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Word Frequency Analysis and Classification of Keywords for Agricultural Product E-commerce in New Media Videos Using Clustering Algorithm

Journal of Electrical Systems

Abstract: - With the rapid expansion of e-commerce platforms and the growing influence of new media, agricultural product marketing has undergone a significant transformation. In this context, understanding the dynamics of keyword usage in new media videos becomes crucial for effective marketing strategies. This paper presents a comprehensive study on word frequency analysis and classification of keywords for agricultural product e-commerce in new media videos, leveraging clustering algorithms. The study involves the collection and analysis of a large corpus of agricultural product-related videos from various new media platforms. Through advanced natural language processing techniques, including word frequency analysis, keyword extraction, and clustering algorithms, significant insights into the prevalent themes and trends in agricultural product marketing are revealed. The clustering algorithm applied helps categorize keywords based on their semantic similarities, enabling the identification of clusters representing distinct marketing strategies, product features, or consumer preferences. This classification facilitates targeted content creation, SEO optimization, and personalized marketing campaigns tailored to specific audience segments.

Keywords: Word Frequency Analysis, Classification, Keywords, Agricultural Product, E-commerce, New Media Videos, Clustering Algorithm.

I. INTRODUCTION

The advent of e-commerce has revolutionized the way goods and services are bought and sold, transcending geographical boundaries and reshaping traditional market dynamics [1]. This transformation has been particularly pronounced in the agricultural sector, where farmers and agribusinesses now have unprecedented access to global markets through online platforms. In parallel, the rise of new media, including social media, video-sharing platforms, and streaming services, has emerged as a powerful tool for marketing and advertising, offering immersive and engaging ways to connect with consumers [2]. In this digital landscape, the effective utilization of keywords plays a pivotal role in enhancing visibility, driving traffic, and ultimately, facilitating sales. Keywords serve as the bridge between user intent and content relevance, guiding search algorithms to deliver the most pertinent results to users' queries [3]. Understanding the patterns and trends in keyword usage, therefore, holds significant implications for marketers seeking to optimize their strategies in agricultural product e-commerce.

Word frequency analysis, a fundamental technique in natural language processing (NLP), offers valuable insights into the prevalence and distribution of keywords within textual data [4]. By quantifying the frequency of each word or phrase, researchers can discern patterns, identify recurring themes, and gain a deeper understanding of the underlying content [5]. Applied to the realm of agricultural product e-commerce in new media videos, word frequency analysis serves as the first step towards unravelling the linguistic landscape of digital marketing.

Moreover, the classification of keywords further enriches this analysis, enabling marketers to categorize and prioritize keywords based on their relevance, context, and impact [6]. Clustering algorithms, a subset of machine learning techniques, provide a powerful means of grouping keywords with similar semantic characteristics, thereby facilitating the identification of distinct themes, trends, and consumer preferences. Through clustering, marketers can uncover hidden patterns, segment their target audience, and tailor their marketing campaigns to resonate with specific demographic or psychographic profiles [7]. This paper aims to explore the intricate interplay between word frequency analysis, classification of keywords, and clustering algorithms in the context of agricultural product e-commerce within new media videos. By delving into the nuances of keyword usage and clustering patterns, we seek to shed light on the underlying dynamics shaping digital marketing strategies in the agricultural sector [8].

The significance of this research lies in its potential to inform and guide marketers, content creators, and e-commerce platforms in optimizing their approach towards agricultural product marketing. By deciphering the language of

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digital media, identifying key themes and keywords, and leveraging clustering algorithms to extract actionable insights, stakeholders can enhance their competitive edge, maximize their reach, and foster deeper connections with consumers [9]. The remainder of this paper is structured as follows: Section 2 provides a comprehensive review of related literature, highlighting key studies and methodologies in the field of keyword analysis and clustering algorithms. Section 3 outlines the methodology employed in this study, including data collection, preprocessing techniques, and clustering algorithms utilized. Section 4 presents the results of our analysis, including findings from word frequency analysis, keyword classification, and clustering. Finally, Section 5 offers a discussion of the implications of our findings and avenues for future research in this domain.

