



Sentiment analysis of WhatsApp user reviews as information evaluation for digital services

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ABSTRACT

This study examines user reviews of the WhatsApp application as digital information objects that reflect user perceptions of digital information service quality. The rapid growth of communication platforms has generated large volumes of user-generated content, which requires systematic analysis and functions as a form of digital documentation. This research aims to evaluate how machine learning and deep learning approaches can support information evaluation through sentiment analysis of user reviews. A publicly available dataset of WhatsApp user reviews obtained from Kaggle was used as the data source. The research methodology consisted of text preprocessing, feature representation, sentiment classification, and performance evaluation. Support Vector Machine (SVM) was employed as a baseline machine learning method, while Long Short-Term Memory (LSTM) and Convolutional Neural Network (CNN) models represented deep learning approaches. The experimental results show that deep learning models outperform the traditional approach, with CNN achieving the best performance across accuracy, precision, recall, and F1-score metrics. These findings indicate that deep learning-based sentiment analysis is effective in transforming large-scale user reviews into actionable information for evaluating digital information services. This study contributes to documentation and information science by demonstrating the role of artificial intelligence in analyzing user-generated digital documentation to support evidence-based decision-making in digital service development.

ABSTRAK

Penelitian ini mengkaji ulasan pengguna aplikasi WhatsApp sebagai objek informasi digital yang merepresentasikan persepsi pengguna terhadap kualitas layanan informasi digital. Perkembangan pesat platform komunikasi digital menghasilkan konten buatan pengguna dalam jumlah besar yang berfungsi sebagai bentuk dokumentasi digital dan memerlukan analisis sistematis. Penelitian ini bertujuan untuk mengevaluasi pemanfaatan pendekatan machine learning dan deep learning dalam mendukung evaluasi informasi melalui analisis sentimen ulasan pengguna. Dataset yang digunakan berasal dari Kaggle dan berisi ulasan pengguna WhatsApp. Metodologi penelitian meliputi tahap prapemrosesan teks, representasi fitur, klasifikasi sentimen, serta evaluasi kinerja model. Support Vector Machine (SVM) digunakan sebagai metode machine learning dasar, sedangkan Long Short-Term Memory (LSTM), dan Convolutional Neural Network (CNN) digunakan sebagai pendekatan Deep Learning. Hasil eksperimen menunjukkan bahwa model Deep Learning memiliki kinerja yang lebih baik dibandingkan metode tradisional. Model CNN menunjukkan performa terbaik pada seluruh metrik evaluasi. Temuan ini menunjukkan bahwa analisis sentimen berbasis Deep Learning efektif untuk mengubah ulasan pengguna berskala besar menjadi informasi yang bernilai dalam evaluasi layanan informasi digital. Penelitian ini berkontribusi pada bidang dokumentasi dan informasi dengan menunjukkan peran kecerdasan buatan dalam analisis dokumentasi digital berbasis konten buatan pengguna.

Keywords: Digital information services; User-generated content; Sentiment analysis; Information evaluation; WhatsApp reviews

1. INTRODUCTION

Advancements in information and communication technology have driven significant transformations in society's production, distribution, and use of information. One of the most prominent manifestations of this transformation is the increasing role of digital platforms as both information service providers and user interaction spaces (Achmad Saefuloh, 2025; Juliana et al., 2023; Rifky & Veri, 2024). Instant messaging applications, such as WhatsApp, function not only as communication tools but also as digital information services that facilitate the rapid and large-scale exchange of messages, documents, multimedia, and knowledge. In this context, every user interaction, including reviews and comments left on application distribution platforms, can be regarded as part of digital documentation that records user experiences, perceptions, and evaluations of the quality of information services provided (Adawiyyah et al., 2024; Amaliadanti, 2024; Harahap et al., 2025).

In the digital era, information management and information behavior have become increasingly important, where user interactions with digital platforms generate large volumes of data that reflect perceptions, experiences, and information needs. From an information management perspective, user reviews provide valuable feedback that can be utilized to evaluate service quality, identify user satisfaction levels, and support evidence-based decision-making. Meanwhile, from the perspective of information behavior, online reviews represent users' responses to information systems and digital services, reflecting how individuals seek, use, evaluate, and communicate information in digital environments. Therefore, the sentiment analysis of user reviews is not only relevant for measuring public opinion but also contributes to understanding user behavior and improving the quality of digital information services.

WhatsApp has become one of the most widely adopted digital communication platforms worldwide and has been increasingly utilized by information institutions, including libraries, archives, educational institutions, and public information service providers. Libraries and information centers use WhatsApp to disseminate information, provide reference services, facilitate user communication, and support digital outreach activities (Chaputula et al., 2020; Stephen, 2021). The widespread adoption of WhatsApp in information services demonstrates its strategic role as a digital communication and information-sharing platform. Consequently, evaluating user perceptions of WhatsApp through sentiment analysis is important for understanding the effectiveness and quality of digital information services that rely on mobile communication technologies.

In the field of documentation and information science, user-generated content holds strategic value as an information source that directly reflects user needs, satisfaction, and challenges (Bezirci & Biçen Aras, 2022; Byun et al., 2023). Application user reviews represent a form of non-conventional digital documents that are dynamic, unstructured, and continuously evolving. Such documents offer substantial potential for supporting information service evaluation, evidence-based decision-making, and digital information system improvement (Ahmed et al., 2021; He et al., 2023). However, the large volume and unstructured textual nature of user reviews present significant challenges for manual information management and analysis.

