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Development of Alakdan: An A.I. virtual assistant for Centro Escolar University processes

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Abstract

This study addresses improvements in student administrative processes at Centro Escolar University (CEU)-Manila by developing and evaluating *Alakdan*, a mobile virtual assistant powered by Natural Language Processing (NLP). The chatbot guides students through key procedures such as admission, enrollment, scholarship applications, and diploma requests. Evaluated against the ISO/IEC 25010 software quality standards, Alakdan demonstrated high performance across seven attributes: functional suitability, performance efficiency, usability, reliability, security, maintainability, and portability. Testing revealed a low error rate (1.50%) and fallback rate (2.79%), with response times averaging 5–8 seconds. Positive user feedback underscores its effectiveness in reducing administrative burdens. This research contributes to AI applications in higher education and offers insights for future chatbot development in academic settings.

Keywords: Mobile virtual assistant app; Natural language processing; Student-related administrative services; Process automation; Software development

1. Introduction

The rapid advancement of technology has revolutionized sectors globally, with education emerging as a key beneficiary. Innovations such as chatbots—AI-driven tools designed to simulate human conversation—have become pivotal in streamlining administrative and academic processes. These systems leverage Natural Language Processing (NLP), a subset of artificial intelligence that enables machines to interpret, analyze, and respond to human language [20]. By integrating NLP, chatbots evolve dynamically, learning from interactions to deliver increasingly accurate and personalized assistance [12]. In educational contexts, chatbots are now widely deployed to handle tasks ranging from enrollment guidance to real-time query resolution, significantly reducing institutional workloads and enhancing student accessibility [21].

Despite these advancements, many universities, including Centro Escolar University (CEU)-Manila, continue to rely on fragmented systems for student support. CEU's current platform offers limited procedural information, forcing students to seek assistance through inefficient channels such as social media help desks, departmental visits, or delayed online responses. These methods not only consume time but also create bottlenecks during critical processes like enrollment, scholarship applications, or transcript requests. For instance, students often navigate multiple departments across campus or await online availability, exacerbating stress in an already demanding academic environment.

To address these challenges, this study introduces *Alakdan*, an NLP-powered mobile chatbot tailored for CEU-Manila. Designed as a centralized virtual assistant, Alakdan provides real-time guidance on administrative workflows, including

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course shifting, diploma requests, and exit clearance procedures. By consolidating information into an intuitive interface, the chatbot minimizes the need for physical visits or prolonged waits, aligning with broader institutional goals of operational efficiency and student-centric service [1]. Preliminary testing indicates that Alakdan enhances procedural awareness among students, reducing administrative burdens while fostering a seamless academic experience.

Statement of the objectives

This study addresses improvements in academic and administrative workflows at Centro Escolar University (CEU)-Manila by developing *Alakdan*, a chatbot-powered virtual assistant application. It serves as a centralized platform to streamline student processes such as admissions, enrollment, scholarship applications, and diploma requests. Specifically, to design, develop, and evaluate Alakdan—a prototype chatbot application leveraging Natural Language Processing (NLP) to optimize student processes at CEU-Manila. By delivering instant, accurate information on institutional workflows, the chatbot aims to:

- Simplify access to administrative guidance (e.g., enrollment, course shifting).
- Reduce operational inefficiencies for staff and faculty.
- Establish a scalable model for AI-driven student support systems in higher education.

2. Theoretical framework

The study adopts Gordon Pask's Conversational Theory as its theoretical framework, which posits that learning emerges through structured dialogue between participants—in this context, humans and machines. By simulating bidirectional interactions, this theory aligns with the design of Alakdan, where the chatbot engages users in dynamic exchanges to guide them through institutional processes. Central to this framework is Natural Language Processing (NLP), a subfield of artificial intelligence that enables machines to interpret, analyze, and generate human language. NLP bridges the gap between unstructured user input like text or speech and structured computational data, allowing Alakdan to mimic human-like comprehension and deliver contextually relevant responses [13].

