Development of Web and Cloud Computing-Based Chatbot Services for Enhancing Academic Services at Panca Budi University

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A B S T R A C T

This research aims to develop web and cloud-computing-based chatbot services that can enhance academic services at Panca Budi University. The study highlights the importance of information and communication technology in education and the challenges universities face, such as less interactive academic services and long waiting times. The proposed solution is the development of a web and cloud-computing-based chatbot that can provide quick and accurate responses to student inquiries. Cloud computing in chatbot management also offers additional benefits, such as efficiency and continuous service availability. The research methodology employed a waterfall-based development approach, outlining the stages of chatbot development. Implementing the web-based chatbot utilized Amazon Lex services and integration with other AWS services. Testing results showed that the chatbot improved accessibility to academic information, reduced waiting times, and enhanced the quality of student interactions. The adoption of AWS cloud computing services enabled the chatbot to be accessed online 24/7. The successful development of the chatbot will help meet student needs and enhance academic services at Panca Budi University

Keywords: Chatbot, Cloud Computing, Amazon Lex, Web, Academic Services

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1. INTRODUCTION

Information and communication technology advancement has brought significant changes in various sectors, including education. Educational institutions, including universities, are increasingly aware of the importance of utilizing information technology to provide better services to their academic community[1]. In this context, Panca Budi University in Medan [2], as one of the private universities, is also striving to enhance the academic services [3] provided to students and all related stakeholders.

Within this background, there are several challenges faced by the university, such as one-way and less interactive academic services through the university's website portal, long waiting times for students to obtain information services through the academic administration service centre, and high workload for the administrative team in responding to frequently repeated questions. Therefore, an innovative solution is needed to address these challenges and improve academic services effectively.

One proposed solution is the development of web[4] and cloud computing-based chatbot services. A chatbot is a computer program that can interact with humans through text or voice messages [5]. In the context of academic services, a chatbot can be an effective tool for quickly and accurately answering frequently asked questions by students [6]. The chatbot can understand user queries and provide relevant responses by utilizing artificial intelligence technology and natural language processing [7] [8].

Furthermore, using cloud computing [9] in managing chatbot services offers additional benefits. With cloud computing, user input management and chatbot service provisioning can be done efficiently and flexibly [10]. Users do not need to invest in expensive server infrastructure, and the service can be accessed continuously (24/7/365) without interruptions [11].

In related literature, previous research has shown the successful use of chatbots in various fields, such as e-commerce [12]–[14], government [15], and companies [12], [13], [16]. Studies have also revealed that using chatbots in academic services can enhance student engagement, reduce operational costs, and improve service levels.

This research aims to develop web and cloud-computing-based chatbot services that can enhance academic services at Panca Budi University. The approach involves using artificial intelligence and natural language processing technologies to improve the responsiveness and accuracy of the chatbot in answering user queries using AWS cloud services. Thus, this research presents an innovation that provides a new solution to enhance academic services and operational efficiency in the university environment.

2. RESEARCH METHOD

This study will utilize a development research design with development stages based on the waterfall approach [17]. The waterfall approach involves sequential steps, including requirement analysis, system design[18], development, testing, and evaluation. This approach aligns with to development of web and cloud computing-based chatbot services.
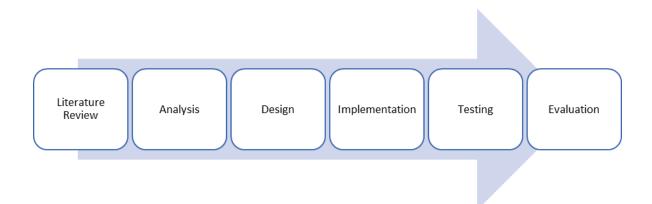

