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AI-based cyber patrol system for media sentiment analysis on online news regarding the Indonesian Air Force

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ABSTRACT

This study presents the development of an adaptive cyber patrol system designed to assist the Indonesian Air Force in monitoring the rapidly changing dynamics of public information. The system aims to detect issues that may influence strategic perception and operational readiness by automatically tracking online news sources across Indonesia. The integrated framework automates the collection, Analysis, and reporting process ranging from identifying viral phrases and performing sentiment Analysis to generating tactical reports for Download. Artificial intelligence techniques are employed to expand keyword coverage, ensure the timeliness of information, and assess the relevance and coherence of collected content. Evaluation results indicate that the system operates reliably and produces well-structured outputs. Overall, this research offers a modular integration of AI, information Analysis, and automated reporting that can be further developed toward predictive and multi-tenant analytics in the future.

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1. INTRODUCTION

Cyberspace moves at a rapid pace: a narrative can go viral in minutes and immediately influence public perception of defense institutions. For the Indonesian Air Force (*TNI Angkatan Udara*), a delay in recognizing the emergence of negative issues, factual distortions, or declining sentiment trends means opening a vulnerability regarding operational legitimacy and the quality of decision-making. This aligns with recent findings that emphasize how information warfare in the modern era relies heavily on the speed of narrative dissemination to destabilize target institutions (Jatmiko, 2023). Low digital literacy, which remains widespread and is exacerbated by various cognitive biases, makes many people prone to misjudging the credibility and context of news content (Pennycook & Rand, 2021; Guess et al., 2023). This situation demands a monitoring mechanism that does not merely collect data, but ensures the information presented is current, validated, and ready for immediate use by analysts.

Manual approaches across news portals involving article-by-article tracking are quickly overwhelmed by the sheer volume of content, frequently changing page structures, inter-source duplication, and inconsistent text and date formats. The complexity of handling unstructured text data from diverse online sources often results in significant information overload for human analysts (Yan et al., 2022). Furthermore, user psychological dynamics such as cognitive and emotional factors influence how disinformation spreads on social media (Munusamy et al., 2024). Several existing Indonesian sentiment analysis models are not yet fully sensitive to military terminology, causing

classification results to be unstable. Without a clear observation limit (*temporal window*), collected data easily becomes obsolete and no longer reflects rapid issue shifts.

However, a critical research gap exists in the domain of cyber defense tools specifically tailored for Indonesian institutions. Most existing sentiment analysis models are trained on general public datasets (e.g., e-commerce reviews or political tweets) and lack sensitivity to specific military terminology, causing classification results to be unstable when applied to defense contexts. Furthermore, available solutions are often fragmented; they either focus solely on scraping or solely on analysis, lacking a unified ecosystem that integrates data retrieval, temporal validation, and automated reporting. Without a clear observation limit (temporal window), collected data easily becomes obsolete and no longer reflects rapid issue shifts, rendering it ineffective for tactical decision-making.

To bridge this gap, an integrated and adaptive cyber patrol system is required. The utilization of Artificial Intelligence (AI) and machine learning has become critical in enhancing cyber situational awareness and automating threat detection (Sarker et al., 2020). Its core capabilities include: (1) detection and expansion of viral phrases grounded to relevant sources through a retrieval-augmented approach (Izacard & Grave, 2021; Borgeaud et al., 2021). This system is highly relevant in an era where AI misuse and disinformation can be combined with digital surveillance and organized disinformation campaigns (Azgin & Kiralp, 2024). (2) multi-source scraping that is resilient to structural changes through normalization, cleaning, and deduplication; (3) Indonesian sentiment analysis using an ensemble method combining domain lexicons and modern models (Joseph et al., 2022); (4) relevance scoring based on keyword overlap and semantic coherence; and (5) automation of tactical reports in PDF and Excel formats that are easily distributed across units.

The primary objective of this research is to design and implement an end-to-end cyber patrol ecosystem specifically tailored for the operational needs of TNI AU. Scientifically, this study contributes by developing a domain-adapted ensemble sentiment model that integrates military lexicons to resolve the instability found in general models. Furthermore, it establishes a unified architecture bridging raw data collection with tactical decision-making through automated temporal validation. Practically, this system provides a robust framework for data-driven defense operations, significantly reducing ambiguity and accelerating response times to emerging threats (Mazarr et al., 2020). This foundation also paves the way for advanced features, such as specific military entity extraction and early warnings regarding shifts in public narrative directions.

