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Message from the General Chair of ICIC 2025



Dear esteemed guests, distinguished speakers, researchers, and participants,

It is my distinct pleasure to welcome you all to the 2025 International Conference on Informatics and Computing (ICIC 2025). As the Chair of this year's conference, I am truly honored to see such an exceptional gathering of scholars, practitioners, and experts from across the globe who have come together to share knowledge, exchange ideas, and explore the latest developments in informatics, computing, and related fields.

This year's conference has been particularly competitive, with 392 paper submissions from various academic institutions and research centers worldwide. After a rigorous peer-review process, we are proud to have accepted 211 papers, resulting in an acceptance rate of approximately 53.8%. This reflects the high standard of quality and innovation in the research presented at ICIC 2025. We are thrilled to showcase these outstanding contributions, which will undoubtedly advance the discourse in our field. All accepted papers are submitted to IEEE Xplore. IEEE Conference Number: #68054 ISBN: 979-8-3315-7583-0

The theme of ICIC 2025 resonates deeply with our collective goal of advancing informatics and computing technologies, especially in areas such as artificial intelligence, data science, cybersecurity, and cloud computing. These fields are pivotal in driving not only academic progress but also societal growth, economic development, and global competitiveness.

I would like to extend my heartfelt gratitude to the organizing committee, our reviewers, authors, and all contributors for their dedication and hard work in making this conference possible. I am confident that the discussions, presentations, and collaborations forged during ICIC 2025 will lead to groundbreaking advancements that will shape the future of informatics and computing.

Once again, welcome to ICIC 2025 in Bandar Lampung, Lampung. I hope you all have a rewarding and insightful experience, and I look forward to the exciting innovations and ideas that will emerge over the course of the conference.

Sincerely,

Dr. Yusuf Durachman, M.I.T.

Chair, ICIC 2025

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Aspect-Based Sentiment Analysis of Indonesian Football Team's Instagram Comments using Naive Bayes

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Abstract—The Indonesian national football team is one of the most followed sports entities in Indonesia, particularly on social media platforms like Instagram. During the third round of the 2026 World Cup Qualifiers, their official Instagram account received thousands of public comments, expressing diverse sentiments. This study aims to analyze these Instagram comments using the Aspect-Based Sentiment Analysis (ABSA) approach. A total of 6.600 comments were collected via web scraping from six match-related posts with 6.216 comments remaining after preprocessing. Aspect extraction was performed using Latent Dirichlet Allocation (LDA), yielding three main aspects: “*Dukungan & Semangat Nasional*,” “*Performa Tim & Lawan*,” and “*Hasil & Situasi Pertandingan*.” These aspects were subsequently validated by linguists. Sentiment labeling was conducted using the InSet lexicon. Comments were then vectorized using TF-IDF and classified with the Multinomial Naive Bayes algorithm, which was optimized using GridSearchCV and validated through Stratified K-Fold cross-validation. The classification results showed the highest accuracy for the “*Performa Tim & Lawan*” aspect (81.44%), followed by “*Dukungan & Semangat Nasional*” (80.70%), and “*Hasil & Situasi Pertandingan*” (79.37%), culminating in an average accuracy of 80.50%. These findings suggest that ABSA can provide detailed insights into public opinion regarding key performance areas of the national team.

Keywords—Indonesian national football team, aspect-based sentiment analysis, LDA, TF-IDF, Naive Bayes

I. INTRODUCTION

Football, or soccer as it's known in some parts of the world, enjoys immense popularity across Indonesia. The Indonesian national football team (Timnas), in particular, consistently captures the public's attention, especially on social media platforms like Instagram [1]. Recently, during the third round of the 2026 World Cup qualifiers, the official Timnas Instagram account was inundated with thousands of comments. These comments offered a diverse range of public opinions and sentiments, from enthusiastic praise to sharp criticism. These comments reflect public perceptions of various aspects, such as player performance, coach strategies, and match results. However, the sentiment expressed in these comments is often complex and multifaceted, varying significantly depending on the specific aspect being discussed. To accurately identify public opinion on different facets of the team, Aspect-Based Sentiment Analysis (ABSA) is essential for social media sentiment analysis. ABSA allows for the identification of specific aspects within comments and then determines the sentiment (positive or negative) associated with each [2-6]. This detailed approach is crucial for gaining a comprehensive understanding of public sentiment surrounding Timnas.

