Development of a Library Information Chatbot for Lampung University Based on Natural Language Processing

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Abstract

The University of Lampung (Unila) Library has over 86,783 registered patrons, with 12,329 active users, including faculty, students, staff, and external patrons. Services include verification, circulation, procurement, e-books, and journals. However, limited staff availability to respond to inquiries has negatively impacted service satisfaction. To address this issue, the implementation of chatbot technology is proposed as a solution. A chatbot simulates human conversation through text, voice, or visuals. There are two types: Flow-Based Chatbots, which follow a predetermined conversation flow, and Open-Ended Chatbots, capable of handling dynamic conversations. Development methods include Fixed Rule-Based and Machine Learning/Natural Language Processing (ML/NLP) Based Chatbots. This research aims to develop a Flow-Based Chatbot using ML/NLP on the Dialogflow platform, integrated with Unila Library's local database through a Python-based API, specifically FastAPI. The implementation of this chatbot is expected to enhance the responsiveness and availability of library services, ultimately increasing patron satisfaction.
Keywords: Chatbot;Library Services;Natural Language Processing;Patron Satisfaction

Introduction

The University of Lampung (Unila) Library has over 86,783 registered patrons, with 12,329 active users, including faculty, students, staff, and external patrons. All patrons can access various services, such as verification, circulation, procurement, e-books, and journals. While these services are used daily, patrons sometimes face access issues. To address this, the library offers a customer complaint service via WhatsApp. However, limited staff availability to respond to inquiries negatively affects patron satisfaction. Thus, there is a need for a technological solution to provide responsive support 24/7. A chatbot can effectively address this challenge.

A chatbot is an intelligent computer program designed to mimic human conversational interactions naturally[1]]. Chatbots are now widely applied across various fields, including education. The trend of using chatbots has gradually increased over time. Figure 1 illustrates the development trend of chatbots.
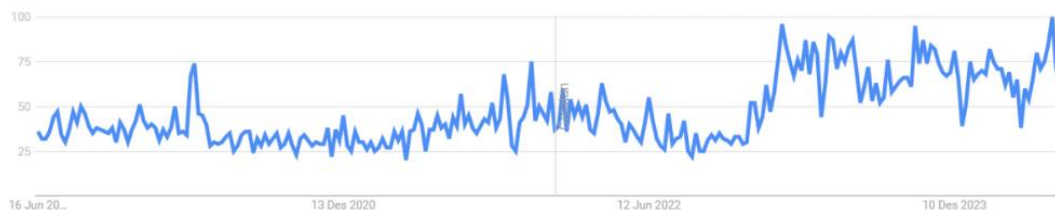

Figure 1. Chatbot Trends Over the Last 5 Years
(Source : Google Trends)

Chatbots are divided into two types: Flow-Based Chatbots and Open-Ended Chatbots. Flow-Based Chatbots are designed to follow a predefined conversation flow. This flow, or "flowchart," typically takes the form of a diagram or decision tree that guides the chatbot in providing responses based on user input. Flow-Based Chatbots are often used in scenarios with a clear and predictable conversational structure[2]. On the other hand, Open-Ended Chatbots are designed to handle conversations that are not limited to a specific flow or structure[3]. Unlike Flow-Based Chatbots, Open-Ended Chatbots can understand and respond to a wide variety of user inputs, including unexpected ones, with greater flexibility and dynamism.

The methods for developing chatbots are diverse and can be broadly categorized into two types: Fixed Rule-Based Chatbots and Machine Learning/Natural Language Processing Based Chatbots (ML/NLP Based Chatbots). Fixed Rule-Based Chatbots are created using programming logic without employing artificial intelligence or machine learning. In contrast, ML/NLP Based Chatbots utilize machine learning algorithms and natural language processing. These chatbots can be implemented using frameworks or custom solutions. Several platforms for developing ML/NLP Based Chatbots

include Dialogflow, Rasa, IBM Watson Assistant, and Amazon Lex.

