EduBot: An AI-Integrated Chatbot for Educational Institution

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ABSTRACT
The rapid advancement of artificial intelligence (AI) has transformed various industries, including education [3]. This paper presents EduBot, an AI-integrated chatbot designed to enhance student engagement and streamline administrative tasks within educational institutions. By leveraging AI and machine learning, EduBot provides real-time responses to student inquiries—covering course details, admission requirements, and institutional policies—contributing to improved learner autonomy [5]. It is seamlessly integrated into the institution's social media platform and website to ensure accessibility and ease of use. Through rigorous testing and evaluation, EduBot demonstrates significant improvements in response accuracy, user satisfaction, and administrative efficiency. The findings highlight the chatbot's potential to reduce the workload for staff, improve student experiences, and foster digital transformation in education. Future enhancements include expanding the chatbot's knowledge base, improving contextual understanding, and integrating multilingual capabilities to cater to a diverse student population.

Keywords
Artificial Intelligence, Application Programming Interface, Chatbot, Educational Technology, Natural Language Processing, Machine Learning, Institutional Support, AI-powered Chatbot, AI in Education.

1. INTRODUCTION
In traditional educational settings, people often face challenges when inquiring about or asking questions related to school matters. People have limited time to seek clarification or ask questions, experience long queues from outside the office, have difficulty approaching authority figures, and have conflicting schedules. Furthermore, having information about the school is particularly important when it comes to the success and safety of a student [7]. As digital technology advances, chatbot adoption offers substantial benefits—when properly trained, a chatbot can deliver accurate answers tailored to a private institution's context. This integration enhances efficiency and accessibility beyond what a limited-hours human operator can provide.

A study involving 237 university students interacting with four different chatbots found that 80% of users reported satisfaction with the interactions, particularly valuing the chatbots' language coherence and interface usability [2]. Another research on educational chatbots highlights their role in delivering timely feedback and fostering learner autonomy and metacognitive strategies [11].

Our project, "EduBot: An AI-Integrated Chatbot for Educational Institution," aims to bridge this gap by offering detailed and precise answers about educational institutions. Enhancing a chatbot's capabilities with Artificial Intelligence (AI) and Natural Language Processing (NLP) can make it highly effective in providing specific information related to an institution. Implementing "EduBot: An AI Integrated Chatbot for Educational Institution" on the institution's social media and website can significantly reduce employee workload and enable the institution to operate more efficiently. "EduBot" can address common issues such as availability and response time, ultimately optimizing customer satisfaction, improving user experiences, and facilitating smoother communication processes within the institution.

2. RELATED LITERATURE
Data gathered by researchers related to this study served as the foundation for the research. One of the major challenges within our education system is the limited availability of comprehensive information provided by various universities. While some information is publicly accessible, it fails to offer a thorough understanding of each institution. Communication of prospective students and other types of customers with the university is usually done manually and it is a very time-consuming process. The opportunity for one-to-one conversation is highly valued but, in most cases, one-to-one conversations are not feasible with many hundreds of applications each year [1]. Social media is one of the quickest forms of online communication. One of the famous social media platforms is Facebook. Whenever and wherever, there is internet access, information can be shared instantly. In fact, nearly 97% of college students report accessing social media platforms daily, and about 74% of teachers believe it improves communication between faculty and students [10].

A study in Educational AI Chatbots for Content and Language Integrated Learning implements the basic idea of learning cultural content and foreign languages in an interactive educational learning environment. The study showed a positive impression of the participants agreeing that it is easy to learn

and reporting that the conversation with a chatbot is engaging [8].

Frameworks such as Dialogflow and Rasa NLU offer distinct advantages in chatbot development. Dialogflow is more accessible, allowing chatbot creation without coding through its comprehensive interface. Rasa, while more flexible, requires manual setup and Python programming for customization [9].

Dialogflow can help in developing chatbots by leveraging algorithms such as natural language processing and machine learning to understand and interpret user queries, accurately identify intents and entities related to the institution, maintain contextual understanding throughout conversations, integrate with backend systems for real-time information retrieval, support deployment across multiple channels, and provide analytics for continuous improvement [6].

