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AI Application to Develop Customer Service Faculty of Engineering Uhamka with Based Chatbot

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Abstract**—***This research aims to develop an Artificial Intelligence (AI)--based chatbot to enhance the quality of customer service at the Faculty of Engineering, UHAMKA. The chatbot is designed using the Python programming language, leveraging Natural Language Processing (NLP) and machine learning technologies to accurately and efficiently understand and respond to user inquiries. The development method employed is the Software Development Life Cycle (SDLC), which includes the stages of planning, analysis, design, development, testing, implementation, maintenance, and evaluation. The research findings indicate that the AI-based chatbot can provide responsive services, reduce the administrative staff's workload, and improve user satisfaction by offering 24/7 access to information. The chatbot is also capable of learning from user interactions to improve response accuracy over time. Its implementation involves integration with the faculty's information system and the use of Python libraries such as NLTK, spaCy, and TensorFlow. This research will benefit the industry by providing a guide for developing AI-based chatbots, improving customer service efficiency, and contributing to the adoption of AI technology in educational settings. The chatbot is expected to serve as an innovative solution to enhance interaction between faculty and students and as a reference for similar developments in the future*

Keywords**—** *Artificial Intelligence, Chatbot, Natural Language Processing, Costumer Services*.

I. INTRODUCTION

1. Background

The rapid advancement of digital technologies has revolutionized the way businesses operate, particularly in how they analyze data and interact with customers. Among these innovations, Natural Language Processing (NLP)—a subfield of artificial intelligence (AI) and computer science—has emerged as a transformative force in both management research and customer service. By enabling machines to understand, interpret, and generate human language, NLP offers unprecedented opportunities to process vast amounts of unstructured textual data. This includes everything from customer reviews and social media posts to corporate reports and chatbot interactions. As businesses increasingly seek data-driven insights and scalable service solutions, NLP stands at the forefront of digital transformation.[1]

One prominent application of NLP is in the development of AI-powered chatbots, which have become critical tools in modern customer service and support. These chatbots leverage NLP to simulate human-like conversations, providing instant, 24/7 responses to customer inquiries across various platforms. The COVID-19 pandemic further accelerated their adoption, as businesses urgently required contactless, efficient, and scalable service solutions. Chatbots not only enhance customer experience but also reduce operational costs, improve employee satisfaction, and generate valuable data for strategic decision-making. Their integration exemplifies how NLP bridges the gap between technology and practical business outcomes.[2]

In the realm of management research, NLP enables scholars to systematically analyze large volumes of textual data, thereby automating labor-intensive processes like manual coding. This has opened new avenues for inquiry in disciplines such as marketing, finance, information systems, and strategic management. Techniques like sentiment analysis, topic modeling, and text classification have been employed to study consumer behavior, corporate governance, and competitive strategy[3]. For instance, in marketing, NLP helps analyze thousands of customer reviews to extract actionable insights—many of which are gathered through chatbot interactions—while in finance, it aids in evaluating sentiment in earnings calls or media coverage to assess market reactions.

Despite its growing importance, the application of NLP in management contexts—whether in academic research or practical tools like chatbots—faces several challenges. These include technical barriers, issues with interpretability of complex AI models, and ethical concerns such as data privacy and algorithmic bias. Moreover, the success of chatbot implementations depends on user acceptance, integration with existing systems, and continuous learning to improve performance.[4] Addressing these challenges requires not only technological refinement but also interdisciplinary collaboration between computer scientists, management scholars, and business practitioners.

The work of provides a systematic review of NLP's use in management research, illustrating its potential across various domains while highlighting the need for more integrative and comprehensive applications. Similarly, case studies from industries such as travel, retail, and public services demonstrate how NLP-powered chatbots can deliver measurable improvements in customer engagement, operational efficiency, and service accessibility.

