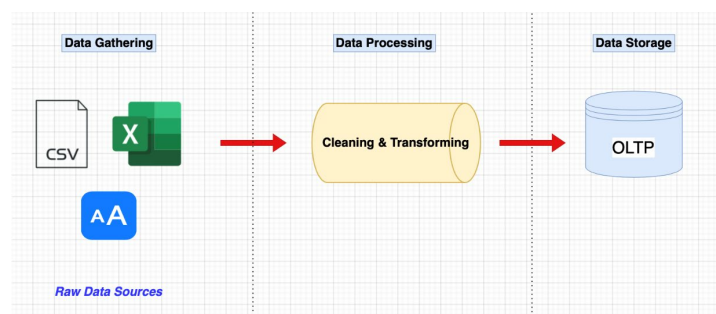


Figure 1. Initial Framework of Data Integration Process

3 Problem Statement

3.1 Business Issues

Liu et al. [10] research reveals an increase in the demand for services, with many restaurants opting to utilize popular delivery platforms such as Grab and Foodpanda. However, customer satisfaction is contingent on the performance of third-party fleets. Given the challenges associated with managing third-party elements in the online food delivery system, ABC Company has initiated its own delivery system. Prioritizing customer satisfaction and understanding customer preferences are paramount in the online food delivery industry, making it essential for ABC to have control over its delivery process. Most restaurants bear responsibility for costs related to unsatisfactory meals delivered by third parties, emphasizing the need for control over food quality until delivery.

External factors such as traffic or road conditions, beyond ABC's control when using third-party fleets, can negatively impact customer impressions and satisfaction. Additionally, relying on third parties may hinder ABC's ability to obtain accurate customer reviews, impacting overall control. Consequently, establishing an in-house online food delivery system allows ABC to retain control over critical aspects of the delivery process. Moreover, addressing information overload and its disorganized presentation is a challenge for online food delivery systems.

Liu et al. [10] identifies various causes, including multiple and irrelevant information sources, difficulty in management, and insufficient time for analysis. Moreover, information overload adversely affects customer decision-making quality and experience when the volume surpasses their processing capabilities. Factors like prolonged loading times due to excessive information can decrease customer satisfaction. ABC Company must address this issue in its system to ensure a well-managed and organized presentation of information, ultimately enhancing customer satisfaction.

3.2 Proposed Solution

In the problem statement outlined in Section 3.1, ABC Company chose not to collaborate with third-party delivery services due to uncontrollable factors and has embarked on establishing its own online food delivery system. However, a primary challenge arises when the company assumes control of the delivery services, as the dynamics of the relationship between customers and third-party delivery services shift directly to the company itself. This entails the direct transfer of all information, including orders, reviews, and ratings from customers to ABC Company's OLTP databases. Consequently, managing these unstructured text data becomes challenging, and accessing stored data from diverse sources proves to be complex.

To address these challenges, ABC Company employs ETL (Extract, Transform, Load) technology to facilitate the transformation of unstructured data from various sources into data warehousing, as mentioned above. Through the ETL process, the company can convert these diverse data sources into readable formats, enabling efficient text mining to extract customer information and feedback promptly. The subsequent figure illustrates the ETL process.

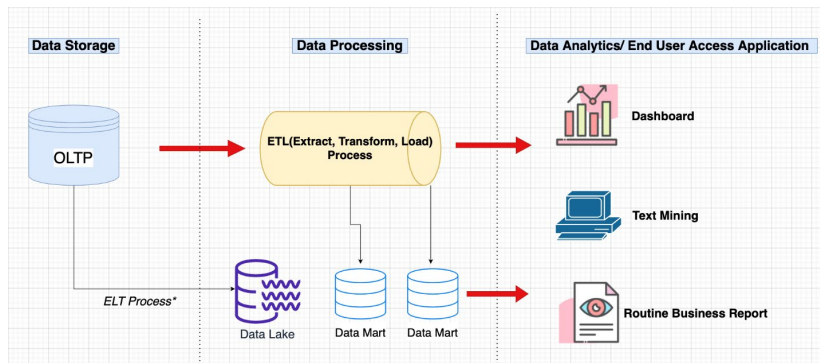


Figure 2. Proposed Framework of Data Integration Process

As depicted in Figure 2, the process of sourcing data and transforming it into OLTP is elucidated in Section 1. Subsequently, the next stage involves data integration, executed through the Extraction, Transformation, and Loading (ETL) process, as illustrated in the figure above. In this phase of data processing, unstructured data in OLTP is extracted, necessitating a series of tasks such as data retrieval from OLTP, SQL utilization for table filtering, and the amalgamation of multiple tables. This process aims to clean the tables and eliminate any extraneous data. Following the extraction and refinement process, the resultant clean data, having undergone tasks

of joining, cleaning, and rejecting from various tables, is loaded into the data warehouse. The subsequent task involves data analytics, where ABC Company leverages this clean and readable data for activities such as text mining, dashboard creation, and the generation of business reports. These analytical processes enable ABC Company to gain insights into customer feedback and preferences.