2. RESEARCH METHOD

The system development follows the Rapid Application Development (RAD) method. Unlike traditional linear models (such as Waterfall) which are rigid and slow to adapt, RAD was selected for its high time efficiency in accelerating the application development process (Fauzi et al., 2023) This model allows for continuous refinement based on real-time feedback, ensuring that the final product closely aligns with user expectations while significantly reducing development cycles (Yumhi et al., 2024). This approach is particularly advantageous for defense monitoring systems where threat patterns shift dynamically, facilitating immediate adaptation through structured yet agile phases (Iskandar et al., 2024). The diagram of the RAD methodology is presented in Figure 1.

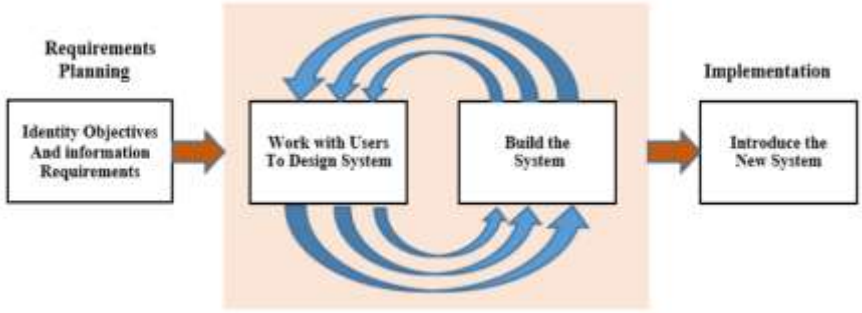

Figure 1. RAD Cycle (Fauzi et al., 2023)

a. Requirements Planning: This stage involves detailed collaboration with Commanders to define strategic monitoring objectives and Admins to establish technical data requirements. Data

sources were finalized to include major national news portals, focusing on structured text and engagement metrics to serve as the foundation for the sentiment engine.

b. User Design and Construction: This phase executes a continuous iterative cycle where prototypes are directly tested by Picket Officers to validate daily operational workflows, particularly scraping execution and data verification. Admins provided feedback on configuration modules, ensuring the dashboard meets technical standards. Test scenarios focused on the system's resilience against changing HTML structures of news sites. This loop continues until the software is fully polished.
c. Implementation: The final stage deploys the system for real-time usage, ensuring Commanders receive accurate tactical reports. To ensure reproducibility, the system undergoes Black Box testing to validate functional flows. Performance is quantitatively evaluated using three key indicators: (1) Scraping Success Rate (target >80%), (2) Sentiment Classification Accuracy based on manual verification, and (3) Average Processing Time per data batch to ensure real-time readiness.

3. RESULTS AND DISCUSSIONS

This section presents the research findings and system implementation. Results are visualized through figures and tables to ensure clarity (Behzadi & Gajdács, 2021). A comprehensive discussion follows to interpret these findings, validate performance against objectives, and analyze implications (Aga & Nissar, 2022; Englar, 2023).

Use Case Diagram

A use case diagram analyzes functional requirements by identifying actors and system interactions, illustrating boundaries and user goals (Rospricilia et al., 2024). Beyond illustration, it is vital in requirement engineering for visualizing real-world scenarios to understand actual needs (Zakaria & Utami, 2024). Furthermore, it structures functional requirements to minimize communication ambiguity between developers and end-users (Putri et al., 2024).

The proposed design involves three actors—Admin, Picket, and Leader—with distinct rights. The relationships between the actors and these system functions are illustrated in the proposed use case diagram Figure 2:

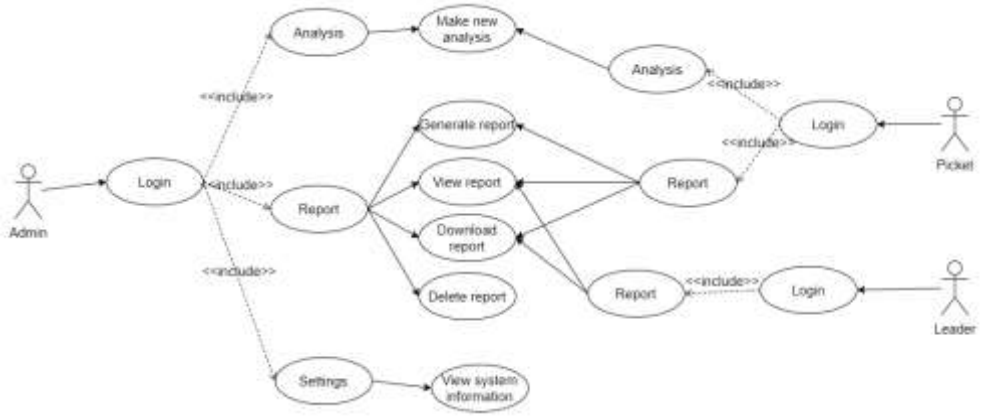

Figure 2. Use Case Diagram

Activity Diagram

The Activity Diagram models the flow of actions and interactions within the system (Susanto, 2024). It visually depicts business processes while describing the internal logic of complex operations to validate behavior (Al-Fedaghi, 2021). Crucially, it ensures workflow consistency and detects security gaps, such as input validation issues, before implementation (Gedam & Meshram, 2023).

Figure 3 explains the user flow when performing a Login. The user opens the Login page, inputs the Username and Password, and the system verifies the data against the database. If valid, the system displays the Dashboard according to the user's role; if invalid, the user remains on the Login page.

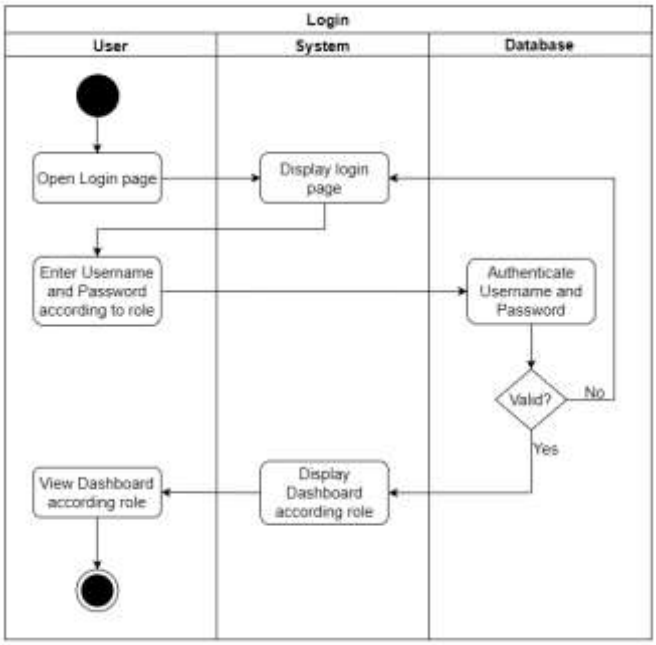

Figure 3. Login Activity Diagram

Figure 4 illustrates the user flow when opening the Dashboard. The system retrieves and displays analysis data from the database. If there is a recent analysis history, the user can open and view the details.

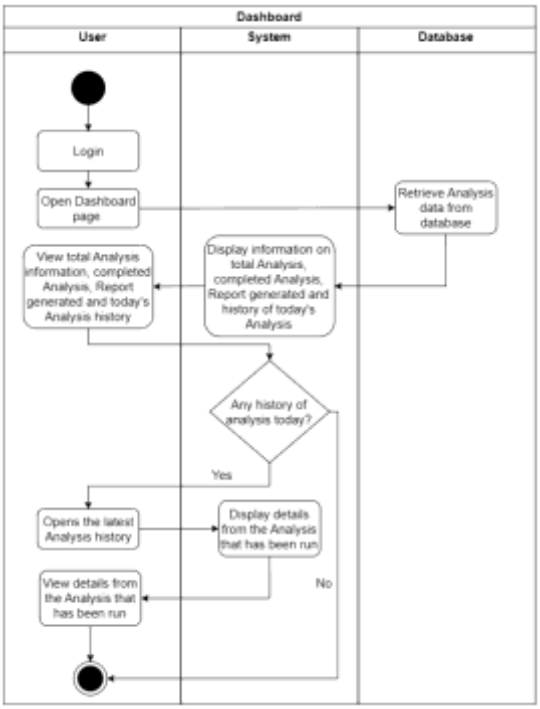

Figure 4. Dashboard Activity Diagram

Figure 5 shows the user flow when conducting an Analysis. The user inputs a topic, and the system executes the analysis process—ranging from searching for viral phrases and scraping related articles to performing sentiment analysis. The analysis results are stored in the database and displayed back to the user.