ABSA offers a powerful tool for team management to analyze fan feedback. It moves beyond simply identifying positive or negative comments, allowing teams to understand what specific aspects of their performance, players, or strategies are being praised or criticized. This granular insight empowers team management and social media managers to pinpoint the team's strengths and weaknesses with far greater precision, leading to more informed and targeted decision-making. For example, a single fan comment might express appreciation for a particular player's performance while simultaneously criticizing the coach's tactical decisions. ABSA can accurately identify and categorize both sentiments, providing a comprehensive understanding that traditional sentiment analysis might miss.

Numerous algorithms and strategies can be applied for ABSA. Among them, Latent Dirichlet Allocation (LDA) [7-9] stands out as a powerful topic modeling technique for aspect extraction. LDA allows us to automatically identify underlying themes or aspects within the vast and unstructured social media comments, avoiding reliance on predefined categories. For sentiment classification, the Multinomial Naive Bayes algorithm is a strong choice. This probabilistic classifier is frequently used in text classification, including sentiment analysis, and is favored for its simplicity and effectiveness, especially with large text datasets [10].

This research's primary purpose is to analyze public sentiment toward the Indonesian national football team on Instagram. We focus specifically on user comments related to the team's performance in the third round of the 2026 World Cup qualifiers. The main objectives are:

1. To evaluate the effectiveness of the Multinomial Naive Bayes algorithm for conducting aspect-based sentiment analysis on social media data.
2. To provide the Indonesian national football team with valuable insights into public perception, thereby informing and improving their communication and fan engagement strategies.

This research aims to demonstrate how algorithmic sentiment analysis can be a powerful tool for organizations to understand and respond to public opinion in real time.

II. LITERATURE REVIEW

Several studies have successfully employed aspect-based sentiment analysis approach, often utilizing Naive Bayes algorithm, across diverse domains. For instance, Fauziyyah et al. [2] analyzed user reviews of the Pegadaian Digital application for ABSA, achieving an accuracy of 78% with F1-score of 71%. Similarly, Parasati et al. [3] classified

sentiment in restaurant customer reviews across three aspects, with their highest accuracy of 88% on the food aspect and F1-score of 93% for positive sentiment. Furthermore, Putri et al. [4] applied a comparable approach to public opinion data from Tegal City, resulting in a training accuracy of 98.67% and F1-score of 91.62%.

Another research, Yutika et al. [5] investigated the performance of Naïve Bayes and Support Vector Machine (SVM) algorithms on Female Daily review data, reporting a peak accuracy of 94.17%. Differently, Simanungkalit et al. [6] employed Complement Naïve Bayes for classifying Shopee application reviews, achieving an accuracy of 91.9%. This latter study particularly emphasized the critical role of manual labeling, citing common discrepancies between numerical ratings and the actual substance of user comments. Table 1 provides a comprehensive summary of the key findings from the literature review.

TABLE 1. SUMMARY OF THE LITERATURE REVIEW

Researcher	Algorithm	Results
Fauziyyah et al. [2]	Naive Bayes	Accuracy = 78%, precision = 81%, recall = 65%, and F1-score = 71%.
Parasati et al. [3]	Naive Bayes	Accuracy of food aspect = 88%, accuracy of services aspect = 76%, accuracy of atmosphere aspect = 84%, the highest F1-score for positive sentiment of food aspect = 93%.
Putri et al. [4]	Naive Bayes	Traning accuracy = 98.67%, F1-score = 91.62%, testing accuracy = 82–98% depend on aspects.
Yutika et al. [5]	Naive Bayes & SVM	The highest accuracy = 94.17%, the F1-score is high and more representative for imbalanced data.
Simanungkalit et al. [6]	Complement Naive Bayes	Accuracy = 91.9%. It was found that reviews with good ratings could contain criticism, thus manual labeling was necessary

Focusing on the unique characteristics of social media discourse, this study applies aspect-based sentiment analysis to informal, concise, and highly contextual comments from the official Indonesian national football team's Instagram account. Our methodology involved using Latent Dirichlet Allocation for aspect extraction and Multinomial Naïve Bayes algorithm for sentiment classification, with thorough evaluation conducted on each automatically discovered aspect. This work offers a significant contribution to ABSA studies, particularly within the dynamic context of sports and social media.