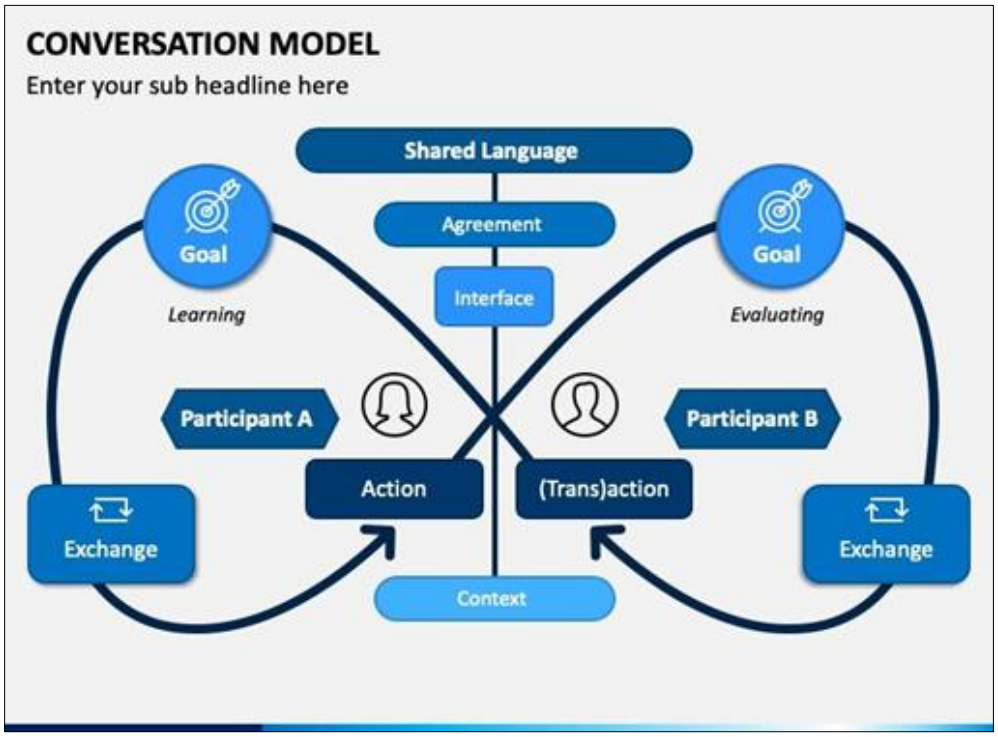

Figure 1 Theoretical Framework

The researchers incorporated NLP into Alakdan due to its synergy with Conversational Theory, leveraging several key features. Sentiment analysis detects the emotional tone in user queries to tailor empathetic responses. Word sense disambiguation resolves ambiguous terms based on context, such as distinguishing between "course" as a class and as an academic path. Named entity recognition identifies key entities, like "TOR request" or "scholarship application," to prioritize actionable tasks. Speech recognition and natural language production enable voice-based interactions and

coherent reply generation. Additionally, part-of-speech tagging parses grammatical structures to infer user intent, enhancing the system's overall responsiveness and accuracy.

These NLP components collectively enhance Alakdan's ability to sustain meaningful dialogues, evolving its conversational accuracy over time. For instance, by converting unstructured queries into structured data, the chatbot can map user needs to predefined workflows (e.g., enrollment steps), ensuring alignment with Pask's emphasis on iterative, context-aware learning. This integration not only refines Alakdan's responsiveness but also reinforces its role as a scalable solution for automating student services at CEU-Manila.

3. Research methodology

The study employed a prototyping methodology, a design approach widely utilized in research and development, to iteratively develop *Alakdan: A Virtual Assistant for Centro Escolar University Processes*. This method prioritized user-centric design by systematically collecting feedback from CEU-Manila students and staff through a structured evaluation process. By integrating user insights at each development stage, the researchers accelerated refinement cycles, enabling rapid implementation of improvements such as interface enhancements and response accuracy adjustments. To ensure alignment with global quality benchmarks, the prototype was evaluated against ISO/IEC 25010 standards for software product quality. A mixed-method survey—distributed via Google Forms—combined Likert-scale ratings with open-ended questions, allowing quantitative assessment of attributes like usability and reliability alongside qualitative feedback on user expectations. This approach not only validated the application's efficiency in streamlining administrative processes (e.g., enrollment, diploma requests) but also ensured its design directly addressed the needs of the CEU-Manila community. The prototyping framework proved instrumental in bridging theoretical objectives with practical outcomes, ultimately yielding a robust tool tailored to institutional workflows while adhering to rigorous quality criteria.