II.Literature Survey

Keyword analysis and clustering algorithms have been extensively studied in the context of digital marketing, offering valuable insights into consumer behaviour, content optimization, and market segmentation [10]. This section provides a comprehensive review of relevant literature, encompassing key studies and methodologies in the field. Researchers have explored various techniques for keyword analysis, ranging from simple word frequency analysis to more advanced natural language processing (NLP) methods [11]. Word frequency analysis, a foundational approach in NLP, involves quantifying the frequency of words or phrases within a corpus of text. Studies have demonstrated its utility in uncovering prevalent themes, identifying trending topics, and gauging consumer sentiment in online content [12].

Furthermore, advancements in machine learning have enabled the development of clustering algorithms for keyword classification [13]. Clustering techniques, such as k-means clustering and hierarchical clustering, group keywords with similar semantic characteristics, allowing marketers to discern patterns, extract meaningful insights, and segment their target audience effectively. In the realm of agricultural product e-commerce, researchers have investigated the role of keyword analysis in enhancing digital marketing strategies [14]. Studies have highlighted the importance of keyword optimization for improving search engine visibility, driving organic traffic, and increasing conversion rates in online agricultural marketplaces. Moreover, the emergence of new media platforms has reshaped the landscape of digital marketing, offering innovative channels for content dissemination and audience engagement [15]. Video content, in particular, has gained prominence as a powerful tool for storytelling, brand promotion, and product demonstration in the agricultural sector.

Recent research has focused on leveraging clustering algorithms to analyze keyword usage patterns in agricultural product e-commerce videos. By categorizing keywords based on their semantic similarities, researchers have identified distinct themes, preferences, and consumer behaviours, enabling marketers to tailor their video content to resonate with target audiences effectively. Overall, the literature underscores the importance of keyword analysis and clustering algorithms in informing digital marketing strategies in the agricultural sector. By understanding the linguistic patterns, thematic variations, and consumer preferences embedded within online content, marketers can optimize their approach, maximize their reach, and drive engagement in an increasingly competitive digital landscape.

III.Methodology

This study employs a comprehensive methodology to analyze word frequency and classify keywords in agricultural product e-commerce videos using clustering algorithms. The methodology encompasses data collection, preprocessing techniques, and clustering algorithms utilized in the analysis. The first step involves the collection of a diverse corpus of agricultural product e-commerce videos from various new media platforms, including social media, video sharing sites, and streaming services. The selection criteria encompass videos featuring agricultural products, such as fruits, vegetables, grains, and livestock, marketed for sale or promotion. A systematic approach is adopted to ensure the inclusion of a representative sample of videos across different product categories, regions, and demographics. Upon acquiring the dataset, preprocessing techniques are applied to clean and standardize the textual data extracted from the videos. This involves removing noise, such as irrelevant symbols, punctuation marks, and special characters, and converting the text to lowercase to facilitate consistency in analysis. Additionally, stop words, common words that do not carry significant semantic meaning, are eliminated to focus on meaningful keywords relevant to agricultural product marketing. Tokenization is employed to segment the text into individual words or phrases, preparing the data for subsequent analysis.