Figure 1. Resarch Method

1. Literature Review: This section provides a comprehensive and detailed explanation of the steps undertaken in conducting the research, starting from problem formulation to conclusion. The literature review references previous studies related to chatbots, such as books, journal articles, research reports, and internet sources.
2. Analysis: This stage will involve interviews with administrative staff, students, and other stakeholders to gather data on the needs and requirements of academic services at Universitas Pembangunan Panca Budi. Information will be collected from data obtained from the academic service centre.
3. Design: Based on the needs analysis, a web and cloud computing-based chatbot system will be designed. This includes user interface design, natural language processing structure, integration with cloud computing platforms, and the artificial intelligence methods to be used.
4. Implementation: In this stage, coding and programming will be carried out to develop the web-based chatbot using suitable technologies and programming languages. The development process will refer to the previously designed system.
5. Testing: After the chatbot is developed, testing will be conducted to evaluate its functionality, responsiveness, and accuracy. The use of the chatbot will involve the participation of students and administrative staff in asking questions and testing the chatbot's ability to provide relevant answers.
6. Evaluation: The results of the testing will be evaluated qualitatively and quantitatively. The assessment will measure user satisfaction, chatbot response time, error rates, and overall performance. The collected data will be analyzed to understand better the chatbot's effectiveness in improving academic services.

3.   RESULTS AND DISCUSSION
3.1. Needs Analysis

In the development of a web and cloud computing-based chatbot service to enhance academic services at Universitas Pembangunan Panca Budi, there are several relevant needs identified:

1. Currently, the academic services at the university do not facilitate two-way interaction between students and the academic information system. A web-based chatbot will allow students to interact directly with the academic information system, enabling them to obtain the required information quickly.
2. The increasing number of students at Universitas Pembangunan Panca Budi has resulted in a high workload for the administrative staff. With the presence of a chatbot, the response time to student inquiries is expected to be accelerated, thereby reducing waiting time and improving user satisfaction.
3. A chatbot system that operates 24/7 will provide flexible service access for students. Students can ask questions and receive answers whenever needed without depending on the working hours of the administrative staff.
4. The chatbot will help manage frequently asked questions by providing accurate responses. This will reduce the workload of the administrative staff and allow them to focus on other tasks that require human expertise.
5. Universitas Pembangunan Panca Budi may experience future growth in the number of students. Therefore, the developed chatbot should be easily adaptable to changing needs and capable of accommodating such growth.

Through this needs analysis, it can be understood that developing a web and cloud computing-based chatbot service will help meet the needs of students and improve academic services at Universitas Pembangunan Panca Budi.

Use Case for Developing a Web and Cloud Computing-based Chatbot Service to Enhance Academic Services at Universitas Pembangunan Panca Budi using Amazon Lex services
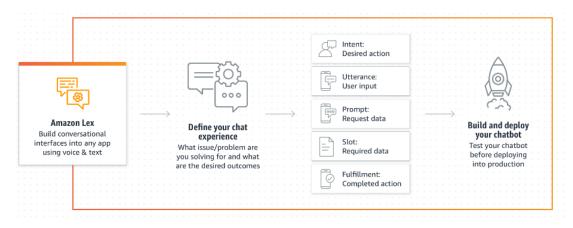

Figure 2. Use Case Chatbot using Amazon Lex

Amazon Lex receives input from users who send text or voice messages to the chatbot. Amazon Lex uses NLP algorithms to understand the user's intent and extract relevant information such as intents and slots. Once the intent of the user's input is determined, Amazon Lex can use Lambda functions or other services to execute business logic and generate a response. Continuous learning and improvement are made from user interactions to enhance the accuracy of recognition and fulfillment processes. Here are some features of Amazon Lex:

1. Intent: Intent refers to the purpose or intention of the user's request, which Amazon Lex uses to determine the actions the chatbot should take. Intents can be configured and customized by developers.
2. Slot: Slots are pieces of information that the chatbot requires to fulfill the intent. Slots can include information such as names, addresses, or phone numbers.
3. Fulfillment: Fulfillment refers to the actions taken by the chatbot to fulfill the user's request, such as sending an email or processing a payment. Fulfillment can be customized and expanded upon by developers
4. Dialog Control: Dialog control is the chatbot's ability to guide the user through a conversation by asking questions and providing feedback. Dialog control can be customized and configured by developers

