International Journal of Frontier Technology and Engineering (IJFTE)
Vol. 01, No. 02, June 2023, pp. 57-62

Dialogflow Performance Analysis for Learning Services in Learning Management Systems Using Chatbots

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Received Date: 12-03-2023 Revised Date: 10-04-2023 Accepted Date: 15-05-2023

Abstract

The variety of smart connection applications continues to increase, and the need for better communication in the network emerges. The conversation application is a solution that users widely use. The one quite popular today is known as Chatbot. In this study, the implementation of the Chatbot application was applied to the LMS (Learning Management System). The implementation of Chatbot used the ReactJS library technology in creating the user interface. This application could help students learn outside the classroom, especially if they experienced difficulties in the learning process. Furthermore, in this study, the Dialogflow technology was tested for matching sentence combinations in the Chatbot application. The tests were carried out on Informatics Engineering Department students at the State Polytechnic of Malang learning Microsoft Office applications. The results of the research experiment resulted in a 100% accuracy value for original sentence questions from the database and 72% accuracy-free questions, for usability testing produces a calculation value of 88.97%. From the results, it could be concluded that it was very feasible and met the criteria in the usability aspect.

Keywords : Learning Services, Learning Management Systems, Chatbots

1 Introduction

Various kinds of learning technologies are growing in the world of education today; one of which is the LMS (Learning Management System) concept [1][2][3][4]. LMS is used to lead to a significant improvement in the learning process of students both in the classroom and outside the classroom. One of them is by applying the LMS concept [5]. In this study, LMS users were students of informatics engineering as well as application testers. The use of AI (Artificial Intelligent) technology in Chatbot applications makes LMS applications better [6][7][8]. In addition, the use of Dialogflow is one of the uses of AI technology. Dialogflow is an API (Application Programming Interface) that functions to process human conversations based on artificial intelligence [9][10]. ReactJS is a JavaScript library that can create various user interface components [11].

In this study, the Dialogflow technology was tested for the application of artificial intelligence in the application of Chatbot [12][13]. It was applied to the LMS system to help the students learn the process [14][15]. Students could ask questions through the Chatbot application to get answers or solutions [16]. Questions in the Chatbot were to assist in learning about Microsoft Office applications [17]. Research testing was carried out by Informatics Engineering students of State Polytechnic of Malang while learning Microsoft Office. The test results were then analyzed on how the artificial intelligent algorithm worked on Dialogflow. The algorithm was used in the process of matching sentence combinations in the implementation of Chatbot [18].

Chatbot technology is software for automated conversational interfaces that speak naturally to users. [19][20]. However, the conversation is still lacking in the rules of good and correct language. From this, the language structure was used to find or match keywords, then these keywords were processed to respond to messages from users [21].

Dialogflow is a platform that serves to help work on Chatbot applications [11]. In Dialogflow, there are important concepts, namely the user request that tries to be delivered through messages and additional information that is stored and accessed during conversations with the user which function to model Chatbot behavior, which is when the user enters a response or action for the bot. In building a Chatbot for understanding the material, the Dialogflow API is needed [22]. The API functions for users to ask questions about learning materials in the Chatbot [23].

ReactJS is a JavaScript library developed by Facebook that functions to create interactive, stateful, and high-performance interface components [24]. ReactJS is also used in the Facebook newsfeed and is one of the tools used to develop popular sites such as Netflix, Paypal, Vevo, and many more [25][26].

2 Method

The first stage in the research method that is carried out is that the user enters questions on the user's computer. The second stage is the input process from the user that will be sent to the web server. The third stage of the Dialogflow API will process input from the web server using the existing data-set in Dialogflow. In the fourth stage, the results of the process are displayed as a Chatbot service on the user's computer screen. The process in the stages of implementing the Chatbot application is shown in Figure 1.

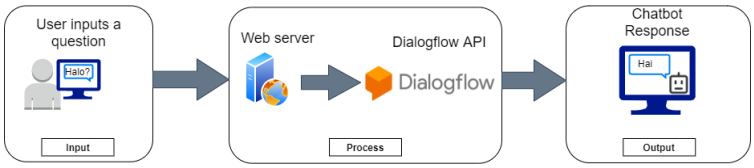

Figure 1: System Design

In training phrases to process questions, Dialogflow used the Cosine Similarity method to calculate the level of similarity (similarity) between two objects. The method is known based on the documentation on the Google cloud in the section on assessing the quality of training phrases in Dialogflow intents. $X \cap Y$ is the number of terms in document X and document Y (1). The following is an example of a question and answer data, each of which has a different context and question word, even though it contains the same word, coded D1 and D2.

$$Similarity(X,Y) = \frac{|X \cap Y|}{|X|^{\frac{1}{2}}.|Y|^{\frac{1}{2}}} \quad (1)$$

The system built did not involve much interaction with fellow actors, as shown in Figures 2. Actors consisted of students only and had the activities as shown in Figure 2 below.