Recent developments in natural language processing have significantly enhanced the capabilities of AI-driven conversational systems. The integration of artificial intelligence in customer service systems has become increasingly popular, with organizations leveraging AI to improve response accuracy and efficiency. Among these advancements, the use of OpenAI's API has gained significant attention due to its powerful natural language processing capabilities [4].

3. METHODOLOGY

The proponent conducted a survey and testing for the proposed project entitled, EduBot: An AI-Integrated Chatbot for Educational Institution. “EduBot” will help incoming students with inquiries about the school to acquire the information they want. By using this bot, individuals can maximize their time and save money by effectively addressing their questions and inquiries about the institution without the need for a physical visit. This approach allows for efficient communication. It empowers users to access information promptly from the comfort of their own space, thereby eliminating unnecessary expenses and time-consuming trips. Individuals who prefer privacy or seek information remotely, potential students seeking information or clarification, and stakeholders will also benefit from this project because it will help them to have a better understanding of the institution by gaining the information that they need. This study will not only implement an effective chatbot solution for the institution but will also contribute valuable insights and methodologies that can serve as a reference for future researchers and developers in the field. During the development phase, the project was meticulously tested to ensure it met all the objectives of the chatbot.

3.1 System Architecture

The development of EduBot followed a modular architecture, integrating various platforms to create an intelligent, responsive, and user-friendly chatbot for institutional use. The system is designed to accept queries through two primary user interfaces: the institution’s official website and its Facebook Messenger page.

The backend is powered by Dialogflow, which handles intent recognition and query categorization. Upon identifying a valid and relevant query, Dialogflow initiates a webhook call routed through Ngrok, allowing secure communication with a Flask server. The server then forwards the structured query to the OpenAI API, which generates a contextually relevant response based on fine-tuned institutional data. The response is then sent back through the same pipeline to the user in real time.

This flow ensures low-latency, accurate, and institution-specific responses, automating what would traditionally require manual administrative effort.

3.2 Materials

The project utilizes the use of materials such as software, hardware, and data to construct the chatbot. Choosing the right materials in crafting this project will play a vital role in developing the methodology and performance of the chatbot.

3.2.1 Software

Dialogflow - Dialogflow will serve as the framework for developing the chatbot, by using its machine learning and natural language processing algorithm will help facilitate seamless user interactions by processing queries, managing the training model, and integrating the bot into the institution's web platforms.

Facebook- The proponents used Facebook Messenger, so that the institution can extend its reach to a broader audience, enabling users to conveniently engage with the chatbot directly within the Messenger interface. By using Facebook, it offers accessibility and fosters greater scalability and accessibility for users, enhancing the effectiveness and utility of the chatbot.

Git - By using Git the proponents can easily revert to the previous version if something goes wrong or compare different versions to understand how the chatbot has evolved.

Google Cloud Platform (GCP) - the proponents can integrate Dialogflow to provide easy development, training, and deployment of the chatbot using Dialogflow's intuitive interface and powerful features directly within the Google Cloud ecosystem.

Python - Python will serve as the primary programming language for crafting the chatbot, with the Natural Language Toolkit library utilized for preprocessing tasks. This preparatory step in Python will optimize the input data before integration with Dialogflow, ensuring a more refined response.

Ngrok - Ngrok will allow the proponent to securely expose a local development server to the internet. In this project, Ngrok will be used to create a public URL that connects Dialogflow to the chatbot's webhook during development.

Table 1. Software Specification

Components	Specification
Dialogflow	Dialogflow ES (Standard Edition)
Git	Version: 2.20
PyCharm	Community Edition 2020.3
Ngrok	Version: 3.18.4

3.2.2 Hardware

The hardware to be utilized in this study will serve as the foundation of the research, furnishing essential tools and equipment for its effectiveness and efficiency. For this project, the proponent will be utilizing a device that has the necessary performance and capabilities to effectively manage the development and deployment tasks associated with building a chatbot.