4. Software development model

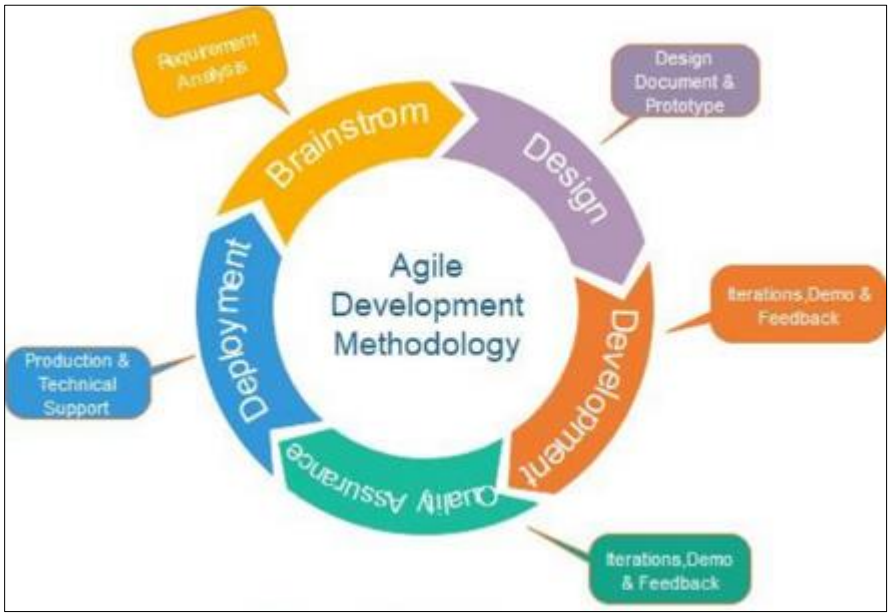

Figure 2 Agile Model

The development of Alakdan began with extensive discussions among the researchers, focusing on gathering essential requirements. They explored various sources and research studies focusing on development of application in education [2][3], including the official CEU website, the CEU handbook, and direct observations of student processes related to exit clearances, enrollment, dropping subjects, and other administrative tasks. The collected information was thoroughly analyzed to define the application's scope, features, and functionalities. Through brainstorming, the researchers identified inefficiencies in existing student processes, particularly outdated and unreliable information, which Alakdan aimed to improve.

Translating these requirements into a tangible application, the researchers designed Alakdan using Android Studio. They developed an intuitive and user-friendly login page for the chatbot while integrating datasets and knowledge base functionalities from Cody AI to ensure seamless access to relevant information. This foundational work was essential in shaping the prototype.

The implementation phase involved active coding within Android Studio, where the team built Alakdan's core functionalities as a mobile chatbot. Programming languages were utilized to enable smooth interactions between the user interface and the backend knowledge base sourced from Cody AI. To ensure quality, the chatbot was evaluated using survey questionnaires aligned with ISO/IEC 25010 standards, assessing characteristics such as functionality, usability, and reliability. Additionally, the researchers conducted performance testing, measuring key metrics such as response time, error rate, and fallback rate. Security testing was also performed, leveraging both Cody AI's built-in security measures and additional security assessments conducted on the application itself.

Once quality assurance was completed and feedback from evaluations was incorporated, Alakdan was prepared for deployment to students. To facilitate its use, the researchers provided user guides and tutorials via a QR code linking to a YouTube video, enabling students to efficiently navigate the chatbot for admission, enrollment, and other academic processes.

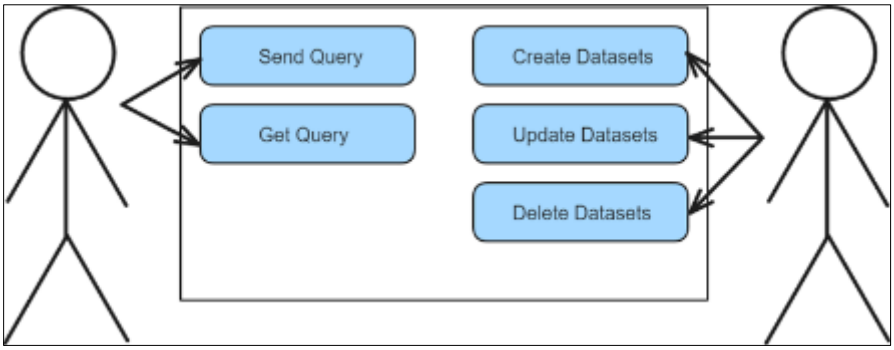

Figure 3 Use Cases

Users interacting with the application can perform two main functions. First, they can inquire about CEU-related processes, including course details, administrative procedures, and other university-related concerns specific to CEU-Manila. The chatbot's knowledge base is built from datasets consisting of Word documents and PDF files extracted from the university, ensuring accurate and up-to-date information. These processes cover various student services, such as admission and enrollment, re-enrollment, scholarship applications, transcript of records (TOR) requests, subject dropping, diploma requests, school transfers, and course shifting.