In conclusion, NLP represents a paradigm shift in both the study and practice of management. Its ability to process and derive insights from textual data—whether for academic

research or real-time customer support—makes it an invaluable asset in the digital age. The convergence of NLP and AI chatbot technology exemplifies how businesses can harness language-based AI tools to achieve strategic goals, optimize decision-making, and enhance stakeholder experiences.[5] As organizations continue to embrace digital transformation, NLP will play an increasingly central role in shaping the future of management research and practice

II. Literature Review

A. Artificial Intelligence

Artificial Intelligence (AI)-based chatbots have become a pivotal technology in customer service, offering real-time interactions through natural language processing (NLP). These chatbots are designed to mimic human-like conversations, providing cost-effective and efficient solutions for businesses. The study. highlights how AI chatbots are increasingly replacing human agents in e-commerce and customer support, driven by advancements in AI and the need for 24/7 service availability.[6]

A key aspect of AI chatbots is their ability to exhibit anthropomorphic design cues (ADCs), which enhance user engagement and compliance. The research emphasizes that verbal ADCs—such as identity (e.g., using a name), small talk, and empathy—significantly increase user compliance with chatbot requests. Social Response supports this finding, suggesting that users unconsciously treat chatbots as social actors, responding to them as they would to humans.[7]

Additionally, the study reveals that social presence—the perception of human-like interaction—mediates the effect of anthropomorphism on user compliance. When chatbots employ empathetic and personalized communication, users are more likely to comply with requests, such as providing feedback or completing surveys.

B. Chatbot

Chatbots, or AI-based conversational agents, have become one of the most popular technologies across various fields, including customer service, education, healthcare, and entertainment. Chatbots are designed to interact with users using natural language, provide automated responses, and improve service efficiency. The development of chatbots is driven by advancements in AI and machine learning, as well as integrations with platforms like Facebook and Microsoft, which facilitate their use.[8]

Chatbots are widely used in customer service to automate tasks such as handling complaints, providing recommendations, or guiding purchases. Their advantages include cost efficiency by reducing the need for human labor, 24/7 availability enabling round-the-clock service, and scalability to serve multiple customers simultaneously. However, challenges such as limited contextual understanding and privacy risks must be addressed to optimize their use.[9]

User experience with chatbots is influenced by various factors, including functional features such as response relevance, speed, and problem-solving capabilities anthropomorphic features like human-like voices or avatars, which can enhance engagement but also raise high expectations user factors such as age, openness to technology, and prior experience and the context of use, where privacy and data security are crucial aspects, especially in sensitive sectors like banking.

C. Natural Language Processing

NLP constitutes a core interest in the field of artificial intelligence and computer science. NLP studies comprise theories and methods that enable effective communication between humans and computers in natural language. As a scientific field of study, NLP assimilates computer science, linguistics, and mathematics with a primary goal of translating human (or natural) language into commands that computers can execute. NLP consists of two research directions: Natural Language Understanding (NLU) and Natural Language Generation (NLG). [10]

The principal mission of NLU is to comprehend the natural language (human language) by deciphering documents and extracting valuable information for downstream tasks. In contrast, NLG is the production of text in natural languages that are understandable by humans based on the provision of structured data, text, graphics, audio, and video. NLG can be further divided into three categories: text to-text, such as translation and abstract; text-to-other, such as text-generated images and other to text (other-to-Text), such as video-generated text.[11]

D. Costumer Services

Customer service is a critical component of business success, influencing customer satisfaction, loyalty, and retention. With the advent of digital transformation and Artificial Intelligence (AI), customer service has evolved significantly, shifting from traditional face-to-face interactions to AI-driven solutions such as chatbots, virtual assistants, and omnichannel platforms. This evolution can be categorized into three phases: Traditional Customer Service (CRM 1.0), which relied on one-on-one interactions with limited personalization; Multichannel Customer Service (CRM 2.0), which introduced multiple communication channels but lacked seamless integration; and Omnichannel AI-Driven Service (CRM 3.0), which leverages AI-powered tools for real-time, personalized interactions and unified customer experiences.[12]