Table2. Hardware Specification

Components	Specification
Processor	Intel Core i3-8100 (4 cores, 4 threads, 3.6 GHz))
Memory	8GB DDR4 RAM
Storage	256 GB SSD
Graphics	NVIDIA GTX 1650
Connectivity	Wi-Fi 5

3.3 Dataset Preparation and Preprocessing

The development of the chatbot involves gathering a comprehensive dataset sourced from the institution. This dataset encompasses a variety of essential elements, including frequently asked questions (FAQs) from students, parents, and staff, along with corresponding answers to ensure accurate responses. Additionally, information on school policies, procedures, rules, and regulations is included, providing clarity on governance matters. Academic offerings such as programs, courses, prerequisites, and distinctive initiatives are detailed to enrich users' understanding of educational opportunities. Moreover, contact information for departments, offices, administrative staff, and available resources is provided to facilitate seamless assistance for user inquiries or concerns. By centralizing and organizing this data, the chatbot becomes a reliable resource for the San Carlos College community, offering prompt and accurate responses to inquiries.

Table 3. Institution's Data

Components	Specification
TuitionFee_Data.txt	Information on tuition fees and payment policies.
Instruction.txt	Instruction for chatbot data file.
Admission_Data.txt	Information on admission requirements and procedures.
Education_Data.txt	Details on education programs and policies.
ContactInformation.txt	Contact details for departments and personnel.
Employees.txt	Employee roles and contact information.
Enrollment.txt	Information on student enrollment procedures.
Examination.txt	Information on faculty research projects and publications.
GeneralInfo.txt	General details about the institution.

3.3.1 Data Processing

Preprocessing was conducted in two major phases to ensure that both Dialogflow and the OpenAI model could accurately understand and respond to user queries.

- Dialogflow Layer: Tokenizes user queries, performs phrase matching, and maps intents using training phrases.
- OpenAI Layer: Uses Byte Pair Encoding (BPE) to tokenize and encode queries for optimized AI comprehension. This allows OpenAI to efficiently handle rare and complex terms (e.g., tuition, enrollment).

To support bilingual queries, the model was also trained to recognize English, Filipino, and mixed-language input. However, responses are always delivered in English to ensure consistency and professionalism.

4. RESULT AND DISCUSSION

To develop the proposed project, EduBot: An AI-Integrated Chatbot for Educational Institution, based on the Operational Framework for the Proposed Project (see Figure 1) The process includes various stages of query processing, starting with the use of social media messenger and the institution's website serves as the user interface (UI) through which a responsive and accessible communication system is established. At the forefront of this interface stands a versatile chatbot that will address inquiries and provide assistance 24/7. Once the data is submitted from the web platform, Dialogflow will retrieve it, analyze the intent, and determine whether the query is relevant to the institution. If the query is valid, Dialogflow will trigger a webhook to send the data to the API. In order to have secure communication between Dialogflow and the API, Ngrok is employed to expose local servers to the internet, allowing the webhook to function seamlessly during development. This step ensures that data from Dialogflow can be effectively processed in real-time. OpenAI processes the data by breaking down the user's input into manageable components. This is the core of OpenAI's conversational ability—understanding input contextually and once the chatbot has gathered the necessary information from the information database, it generates a response to the user query. The response is crafted to be clear, informative, and contextually relevant based on the user's query and the information retrieved from the knowledge base.

- It can be seamlessly integrated into both the institution's social media page and official website.
- It responds to inquiries quickly and efficiently, enhancing user experience.
- It can understand and process inputs in Filipino, English, or a combination of both languages.
- Information retrieval is performed exclusively through text-based input and output.
- It ensures user privacy by adhering to data privacy regulations and institutional policies.
- It is capable of identifying and invalidating hypothetical or irrelevant inputs.