In the context of digital documentation, user reviews can be categorized as User-Generated Content (UGC), which refers to content voluntarily created and shared by users through digital platforms. UGC constitutes an important digital information source because it captures authentic user experiences, opinions, and product or service evaluations. In information science, UGC contributes to the creation of digital records that can be organized, analyzed, preserved, and utilized for knowledge generation and service improvement. In this context, user reviews preserved within digital repositories, application review datasets, and online platforms represent valuable documentary resources that can be systematically analyzed using text mining and sentiment analysis techniques to generate meaningful insights regarding user perceptions, service quality, and information management practices.

With the increasing volume of digital documentation, artificial intelligence-based approaches to information analysis have become increasingly relevant. One widely adopted approach is sentiment analysis (Alaei et al., 2019; Ligthart et al., 2021), a method used to identify attitudes, opinions, or emotions embedded within text. From the perspective of documentation and information science, sentiment analysis can be viewed as a modern form of content analysis that enables the extraction of meaning and informational value from large-scale textual documents. Through this approach, user reviews are treated not only as isolated opinions but also as structured information sources that can be interpreted to evaluate the quality of digital information services.

The application of sentiment analysis in the context of digital application reviews, social media, and online services has been extensively explored in previous studies. Most findings indicate that sentiment analysis provides an overall picture of user satisfaction levels and highlights key issues encountered during system usage. Sentiment analysis methods have evolved from rule-based and simple statistical approaches to more advanced machine learning and deep learning techniques. Traditional machine learning models, such as SVM, are widely used due to their ability to handle high-dimensional data and their stable performance in text classification tasks. However, these approaches still face limitations in capturing semantic context and complex relationships among words within textual documents (Alam et al., 2025; Chen, 2021; Dwijaya & Laksito, 2023; Sujana, 2023).

In response to these limitations, deep learning approaches have been increasingly adopted in sentiment and information analysis. Models such as LSTM are designed to process sequential data and can capture long-term contextual dependencies in text (Fitroh & Hudaya, 2023; Ligthart et al., 2021). Meanwhile, CNN has proven effective in extracting local patterns and salient features from short texts, such as phrases or word combinations that explicitly reflect certain sentiments. In the context of application user reviews, which are generally brief and concise, CNN often demonstrates superior performance compared with purely sequential models (Nayoan et al., 2021; Pardede et al., 2025).

Despite the rapid development of sentiment analysis research on application reviews, most studies still emphasize the technical aspects of modeling and algorithm evaluation, with relatively limited attention to their implications in the field of documentation and information science. Many studies treat user reviews merely as training data to assess model performance, without thoroughly examining their role as valuable informational documents for evaluating digital information services. Furthermore, comparative studies that systematically examine machine learning and deep learning approaches within an information evaluation framework remain limited, particularly in the context of large-scale instant messaging platforms such as WhatsApp (Dwijaya & Laksito, 2023; Ryan et al., 2024).

As one of the most widely used communication applications globally, WhatsApp generates a large and diverse number of user reviews. These reviews reflect user experiences related to functionality, system reliability, usability, and the quality of information services provided (Bajrogowska, 2019; Kharisudin & Masri, 2022). From a documentation perspective, WhatsApp reviews can be regarded as a growing digital archive of user experiences that requires effective management and analysis. Therefore, there is a need for information analysis approaches capable of processing such digital documentation automatically, accurately, and in a scientifically accountable manner (Irfan et al., 2022; Kharisudin & Masri, 2022).

Based on this background, this study aims to analyze WhatsApp user reviews as a form of digital documentation and to evaluate the quality of information services through a sentiment analysis approach. Specifically, this study compares the performance of machine learning and deep learning models in classifying user review sentiments. The novelty of this research lies in positioning

sentiment analysis not merely as a technical task of text classification, but as an information analysis method relevant to the field of documentation and information science. By integrating perspectives from information science and artificial intelligence, this study is expected to provide both theoretical and practical contributions to the development of user-based digital information service evaluation methods.

The findings of this study are expected to benefit digital information service providers, system developers, and researchers in the field of documentation and information science. Practically, the results can serve as a basis for evidence-based decision-making to improve the quality of digital services. Academically, this study contributes to the body of knowledge in documentation and information science by demonstrating how artificial intelligence-based analytical techniques can be utilized to manage and evaluate large-scale digital documentation.

2. LITERATURE REVIEW

2.1 Digital Documentation and User-Generated Content (UGC)

The concept of documentation has expanded in the fields of documentation and information science alongside the advancement of digital technology. Documentation is no longer limited to printed materials or conventional archives but now encompasses various forms of digital information objects created, stored, and utilized in online environments (Amiraslani & Dragovich, 2022; Fanani, 2023; Yaman et al., 2019). According to the Online Dictionary for Library and Information Science (ODLIS), a document can be defined as any object that functions as a carrier of information and holds value for storage, organization, and future use (Ahmar et al., 2018; Hasanah & Rachman, 2021; Radyuli et al., 2023). In this context, UGC, such as application reviews, online comments, and user feedback, can be positioned as a form of digital documentation that records interactions between users and information systems (Siregar et al., 2024; Wąsowicz-Zaborek, 2023).