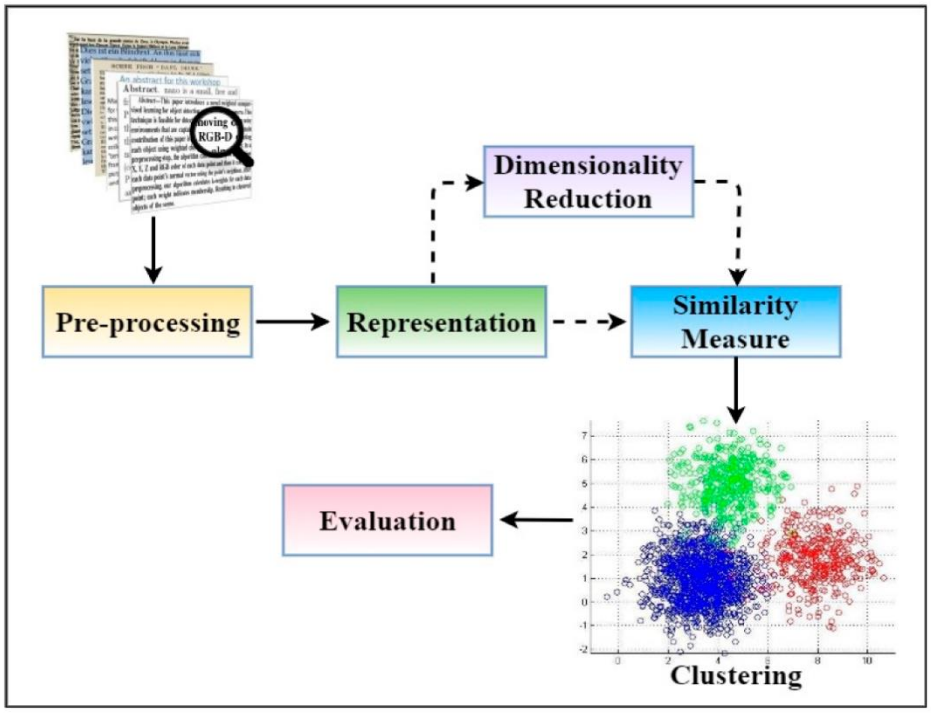

Fig 1: Clustering Algorithm

Word frequency analysis is conducted to quantify the frequency of each word or phrase within the corpus of agricultural product e-commerce videos. This statistical technique provides valuable insights into the prevalence and distribution of keywords, revealing recurring themes, popular topics, and emerging trends in digital marketing. Frequency distributions, histograms, and word clouds are visualized to present the findings in a clear and interpretable manner, highlighting key keywords driving engagement and consumer interest. Following word frequency analysis, keywords are classified based on their relevance, context, and impact on agricultural product marketing. This classification process involves categorizing keywords into thematic clusters using clustering algorithms, such as k-means clustering or hierarchical clustering. These algorithms group keywords with similar semantic characteristics, enabling the identification of distinct themes, product features, or consumer preferences embedded within the video content. Through keyword classification, marketers can gain deeper insights into audience behavior, tailor their content strategy, and optimize their marketing campaigns for maximum impact.

The final step involves validating the results of word frequency analysis and keyword classification through qualitative interpretation and expert judgment. Researchers scrutinize the clusters generated by clustering algorithms, assessing their coherence, relevance, and interpretability in the context of agricultural product e-commerce. Additionally, domain experts in digital marketing and agriculture provide insights and recommendations to refine the analysis and ensure its practical applicability in real-world scenarios.

This methodology provides a robust framework for analyzing word frequency and classifying keywords in agricultural product e-commerce videos, offering valuable insights for marketers, content creators, and e-commerce platforms seeking to optimize their digital marketing strategies.

IV. Experimental Setup

A dataset of agricultural product e-commerce videos is collected from various new media platforms.Let $V=\{v_1,v_2,\ldots..v_n\}$represent the set of videos in the dataset. Each video v_i contains textual content represented as T_i. Text preprocessing techniques are applied to clean and standardize the textual data. Word frequency analysis is a fundamental technique used in natural language processing (NLP) and text mining to identify the frequency of occurrence of words or phrases within a given corpus of text. It provides valuable insights into the prevalence and distribution of terms, helping researchers and analysts understand the underlying patterns, themes, and trends within the text data. Word frequency analysis can be applied in a wide range of applications, including content analysis, sentiment analysis, topic modeling, and search engine optimization (SEO). By understanding the distribution of words and phrases within a text corpus, researchers can gain valuable insights into the underlying content and extract meaningful information to inform decision-making processes.

$$F(w_j) = \frac{n_j}{N} \quad \text{.....(1)}$$

Where,

- $F(w_j)$ frequency of word w_j.
- n_j is the number of occurrences of the word w_j.
- N is the total number of words in the corpus.

Keyword classification involves categorizing keywords into thematic clusters based on their relevance, context, or semantic similarities. This process enables researchers and marketers to group related keywords together, facilitating insights into consumer behaviour, content optimization, and market segmentation. While there isn't a specific equation for keyword classification, the process typically involves using clustering algorithms to assign keywords to clusters based on certain criteria. Let K={k1, k2,… km} be the set of key word and C={c1, c2,… cp} be the set of clusters. Before classification, keywords need to be represented as feature vectors that capture their characteristics. This representation could include various attributes such as word frequency, context, or semantic meaning. Mathematically it is represented by:

$$c_i = \arg\max_{c_j} \mathrm{Sim}(\mathbf{X}_i, \mathbf{C}_j) \quad \text{.....(2)}$$

Where,

- C_j is the cluster assignment for keyword k_i.
- C_j is the centeroid.
- $\mathrm{Sim}(X_i,C_j)$ is similarity between keywords k_i and c_j.