4 Text Data Retrieval

In straightforward terms, data integration is a vital technique applicable across various industries. Particularly for ABC Company, urgently seeking to access and analyze customer sentiment and feedback, the collected data stored in disparate systems becomes inaccessible without the implementation of data integration. To address this challenge, the company may employ data integration technologies, with the ETL (Extract, Transform, Load) process being a widely used method. This involves extracting diverse data, including structured and unstructured data, from different source systems that collect data. The extracted data is then transformed from an unreadable format to the required form, facilitating easy loading into a data warehouse. The subsequent loading step involves loading the transformed data into the data warehouse. This entire process constitutes data integration, enabling ABC Company to utilize the data for various analytical tasks such as sentiment and text analysis, as well as creating dashboards to understand customer preferences. In essence, in the contemporary era of big data, data integration stands out as an indispensable technique across all industries.

4.1 *Advantages and Disadvantages of Using Text Data Retrieval*

The preceding section highlighted two challenges. With the recent initiation of ABC Company's online food delivery system, ensuring customer satisfaction is paramount for retaining the customer base. Data obtained from the web, coupled with text analytics, provides insights into customer behavior, enabling ABC Company to enhance its services based on customer requirements. Customer reviews play a pivotal role in establishing a positive reputation for a restaurant [3], [5], [6], [8]. Furthermore, the application of Extraction, Transformation, and Load (ETL) processes, as illustrated in Figure 1, reduces redundancy within the system. This eliminates unnecessary data, preventing information overload, and enhances the efficiency and data quality of ABC Company's online food delivery system.

Addressing the aforementioned challenges, information overload is a potential issue for online food delivery systems. Text data retrieval helps users extract pertinent information efficiently using keywords, reducing the time required when utilizing the search engine within the food delivery application [9]. Moreover, text data retrieval aids users in uncovering hidden information within the food delivery system, fostering new knowledge and a deeper understanding of the system. However, it is crucial to acknowledge the challenge of dealing with copyright legislation when using text data retrieval in the system. Obtaining permission from food owners for items in the delivery system requires careful consideration of legislative and copyright principles.

4.2 *Data Collection*

Drawing from the insights provided by Dange [11], the utilization of a web crawler allows the acquisition of customer preferences and views from the World Wide Web (WWW). This gathered data is then categorized based on data types and stored in a data warehouse for subsequent analysis. Similarly, in social media analytics, data is collected from social network sites and undergoes a similar processing procedure. Consequently, all unstructured data, encompassing user dwell time on the website, page visits, click maps, and customer reviews, is now consolidated in the data warehouse, ready for utilization. However, navigating this stage presents challenges related to privacy concerns and user permissions. The web crawler can only access legally obtainable data, requiring administrator permission before data retrieval.

Due to the inherent complexity of unstructured data, proper organization becomes imperative for analysis. Subsequently, unstructured data, such as customer comments, undergoes parsing. Lexicons are then employed to extract root words or terms according to predefined rules set by the company's technical staff. The meaningful words or terms are indexed based on frequency, considering the relationship between words and terms. This step also considers the weights of words and terms, recognizing that high-frequency words may not necessarily be the most effective document discriminators. Following the entire data stream process, text analysis is performed to complete the text analytics process, unveiling insights into customer behavior within the online food delivery system, addressing the business issues outlined in Section 3. Figure 4 illustrates the dataset dashboard utilizing customer reviews fetched from social media.