III. METHODOLOGY

This research applies an aspect-based sentiment analysis approach, as shown in Fig. 1. The methodological stages include data collection, preprocessing, labeling, classification, and evaluation.

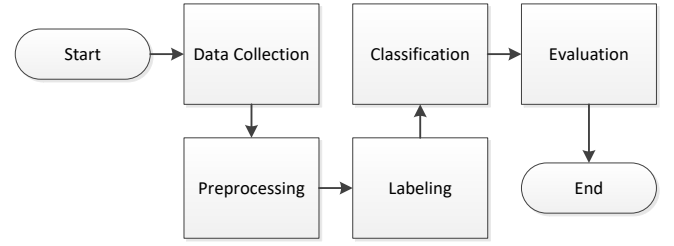


Fig. 1. ABSA framework

A. Data Collection

Data for this study were systematically collected from six official Instagram posts of the Indonesian national football team, all of which reported match scores from the third round of the 2024 World Cup qualifiers. These posts spanned the period from September 6 to November 19, 2024. Through targeted web scraping, 1.100 comments were retrieved per post, yielding a comprehensive dataset of 6.600 comments.

B. Preprocessing

Preprocessing was conducted to enhance data quality, specifically by eliminating irrelevant information and transforming the text into a suitable format for subsequent modeling. The steps undertaken included:

1) Case folding

All letters in the comments were converted to lowercase to ensure consistent comparisons, irrespective of original casing.

2) Data cleaning

To ensure the quality of the dataset, a comprehensive data cleaning process was undertaken. This involved systematically eliminating noise through several key procedures: removing special characters; deleting comments consisting only of emojis or numbers; correcting typos and separating combined words; translating English words; and removing unidentified words.

a) Removing special characters

Comments containing only numbers or emojis, without any words, were removed because they were not considered to express analyzable opinions.

b) Deleting comments consisting only of emojis or numbers

Comments containing only emojis or numbers were deleted as they did not contain meaningful textual information.

c) Correcting typos and separating combined words

Typographical errors and merged words were corrected using an internal dictionary, which was a CSV file manually compiled from training data.

d) Translating English words

English words were translated into Indonesian using the deep_translator library to ensure language consistency.

e) Removing unidentified words

To maintain standard Indonesian within the text, words originating from regional dialects and foreign languages

(other than Indonesian and English) were removed based on a pre-compiled list of foreign words.

3) Tokenizing

The sentence in the comment was broken down into word tokens using the `word_tokenize` function from the NLTK library.

4) Normalization

Informal and slang words were standardized to their formal forms with an internal slang dictionary, ensuring text consistency and enhancing data quality for further analysis.

5) Stemming

The stemming process was performed using the Sastrawi library to convert words into their basic form.

6) Stopword Removal

Words without significant meaning were removed based on the expanded stopwords list from the Sastrawi library.

C. Labeling

1) Aspect Labeling

Aspect labeling is crucial for identifying topics discussed in comments. This research employs LDA to identify hidden topics within a collection of comments by analyzing word distribution. The preprocessed comments were converted into numerical representations using CountVectorizer (Bag of Words method). This representation resulted in a word frequency matrix, which was then used as input for the LDA model.

LDA process began by creating a corpus and dictionary from existing comments. Next, the LDA model was trained using parameters such as the number of aspects, alpha, beta, and the number of iterations. To identify the optimal number of aspects, evaluation was performed using a coherence score, a metric that measures the semantic relatedness between words within a topic. Various configurations for the number of aspects were tested, and the model that yields the highest coherence value was selected. To ensure accurate linguistic meaning and contextual alignment, aspects labels were named in consultation with linguists. They interpreted word sets within each topic, providing representative and linguistically appropriate labels.