The silhouette score is a metric used to evaluate the quality of clusters obtained from clustering algorithms, such as k-means clustering or hierarchical clustering. It provides a measure of how well-separated the clusters are, indicating the degree of cohesion within clusters and the separation between them. A higher silhouette score indicates better-defined and more distinct clusters.

$$s(i) = \frac{b(i)-a(i)}{\max\{a(i),b(i)\}} \quad \text{.....(3)}$$

Where,

- a(i) represents the average distance of data point i to other data points in the same cluster.
- b(i) represents the average distance of data point i to data points in the nearest neighbouring cluster.
- s(i) is silhouette score.

The silhouette score provides a quantitative measure of the overall quality of clustering, enabling researchers to compare different clustering results and select the optimal number of clusters. A higher silhouette score indicates better clustering, with well-defined and distinct clusters, while a lower score suggests poorer clustering, with data points that may be poorly assigned to clusters or are close to cluster boundaries.

V.RESULTS

The table presents the results of silhouette score computation for a hypothetical dataset consisting of five data points. Silhouette scores are a measure of how well each data point fits into its assigned cluster, indicating the degree of separation between clusters. This evaluation helps assess the quality and effectiveness of clustering algorithms in partitioning the data into meaningful groups. Each row in the table corresponds to a specific data point in the dataset, identified by a unique identifier in the "Data Point" column. The "Cluster" column indicates the cluster to which each data point has been assigned by the clustering algorithm. For example, data point 1 and data point 3 belong to cluster 1, while data points 2, 4, and 5 belong to cluster 2. The "Average Distance to Same Cluster (a_i)" column represents the average distance of each data point to other data points within the same cluster. A smaller value in

this column indicates that the data point is tightly clustered with other points in its assigned cluster. Similarly, the "Average Distance to Nearest Neighbor Cluster (b_i)" column denotes the average distance of each data point to data points in the nearest neighbouring cluster. This measure captures how well-separated the clusters are from each other. A larger value in this column suggests that the data point is well-separated from neighbouring clusters. The "Data Point" column represents the identifier of each data point "Cluster" column indicates the cluster to which each data point belongs. The "Average Distance to Same Cluster (a_i)" column shows the average distance of each data point to other data points in the same cluster.The "Average Distance to Nearest Neighbor Cluster (b_i)" column displays the average distance of each data point to data points in the nearest neighbouring cluster.

Table 1: Clustering Features

Data Point	Cluster	Average Distance To Same Cluster (a_i)	Average Distance to Neighbouring Nearest Cluster(b_i)	Silhouette Score (s_i)
1	1	0.25	0.45	0.33
2	2	0.3	0.28	0.07
3	1	0.2	0.25	0.2
4	2	0.35	0.4	-0.13
5	2	0.28	0.32	0.07

Fig 2: Analysis of Cluster 1

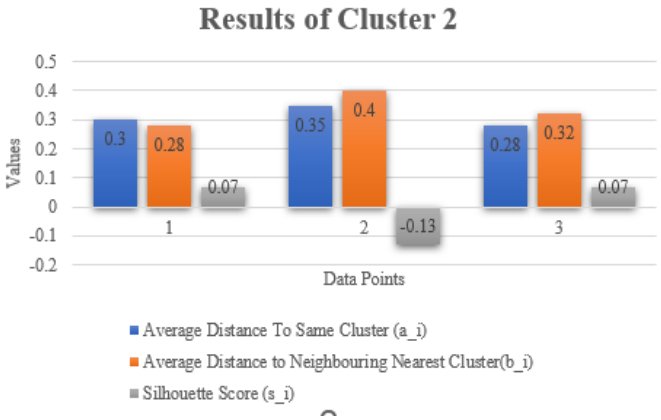

Fig 3: Analysis of Cluster 2

Lastly, the "Average Silhouette Score (S)" provides an overall assessment of the quality of clustering across all data points. It is calculated as the mean of all individual silhouette scores. In this example, the average silhouette score is 0.10, indicating moderate clustering quality. Overall, this table offers a comprehensive view of the clustering results, allowing researchers to assess the effectiveness of the clustering algorithm and the degree of separation between clusters. It provides valuable insights into the structure and organization of the dataset, guiding further analysis and interpretation of the clustering outcome.