Meanwhile, software administrators have the capability to manage the application's knowledge base. They can add, edit, or delete datasets as needed, ensuring that the chatbot remains updated and aligned with the university's latest policies and procedures.

5. Results and discussion

Table 1 Hardware Specifications for Alakdan Development

Component	Hardware 1 (Laptop)	Hardware 2 (Laptop)	Hardware 3 (Laptop)	Hardware 4 (Laptop)
CPU	Intel Core i7-9750H	Intel Core i5-11400H	Intel Core i7-8557U	Intel Core i7-8850H
RAM	16GB DDR4	8GB DDR4 3200MHz	8GB DDR4 2400MHz	8GB DDR4-2666 2400MHz
GPU	GeForce GTX 1660 Ti	GeForce GTX 1650 Ti	Intel Iris Plus Graphics 645	Intel UHD Graphics 630
Storage	512GB SSD	512GB SSD	1TB HDD	1TB HDD

5.1.1. Analysis of Hardware Performance

During the development of Alakdan, four hardware configurations were tested to assess their ability to handle the computational demands of Natural Language Processing (NLP) algorithms and machine learning tasks. The first configuration, featuring an Intel Core i7-9750H processor, 16GB RAM, a GTX 1660 Ti GPU, and a 512GB SSD, demonstrated optimal performance. The powerful processor and ample RAM provided sufficient processing capability for NLP tasks, while the dedicated GPU enhanced graphic-intensive operations. Additionally, the SSD storage ensured rapid data access and minimized loading times, making this setup ideal for seamless application development and testing.

The second configuration, consisting of an Intel Core i5-11400H processor, 8GB RAM, a GTX 1650 Ti GPU, and a 512GB SSD, performed adequately but faced occasional limitations due to the lower RAM capacity. This affected multitasking efficiency, particularly when multiple applications were running simultaneously. Although the GTX 1650 Ti GPU supported machine learning tasks, the overall performance was slightly constrained compared to the first configuration.

The third configuration, which included an Intel Core i7-8557U processor, 8GB RAM, an Intel Iris Plus Graphics 645 GPU, and a 1TB HDD, exhibited performance bottlenecks. Despite the i7 processor, the integrated GPU and slower HDD storage significantly hindered efficiency. The absence of a dedicated GPU and slow data access speeds made this setup unsuitable for intensive NLP and machine learning workflows.

Similarly, the fourth configuration, featuring an Intel Core i7-8850H processor, 8GB RAM, an Intel UHD Graphics 630 GPU, and a 1TB HDD, struggled with graphic-intensive tasks. The integrated GPU limited processing power, and the reliance on HDD storage led to extended loading times, reducing overall development efficiency.

Based on the evaluations, the recommended hardware specifications for developing and deploying NLP-driven applications like Alakdan include an Intel Core i5 or i7 processor (or equivalent) to ensure efficient processing, along with 16GB DDR4 RAM for optimal multitasking and handling of complex algorithms. A dedicated graphics card, such as the GTX 1660 Ti or higher, is advised to support machine learning and graphic-intensive tasks. Additionally, a 500GB SSD or larger is recommended for faster data access and improved application responsiveness. These specifications strike a balance between performance and cost-effectiveness, facilitating the efficient development and deployment of AI-driven tools in academic settings.

Table 2 Software Tools for Alakdan Development

Software	**Pros**	**Cons**
Adobe Photoshop	- Offers advanced tools for photo editing, graphic design, and UI/UX design. - Provides fine control over design elements (e.g., colors, layers, effects). - Ideal for high-quality, detailed visual work.	- Steep learning curve, making it challenging for beginners. - Subscription-based pricing may be costly for occasional users. - Demands high system resources, requiring a powerful computer.
Canva	- User-friendly interface, accessible to beginners and non-designers. - Offers pre-designed templates for quick, professional-looking designs. - Supports collaboration and sharing for team projects.	- Limited customization compared to advanced tools like Photoshop. - Advanced features require a paid subscription. - Primarily web-based, limiting offline use and requiring stable internet.
Android Studio	- Official IDE for Android development, with robust support from Google. - Includes tools for coding, debugging, and performance analysis. - Integrates with Google services and libraries for seamless development.	- Complex for beginners, requiring time to learn. - Resource-intensive, especially when running emulators. - Gradle build system can be slow for larger projects.
Flutter	- Enables cross-platform development (Android and iOS) from a single codebase. - Hot reload feature speeds up development by	- Smaller ecosystem with fewer third-party libraries compared to native frameworks. - Performance may degrade on older devices with

Software	Pros	Cons
	reflecting changes in real-time. - Rich library of customizable widgets and animations.	complex UIs. - Larger app file sizes compared to native apps.