The selected model presented probability distributions of words within topics and topics within comments. This word-per-topic distribution was very useful for understanding the context of each topic. This result was then interpreted as a key aspect of aspect-based sentiment analysis.

2) Sentiment Labeling

Sentiment labeling is also crucial for categorizing datasets by their emotional tone or opinion. This involves assigning predefined labels, such as "positive" or "negative," to the comments. In this research, sentiment labeling was performed using an Indonesian lexicon dictionary called InSet (Indonesian Sentiment Lexicon). This lexicon consists of 3.609 positive words and 6.609 negative words, with sentiment weights ranging from -5 to +5. Each word in a comment was matched with an entry in the dictionary and scored according to its polarity. If the positive score is greater

than or equal to the negative score, the comment is labeled positive; otherwise, it's labeled negative.

D. Classification

Sentiment classification in this research was performed using Multinomial Naive Bayes algorithm. It is one of the most popular probabilistic methods for text classification tasks. This algorithm is very well-suited for use with frequency-based feature representations like Term Frequency-Inverse Document Frequency (TF-IDF).

To process text data for classification algorithm, firstly, TF-IDF was constructed from the dataset. Scikit-learn's `TfidfVectorizer` function was used for this transformation, converting preprocessed text into a numerical representation. TF-IDF effectively captures the importance of words: Term Frequency (TF) measures how often a word appears in a document, while Inverse Document Frequency (IDF) assigns greater weight to words that are uncommon across the entire dataset.

The classification process then assigned comments (X) to a sentiment class (C, positive or negative) by leveraging their TF-IDF values and applying Bayes' Theorem to determine the probability of each class as defined in (1).

$$P(C|X) = \frac{P(X|C)P(C)}{P(X)} \quad (1)$$

where,

$P(C|X)$ is the conditional probability of C given X

$P(X|C)$ is the conditional probability of X given C

$P(C)$ is the probability of C

$P(X)$ is the probability of X

In the context of text classification, probability calculations were performed using (2), (3), and (4).

$$P(C) = \frac{\text{number of comments in class } C}{\text{number of comments}} \quad (2)$$

$$P(w|C) = \frac{w \text{ frequency in class } C + \alpha}{\text{number of words in class } C + \text{number of unique words}} \quad (3)$$

$$P(C|W) = P(C) \times \prod P(W_i|C) \quad (4)$$

where,

w is a word

$\alpha = 1$, Laplace Smoothing to prevent zero probability

π is the product of all W_i words in the sentence

W_i is the i -th word in the comment

Once the probability for each class was found, the class with the highest value was selected as the result (either positive or negative).

E. Evaluation

The evaluation was conducted using 5-fold Stratified K-Fold Cross Validation. The best alpha parameter was determined using GridSearchCV on Multinomial Naive

Bayes model. The model was evaluated using accuracy (5), recall (6), precision (7), and F1-score (8).

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN} \quad (5)$$

$$Recall = \frac{TP}{TP + FN} \quad (6)$$

$$Precision = \frac{TP}{TP + FP} \quad (7)$$

$$F1 - Measure = 2x \frac{Precision \times Recall}{Precision + Recall} \quad (8)$$

where,

TP is true positive

TN is true negative

FP is false positive

FN is false negative

IV. RESULTS AND DISCUSSION

A. Evaluation of LDA Aspects

The optimal number of aspects in the LDA model was determined by evaluating the coherence score (a metric measuring semantic relatedness between words within a topic), with trials conducted for 2 to 5 aspects. As depicted in Fig. 2, an optimal coherence score of 0.538 was achieved with three topics, thereby establishing this as the most suitable configuration for the aspect extraction process.