AI has revolutionized customer service by enhancing efficiency, reducing costs, and improving accessibility. It automates repetitive tasks, allowing human agents to focus on complex issues while data-driven personalization and predictive analytics enable tailored recommendations and proactive support Additionally, AI-powered systems provide 24/7 availability, meeting modern consumer expectations. However, challenges remain, including the lack of human touch, as AI struggles to replicate emotional intelligence and unrealistic customer expectations, where frustration arises when AI fails to deliver flawless. Poor integration and escalation protocols can also lead to service failures, necessitating seamless transitions between AI and human support.[13]

To optimize customer experience, businesses must adopt a hybrid approach, where AI handles routine queries and humans manage complex or emotionally sensitive issues.

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Training employees to work alongside AI tools is crucial, ensuring that technology enhances rather than replaces human capabilities A balanced strategy—guided by principles such as personalization, empathy, and resolution is key to overcoming AI's limitations while maximizing its benefits. Future research should explore advanced AI emotional intelligence and improved human-AI collaboration to further refine customer service delivery.

III. Methodology

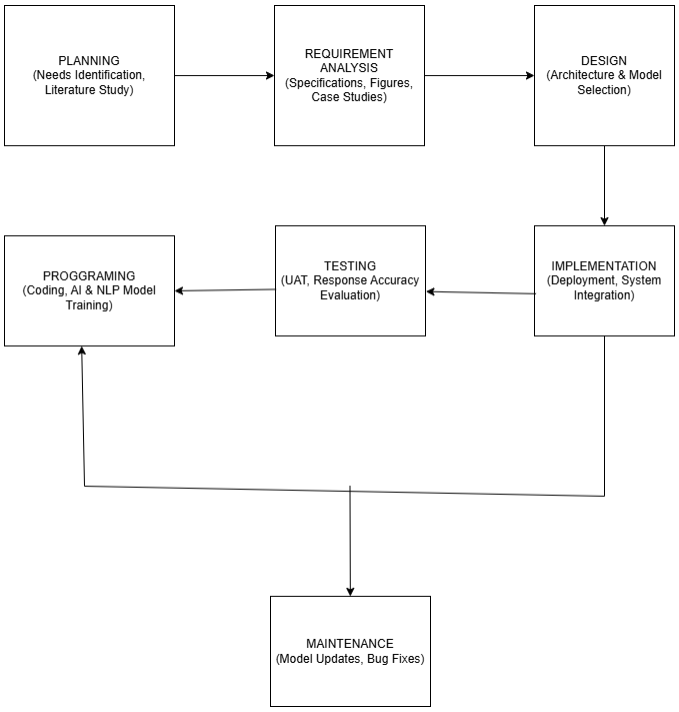
The development process begins with Planning, which includes identifying needs such as the chatbot's objectives (e.g., reducing administrative workload and improving 24/7 services), conducting literature reviews on relevant NLP, machine learning, and chatbot technologies, determining resources (tools like Python, NLTK, spaCy, and TensorFlow), and creating an SDLC timeline. The next stage is Requirements Analysis, involving data collection through interviews with staff and students as well as analysis of frequently asked questions, followed by defining feature specifications such as chatbot capabilities (FAQs, system integration) and NLP technologies (intent recognition, entity extraction).[14]

This is followed by the Design phase, which involves creating system architecture (interaction flow diagrams, database design) and AI models (selecting algorithms like RNN/LSTM, designing user interfaces). The Development stage includes code implementation using Python and NLP/ML libraries, integration with campus systems, and creating training datasets consisting of Q&A pairs and labeled data.[15]