5.1.2. Analysis of Software Tools

The development of Alakdan utilized a combination of software tools to meet both front-end and back-end requirements. Adobe Photoshop served as the primary tool for designing the virtual assistant's user interface (UI), ensuring a visually appealing and intuitive design. Its advanced features allowed for precise control over design elements, resulting in high-quality visuals. However, the software's complexity required a learning curve, and its resource-intensive nature demanded high-performance hardware. Complementing this, Canva was used for creating visual aids and supplementary design assets. Its ease of use and pre-designed templates facilitated the quick creation of professional-looking materials, though limited customization options and dependency on internet connectivity posed some restrictions.

For development, Android Studio was the core environment for building and testing Alakdan's functionality on the Android platform. Its comprehensive tools for coding, debugging, and performance optimization contributed to the robustness of the application. However, the complexity of Android development and the platform's resource demands presented challenges, particularly for beginners. Flutter was initially considered for cross-platform development to support both Android and iOS. While its hot reload feature and single-codebase development offered potential time savings, limited third-party libraries and performance concerns on older devices ultimately led to its exclusion in favor of Android Studio.

Table 3 Operating Systems for Alakdan Development

Operating System	Pros	Cons
Windows 7	- Known for stability and reliability. - Wide compatibility with older software applications.	- Lacks modern optimizations and features. - Potential compatibility issues with newer hardware and software. - No longer supported, leading to security vulnerabilities.
Windows 10	- Built-in security features like Windows Defender Antivirus protect against malware. - Optimized for modern hardware, improving performance and resource management. - Enhanced efficiency over Windows 7.	- Resource-intensive background processes and updates can slow down lower-end devices. - Occasional compatibility issues with older or newer software.
Windows 11	- Improved optimization for better performance, battery life, and faster loading times. - Modern design and user-friendly interface enhance the overall user experience.	- Strict hardware requirements limit compatibility with older devices. - New interface may require adaptation, potentially confusing users familiar with older versions.

5.1.3. Analysis of Operating Systems

The development of Alakdan required careful evaluation of different operating systems to ensure optimal performance, security, and compatibility. Three Windows OS options were considered: Windows 7, Windows 10, and Windows 11. Windows 7 was recognized for its stability and reliability, making it a dependable choice for running legacy applications with broad software compatibility. However, as an outdated OS, it lacked modern optimizations, security updates, and compatibility with newer hardware, posing significant risks for development and deployment.

Windows 10 emerged as a strong contender due to its robust security features, including Windows Defender Antivirus, which protects against malware. Optimized for modern hardware, it enhances performance and resource management, making it a reliable choice for development. However, it can be resource-intensive on lower-end devices due to background processes and frequent updates, and occasional compatibility issues with older or newer software may arise.

Windows 11, on the other hand, provided improved optimization, resulting in faster loading times, better battery life, and an enhanced user experience through a modernized interface. Despite these advantages, its stringent hardware requirements limited compatibility with older devices, and the redesigned interface introduced a learning curve for users accustomed to previous versions.

5.1.4. Key Insights and Recommendations

For the development of Alakdan, Windows 10 and Windows 11 were identified as the most suitable operating systems, offering modern features, enhanced security, and improved performance, which are essential for handling NLP and machine learning tasks. While Windows 11 delivers the latest optimizations, its hardware requirements may exclude older systems. In contrast, Windows 10 provides a balance between performance and compatibility, making it a more versatile choice for a wider range of devices.

Both Windows 10 and Windows 11 ensure a secure development environment with built-in security features, whereas Windows 7, despite its past reliability, is no longer viable due to its lack of support and security updates. Ultimately, the choice between Windows 10 and Windows 11 depends on the available hardware and the need for cutting-edge features. For most development scenarios, Windows 10 is recommended due to its balanced approach to performance, compatibility, and security.