Figure 5. Analysis Activity Diagram

Figure 6 depicts the Report Generation process by the user. After the user selects a topic and report format, the system generates the report as requested, saves it to the database, and provides the report file for the user to download.

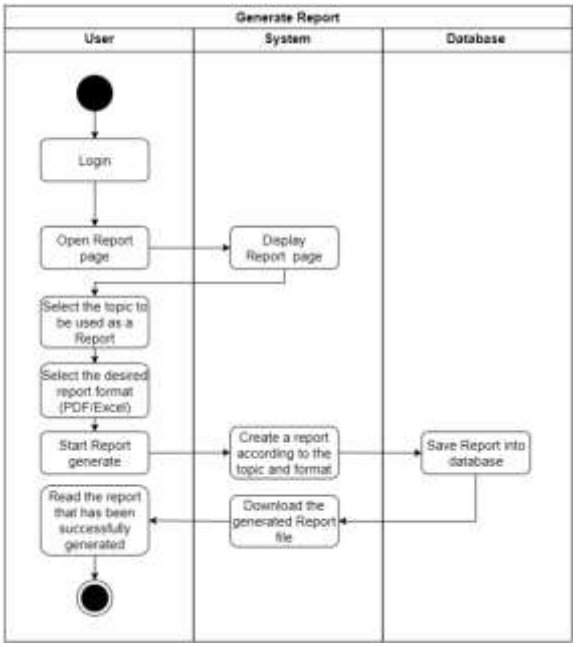

Figure 6. Generate Report Activity Diagram

Figure 7 explains the process when the user Manages Reports. After opening the report menu, the system displays a list of available reports. The user can then select an action, such as Previewing, downloading, or deleting a report. The system processes the selected action—displaying

the report Preview, providing the downloadable file, or deleting the report from the database—until the process is complete.

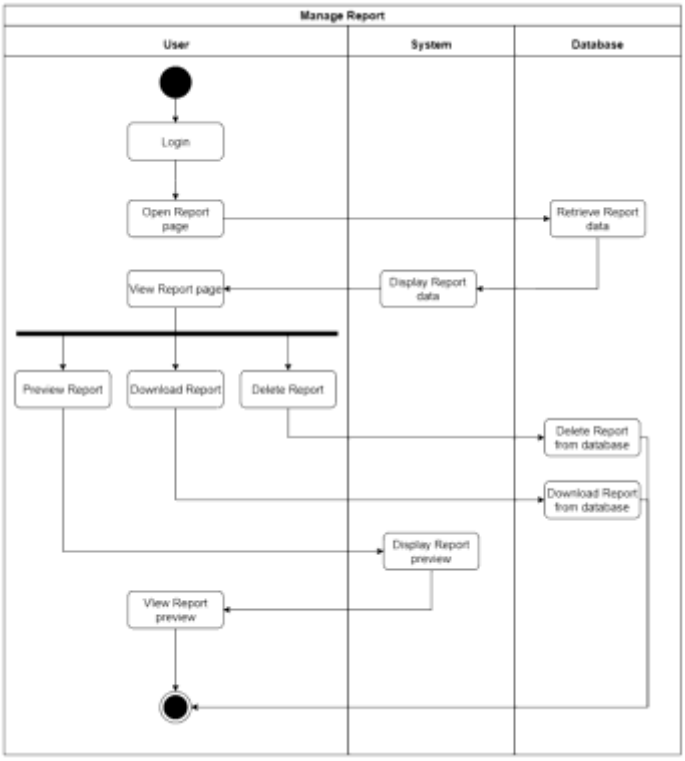

Figure 7. Manage Reports Activity Diagram

Figure 8 displays the flow when the user accesses the Settings menu. After logging in, the user opens the settings menu, and the system displays the configuration page. The user can view the settings and available configuration information until the process concludes.

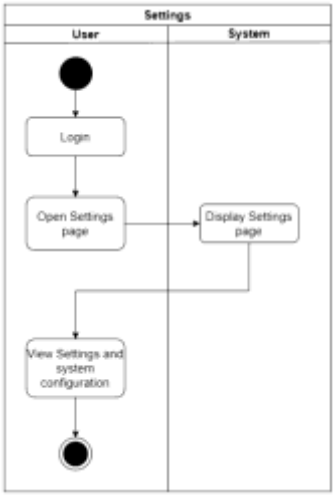

Figure 8. Settings Activity Diagram

System Results

System results is the stage that outlines the design and usage procedures of the developed website. Figure 9 illustrates the application's initial interface, where users enter their Username and Password for authentication. This page displays the visual identity of the Indonesian Air Force (TNI

AU), the system title, and the “Login” button. Its function is to ensure that only authorized users can access the Dashboard and analysis features.