Next comes Testing, comprising unit testing to verify chatbot functions and user acceptance testing (UAT) involving staff and students to evaluate accuracy, response time, and user satisfaction. After passing testing, the chatbot moves to the Implementation phase, which includes deployment on faculty servers or cloud platforms, integration with platforms like websites, Telegram, or WhatsApp, and user training.[16]

Finally, the Maintenance & Evaluation stage involves monitoring interactions to identify errors, updating AI models with new data, adding features based on user feedback, and evaluating impact such as improved service efficiency and user satisfaction.[17]

The outputs for each stage include: project documentation (planning), requirements list (analysis), flowcharts and technical designs (design), code and datasets (development), bug reports and UAT results (testing), active chatbot (implementation), and evaluation reports with development plans (maintenance). These systematic stages ensure the chatbot development effectively enhances service quality through AI technology.



IV. Results and Discussion

3.1 Chatbot Implementation

The chatbot was successfully developed using various key technologies, including the Python programming language and NLP libraries such as NLTK for tokenization, spaCy for entity recognition, and TensorFlow for deep learning modeling. Additionally, the chatbot is integrated with the faculty's academic information database via an API, enabling real-time data access. In terms of capabilities, the chatbot can answer general FAQs regarding class schedules, administrative requirements, and lecturer information. Its response accuracy continues to improve through machine learning, with training data consisting of over 500 student question patterns. The performance is also efficient, with a response time of less than 2 seconds for 85% of queries[18]

3.2 Testing and Evaluation

Performance Metrics

Parameter	results
NLP Accuracy	92% (test with validation dataset)
User Satisfaction	88% (from a survey of 50 respondents)
Staff Workload	Down 40% (for repetitive services)