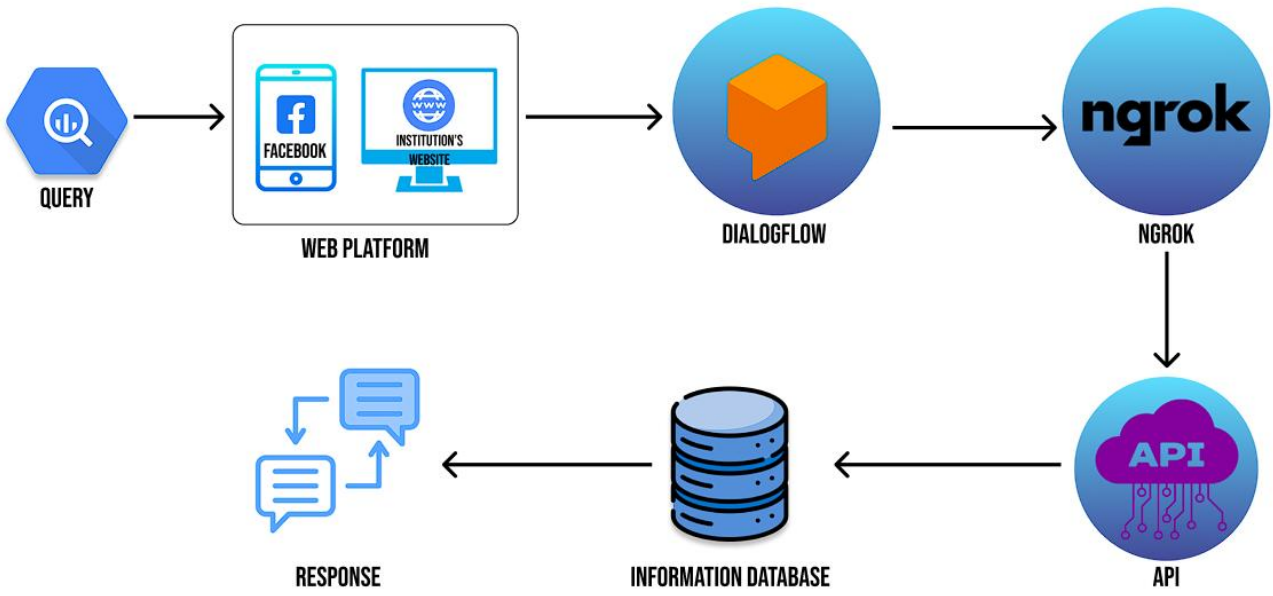

Fig 1: Operational Framework for the Proposed Project

A query is an input or question a user provides to a chatbot, typically a message or text, used to request information, assist, or prompt an action. "EduBot" processes these queries by interpreting the user's intent and generating a response based on the data it holds. Leveraging data from the Institution, "EduBot" delivers accurate and detailed information about the institution while adhering strictly to data privacy standards.

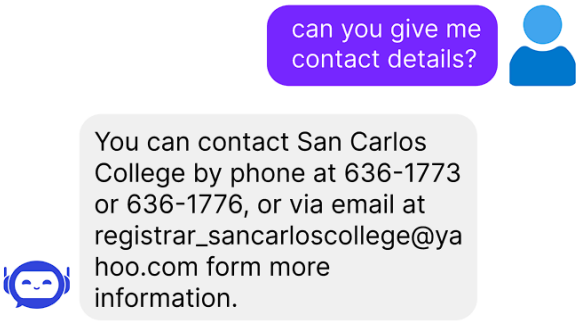

Fig 2. Sample of Valid Query

Valid queries are text inputs directly related to the institution and compatible with EduBot's capacity to process and deliver accurate information (see Figure 2). These queries typically pertain to factual matters such as academic programs, admission requirements, faculty, or campus services. In essence, valid queries are those based on verifiable facts relevant to the institution.

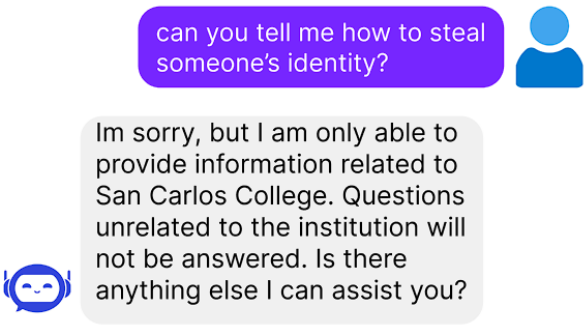

Fig 3. Sample of Invalid Query

Invalid queries are those questions that are not related to the institution. Queries that conflict with the institution's data privacy policies, such as requests for sensitive or confidential information, will be addressed as invalid queries (see Figure 3).