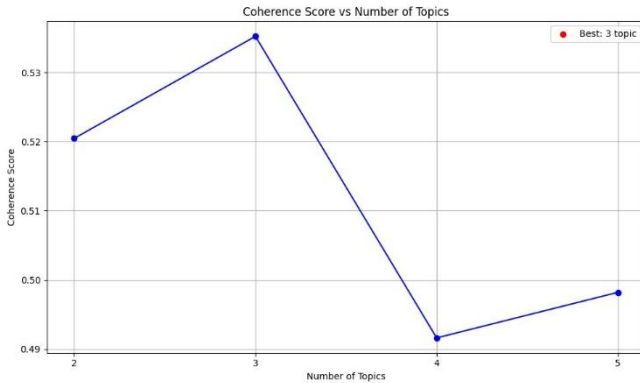


Fig. 2. Coherence score versus the number of topics, showing that a topic count of 3 yields the highest score.

Table 2 lists the three aspects, which were then semantically validated and labeled by linguists.

TABLE II. KEYWORDS FOR THE THREE ASPECTS

Aspect	Keywords
Performa Tim & Lawan	main indonesia shin wasit tae yong lawan latih arab jepang bapak imbang jadi kalau raja grup buat kalah lebih bagus
Dukungan dan Semangat Nasional	nasional tim tetap semangat garuda indonesia kalian terus kakak paes menang nyala juang dukung bangga baik dunia kasih kalah verdonk

Hasil & Situasi Pertandingan	main bahrain kalau kalah menang jangan asnawi jadi dunia banyak piala bung tanggal gelora mau karno dikit guling lawan rumput
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B. Evaluation of Multinomial Naive Bayes

Sentiment classification in this study was conducted using Multinomial Naive Bayes algorithm, complemented by TF-IDF feature representation. The data was partitioned into 75% for training and 25% for testing. To enhance the model, GridSearchCV was applied to determine the optimal smoothing parameters, and validation was carried out with Stratified K-Fold Cross Validation (k=5), thereby maintaining a balanced label distribution within each fold. Table 3 presents the evaluation results.

TABLE III. EVALUATION RESULTS

Evaluation Metric	Result (%)
Accuracy	79.31
Precision	79.20
Recall	79.31
F1-Score	79.24

With alpha value of 1.895 and accuracy of 79.31%, the model demonstrates strong performance, correctly classifying almost 80% of comments. The balanced precision and recall metrics highlight the model's ability to accurately detect positive sentiment (precision) without significantly missing comments that should have been classified as either positive or negative (recall).

With F1-score of 79.24%, the model demonstrates consistently effective performance in aspect-based sentiment analysis. This strong result indicates that the combined approach of TF-IDF for feature extraction and Multinomial Naive Bayes for classification is highly capable. This is particularly noteworthy given the challenging nature of social media data, which is often characterized by its informality (e.g., slang, misspellings) and imbalanced sentiment distribution (e.g., more positive than negative mentions or vice-versa), yet the model still achieves competitive and reliable outcomes.

C. Evaluation of Classification by Aspect

To gain a deeper understanding of the model's effectiveness beyond its overall performance, further analysis was conducted focusing on each individual aspect identified through the LDA topic extraction process. This allows us to assess the model's ability in accurately understanding and classifying sentiments to specific dimensions within user comments, rather than solely from a general perspective. This also offers a more comprehensive evaluation of its analytical capabilities. Table 4 presents the results.

The model demonstrated its strongest performance on the *Performa Tim & Lawan* aspect, achieving 81.44% accuracy and 80.81% F1-score. This suggests that comments discussing technical aspects of the game, including strategy, coaches, and opponents, are more linguistically consistent, making them easier for the classification model to recognize.

TABLE IV. EVALUATION RESULTS BY ASPECT

Aspect	Best Alpha	Accuracy (%)	Precision (%)	Recall (%)	F1-Score (%)
<i>Dukungan & Semangat Nasional</i>	2.0	80.70	80.80	80.70	80.73
<i>Performa Tim & Lawan</i>	1.7	81.44	80.75	81.44	80.81
<i>Hasil & Situasi Pertandingan</i>	0.5	79.37	79.46	79.37	79.42

Meanwhile, the *Dukungan & Semangat Nasional* aspect also performed strongly, achieving an 80.70% accuracy. Comments in this aspect were generally positive and expressive, yet structured enough for the model to recognize. This stable performance indicates that the model effectively capture the nuances of appreciative or motivational sentiment from national team supporters.