3.2. Architecture

The admin implements a solution to the login account with an authentication system using Amazon Cognito for UI design and a web client. After authentication, Amazon CloudFront and Amazon S3 deliver the UI content to the content designer. The admin configures the questions and answers obtained from the BPAA API Gateway data to be inputted into the database and stored.
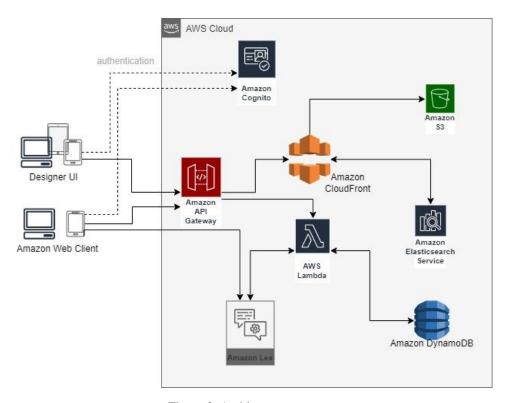

Figure 3. Architecture

3.2. Implementation of Chatbot Web

Amazon S3 stores data in objects, such as images, videos, documents, or other data in string format. The data in the web-based user interface is uploaded as objects to a bucket (container) in the S3 service, making it accessible from anywhere. Access to the system is granted using a predefined username and password.

Figure 4. Login Web Admin Chatbot

The admin can add IDs, types, questions asked by students, and corresponding answers as solutions to those questions. Figure 5 shows the question database input into the system based on the data obtained from the student service unit.

Figure 5. List Data Answer

Amazon Lex enables application conversation integration using the Amazon Lex web client. Amazon Lex chat uses intents to summarize the purpose of interaction and slots to capture information elements from that interaction. This generated bot aims to answer questions posed by users, in this case, students. These intents have slots that are trained to capture text from the questions.
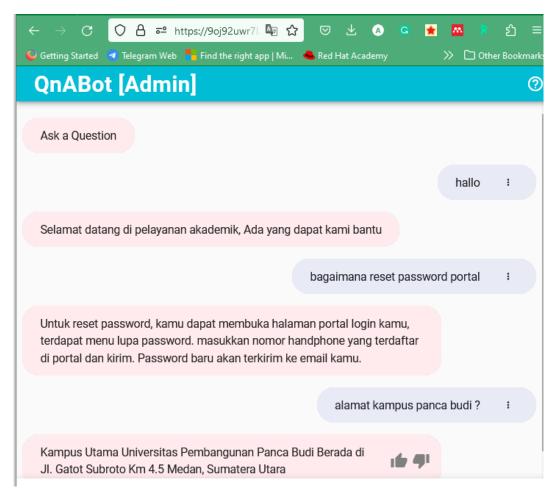
Figure 6. Chatbot Web

4. CONCLUSION

In this study, we have successfully developed a web-based and cloud-computing chatbot service to improve academic services at Universitas Pembangunan Panca Budi. The use of chatbot technology provides an effective solution in enhancing accessibility to academic information, reducing waiting time, and improving the quality of interactions between students, lecturers, and administrative staff.

Using AWS services such as Amazon Cognito, Amazon S3, Amazon CloudFront, Amazon API Gateway, Amazon Lex, Amazon DynamoDB, and Amazon Web Client, we have built a reliable and scalable architecture to support the chatbot. The cloud computing services provided by AWS enable us to deliver a chatbot service that is accessible online 24/7, providing convenience for users to obtain the information they need.

Our requirements Analysis helped us understand users' primary needs and design relevant chatbot features. Questions are processed and transcribed by Amazon Lex using Natural Language Understanding (NLU) and Natural Language Processing (NLP). The initial solution involved training the NLP engine to match various possible questions and statements so that the Amazon Lex chatbot can handle almost any user query. The interaction model of Amazon Lex is configured with intents and example utterances. These questions are then sent to the Amazon OpenSearch service for matching to retrieve answers. Relevance is calculated based on count (how often terms appear in documents), frequency (how frequently keywords occur in a document), and importance (the rarity or freshness of keywords appearing alongside phrases).

Using the chatbot also provides significant efficiency and time management benefits. Administrative staff can reduce their workload in answering repetitive questions, while students do not have to wait long to receive responses. This research brings added value in the form of technological innovation in the context of academic services. Implementing web-based and cloud-computing chatbots in a university environment can serve as a model that other educational institutions can adopt to enhance service quality and operational efficiency.

Therefore, developing web-based and cloud-computing chatbot services has positively improved academic services at Universitas Pembangunan Panca Budi. We believe this research can contribute to developing information technology solutions in education, inspiring future innovations and service improvements.

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