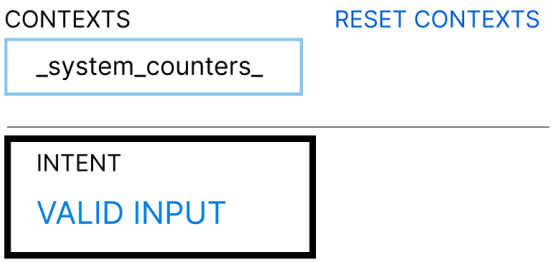

Fig 4. Dialogflow Intent Recognition

After tokenizing the input and identifying keywords, Dialogflow tries to match the user's query to one of the predefined intents that the system has been trained to recognize (see Figure 4). An intent represents what the user wants to know. In Dialogflow, each intent is trained using training phrases sample sentences that help Dialogflow recognize similar inputs. If Dialogflow has identified the correct intent, it will try to extract any additional parameters or entities needed to provide a more specific answer. The system matches the

user's input to the intent based on its similarity to the trained phrases.

In this section, the proponents use sets of valid and invalid queries in order to present the methodology and results of identifying appropriate and invalid contextual inquiries based on the interactions between users and EduBot.

To achieve this, the proponents use Dialogflow's intent recognition to evaluate the context of user inputs, ensuring that users receive accurate and helpful information related to the institution. Dialogflow distinguishes between valid and invalid inputs by mapping user queries to predefined intents, allowing EduBot to provide contextually relevant responses based on the identified intent.

The queries used in testing the chatbot's response were sourced from students through surveys and from actual queries entered into EduBot. These queries, totaling 50, are a mix of valid and invalid questions, ensuring that EduBot continues to provide reliable responses while adapting to user needs and maintaining standards of accuracy and relevance.

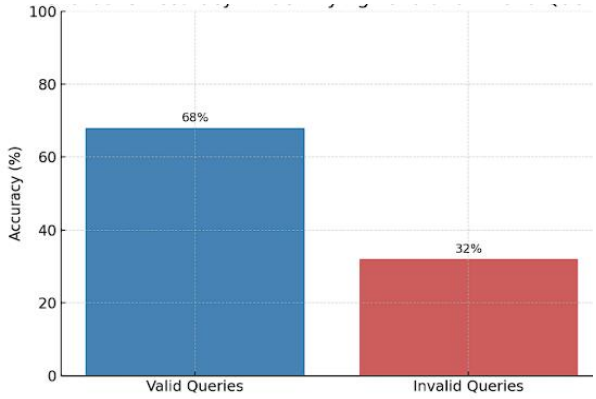

Fig 5. Chatbot's Accuracy in Identifying Valid and Invalid Queries Bar Chart

$$Accuracy = \frac{Correctly\ Classified\ Queries}{Total\ Number\ of\ Queries}\ x\ 100$$

The computational analysis conducted during the testing phase of the chatbot reveals that it successfully identified valid queries with an accuracy rate of 68% and invalid queries with an accuracy rate of 32%. These results demonstrate the chatbot's moderate effectiveness in distinguishing between appropriate and inappropriate user inputs based on predefined institutional criteria. While the performance indicates a solid foundation for practical use, it also highlights areas for improvement. A closer examination of misclassified queries, particularly those that are ambiguous or contextually complex—may provide valuable insights into the system's current limitations and guide future enhancements aimed at improving accuracy and overall reliability.