The *Hasil & Situasi Pertandingan* aspect showed the lowest performance, with accuracy of 79.37% and F1-score of 79.42%. This slight drop in performance is likely due to the ambiguity in comments discussing match results. For instance, a single comment might express mixed sentiments, like disappointment over a loss alongside pride in the team's fighting spirit.

D. Sentiment Distribution by Aspect

Fig. 3 illustrates the distribution of comments, revealing the following sentiment patterns for positive and negative sentiments within each aspect:

- *Performa Tim & Lawan*: Dominance of negative comments (1.738 negative vs. 697 positive), reflecting public criticism of both technical performance and game strategy.
- *Dukungan & Semangat Nasional*: The majority of comments are positive (1.349 positive vs. 951 negative), reflecting the loyalty and nationalism of the supporters.
- *Hasil & Situasi Pertandingan*: Sentiment is generally negative (1.254 negative vs. 527 positive), often triggered by match results or referee decisions.

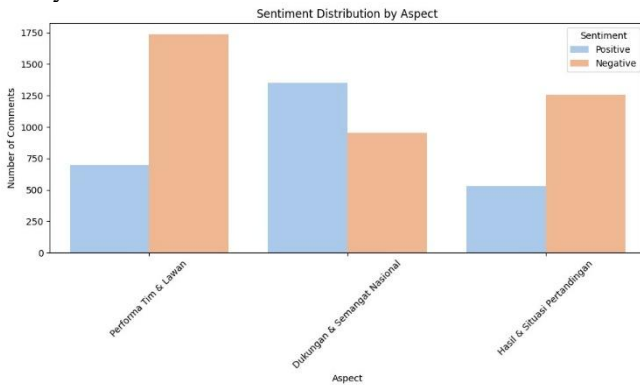


Fig. 3. Sentiment distribution by aspect

While other studies in other contexts have reported higher performance metrics (as seen in Table 1), our results reflect the unique challenges of analyzing informal and highly

contextual social media data. We applied ABSA to comments on the Indonesian national football team's Instagram account, a dataset with very different characteristics than those used in prior research. Our methodology, which combined LDA for aspect extraction with a Multinomial Naïve Bayes classifier, was specifically designed for this dynamic and often noisy environment. By evaluating our model on each automatically discovered aspect, we offer a significant contribution to ABSA, providing insights into a nuanced domain, sports-related social media, that has not been widely explored.

V. CONCLUSION

This study successfully used ABSA to analyze public opinion on the Indonesian national football team's Instagram account. Our findings identified three key aspects: “*Dukungan & Semangat Nasional*,” “*Performa Tim & Lawan*,” and “*Hasil & Situasi Pertandingan*,” demonstrating that sentiment varies across these distinct topics. The most dominant positive sentiment was found in the *Dukungan & Semangat Nasional* aspect, while *Performa Tim & Lawan* aspect tended to receive more negative sentiment from users. This work validates the use of an ABSA approach to uncover a granular and nuanced understanding of public opinion in a highly dynamic social media context. The results provide valuable insights for stakeholders, highlighting specific areas of strength and weakness from the public's perspective.

A key limitation of this study is its focus on a single algorithmic model for sentiment analysis. While this approach was effective for our exploratory, proof-of-concept investigation into the application of sentiment analysis for real-time public opinion, it does not provide a comparative performance analysis against other available models.

Further research can be conducted to improve sentiment classification accuracy by focusing on exploring advanced deep learning models, such as Long Short-Term Memory (LSTM), BERT (Bidirectional Encoder Representations from Transformers), or RoBERTa (Robustly Optimized BERT Pretraining Approach), which are better at understanding sentence context. A comprehensive comparison of various algorithms would also be a valuable and logical next step. Such a comparative study could identify which specific models are most effective for this type of data and application, thus providing a more robust foundation for future research in this domain.

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