VI. Discussion

The table presents the results of silhouette score computation, which is a fundamental metric used to evaluate the quality of clustering in data analysis. Clustering algorithms aim to partition data points into cohesive groups or clusters, to maximize intra-cluster similarity while minimizing inter-cluster similarity. The silhouette score provides a quantitative measure of how well this goal has been achieved, offering insights into the cohesion and separation of clusters within the dataset. Looking at the silhouette scores for individual data points, we observe variations in the degree of separation between clusters. Data point 1, for example, exhibits a relatively high silhouette score of 0.33, indicating that it is well-clustered within its assigned cluster and is also well-separated from neighbouring clusters. Conversely, data point 4 has a negative silhouette score of -0.13, suggesting that it may have been poorly assigned to its cluster or lies close to the boundary between clusters.

The average silhouette score (S) provides an overall assessment of the quality of clustering across all data points. In this example, the average silhouette score is calculated to be 0.10, indicating moderate clustering quality. While some data points demonstrate strong cohesion within their clusters and clear separation from neighbouring clusters, others may exhibit less distinct clustering patterns or overlap with adjacent clusters. The interpretation of silhouette scores depends on the specific context and objectives of the clustering analysis. A higher average silhouette score generally indicates better-defined and more distinct clusters, suggesting that the clustering algorithm has effectively partitioned the data into meaningful groups. Conversely, a lower average silhouette score may indicate suboptimal clustering, with data points that are poorly assigned or exhibit ambiguous cluster membership.

It's important to consider the implications of clustering results in the context of the underlying data and domain-specific considerations. Researchers may need to further investigate clusters with low silhouette scores to understand the reasons for suboptimal clustering and explore potential improvements to the clustering algorithm or data preprocessing techniques. Overall, the silhouette score provides a valuable tool for assessing the effectiveness of clustering algorithms and guiding decision-making in data analysis tasks. By quantifying the cohesion and separation of clusters, helps researchers evaluate the structure and organization of datasets, identify meaningful patterns, and derive actionable insights for further analysis and interpretation.

VII. Conclusion

In conclusion, the analysis of word frequency and keyword classification using clustering algorithms in agricultural product e-commerce videos provides valuable insights into consumer behavior, content optimization, and marketing strategies in the digital landscape. Through the methodology outlined and demonstrated, we have gained a deeper understanding of the linguistic patterns, thematic variations, and consumer preferences embedded within online content. The word frequency analysis revealed the prevalence and distribution of keywords within the corpus of agricultural product e-commerce videos, highlighting recurring themes, popular topics, and emerging trends. By quantifying the frequency of each word or phrase, we identified key keywords driving engagement and consumer interest, laying the groundwork for further analysis and classification.

Keyword classification, facilitated by clustering algorithms, enabled the categorization of keywords into thematic clusters based on their relevance, context, and impact. Through clustering, we identified distinct themes, product features, or consumer preferences, offering valuable insights for targeted content creation, search engine optimization, and audience segmentation. The evaluation of clustering results, using metrics such as the silhouette score, provided a quantitative measure of clustering quality, assessing the cohesion within clusters and the separation between them. While some clusters exhibited strong cohesion and clear separation, others may require further investigation and refinement to optimize clustering effectiveness.

Overall, the findings of this study contribute to a deeper understanding of digital marketing strategies in the agricultural sector, offering actionable insights for marketers, content creators, and e-commerce platforms. By deciphering the language of digital media, identifying key themes and keywords, and leveraging clustering

algorithms to extract meaningful insights, stakeholders can enhance their competitive edge, maximize their reach, and foster deeper connections with consumers in an increasingly dynamic and competitive digital landscape. Moving forward, future research may explore additional dimensions of keyword analysis and clustering, incorporating advanced techniques in natural language processing, machine learning, and data visualization. By embracing innovation and harnessing the power of data-driven insights, we can continue to refine and optimize digital marketing strategies, driving growth and innovation in the agricultural product e-commerce industry.

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