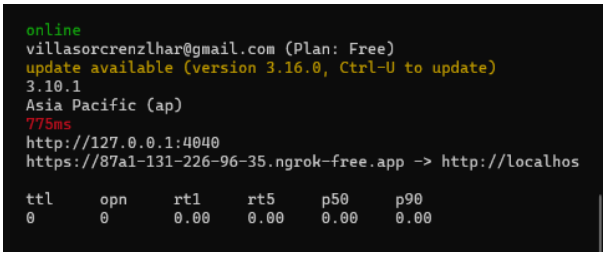

Fig 6. Ngrok Local Server for Dialogflow

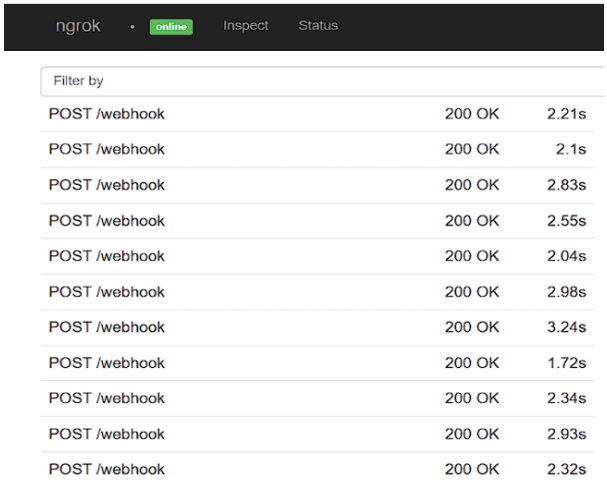

Fig 7. Example of Ngrok Post/Webhook Time Measurement

Ngrok is a tool that enables the proponents to expose local servers to the internet securely (see Figure 6). It creates a secure tunnel from a public URL to a local server running on a developer's machine. This allows the Proponents to use external services like Dialogflow to communicate with the locally hosted webhook without needing to deploy the server to the cloud. This is particularly useful for testing and developing chatbots, as it allows for real-time interactions without the need for a fully deployed application. Once Ngrok exposes the local server, the proponents update the webhook URL in Dialogflow to the new public URL generated by Ngrok.

The timeliness of responses is another critical factor in evaluating EduBot's performance. To measure the response time of the chatbot, the proponent utilized the Ngrok POST/webhook (see Figure 7), which allows for accurate tracking of how quickly the chatbot responds to user inquiries. During the testing phase, response times were carefully recorded to ensure that the chatbot provides prompt replies, delivering near-instantaneous answers to users. These response times were then categorized into various ranges to facilitate a comprehensive analysis of the chatbot's performance. This categorization helps identify areas for improvement and ensures that the EduBot meets user expectations for timely interactions.

Table 4. EduBot's Response Time

Response Time (seconds)	No. of Queries Answered	Percentage of Queries (%)
<3 seconds	31	61.66%
<5 seconds	29	48.33%
>5 seconds	0	0%

The response time analysis indicates that 31 queries (51.67%) were answered in under 3 seconds, while 29 queries (48.33%) were processed between 3 to 5 seconds. These results reflect EduBot's ability to deliver prompt replies for most user interactions. Variations in response time may be attributed to factors such as network connectivity and query complexity. Overall, the data provides a clear overview of the system's speed and performance under test conditions.

```
# Set your OpenAI API key as an environment variable
os.environ["OPENAI_API_KEY"] = "sk-Lsj9yz0uQwuTBdjaIrScT3BlbkFJKx

# Configure logging
logging.basicConfig(level=logging.DEBUG)

# Initialize static objects
embeddings = OpenAIEmbeddings()
llm = OpenAI(temperature=0)  # Adjust temperature as needed
loader = DirectoryLoader(".", glob="*.txt")
index_creator = VectorstoreIndexCreator(embedding=embeddings)
index = index_creator.from_loaders([loader])
```

Fig 8. Overview of OpenAI Key Stages

The innovative large language model developed by OpenAI undergoes several key stages in its operations, including data collection, training, fine-tuning, and evaluation. The first stage involves gathering a substantial corpus of text data for training the model, sourced from various outlets, including books, websites, and social media. Once collected, the data is pre-processed to convert it into a format suitable for training. This step often includes tokenization, where the text is split into smaller units like words or subwords. Following pre-processing, the model architecture is fine-tuned specifically for processing sequences of data, such as text. The design of this architecture significantly impacts the model's performance and efficiency. Next, the model is trained on pre-processed text data using a method known as supervised learning. During this phase, the model is presented with input text and the corresponding desired output, adjusting its weights to minimize the difference between its predictions and the actual outputs. This process is repeated for thousands of iterations until the model effectively learns to generate outputs that closely align with the desired responses.

```
cache-status': 'DYNAMIC', 'x-content-type-options': 'nosniff', 'server': 'cloudflare', 'cf
00'})
i._base_client:request_id: req_5e837e00058a0130de68dad2c9d63b09
Result:  The San Carlos College is located at Mabini Street, San Carlos City, Pangasinan.
Time taken for processing: 2.48 seconds
ug:127.0.0.1 - - [10/Dec/2024 07:19:45] "POST /webhook HTTP/1.1" 200 -
```

Fig 9. Response Generated by OpenAI

Once the model has gone through all the necessary stages, it's ready to generate responses (see Figure 9). The response is then sent back to Dialogflow, which presents it to the user in the chatbot interface, providing a seamless and informative interaction. This process ensures that the responses provided by the chatbot are dynamic, relevant, and tailored to the context of San Carlos College, allowing users to obtain the information they need quickly and accurately.