Table 4 AI Platforms for Alakdan Development

Platform	Pros	Cons
Cody AI	- User-friendly interface, accessible even to users with minimal technical expertise. - Seamless integration across multiple platforms, enhancing adaptability. - Efficient and straightforward for rapid deployment.	- Limited customization options, restricting adjustments to fit specific branding or needs. - Limited control over response accuracy and contextual relevance. - Potential for generating inaccurate or nonsensical responses.
Flowise AI	- Offers a wide range of features to meet diverse chatbot requirements. - Supports deployment across multiple channels, increasing accessibility. - Provides access to various language models (LLMs) for tailored solutions.	- Steeper learning curve due to platform complexity. - Advanced features can be expensive, limiting accessibility for some users. - Inconsistent online deployment may impact reliability.
Voiceflow	- Strong collaboration features, ideal for team-based projects. - Integrates smoothly with various platforms and websites. - Capable of handling large volumes of text data efficiently.	- Challenging for beginners, requiring significant time to master. - Complex projects may be difficult to manage due to the platform's advanced features. - High costs for advanced features may be prohibitive.

5.1.5. Analysis of AI Platforms

The development of Alakdan required selecting an AI platform capable of supporting Natural Language Processing (NLP) and chatbot functionalities. Three platforms were evaluated: Cody AI, Flowise AI, and Voiceflow. Cody AI stood out for its user-friendly interface and seamless integration capabilities, making it an ideal choice for rapid deployment. Its simplicity allowed researchers with limited technical expertise to efficiently develop and test Alakdan. However, its limited customization options restricted the ability to tailor the chatbot to specific branding or functional needs, and the lack of control over response accuracy occasionally resulted in less contextually relevant replies.

Flowise AI, on the other hand, provided greater flexibility and support for multiple deployment channels, making it a versatile solution for diverse chatbot requirements. Its access to various language models (LLMs) enabled tailored implementations. Despite these advantages, its complexity posed a steep learning curve, making it less accessible for beginners, and the high cost of advanced features, along with inconsistent online deployment, raised concerns about reliability and affordability.

Voiceflow offered robust collaboration features and smooth integration with other platforms, making it particularly useful for team-based projects. Its ability to handle large volumes of text data efficiently was an advantage in scaling Alakdan. However, the platform's advanced features required significant time and effort to master, limiting accessibility for new users. Additionally, the high costs associated with advanced functionalities made it less practical for smaller teams or projects.

5.1.6. Key Insights and Recommendations

Cody AI emerged as the most suitable platform for Alakdan due to its ease of use, rapid deployment capabilities, and seamless integration. While it has limitations in customization and response control, its efficiency and simplicity aligned well with the project's goals. Flowise AI and Voiceflow offer advanced features and scalability but are better suited for more complex projects with experienced developers and larger budgets.

For future iterations of Alakdan, exploring AI platforms with greater customization and enhanced control over response accuracy could improve the chatbot's functionality and user experience. Overall, Cody AI played a crucial role in achieving Alakdan's vision, providing a balance of simplicity and efficiency that met the project's immediate needs.

6. ISO/IEC 25010 standards on software product quality

Table 5 Evaluation of Alakdan using ISO/IEC 25010 Standards on software product quality

Evaluation of Alakdan using ISO/IEC 25010 Standards on software product quality	**Mean**	***SD***	**Verbal Interpretation**
Functional Suitability	3.85	0.37	Strongly Agree
Performance Efficiency	3.61	0.5	Strongly Agree
Compatibility	3.73	0.48	Strongly Agree
Usability	3.74	0.42	Strongly Agree
Reliability	3.61	0.47	Strongly Agree
Security	3.67	0.48	Strongly Agree
Maintainability	3.60	0.49	Strongly Agree
Portability	3.57	0.49	Strongly Agree

The evaluation of Alakdan under the ISO/IEC 25010 software quality standards demonstrates robust performance across all eight attributes, with mean scores ranging from 3.57 to 3.85 (on a 4-point scale) and consistently low standard deviations (0.37–0.50), reflecting strong user consensus. In terms of Functional Suitability (Mean=3.85, SD=0.37), Alakdan excels in fulfilling its intended purpose. Users strongly agree that it effectively supports critical university processes such as admissions, enrollment, scholarship applications, and transcript requests. The narrow standard deviation indicates uniform satisfaction, highlighting the chatbot's ability to comprehend inquiries and deliver precise, contextually relevant responses.

Performance Efficiency (Mean=3.61, SD=0.50) received the second-lowest mean score, with a slightly higher standard deviation suggesting variability in user experiences, potentially due to resource utilization or response times under heavy load. This presents an opportunity to optimize backend algorithms or infrastructure for more consistent performance. Regarding Compatibility (Mean=3.73, SD=0.48), users affirmed Alakdan's seamless integration with existing university systems, minimizing disruptions and ensuring smooth workflows, which is crucial for institutional adoption.