This research aims to develop a Flow-Based Chatbot based on Machine Learning/Natural Language Processing using the Dialogflow platform

This research aims to develop a Flow-Based Chatbot utilizing Machine Learning and Natural Language Processing with the Dialogflow platform. The chatbot will be designed to enhance user interaction by providing quick and accurate responses to common inquiries. By integrating advanced algorithms, the chatbot will be able to simulate human-like conversations and effectively guide users through various library services. This development will not only improve accessibility but also ensure that users receive timely assistance, thereby enhancing overall satisfaction with the library's offerings. The integration of this technology aims to streamline communication and support within the library environment.

Literature Review

This research refers to several recent primary reference sources taken from national and international journals/proceedings in the field of artificial intelligence, specifically in chatbot development, as shown in Table 1. Previous studies have indicated that developing machine learning/NLP-based chatbots using the Dialogflow platform can achieve maximum accuracy and satisfy users. In this research, a library service chatbot application will be developed based on machine learning/NLP using the Dialogflow platform.

Table 1. Related Research

Title	Journal /Proceeding	Description
Conversational virtual educator using Google's dialogflow(Shruti Agrawal & Satheesh Abimannan, 2023)	2nd International Conference On Recent Advances In Computational Techniques AIP Conference Procesing Volume 2755, Issue 1 11 September 2023 https://doi.org/10.1063/5.0150047	This research successfully developed a chatbot application that can answer student questions without the involvement of instructors in the classroom.
Pengembangan Chatbot Berbasis Dialogflow Dengan Metode Natural Language Processing Untuk Menyediakan Informas Mengenai Stunting Melalui Platform Telegram[5]	Jurnal Riset Sistem Informasi Dan Teknik Informatika (JURASIK) Volume 9 No 1 1 Februari 2024 http://dx.doi.org/10.30645/jurasik.v9i1	This research successfully developed a Dialogflow-based chatbot, achieving a 90% accuracy in black box testing. The User Experience Questionnaire (UEQ) results showed a score of 1.8 for attractiveness, 1.17 for clarity, 1.81 for efficiency, 1.74 for accuracy, 1.59 for stimulation, and 1.14 for novelty.
Implementasi Chatbot untuk Layanan Frequently Asked Question Akademik dengan Penggunaan Dialogflow.[6]	Jurnal Saintekom : Sains, Teknologi, Komputer dan Manajemen | Vol. 13 No. 1 (2023) 1-10 31-03-2023 https://doi.org/10.33020/saintekom.v13i1	Hasil survei User Experience Questionnaire (UEQ) mendapatkan skor 1.536 untuk daya tarik, 1.714 untuk kejelasan, 1.375 untuk efisiensi, 1,357 untuk ketetapan, 1,536 untuk stimulasi, dan 0,964 untuk kebaruan
Pengembangan Chatbot Informasi Pariwisata di Kabupaten Pati Menggunakan Metode Natural Language Processing Berbasis Dialogflow.[7]	Jutisi: Jurnal Ilmiah Teknik Informatika dan Sistem Informasi Volume 313	This research successfully developed a Dialogflow-based chatbot with an accuracy of 92.3%. The results from the User Experience Questionnaire (UEQ) indicated a score of 1.62 for attractiveness, 1.57 for clarity, 1.60 for efficiency, 1.30 for accuracy, 1.47 for stimulation, and 1.23 for novelty.

Based on the aforementioned studies, this research focuses on the development of a Natural Language Processing-based library chatbot for the University of Lampung using the Dialogflow platform to assist in providing information to

patrons.

Materials & Methods

The research materials used in this study include data on questions and answers from patrons found on social media, WhatsApp chat history, surveys conducted with patrons at the University of Lampung Library, and information from the Unila Library's local database.