Application user reviews constitute digital documents that are dynamic, unstructured, and continuously growing. These characteristics make them a rich yet challenging source of information to manage. From a documentation perspective, such reviews function as an archive of user experiences that reflect perceptions of digital information service quality. Therefore, UGC management and analysis are crucial components of the information management cycle, particularly in the evaluation and use stages.

2.2 Evaluation of Digital Information Services

The evaluation of information services is a central focus in library and information science (Faridan & Lawanda, 2024; Quddus & Sabarina, 2022). It aims to assess the extent to which a service meets user needs, delivers satisfaction, and supports the service provider's objectives. In digital environments, this evaluation becomes more complex due to the interaction between users and technology-based systems, digital interfaces, and dynamically evolving content.

Traditionally, the evaluation of information services relied on surveys, interviews, or direct observation. Although these methods provide in-depth insights, their application is often constrained by scale, time, and resource limitations. The emergence of user reviews on digital platforms offers new opportunities for data-driven evaluation based on widely available secondary data. These reviews contain spontaneous and authentic user assessments that provide a more realistic representation of the quality of digital information services.

Within the framework of information science, utilizing user reviews as a source for service evaluation requires a systematic analytical approach. It is necessary to transform unstructured textual data into meaningful information that can support decision-making. Consequently, there is a need for information analysis methods capable of extracting patterns, trends, and insights from large-scale digital document collections.

2.3 Sentiment Analysis as an Information Analysis Method

Sentiment analysis is a widely used text analysis technique for identifying attitudes, opinions, or emotions embedded in textual documents. From the perspective of documentation and information science, sentiment analysis can be viewed as an advanced form of content analysis that leverages computational technology to process large volumes of documents. Through sentiment analysis, textual documents such as user reviews, can be classified based on sentiment polarity, for example, positive, negative, or neutral (Asri et al., 2025).

As an information analysis method, sentiment analysis transforms data into meaningful information. Initially, unstructured digital documents are processed and analyzed to produce structured information that reflects the collective perceptions of users. This information can then be utilized for service evaluation, system improvement, and evidence-based policy formulation. Beyond classification purposes, sentiment polarity contributes to information organization, digital archiving, and information retrieval processes. By transforming textual reviews into positive, negative, and neutral categories, large collections of user-generated documents can be systematically grouped and managed according to user perceptions and evaluative attributes. Such categorization supports the preservation of digital records as structured documentary evidence and facilitates the retrieval of information related to user satisfaction, service issues, and recurring concerns. Consequently, sentiment analysis serves not only as a text mining technique but also as an information management mechanism that enhances the accessibility and usability of digital documentation. Thus, sentiment analysis holds strong relevance in the study of documentation and information science, particularly in the context of digital information management.

2.4 Machine Learning Approaches for Information Analysis

Machine Learning (ML) approaches have long been applied in various information analysis tasks, including document classification, information retrieval, and text mining. Traditional machine learning models, such as SVM, are known for their effectiveness in handling high-dimensional data and are commonly used in text classification based on feature representations, such as Term Frequency–Inverse Document Frequency (TF-IDF) (Ilfa Minatika, 2025).

In the context of digital documentation, ML enables the automation of document grouping and analysis at scale. However, such approaches generally rely on explicitly engineered features and have limitations in capturing deeper semantic meanings. As a result, although effective in certain cases, traditional machine learning often faces challenges when applied to informal, short, and context-rich textual data, such as application user reviews.

2.5 Deep Learning Approaches for Digital Document Analysis

The development of deep learning has introduced a new paradigm in the analysis of digital documents and textual information. Deep learning models, such as LSTM and CNN, can automatically learn feature representations from raw data without the need for extensive feature engineering. This capability is highly relevant in information science as it enables more adaptive analysis of linguistic variation and contextual nuances in documents (Ahmad et al., 2023; Fitroh & Hudaya, 2023).

The LSTM is designed to process sequential data and can capture long-term contextual dependencies within text. It is often applied in narrative analysis and documents with complex sentence structures. In contrast, CNN is more effective at extracting local features, such as phrases or word combinations that reflect specific sentiments, from short texts. In the context of application user reviews, which are generally concise, CNN often demonstrates superior performance.

Support Vector Machine (SVM) has been recognized for its effectiveness in handling high-dimensional textual data, relatively low computational requirements, and strong performance on datasets with limited training samples. Furthermore, SVM provides stable classification results and

has been extensively applied in text mining and opinion mining studies. However, SVM relies heavily on manual feature engineering and often struggles to capture contextual and semantic relationships among words within complex textual documents.

In contrast, Convolutional Neural Network (CNN) automatically learns hierarchical feature representations from textual data without requiring extensive feature engineering. CNN is particularly effective in identifying local patterns, phrases, and sentiment-bearing expressions within short texts, making it suitable for analyzing user reviews on digital platforms. Nevertheless, compared with traditional machine learning approaches, CNN generally requires larger training datasets and greater computational resources. Therefore, the comparative evaluation of SVM and CNN remains relevant for determining the most effective method for sentiment classification in digital documentation environments.