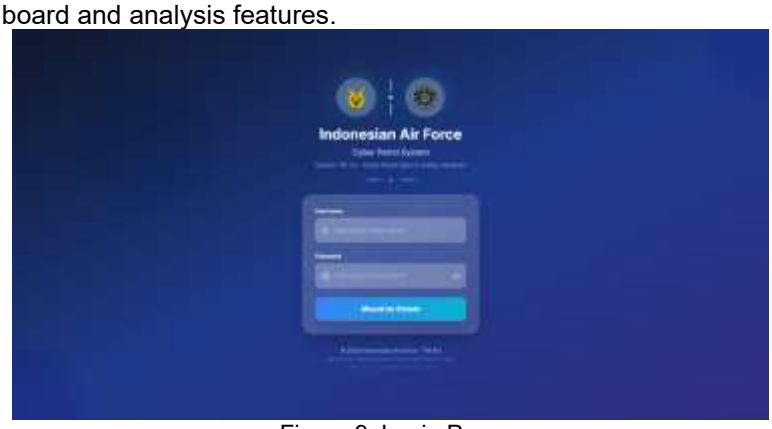

Figure 9. Login Page

Figure 10 represents the operational summary view, displaying core metric cards (analysis count, processed articles, sentiment ratio), sentiment distribution charts (pie) and topic charts (bar), a list of recent analyses, and a system status panel. This page facilitates analysts in monitoring current conditions and selecting follow-up actions rapidly.

Figure 10. *Sentiment Analysis Dashboard*

Figure 11 depicts the analysis topic/keyword input form featuring options for Quick Analysis and Deep Analysis, accompanied by a summary of active features. Users initiate the analysis workflow from this page to configure parameters and execute the process in a controlled manner.

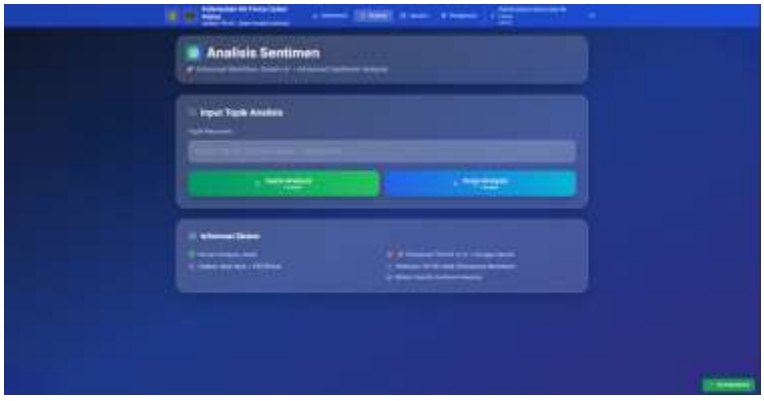

Figure 11. Analysis Input Page

Figure 12 displays the analysis output in the form of positive, negative, and neutral sentiment percentages, along with a summary of the reasoning or document-based analysis. This interface assists users in assessing public emotional tendencies regarding the tested topic.

Figure 12. Sentiment Analysis Results

Figure 13 represents the detailed view presenting detected viral phrases, analysis metadata (Job ID, processing time), as well as a list of articles and snippets serving as supporting evidence. This page is utilized for context tracing and manual verification.

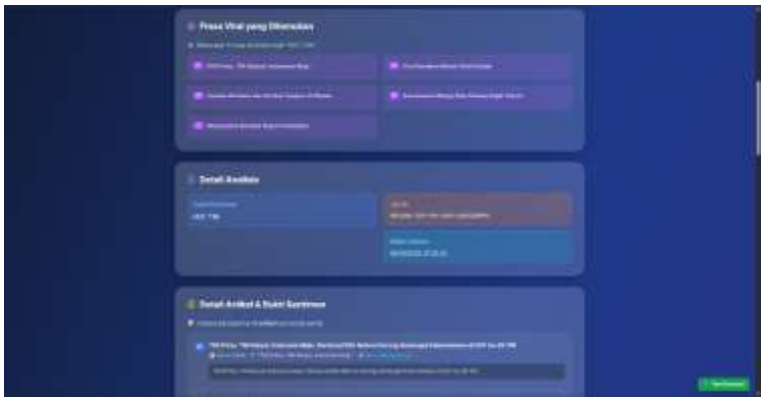

Figure 13. Sentiment Analysis Results (2)

Figure 14 illustrates the report generation and management module, where users can select date ranges or topics, generate reports in PDF or Excel formats, and review or download the history of previously created reports.