The development of this chatbot begins with a systems analysis phase, during which the system requirements are identified. This requirements analysis stage involves relevant stakeholders, including the Unila Library administration, the development team, the head librarian, library staff, and, of course, the patrons of the Unila Library. The systems analysis phase results in the identification of system requirements, leading to the design of the Unila Library chatbot architecture, as shown in Figure 2.
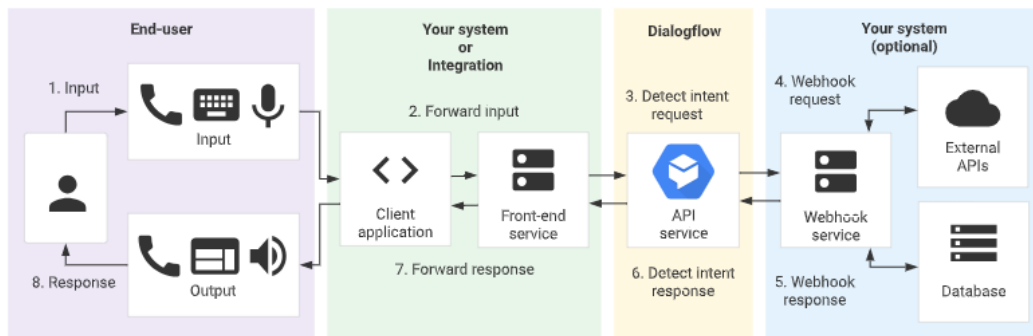

Figure 2. Unila Library chatbot architecture

The next stage is the development of a system flowchart that illustrates the usage flow of the chatbot application. The flowchart shows that the user begins the conversation by typing a question into the chatbot application. The chatbot then identifies the question with the appropriate intent. If a matching intent is found, the user is directed to that intent to receive the pre-defined response. If no matching intent is found, the chatbot will generate a response indicating that the question is unrecognized. The conversation will conclude when the user responds with a statement indicating a desire to end the interaction.
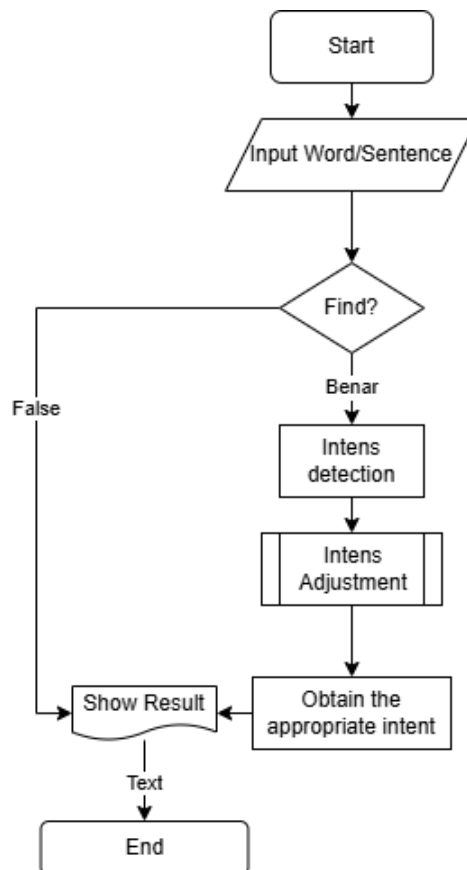

Figure 3. Flowchart

Results And Discussion

The development of this chatbot results in at least 10 intents, including default welcome intent, default negative intent, redirect.skbp, confirm, islamic greetings, redirect.verifikasi, redirect.contactperson, redirect.jamlayanan, and decline. Information about the intents is shown in Table 1.