The application of deep learning in the sentiment analysis of user reviews offers significant potential for advancing the evaluation methods of digital information services. With higher accuracy, analytical results can provide a more reliable representation of user perceptions. This supports evidence-based decision-making and enhances the digital documentation management quality.

2.6 State of the Art of Research

The current state of the art indicates a shift in focus from merely applying classification algorithms to sentiment analysis as a tool for service evaluation and information management. Several previous studies have demonstrated the superiority of deep learning over traditional machine learning in sentiment analysis tasks. However, most of these studies focused on improving the performance of technical models, with limited discussion of their implications for documentation and information science.

Recent studies have increasingly explored sentiment analysis on digital documents, social media content, and user-generated reviews using machine learning and deep learning approaches. Several studies have reported that deep learning models, particularly CNN and LSTM, achieved higher performance than traditional machine learning techniques in capturing contextual information and semantic relationships within textual data. However, most existing studies have focused on predictive accuracy and algorithmic optimization. The role of user reviews as digital documentary resources that support information management, service evaluation, and evidence-based decision-making has received limited attention. This limitation highlights the need for research that integrates sentiment analysis with the documentation and information science's theoretical perspectives.

The research gap lies in the need to integrate technical sentiment analysis approaches with the documentation and information science conceptual framework. This study addresses this gap by positioning user reviews as digital documentation and sentiment analysis as an information analysis method for evaluating digital information services. Therefore, this research not only contributes to the development of artificial intelligence-based analytical methods but also enriches the field of documentation and information science in addressing the challenges of large-scale digital information management.

3. METHOD

This method section is structured by positioning sentiment analysis as an information analysis method within the documentation and information science framework. The technical approaches employed, namely Machine Learning and Deep Learning, are treated as tools to support the processing and evaluation of digital information derived from user review documentation.

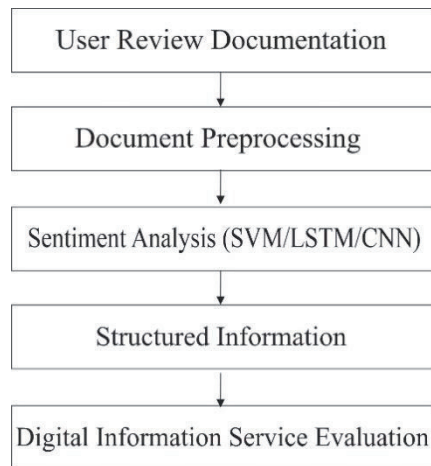


Figure 1. Sentiment Analysis Workflow as an Information Analysis Method
Source: Author's Elaboration, 2026

Figure 1 illustrates the sentiment analysis workflow as an information analysis method that leverages user review documentation to generate structured information for evaluating digital information services. The first step involves documenting user reviews. The next stage consists of document preprocessing before analysis and classification. This is followed by structured information analysis, and the final stage involves the evaluation of digital information services.

3.1 Research Design and Information Analysis Approach

This study employs a quantitative approach using a text-based information analysis method. WhatsApp user reviews are treated as digital documents representing users' perceptions and experiences of information services. Sentiment analysis is performed to extract meaning and attitudinal tendencies from unstructured textual documents, thereby producing structured information that can be used to evaluate digital information services.

The dataset used in this study consisted of 5,400 user reviews of WhatsApp obtained from a publicly available Kaggle repository. Based on the dataset characteristics, the reviews were collected between 21 November 2025 and 26 November 2025 and represent recent user experiences with the WhatsApp application. The dataset primarily contains English-language reviews because the source platform predominantly records reviews in English. To improve data quality, reviews containing fewer than 10 characters and empty review fields were excluded during preprocessing. Each review was treated as an individual digital document representing user perceptions of digital information services.

The sentiment labels were derived from user ratings, where ratings of 4–5 were categorized as positive, ratings of 1–2 as negative, and rating 3 as neutral. This labeling strategy follows common practices in review-based sentiment analysis and enables consistent sentiment categorization across the dataset.

The research design is comparative in nature, aiming to compare the effectiveness of several artificial intelligence-based information analysis models in classifying sentiment within digital documents. This comparison is intended to assess the reliability of each model as an information analysis instrument (Malavade & Sureshkumar, 2023; Seo et al., 2020).

3.2 Data Sources and Digital Documentation Characteristics

The data used in this study consist of WhatsApp user reviews collected from application distribution platforms. These reviews represent user-generated digital documentation that is dynamic, unstructured, and expressed in natural language, often informal in nature. Each review is treated as a single unit of an information document.

Prior to analysis, the data are selected to ensure relevance and suitability as an information source. This process is essential in the context of documentation to maintain the quality of analyzed documents and to reduce informational noise (Nguyen et al., 2022). Table 1 presents the characteristics of WhatsApp user reviews as digital documentation used as the source of information analysis in this study.