The Usability (Mean=3.74, SD=0.42) attribute also received high praise, with an intuitive interface and accessible design, confirming widespread user satisfaction. Features like clear navigation and concise responses align with best practices in user-centered design, reducing cognitive load. In terms of Reliability (Mean=3.61, SD=0.47), Alakdan demonstrated dependable performance with minimal downtime or errors, though the moderate standard deviation points to occasional inconsistencies, particularly during peak usage. Enhancing error-handling protocols could further stabilize the system.

Security (Mean=3.67, SD=0.48) reflected strong user confidence in Alakdan's data protection measures, including encryption and access controls, with compliance to evolving standards like GDPR being crucial as the system scales. Regarding Maintainability (Mean=3.60, SD=0.49), while users acknowledged ease of updates and troubleshooting, this attribute scored the second-lowest. The moderate standard deviation suggests opportunities to streamline maintenance workflows, such as adopting modular coding practices. Portability (Mean=3.57, SD=0.49) was the lowest-scoring attribute, highlighting an area for improvement. Future iterations could prioritize cross-platform compatibility (e.g., iOS support) to expand accessibility.

6.1.1. Synthesis of Findings

The results confirm Alakdan's effectiveness as a reliable, user-centric tool for streamlining administrative processes at CEU-Manila. The overwhelmingly positive feedback aligns with studies emphasizing that user satisfaction drives technology adoption [5]. However, neutral/negative comments—particularly related to portability and maintainability—signal areas for refinement.

Table 6 Performance Testing Results for Alakdan

Category	Details	Metrics/Findings
Security Policy	- Firewall - Encryption of Storage - Denial of Public SSH - Malware Detection	All security measures are implemented (✓).
System Access Control	- SSL/TLS Enforcement - Vector Database (Pinecone) - Cloud Storage (S3)	All access control measures are implemented (✓).
Response Time	- Simple Queries - Complex Queries - Fallback Responses - Error Responses	- Simple: 5 seconds (967 queries) - Complex: 8 seconds (1615 queries) - Fallback: 3 seconds (321 queries) - Error: 4 seconds (967 queries)
Fallback Rate	Total Requests: 3870 Fallback Responses: 108	Fallback Rate: 2.79%
Error Rate	Total Requests: 3870 Failed Requests: 58	Error Rate: 1.50%

6.2. Analysis of Performance Testing Results

The performance testing of *Alakdan* evaluated its security protocols, response efficiency, and overall reliability, offering critical insights into its operational effectiveness.

6.3. Security and Access Control

Alakdan incorporates a multi-layered security framework to safeguard user data and system integrity. Firewalls screen incoming and outgoing network traffic to block unauthorized access, while encrypted storage ensures sensitive information remains protected against breaches. The denial of public SSH access further limits external vulnerabilities, and malware detection mechanisms proactively identify and neutralize threats. Complementing these measures, SSL/TLS encryption secures data transmission, and the vector database (Pinecone) adheres to SOC2 Type II certification and GDPR compliance, ensuring industry-standard data protection. Routine penetration tests and isolated Kubernetes containers on AWS infrastructure further fortify resilience against cyberattacks, aligning with global security benchmarks.

6.4. Response Efficiency

Alakdan demonstrates robust efficiency in handling user inquiries. Simple queries, such as direct requests for procedural information, are resolved in an average of 5 seconds, while complex queries requiring detailed instructions take 8 seconds. Fallback responses—triggered when queries fall outside the chatbot's knowledge base—are addressed in 3 seconds, typically with a default message directing users to relevant resources. Error responses, resulting from the

chatbot generating unsupported answers, are resolved in 4 seconds. These metrics reflect a well-optimized system capable of balancing speed and accuracy. However, the fallback rate of 2.79% (108 out of 3,870 queries) highlights opportunities to expand the knowledge base, reducing reliance on generic replies. Similarly, the low error rate of 1.50% (58 failed requests) underscores *Alakdan*'s reliability, critical for maintaining user trust in academic environments where precision is paramount.