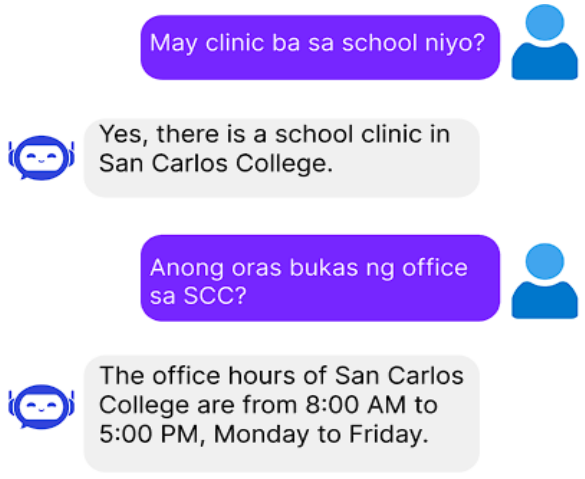

Fig 10. Example of an Actual Conversation Between the Chatbot and User

The responses generated by the chatbot are subject to continuous improvement through ongoing training and chatbot configuration. This process allows the model to adapt to changing information about the institution and to enhance the quality of interactions based on user experiences. Feedback from users is invaluable, as it helps identify areas where the model can improve accuracy, relevance, and overall user satisfaction.

EduBot's responses are evaluated based on how well they address the user's question within the specific context provided. A contextually accurate response ensures the chatbot not only understands the question but also provides relevant, precise, and clear information that is directly related to the user's needs, without unnecessary complexity or ambiguity.

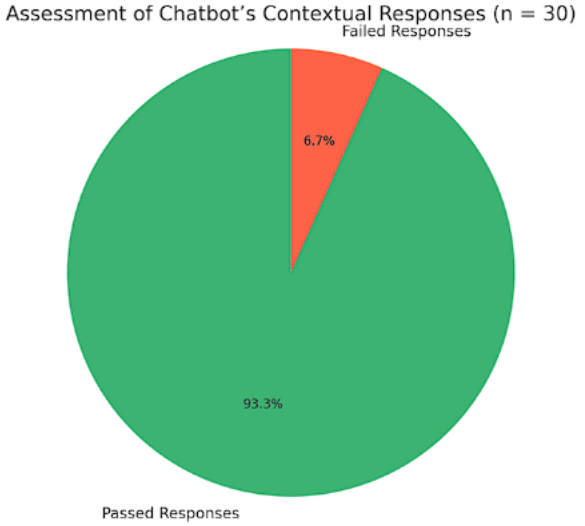

Fig 11. Assessment of Chatbot's Contextual Responses Pie Chart

$$Accuracy = \frac{Number\ of\ Passed\ Responses}{Total\ Number\ of\ Test\ Queries}\ x\ 100$$

Based on the computation, the overall performance rate of the chatbot is 93.33%, as evaluated through a test involving 30 queries. These questions were sourced from students via surveys and from actual queries entered into the chatbot. The chatbot successfully answered 28 questions, achieving an accuracy rate of 93.33%. The results demonstrate that the chatbot effectively addressed the majority of queries related to San Carlos College, providing accurate and contextually appropriate responses in most cases.

The evaluation revealed the chatbot's reliability in delivering information on topics such as tuition fees, scholarships, and contact details. Respondents expressed confidence in its ability to handle a wide range of inquiries, highlighting the clarity and relevance of its responses.