Table 1. Characteristics of The WhatsApp User Review Digital Documentation

Documentation Aspect	Description
Documentation source	User reviews of WhatsApp application
Number of documents	5,400 reviews
Document type	User-generated digital text
Language	Natural language (informal, multilingual)
Main metadata	Rating (1–5), review date, helpful
Information function	Evaluation of digital information services
Nature of information	Subjective, evaluative, dynamic

Source: Processed Primary Data, 2026

3.3 Text Document Preprocessing

Preprocessing is conducted as an initial stage in handling digital documentation to ensure that textual documents are ready for computational analysis. The preprocessing steps include cleaning the text from non-relevant characters, case normalization, tokenization, removal of common words that do not carry significant informational meaning and stemming or lemmatization. From an information science perspective, preprocessing can be understood as the normalization and standardization of digital documents. This stage aims to improve document representation consistency, enabling more accurate and reliable information analysis (Chai, 2023; Dankolo et al., 2023).

3.4 Document Representation as Structured Information

After preprocessing, textual documents are transformed into formats that can be processed by computer-based information analysis systems. For traditional machine learning models, document representation uses statistical approaches based on term frequency, such as TF-IDF. This representation allows digital documents to be mapped into a vector space that reflects each term's informational weight.

In deep learning approaches, the model automatically learns document representation through internal representation learning. This process enables the system to capture semantic patterns and contextual relationships between words without the need for manual feature engineering (Kamkarhaghghi et al., 2019; Kozlowski et al., 2021; Pavlick, 2022).

3.5 Machine Learning–Based Information Analysis Model

SVM is used as one of the machine learning–based information analysis models. In this study, SVM functions as a classification tool for digital documents based on the sentiment they contain. SVM is well known for its capability to handle high-dimensional data and is widely applied in textual information analysis.

SVM was selected as the baseline machine learning model because it has demonstrated robust performance in high-dimensional text classification tasks and remains one of the most widely adopted approaches in sentiment analysis research. SVM is computationally efficient, performs

well on sparse TF-IDF feature representations, and provides a reliable benchmark for evaluating the effectiveness of more advanced deep learning models (Didi et al., 2022; More et al., 2025; Nafis & Awang, 2021).

For the experimental setting, the document representation was generated using TF-IDF weighting. The SVM classifier employed a linear kernel because textual sentiment classification typically involves high-dimensional sparse feature spaces, where linear kernels have been shown to provide competitive performance while maintaining computational efficiency and interpretability. The regularization parameter (C) was set to 1.0. The dataset was divided into training and testing sets using an 80:20 ratio (Mauritsius et al., 2026; Prastyo et al., 2020; Siroot et al., 2024).

3.6 Deep Learning-Based Information Analysis Model

Deep learning approaches were employed to improve the system's capability to capture semantic and contextual information embedded in user reviews. Two representative architectures, namely LSTM and CNN, were selected due to their extensive application in sentiment analysis studies (Ali et al., 2019; Tanwar, 2026).

LSTM was chosen because of its ability to model sequential dependencies among words and capture contextual information over longer text sequences. The LSTM architecture consisted of an embedding layer, one LSTM layer with 128 hidden units, a dropout layer (0.5), and a dense output layer with SoftMax activation. The Adam optimizer was used to train the model with a batch size of 32 for 10 epochs (Noori et al., 2025; Sari et al., 2019).

The CNN was selected because application reviews are generally short texts that contain local sentiment-bearing expressions. CNN is particularly effective in identifying important phrases and word combinations associated with sentiment polarity. The CNN architecture consisted of an embedding layer followed by one-dimensional convolution layers with filter sizes of 3, 4, and 5 words, with 128 filters for each size. Max-pooling was applied after each convolution layer, followed by a fully connected dense layer and SoftMax output layer. Similar to the LSTM model, the Adam optimizer, batch size of 32, and 10 training epochs were employed (Agustin Fitriana et al., 2026; Yuliska et al., 2021).

SVM, LSTM, and CNN selection enables a comprehensive comparison between traditional machine learning and deep learning approaches. SVM represents feature-based statistical learning, LSTM captures sequential contextual dependencies, and CNN extracts salient local textual features. This comparative design allows the evaluation of different information analysis paradigms for processing digital documentation and user-generated content (Sandhi et al., 2024; Tanwar, 2026).

3.7 Training and Evaluation Procedures

The model training process is conducted by splitting the dataset into training and testing sets. This step ensures that the information analysis models are not only capable of interpreting known documents but also demonstrate generalization ability when applied to new data (Burzykowski et al., 2023).

Model performance is evaluated using accuracy, precision, recall, and F1-score metrics. Within the information science framework, these metrics represent the system's effectiveness in correctly classifying and interpreting digital documents. These evaluation measures are used to assess the extent to which each model can be used as an information analysis tool for evaluating digital information services.

To ensure experimental reproducibility, all models were trained and evaluated using the same training and testing partitions. Performance was assessed using Accuracy, Precision, Recall, and F1-score metrics. The hyperparameter settings were consistently maintained across experiments to facilitate fair comparison among the models evaluated.

4. RESULT AND DISCUSSION

This section presents the results of sentiment analysis on WhatsApp user reviews and discusses these findings within the documentation and information science framework. The analysis not only focuses on model performance comparison but also on interpreting the results as a basis for evaluating digital information services and managing user review-based documentation (Baj-roowska, 2019; Irfan et al., 2022).

4.1 Characteristics of The WhatsApp User Review Documentation

In this study, the analyzed WhatsApp user reviews represent a form of digital documentation generated voluntarily by users. These documents are unstructured, vary in length, and reflect diverse aspects of user experience, including ease of use, system stability, service features, and the quality of information delivery. From a documentation perspective, these reviews function as a continuously evolving archive of user experiences with high informational value for service evaluation.