6.5. Reliability and User Satisfaction

The combination of rapid response times, low error rates, and minimal fallbacks underscores *Alakdan*'s effectiveness as a virtual assistant. These results align with studies emphasizing the importance of minimizing errors and fallbacks in automated systems to enhance user engagement [28][23]. For instance, the chatbot's ability to resolve 97.21% of queries without resorting to fallback mechanisms demonstrates its capability to handle most student inquiries autonomously. Nevertheless, continuous monitoring and refinement are recommended to further reduce inefficiencies. Integrating advanced NLP techniques and expanding the training dataset could improve contextual understanding, enabling *Alakdan* to address a broader range of user needs.
Recommendations for Future Development

To sustain and enhance performance, *Alakdan*'s security protocols should remain a priority, particularly as user traffic scales. Optimizing response accuracy through iterative updates to the knowledge base and refining NLP models will further reduce fallback instances. Additionally, prioritizing scalability—such as compatibility with emerging technologies and cross-platform integration—will ensure long-term relevance. Regular user feedback loops and data-driven updates will be essential to maintaining high satisfaction levels, ensuring *Alakdan* continues to meet the evolving demands of the CEU-Manila community.

This comprehensive evaluation confirms *Alakdan*'s viability as a reliable, efficient, and secure tool for streamlining administrative processes in higher education, while also charting a clear path for ongoing improvement.

7. Technical requirements

The development of Alakdan, a chatbot built using Android Studio, requires specific software and hardware configurations to ensure optimal performance. During development, a laptop equipped with an Intel Core i7-9750H 2.60GHz CPU, 16GB DDR4 RAM, a GeForce GTX 1660 Ti GPU, and a 500GB SSD was used for processing and data storage. Various software tools, including Adobe Photoshop and Canva for design, Cody AI for knowledge base integration, and the Java Development Kit (JDK) for coding, were utilized to streamline development.

For implementation, Alakdan was designed to run on Android 13, tested both on a virtual device within Android Studio and a physical Xiaomi Poco F3. The device, powered by a Qualcomm Snapdragon 870 Octa-Core 3.2GHz CPU, 8GB RAM, an Adreno 650 GPU, and 256GB of storage, provided a real-world testing environment. These hardware and software specifications ensured the chatbot's smooth functionality, from development to deployment.

8. Conclusion

The development and evaluation of *Alakdan: A Virtual Assistant for Centro Escolar University Processes* demonstrate its effectiveness as a robust, user-centric solution for streamlining administrative workflows in higher education. Leveraging high-performance hardware (e.g., Intel Core i7 processors, 16GB RAM, SSD storage) and software tools like Android Studio and Cody AI, the chatbot efficiently handles NLP algorithms and machine learning tasks, though limitations in cross-platform development tools like Flutter highlight opportunities for future adaptability. Operationally, *Alakdan* achieved rapid response times (5–8 seconds for queries) and low error/fallback rates (1.50% and 2.79%, respectively), ensuring reliable real-world performance. Its multi-layered security protocols, including firewalls, SSL/TLS encryption, and GDPR-compliant storage, align with industry standards, safeguarding user data. Evaluation under ISO/IEC 25010 standards revealed high user satisfaction, with mean scores ranging from 3.57 to 3.85/4, particularly excelling in functional suitability, usability, and security. Stakeholders, including students and staff, reported reduced administrative burdens and improved access to institutional processes. However, challenges remain in portability (e.g., iOS compatibility) and scalability (e.g., maintainability and performance optimization under growing demand). The study advances AI in education by providing a replicable framework for chatbot development, emphasizing NLP integration and user-centric design, while offering insights for future research, such as multilingual support and advanced AI model integration. To maximize impact, future iterations should prioritize cross-platform deployment, continuous NLP training, and infrastructure upgrades. *Alakdan* sets a precedent for AI-driven solutions in academia, balancing innovation with practicality to enhance institutional efficiency and user experiences.

Recommendations

Based on the findings of this study, the following recommendations are proposed to further improve Alakdan:

- Incorporate additional functionalities to assist student leaders with event planning, semester-end requirements, audit forms, and institutional guidelines. Similarly, extend support for faculty and staff by including onboarding procedures, special examinations, grading policies, and institutional rules and regulations.
- Explore a new AI development platform with enhanced customization, improved response accuracy, and greater flexibility in managing chatbot functionalities.
- Embed Alakdan within the official CEU website to increase accessibility and streamline information retrieval for students, faculty, and staff.
- Implement text-to-speech and speech-to-text functionalities to improve user experience, particularly for individuals with accessibility needs.
- Develop an iOS-compatible version of Alakdan to expand its availability across multiple operating systems.
- Include references within Alakdan's responses to enhance credibility and provide users with reliable sources for further reading.

9. Demonstration

Figure 4 QR Code

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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