Table 5. User Satisfaction Survey Questionnaire

Questions	Yes	No
1. Did the chatbot provide a clear and accurate response to your query?	27	3
2. Was the chatbot able to identify and answer your query related to San Carlos College?	29	1
3. Did the chatbot respond to your query in a timely manner?	28	2

4. Did the chatbot handle invalid or unrelated queries appropriately?	22	8
5. Was the chatbot's response helpful in resolving your issue or answering your question?	23	7
6. Was the chatbot easy to interact with during your session?	24	6
7. Did the chatbot understand your query on the first attempt?	26	4
8. Did the chatbot offer alternative solutions when it couldn't answer your query?	23	7
9. Were you able to get the information you were looking for using the chatbot?	29	1
10. Did the chatbot's responses meet your expectations for clarity and relevance?	27	3
11. Did the chatbot maintain a polite and professional tone throughout the conversation?	28	2
12. Would you use the chatbot again for future inquiries related to San Carlos College?	25	5
13. Were you satisfied with the chatbot's handling of personal data and privacy concerns?	28	2

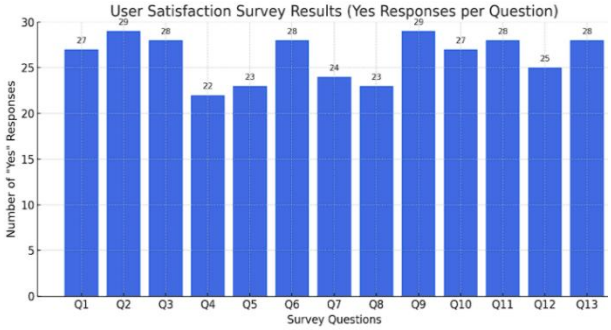

Fig 12. User Satisfaction Survey Result Bar Chart

$$Accuracy = \frac{Total\ Number\ of\ Yes\ in\ the\ Survey}{Total\ Number\ of\ Ques}\ x\ 100$$

With the computation, the overall satisfaction rate of the project is 86.92%, as evaluated by survey participants. The results indicate that the majority of respondents are satisfied with EduBot's performance, particularly in areas such as clarity, timeliness, and helpfulness of responses. The respondents, consisting of 30 individuals, 21 respondents or 70% from the institution and 9 respondents or 30% from other educational institutions tested the chatbot and confirmed that it effectively addressed their queries related to the institution. Participants expressed confidence in the chatbot's ability to provide relevant and accurate information, finding it easy to use and reliable. The chatbot was especially praised for its timely responses and valuable assistance to students, particularly for new, transfer, and other students seeking information about the institution. These responses reflect the users' evaluation of the chatbot's functionality and responsiveness when used in an educational context.

5. CONCLUSION AND FUTURE WORK

The project utilizes Dialogflow and the OpenAI API to process user queries efficiently. The chatbot supports both Filipino and English inputs, but responses will be provided exclusively in English to accommodate a wide range of communication preferences. Additionally, the project is designed to handle both valid and invalid inputs, ensuring timely and accurate responses. The testing phase of the chatbot revealed a strong performance in identifying valid and invalid queries, with accuracy rates of 68% for valid queries and 32% for invalid queries. These results demonstrate the chatbot's high effectiveness in distinguishing between valid and invalid inputs, ensuring reliable and consistent user interaction. With a performance rate of 93.33% on the actual assessment of the chatbot, the chatbot successfully handled most queries related to San Carlos College, providing clear and accurate responses on topics such as tuition fees, enrollment procedures, scholarships, and contact information. While the chatbot's capabilities are impressive, further analysis of misclassified queries could offer insights for future improvements, enhancing its accuracy and performance even further. In addition to accuracy, the response time analysis highlighted key insights into EduBot's speed and reliability. The majority of queries, 51.67%, were answered in less than 3 seconds, ensuring quick and efficient responses that are crucial in maintaining a smooth user experience, especially in educational contexts. However, 48.33% of queries took between 3 and 5 seconds, indicating slight delays, which could be attributed to factors such as server load or the complexity of certain requests. While these delays are minimal, they highlight areas for potential optimization, particularly for handling more complex or resource-intensive queries. The overall satisfaction rate of the EduBot project is 86.92%, based on the evaluation of survey participants. The results indicate that most users are satisfied with the chatbot's performance, particularly in terms of clarity, timeliness, and helpfulness of its responses. Survey respondents confirmed that EduBot effectively addressed their queries related to San Carlos College, with many expressing confidence in its ability to provide accurate and relevant information. Users also found the chatbot easy to use and reliable. While the project is considered functional and valuable, there are areas, such as handling unresolvable queries, where improvements could further enhance the user's experience.

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