The preprocessing results indicate that most reviews are relatively short and expressed in informal language. This characteristic highlights that managing user review-based digital documentation requires automated analytical approaches capable of capturing the core meaning of concise yet information-dense text. Therefore, sentiment analysis is a relevant method for transforming raw textual documents into structured information.

4.2 Sentiment Classification Results as Structured Information

The sentiment distribution results are presented in Table 2. The classification outcomes show a dominance of positive sentiment, indicating a relatively high level of user satisfaction with the information services provided. However, negative and neutral reviews remain important sources of evaluative information that should be considered in efforts to improve digital services.

Table 2 shows that negative reviews account for 32.26% of the total dataset. Although positive sentiment remains dominant, the relatively large proportion of negative reviews indicates that a considerable number of users have experienced dissatisfaction with certain aspects of the WhatsApp service. These complaints may be associated with issues related to application performance, system stability, feature changes, privacy concerns, or communication reliability. From the perspective of digital information service evaluation, this finding suggests that user-generated reviews serve as an important source of documentary evidence for identifying recurring service problems and areas requiring improvement.

The presence of more than one-third of negative sentiment also highlights that user satisfaction is not uniformly distributed across the user population. Consequently, service providers should not rely solely on the dominance of positive sentiment but should also systematically examine negative feedback to support evidence-based service enhancement.

Table 2. Sentiment Distribution as Structured Information

Sentiment Category	Number of Reviews	Percentage
Positive	3.317	61.43%
Negative	1.742	32.26%
Neutral	341	6.31%
Total	5.400	100%

Source: Processed Primary Data, 2026

The sentiment distribution presented in Table 2 is further visualized in Figure 2, which illustrates overall user perception trends toward WhatsApp digital information services.

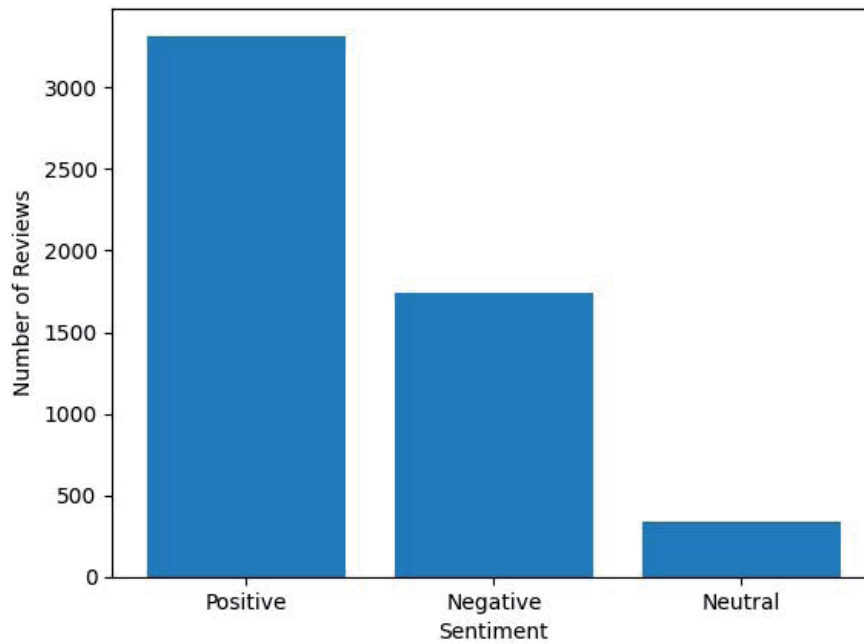


Figure 2. Distribution of WhatsApp User Review Sentiment
 X-axis: User Review Sentiment Categories (Positive, Negative, Neutral)
 Y-axis: Percentage of Reviews (%)
 Source: Processed Primary Data, 2026

Figure 2 presents the distribution of user review sentiment with varying results. Positive sentiment dominates, with the highest number of reviews falling into this category. This indicates that most users are satisfied with the quality of the digital information services provided through WhatsApp. Supporting factors include ease of use, response speed, and information accessibility.

The negative sentiment remains significant, as reflected by its position as the second-largest category. Although the proportion is lower than positive sentiment, it is substantial and cannot be overlooked. This suggests the presence of ongoing issues, such as delayed responses, inaccurate information, or technical constraints.

Neutral sentiment is the least represented, indicating that only a small proportion of users express neutral opinions. This suggests that most users have clear evaluations, either positive or negative, rather than indifferent perspectives. Overall, user perception tends to be positive, indicating that WhatsApp's digital information services perform reasonably well. However, the relatively high proportion of negative sentiment highlights the need for improvements, particularly in terms of service quality and user experience. The low level of neutral sentiment further indicates that the service has a noticeable positive and negative impact. In general, the quality of digital information services via WhatsApp is perceived as good by most users, but further improvements are necessary to reduce significant dissatisfaction.

4.3 Model Performance Comparison in Information Analysis

Model performance was evaluated using accuracy, precision, recall, and F1-score metrics. From a documentation and information science perspective, these metrics reflect the reliability of analytical systems in accurately interpreting digital documents. The experimental results indicate that deep learning models, particularly CNN, achieve the highest performance compared to SVM and LSTM (Handoko et al., 2024).