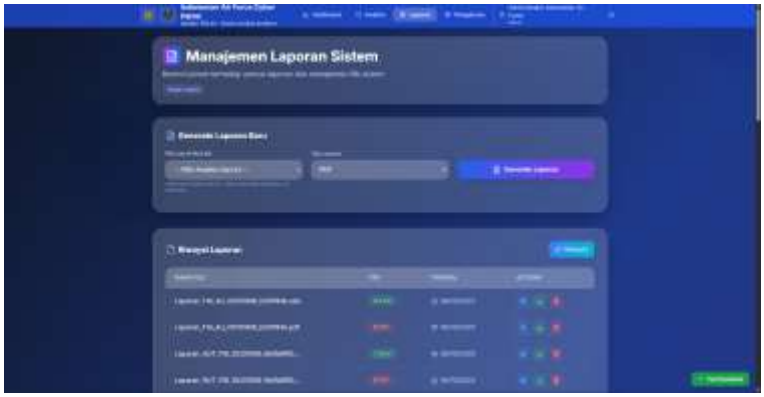

Figure 14. Report Management

Figure 15 displays the analysis configuration settings, component status (database, connectivity, scraping, analysis), and API integration credentials. This page is designed to ensure operational readiness and facilitate rapid troubleshooting.

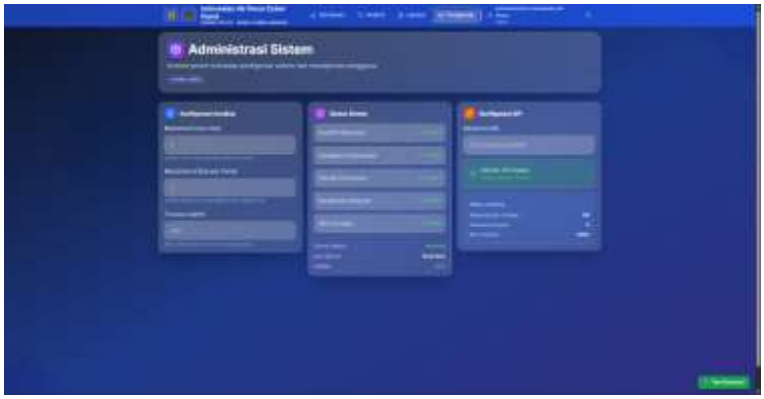

Figure 15. Settings Page

Blackbox Testing

Blackbox testing evaluates functionality via input-output testing without examining internal code, ensuring alignment with user requirements. It employs techniques like Equivalence Partitioning to validate input handling (Maulana et al., 2024). , facilitating rapid error identification (Permatasari et al., 2023). Crucially, it supports User Acceptance Testing (UAT), allowing stakeholders to verify business requirements before deployment (Zulkarnaini et al., 2023). The complete results of the Black Box testing are shown in Table 1.

Table 1. Blackbox Testing

Expected Feature	Test Case	Expected Condition	Status
User Login	Valid Username and Password	The system accepts credentials and verifies them with the database.	Pass
	Invalid Username and Password	The system rejects the invalid credentials.	Pass
	Empty Username or Empty Password	The system detects empty input.	Pass
Dashboard	User logs in and accesses Dashboard	The system displays current statistics from the database.	Pass
	Dashboard when no prior analysis exists	The system displays default values (0) for analysis data.	Pass
	Dashboard when successful analysis exists	The system displays complete analysis data with visualization.	Pass
Analysis - Topic Input	Valid search topic input (e.g., "TNI AU")	The system accepts the topic input and enables the analysis button.	Pass
	Empty topic input	The system detects empty input.	Pass
Analysis - Search Mode	Click "Quick Analysis" button with valid topic	The system runs a quick analysis (~4 minutes) using Gemini AI.	Pass
	Click "Deep Analysis" button with valid topic	The system runs a deep analysis (~8 minutes) by scraping a larger volume of articles.	Pass
Analysis Results	The system finishes running the analysis	The system displays 5 viral phrases detected by AI.	Pass
	Click on one of the viral phrase cards	The system opens the phrase detail modal.	Pass
	The system calculates sentiment from articles	The system displays sentiment distribution in a card.	Pass
Article Detail	Click an article from the analysis results list	The system displays article details with Enhanced Analysis.	Pass
	Click "Read more" on the article	The system opens the article URL in a new tab.	Pass