Table 1. Intens

Intens Name	Training Phrases
Default Welcome Intent	10
Default Negative Intent	2
redirect.skbp	6
Confirm	9
islamic greetings	4
redirect.peminjamanbuku	8
redirect.verifikasi	6
redirect.contactperson	7
redirect.jamlayanan	8
Decline	4

The intents are connected to 5 flows, which consist of the default flow, reference flow, circulation flow, verification flow, and general flow. Complete information about the flows is presented sequentially in Figures 4-8.
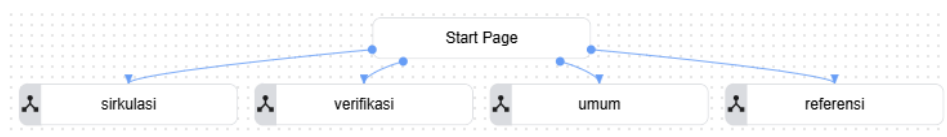

Figure 4. Default Start Flow

The default start flow is the initial flow that determines the direction of the conversation initiated by the user. This flow will direct users to several other flows, namely general, circulation, verification, or reference flow.

Figure 5. General Flow

The general flow addresses questions from patrons related to common inquiries, such as the name of the head librarian, information about library opening hours, or other general topics.
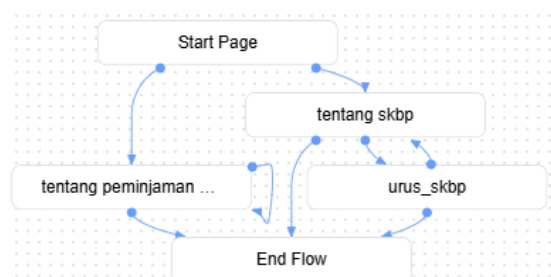
Figure 6. Circulation Flow

The circulation flow addresses questions from patrons related to the circulation department, where patrons can borrow and return books, including services related to the library's SKBP (Free Library Services).
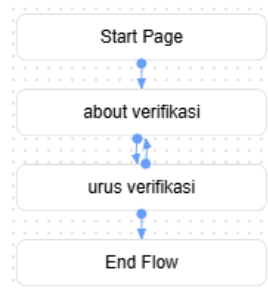
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Figure 7. Verification Flow

The verification flow pertains to questions related to academic works, such as how to upload academic papers and how to borrow academic materials.

The chatbot application is placed on the main website of the library located at www.library.unila.ac.id. Figure 8 shows the appearance of the chatbot.
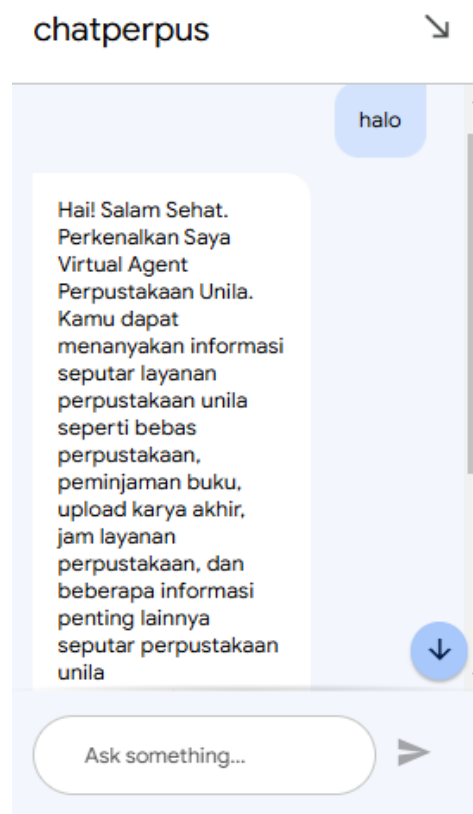

Figure 8. Chatbot

Conclusions

This research resulted in a library chatbot with a total of 10 intents and 5 main flows. The chatbot successfully answered 90 percent of user questions accurately. Software testing using the User Experience Questionnaire (UEQ) yielded a "good" score. The aspects of attractiveness, clarity, and efficiency each received a "good" rating, indicating that users were engaged and did not encounter significant difficulties while using the chatbot. The accuracy aspect received an "excellent" rating, as the chatbot was able to answer user questions accurately. This research successfully aids the Unila Library in providing information accessibility despite the limited number of staff.

Acknowledgments

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