The superiority of CNN can be attributed to its ability to extract local features from text, such as key phrases or word combinations representing specific sentiments. Given that WhatsApp user reviews are generally short, this capability is essential for efficiently capturing informational

meaning. In contrast, although LSTM can model sequential context, its advantage is not always optimal for short documents. The performance of the SVM model is low, indicating the limitations of statistical feature-based approaches in representing the complexity of informal language.

As shown in Table 3 and Figure 3, CNN achieved the highest performance among the evaluated models, with an accuracy of 90%, precision of 88%, recall of 90%, and F1-score of 89%. These results indicate that CNN can correctly classify nine of ten user reviews, demonstrating strong reliability in extracting sentiment-related information from digital documents. In addition to accuracy, precision, and recall, the F1-score provides a balanced evaluation of classification performance by simultaneously considering both precision and recall. The CNN model achieved the highest F1-score (0.89), indicating its superior capability to identify sentiment patterns consistently while minimizing classification errors. By comparison, LSTM obtained an F1-score of 0.84 and SVM achieved 0.78, confirming that CNN offers the most reliable performance for transforming unstructured user-generated content into meaningful evaluative information.

From the information analysis perspective, the high performance of CNN suggests that local textual patterns, such as sentiment-bearing phrases and expressions, play a crucial role in understanding user perceptions within application reviews. The model's ability to automatically capture these patterns contributes to more accurate information extraction and supports the transformation of unstructured user-generated content into meaningful evaluative information.

Furthermore, the superior performance of CNN confirms the suitability of deep learning approaches for managing large-scale digital documentation. The findings imply that artificial intelligence can support information professionals and digital service providers in efficiently processing extensive user feedback collections while maintaining high analytical accuracy.

Table 3. Model Performance Comparison as an Information Analysis Tool

Information Analysis Model	Accuracy	Precision	Recall	F1-Score
Support Vector Machine (SVM)	0.80	0.77	0.79	0.78
Long Short-Term Memory (LSTM)	0.85	0.83	0.85	0.84
Convolutional Neural Network (CNN)	0.90	0.88	0.90	0.89

Source: Processed Primary Data, 2026

The comparative performance results presented in Table 3 are further visualized in Figure 3 to facilitate interpretation of the differences among the evaluated models. Subsequently, a visualization of model performance comparison is presented in Figure 3.

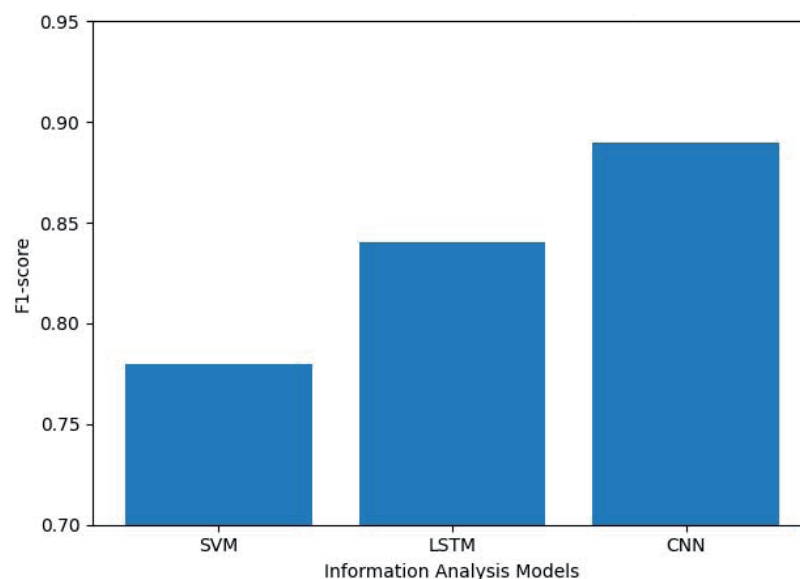


Figure 3. Model Performance Comparison

Source: Processed Primary Data, 2026

Figure 3 illustrates the comparative performance of the sentiment analysis models used as information analysis tools. The CNN model demonstrated the highest level of reliability in interpreting the user review documentation, followed by LSTM and SVM. This is because CNN can automatically learn patterns, structures, and features within text during the training process, thereby reducing the need for manual feature engineering. Additionally, CNN is widely recognized for achieving high accuracy in tasks such as image classification, object detection, and text classification.

In this case, the SVM exhibits the lowest performance. This can be attributed to its inefficiency when handling very large datasets, as the training time increases and computational complexity increases. Furthermore, SVM is sensitive to overlapping data and extreme outliers. The resulting hyperplane may not be optimal when the training data contains significant noise..

4.4 Implications for Digital Information Service Evaluation

The results of the sentiment analysis have direct implications for evaluating digital information services. The structured information derived from user reviews enables service providers to comprehensively understand user perceptions without manually examining each document. In the context of WhatsApp, this information can be used to evaluate the quality of the communication service, system reliability, and the effectiveness of the provided information features.

Deep learning–based approaches, particularly CNN, offer higher accuracy, making the resulting information more reliable for decision-making. Thus, sentiment analysis functions not only as a technical analytical tool but also as a strategic instrument in information management and digital service quality improvement (Khader & Zarzour, 2025).