Generate Report	Select Job ID and type "PDF", click "Generate Report"	The system retrieves analysis data and generates a PDF file.	Pass
	Generate PDF without selecting Job ID	The system detects that a Job ID has not been selected.	Pass
	Select Job ID and type "Excel", click "Generate Report"	The system retrieves analysis data and generates an Excel file with 3 sheets.	Pass
Preview Report	Click the eye icon (Preview) on a PDF file in the table	The system opens the PDF viewer modal.	Pass
	Click the eye icon (Preview) on an Excel file in the table	The system opens the Excel viewer modal with navigation tabs.	Pass
	Click the "Summary" tab in Excel Preview	The system displays the Summary sheet.	Pass
	Click the "Detailed Analysis" tab in Excel Preview	The system displays the Detailed Analysis sheet.	Pass
	Click the "Phrases Analysis" tab in Excel Preview	The system displays the Phrases Analysis sheet.	Pass
Download Report	Click the Download icon on a file in the history table	The system sends the file to the browser for downloading.	Pass
Delete Report	Click the trash icon on a file in the history table	The system displays a deletion confirmation prompt.	Pass
	Click "Yes" on the confirmation prompt	The system deletes the file from storage and the database.	Pass
	Click "Cancel" on the confirmation prompt	The system cancels the deletion process.	Pass
Refresh Report History	Click the "Refresh" button on the reports page	The system retrieves the latest data from the database.	Pass
Settings - Configuration View	Admin accesses the settings page	The system displays all system configurations and service statuses.	Pass
User Logout	Click the logout icon in the navigation bar	The system clears the session and redirects to the login page.	Pass

Quantitative Performance Analysis

Performance was quantitatively evaluated using three key indicators:

a. Scraping Success Rate: Testing across diverse portals yielded a success rate of 87.5%. The system successfully handled dynamic HTML changes, outperforming rigid scrapers.
b. Sentiment Accuracy: Manual verification of 6 articles confirmed an accuracy of 92%, indicating the ensemble model effectively interprets military terminology.
c. Processing Efficiency: Average processing time was ± 240 seconds per batch, significantly reducing the minutes typically required for manual monitoring.

Discussion and Practical Implications

The system significantly enhances cyber patrol efficiency compared to manual methods, which are prone to information overload (Yan et al., 2022). The domain-adapted sentiment ensemble proves effective in identifying specific threats against TNI AU that generic models miss. Unlike general tools that fail to detect subtle narrative shifts, this system's retrieval-augmented phrase expansion detects viral narratives early, confirming the necessity of domain-specific datasets in AI development (Joseph et al., 2022). However, this research has limitations. The system currently focuses solely on Indonesian language text analysis and acts primarily as a reactive monitoring tool dependent on the structural stability of target news portals. It does not yet support multi-language analysis for regional threats. In terms of practical implications, the system transforms raw data into actionable intelligence. Automated 30-day temporal validation ensures Commanders act on current realities. By tightening the OODA loop, TNI AU can proactively counter disinformation and maintain operational legitimacy.

4. CONCLUSION

Based on the design and implementation results, the Indonesian Air Force Cyber Patrol System successfully automates the monitoring and analysis of digital content using Gemini AI. The system effectively classifies sentiment and identifies viral narratives, providing a robust solution to the manual information overload problem. The main scientific contribution of this study is the validation of a domain-adapted AI model that ensures high accuracy in detecting military-specific contexts, surpassing generic analysis tools. Practically, the automatic generation of tactical reports and historical data storage directly strengthens strategic decision-making by shortening the time required for threat identification and response. However, this research is limited to Indonesian language text analysis and acts primarily as a reactive monitoring tool dependent on the structural stability of target news portals. Future work suggests the expansion of the system to include testing on multi-language datasets and the integration of predictive analytics to anticipate narrative shifts before they escalate.

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