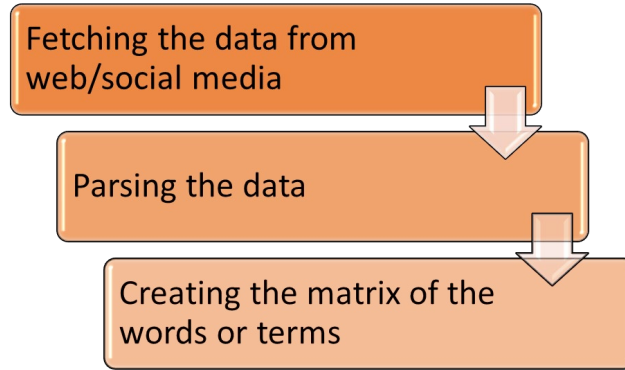


Figure 3. Process of Data Stream to Retrieve the Data

4.3 Dashboard Design

Table 1. Customer Distribution

State	Female	Male
Cheras	1	4
Ampang	3	4
Kajang	3	3
Semenyih	2	5

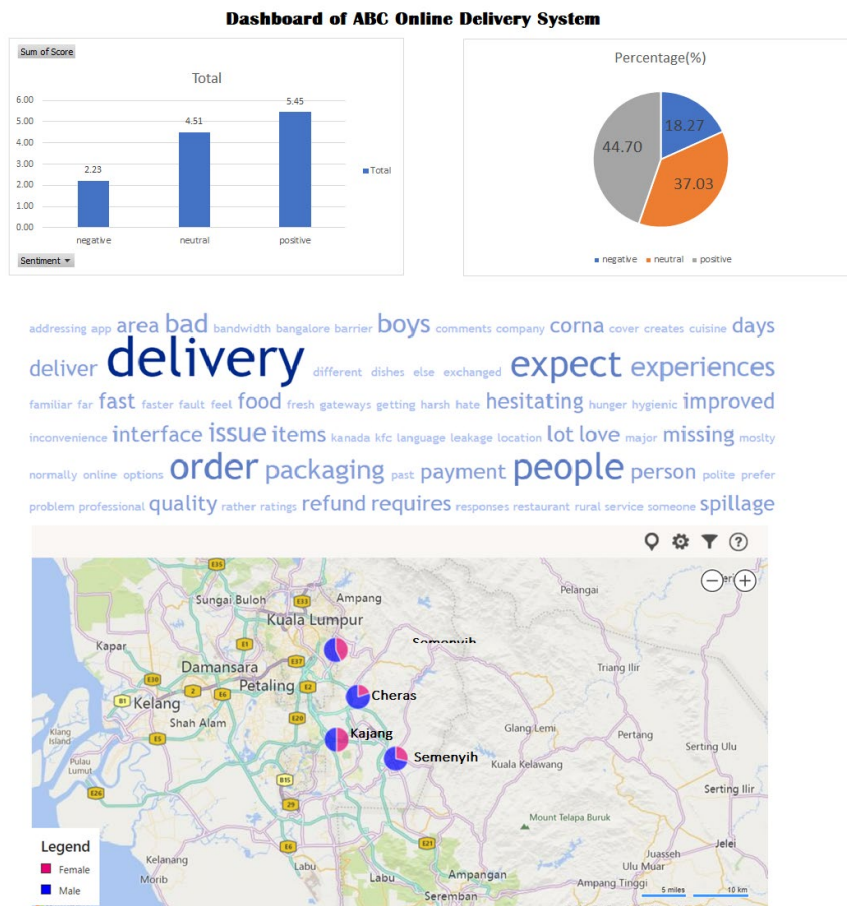


Figure 4. Dashboard of ABC Customers Reviews

The dashboard presented in Figure 4 for ABC's online delivery system showcases various visualizations, including a bar chart, pie chart, word cloud, and map visualization. The bar chart effectively illustrates the distribution of data points, categorizing them into negative, positive, and neutral sentiments. Notably, the positive score dominates at 5.45, followed by the neutral score at 4.51, and the least is the negative score at 2.23. This suggests a high level of customer satisfaction with the online food delivery service. The pie chart visually inspects the reasonableness and accuracy of calculations, clustering review data into negative, positive, and neutral sentiments. The chart reveals a higher percentage of positive sentiments, indicating overall customer satisfaction. The company can leverage this information for improved decision-making, focusing on addressing negative reviews to further enhance the positive sentiment percentage.

Utilizing the TagCrowd website, the word cloud is generated to visually represent the most frequently appearing words in customer reviews. The word cloud demonstrates a prevalence of positive words, such as "delivery," "quality," and "fast," outweighing negative words. The map visualization displays geographic information related to customer reviews in Malaysia. Notably, the map reveals that the majority of reviews are from males, except in Kajang, where the distribution is equal between males and females, each contributing 50% of the reviews. This insight into gender distribution across different locations aids in understanding the demographic composition of customer reviews for the online food delivery services.

5 Conclusion

In summary, data integration serves as a crucial solution to address business issues within the online food delivery system. Effective implementation of text analytics becomes instrumental in overcoming challenges related to lack of control and information overload in the online food delivery system. The integration process, particularly the ETL phase, plays a pivotal role in resolving these issues by eliminating unnecessary data. Moreover, data streaming facilitates the retrieval of information from the web and social media, allowing the indexing of unstructured data for utilization in text analytics. Additionally, text data retrieval aids in the analytical process by categorizing text into three distinct data categories. Tools like the Azure Machine Learning Extension and Bing Map Extension in Microsoft Excel, along with the online word cloud generator TagCrowd, are employed for visualizations.

In essence, text analytics proves to be a valuable strategy for ABC Company to enhance its customer base through the thorough analysis of customer reviews.

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