Table 4. Implications of Information for Digital Service Evaluation

Information Findings	Evaluative Meaning	Implication
Dominance of positive sentiment	High satisfaction	Stable service
Significant negative proportion	Functional issues	Requires improvement
Low neutral sentiment	Information ambiguity	Further analysis needed

Source: Author's Elaboration, 2026

4.5 Error Analysis and Information Ambiguity

Further analysis of classification errors reveals that most misclassifications occur in neutral sentiment reviews. This can be explained by the fact that neutral reviews often contain a mixture of positive and negative expressions or are conveyed implicitly. This phenomenon in documentation studies reflects the ambiguity of information commonly found in natural language documents.

These findings indicate that while sentiment analysis provides useful general insights, result interpretation still requires contextual understanding. Therefore, to achieve deeper insights, the analysis should be complemented with other information analysis approaches, such as topic analysis or aspect-based analysis.(Kumar et al., 2025; Kumar & Garg, 2020).

4.6 Contribution to Digital Documentation Management

From the perspective of documentation and information science, this study demonstrates that artificial intelligence–based sentiment analysis can serve as a mechanism for managing large-scale digital documentation. User reviews, which are initially scattered and unstructured, can be transformed into organized information that supports evaluation, planning, and service development (Alam et al., 2025; Ariono & Alrasyid, 2025; Cahyani & Prasetyaningrum, 2026; Peng & Li, 2025; Taherdoost & Madanchian, 2023).

In this context, the application of deep learning models expands the role of information technology in documentation studies, not only as a tool for information storage and retrieval but also as a means of analyzing and interpreting digital documentation. Therefore, this study reinforces

the integration of artificial intelligence and information science in addressing the challenges of information management in the digital era (Bajaj et al., 2020; Rehman et al., 2022; Tao, 2020).

5. CONCLUSION

This study confirms that WhatsApp user reviews can be positioned as a form of digital documentation with high informational value for evaluating information services. Unstructured textual documents generated by users can be transformed into structured information that reflects collective perceptions of digital service quality using sentiment analysis as an information analysis method. The findings indicate that deep learning approaches, particularly CNN, demonstrate higher reliability in interpreting user review sentiment than SVM and LSTM. The advantage of CNN in extracting local features from short texts makes it an effective tool for processing concise and informal review documentation. These results suggest that selection of appropriate tools for information analysis directly influences the quality of information produced in the service evaluation process.

From the perspective of documentation and information science, this study contributes to expanding the application of artificial intelligence in digital documentation management. Sentiment analysis functions not only as a computational technique but also as a strategic instrument to support the evaluation of information services, evidence-based decision-making, and digital information system improvement. The integration of technical approaches with the conceptual framework of information science enriches the understanding of the role of information analysis in the era of large-scale data.

However, this study has several limitations, particularly related to information ambiguity in neutral sentiment reviews and the models' limited contextually understanding. Future research is recommended to combine sentiment analysis with other information analysis methods, such as topic analysis or aspect-based analysis, to achieve more comprehensive insights. In addition, exploring other sources of digital documentation may broaden the application of this approach across various information service contexts. Overall, this study highlights the relevance of artificial intelligence-based sentiment analysis as an information analysis method in documentation and information science and demonstrates its potential as an effective and sustainable tool for evaluating digital information services.

Practical implications of this study are particularly relevant for digital information service providers, including libraries, educational institutions, public information agencies, and platform developers. The sentiment information generated from user reviews can be utilized as an evidence-based evaluation resource to identify recurring service issues, monitor user satisfaction trends, prioritize system improvements, and support strategic decision-making. Organizations can reduce reliance on manual feedback assessment and respond more effectively to user needs and expectations, by systematically analyzing large volumes of user-generated content,

Furthermore, the findings demonstrate that CNN provides a reliable approach for the continuous monitoring of digital services due to its superior classification performance. The ability of CNN to accurately identify sentiment patterns from large-scale review data enables organizations to implement automated sentiment monitoring systems that support real-time evaluation of user perceptions. This capability contributes to proactive service management, early detection of emerging problems, and continuous quality improvement of digital information services. Therefore, the application of CNN extends beyond sentiment classification and serves as a practical tool for strengthening data-driven management and sustainable digital service development. CNN-based sentiment analysis also contributes to the management of large-scale digital documentation from the documentation and information science perspective by transforming unstructured user reviews into organized evaluative information that can be preserved, retrieved, and utilized for continuous service assessment.

DECLARATIONS

Data Availability

The data used in this study consist of WhatsApp user reviews obtained from publicly available data sources and processed for analytical purposes. The dataset and analysis scripts are openly accessible through an online repository to ensure transparency and reproducibility of the research.

Aminudin, N., Wantoro, A., & Saptasari, D. (2026). Sentiment Analysis of WhatsApp User Reviews as Information Evaluation for Digital Services (1.0) [Data set]. Zenodo. <https://doi.org/10.5281/zenodo.19396605>

CRedit (Contributor Roles Taxonomy)

Nur Aminudin: conceptualization; methodology; data curation; formal analysis; writing original draft; writing review and editing. **Agus Wantoro:** methodology; validation; formal analysis; writing review and editing; supervision. **Dita Septasari:** data accuracy; visualization; investigation; writing review and editing.

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