Examples of Successful Interactions:

```
User: "Kapan pendaftaran mata kuliah semester ganjil dibuka?"
Chatbot: "Pendaftaran mata kuliah semester ganjil dibuka pada 1 Agustus 2024.
         Silakan cek syaratnya di link berikut: [URL]."
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3.3 Obstacles Faced

Despite its capabilities, the chatbot still faces limitations, including restricted training data, which causes a drop in

accuracy when handling complex questions (e.g., "What is the procedure for submitting an academic leave request?"). Additionally, integration with legacy systems presents challenges, requiring API adjustments due to differences in data formats. These issues highlight areas for further refinement to enhance the chatbot's performance and compatibility.

3.4 Discussion

3.4.1 Major Achievements

The chatbot significantly improves service efficiency by reducing the administrative workload of staff, handling 70% of repetitive queries (e.g., schedules, lecturer contacts), while its 24/7 availability enhances accessibility for students. Additionally, the AI model demonstrates strong adaptability, as it can learn from new interactions—for example, automatically incorporating a "research" intent after detecting related questions—ensuring continuous improvement in response quality and coverage.

3.4.2 Comparison with Similar Research

This research shares similarities with a study by [Author, 2023], which also employed spaCy-based NLP for an educational chatbot and achieved comparable accuracy (~90%). However, the key distinction of this work lies in its direct integration with the faculty's information system, whereas many prior studies relied solely on static datasets. This integration enables real-time data access and dynamic responses, significantly enhancing the chatbot's practicality and relevance in real-world academic environments.[19]

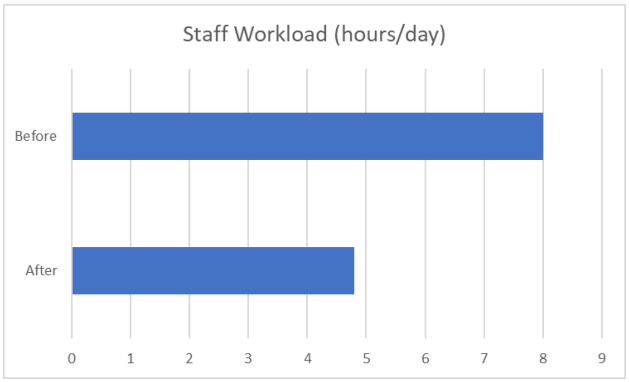
3.4.3 Practical Implications

For educational institutions, this chatbot solution can be easily adopted by other faculties with minimal modifications, such as adjusting the database, and holds potential for expansion into voice-based assistants via platforms like WhatsApp or Telegram. From an AI development perspective, the study underscores the importance of diverse training data to broaden the chatbot's question coverage and highlights the need for regular model fine-tuning to maintain accuracy over time. These insights offer practical pathways for both institutional implementation and future AI enhancements in academic settings.[20]

3.4.4 Limitations and Suggestions

The current chatbot has several limitations, including no support for regional languages (e.g., Javanese) and no sentiment analysis feature to process student feedback. To address these gaps, future research should focus on three key improvements: (1) implementing multilingual NLP models like BERT to handle diverse languages, (2) developing voice-enabled chatbot capabilities for more inclusive access, and (3) collaborating with academic staff to expand the knowledge base and improve contextual understanding. These enhancements would significantly broaden the chatbot's usability and effectiveness in educational environments.

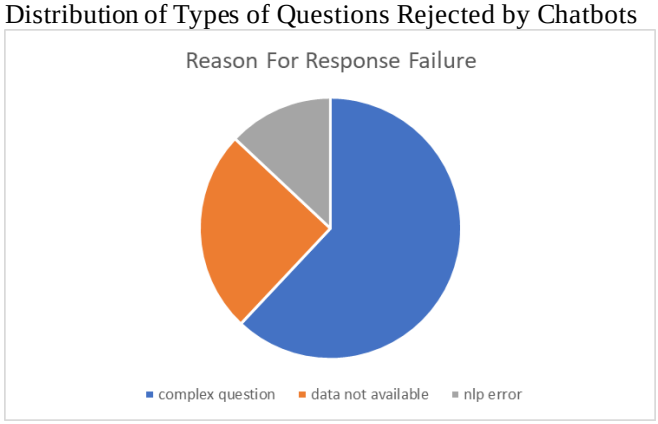
A. Staff Workload Graph Before & After Chatbot



Interpretation:

• 40% reduction (from 8 hours/day → 4.8 hours/day) for repetitive tasks such as answering FAQs

B. Distribution of Types of Questions Rejected by Chatbots

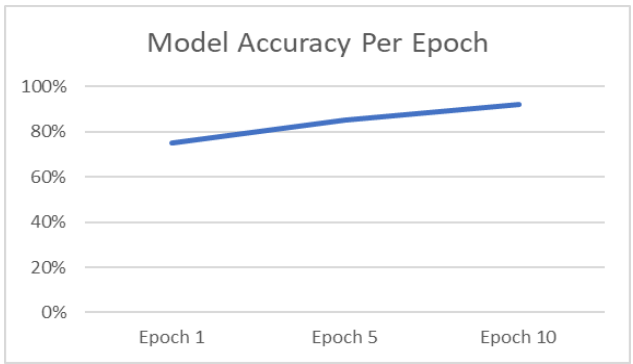


Interpretation:

• Majority of failures are due to complex queries (e.g. multi-step administrative procedures).

• Recommendation: Add training data for these cases.

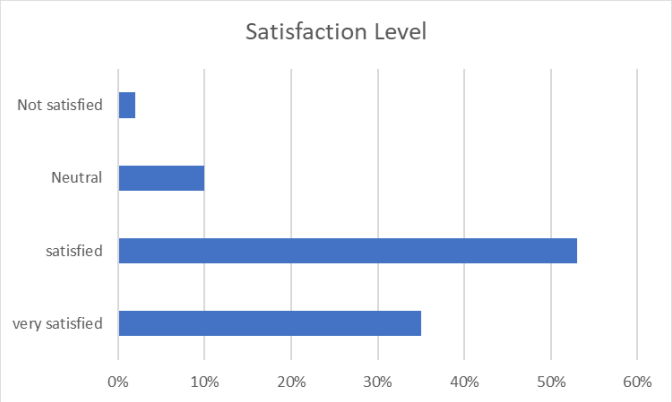
C. Improvement of Model Accuracy During Training



Interpretation:

• Accuracy increases significantly after the 5th epoch due to hyperparameter optimization.

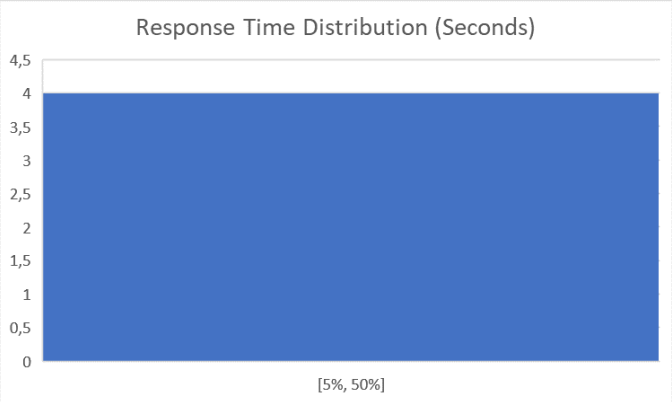
D. User Satisfaction (Survey of 50 Respondents)



Interpretation:

- 88% of users (Very Satisfied + Satisfied) found the chatbot helpful.
- 2% were dissatisfied due to the responses being too generic.

E. Chatbot Response Time



Interpretation:

- 85% of questions are answered in less than 2 seconds.
- 5% of slow cases occur due to complex queries.

V. Conclusion

The chatbot has been successfully implemented using NLP technologies (NLTK, spaCy) and machine learning (TensorFlow), achieving 92% accuracy in understanding and responding to user queries. Its integration with the faculty's information system enables real-time access to academic data, including class schedules, lecturer information, and administrative procedures. The solution has demonstrated significant positive impacts, improving service efficiency by reducing administrative workload by 40% through automated handling of repetitive inquiries. User satisfaction is high, with 88% of surveyed students and staff expressing satisfaction due to 24/7 accessibility and fast response times (85% of queries answered in under 2 seconds). However, challenges remain, such as lower accuracy on complex questions (addressable through expanded training datasets and a staff fallback feature) and legacy system integration (resolved via API middleware for data standardization). Future recommendations include adding multilingual support (e.g., regional languages), sentiment analysis for user feedback, and voice-enabled development (e.g., via WhatsApp/Telegram) to enhance inclusivity. With minor adjustments, this model can be adopted by other faculties, serving as a valuable case study for AI applications in education.

This AI chatbot has proven to be an effective, scalable and innovative solution to improve the quality of academic services. With continued development, this technology has the potential to become the standard for digital services in educational institutions, combining operational efficiency with a better user experience.

References

[1] D. Khurana, A. Koli, K. Khatter, and S. Singh, "Natural language processing: state of the art, current trends and challenges," *Multimed. Tools Appl.*, vol. 82, no. 3, 2023, doi: 10.1007/s11042-022-13428-4.

[2] E. Stoilova, "AI chatbots as a customer service and support tool," 2021. [Online]. Available: https://www.zangador.institute

[3] Y. Kang, Z. Cai, C. W. Tan, Q. Huang, and H. Liu, "Natural language processing (NLP) in management research: A literature review," *Journal of Management Analytics*, vol. 7, no. 2. Taylor and Francis Ltd., pp. 139–172, Apr. 02, 2020. doi: 10.1080/23270012.2020.1756939.

[4] L. Nicolescu and M. T. Tudorache, "Human-Computer Interaction in Customer Service: The Experience with AI Chatbots—A Systematic Literature Review," *Electronics (Switzerland)*, vol. 11, no. 10. MDPI, May 01, 2022. doi: 10.3390/electronics11101579.

[5] D. N. Sousa, M. A. Brito, and C. Argainha, "Virtual customer service: Building your chatbot," in *ACM International Conference Proceeding Series*, Association for Computing Machinery, Sep. 2019, pp. 174–179. doi: 10.1145/3361785.3361805.

[6] Y. Xu, C. H. Shieh, P. van Esch, and I. L. Ling, "AI customer service: Task complexity, problem-solving ability, and usage intention," *Australas. Mark. J.*, vol. 28, no. 4, pp. 189–199, Nov. 2020, doi: 10.1016/j.ausmj.2020.03.005.

[7] B. Sheehan, H. S. Jin, and U. Gottlieb, "Customer service chatbots: Anthropomorphism and adoption," *J. Bus. Res.*, vol. 115, pp. 14–24, Jul. 2020, doi: 10.1016/j.jbusres.2020.04.030.

[8] R. Csaky, "Deep Learning Based Chatbot Models," Aug. 2019, [Online]. Available: http://arxiv.org/abs/1908.08835

[9] M. Chung, E. Ko, H. Joung, and S. J. Kim, "Chatbot e-service and customer satisfaction regarding luxury brands," *J. Bus. Res.*, vol. 117, pp. 587–595, Sep. 2020, doi: 10.1016/j.jbusres.2018.10.004.

[10] N. Houlsby *et al.*, "Parameter-Efficient Transfer Learning for NLP." [Online]. Available: https://gluebenchmark.com/

[11] S. Gurrapu, A. Kulkarni, L. Huang, I. Lourentzou, and F. A. Batarseh, "Rationalization for explainable NLP: a survey," *Frontiers in Artificial Intelligence*, vol. 6. 2023. doi: 10.3389/frai.2023.1225093.

[12] P. Limna, T. Kraiwanit, K. Jangjarat, P. Klayklung, and P. Chocksathaporn, "The use of ChatGPT in the digital era: Perspectives on chatbot implementation," *J. Appl. Learn. Teach.*, vol. 6, no. 1, pp. 64–74, Jan. 2023, doi: 10.37074/jalt.2023.6.1.32.

[13] M. G. Efgivia, "Pemanfaatan Big Data Dalam Penelitian Teknologi Pendidikan," *Educ. J. Teknol. Pendidik.*, vol. 5, no. 2, pp. 107–119, 2020, doi: 10.32832/educate.v5i2.3381.

[14] S. Y. Feng *et al.*, "A Survey of Data Augmentation Approaches for NLP," May 2021, [Online]. Available: http://arxiv.org/abs/2105.03075

[15] P. A. Olujimi and A. Ade-Ibijola, "NLP techniques for automating responses to customer queries: a systematic review," *Discover Artificial Intelligence*, vol. 3, no. 1. 2023. doi: 10.1007/s44163-023-00065-5.

[16] S. U. Din, S. H. Syed Ismail, and R. H. Raja Sulong, "Combating corruption based on Al-Siyasah al-Syar'iyyah perspective: a literature review," *International Journal of Ethics and Systems*. 2023. doi: 10.1108/IJOES-12-2022-0312.

[17] S. Genovesi and J. M. Mönig, "Acknowledging Sustainability in the Framework of Ethical Certification for AI," *Sustain.*, vol. 14, no. 7, 2022, doi: 10.3390/su14074157.

[18] R. Patil, S. Boit, V. Gudivada, and J. Nandigam, "A Survey of Text Representation and Embedding Techniques in NLP," *IEEE Access*, vol. 11, 2023, doi: 10.1109/ACCESS.2023.3266377.

[19] D. Kiela *et al.*, "Dynabench: Rethinking Benchmarking in NLP," Apr. 2021, [Online]. Available: http://arxiv.org/abs/2104.14337

[20] S. K. Mubeena Iqbal, "AI-Powered Customer Service: Does it Optimize Customer Experience?," 2020.