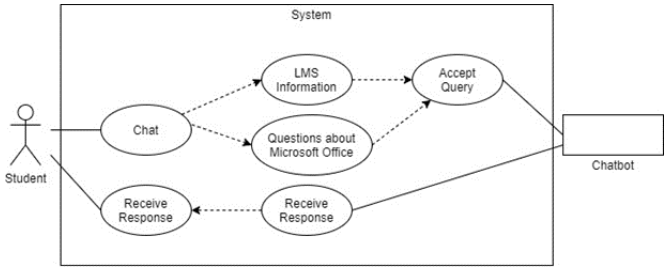

Figure 2: Use Case System

Students were the main users associated with the system, from learning using Chatbot to interact using bots.

3 Results and Discussion

This section discusses how the Cosine Similarity method works using a data set of questions and queries from user input, shown in Table 1.

Table 1: Sample Data Questions

Code	Questions
D1	how to convert or save to PDF?
D2	how to save a document?

Then the following is a query or sample sentence message from a chat user. This sentence was processed and then the level of similarity with the questions in the table above was calculated, as shown in Table 2.

Table 2: Query

Code	Query
Q	How to save pdf format

After getting sample data and queries, tokenization was carried out, namely breaking a sentence into several words and eliminating unimportant words. Here are the results of text processing, as shown in Table 3.

Table 3: Tokenization

No.	Token
1	how
2	to
3	save
4	pdf

The weighting of the text processing results was calculated by how many words were in each column D1, D2, and Q. The process is called Term Frequency, DF is the number of TF from the question data; then, the number of sentences n/DF was divided by DF or the number of TF. Furthermore, the weight of the value IDF (log n/DF)+1 was calculated. The following table shows the results of TF-IDF [5].

Table 4: Tokenization

No.	Token
1	how
2	to
3	save
4	pdf

The weighting of the text processing results was calculated by how many words were in each column D1, D2, and Q. The process is called Term Frequency, DF is the number of TF from the question data; then, the number of sentences n/DF was divided by DF or the number of TF. Furthermore, the weight of the value IDF (log n/DF)+1 was calculated. The following table shows the results of TF-IDF [5].

Table 5: Tokenization and TF-IDF

Term.	Q	D1	D2	DF	n/DF	IDF (log n/DF)+1
how	0	1	1	2	1	1
to	1	1	1	2	1	1
save	1	1	1	2	1	1
pdf	1	1	0	1	2	1.301

After getting the value weights, then TF was filled with weights and made column WQ as the result of query weights, and WD1 and WD2 as values from D1 and D2, as shown in Table 5.

Table 6: Term Frequency

Term.	IDF	WQ	WD1	WD2
how	1	0	1	1
to	1	1	1	1.301
save	1	1	1	1
pdf	1.301	1.301	1.301	0

For the calculation of Cosine Similarity, a search was carried out to add up the values. Then, the total root of the number of values, and finally calculated using the Cosine Similarity, as shown in Table 6.

Table 7: Term Frequency

Description	Q	D1	D2
The total sum of squares (ΣW^2)	3.692601	4.692601	3.692601
Total square root	1.921614166	2.166241215	1.921614166
The sum of the query weights and the document's squared weights		3.692601	2.692601
Cosine Similarity		0.786898566	0.7291881792

To find out the accuracy of the answer with the Chatbot, that is testing it, taken from the question repository (2). The first scenario is with a question sentence that comes from the database. Number of appropriate questions: 40 Number of questions asked: 40

$$Accuration = \frac{40}{40} \times 100 \tag{2}$$

Accuration = 100% The second scenario with free-question sentences Number of appropriate questions: 36 Number of questions asked: 50

$$Accuration = \frac{36}{50} \times 100 \tag{3}$$

Accuration = 72%

After that, usability testing was carried out to determine whether the application was following user needs or not. The test was conducted by 17 respondents. The usability test results were grouped into Strongly Agree (SS) totaling 69, Agree (S) amounting to 59, Neutral (N) amounting to 8, Disagreeing (TS) amounting to 0, and Strongly disagreeing (STS) totaling 0. The data was then calculated using the following formula (4).

$$\begin{aligned} Totalscore &= (JSS \times 5) + (JS \times 4) + (JN \times 3) + (JTS \times 2) + (JSTS \times 1) \\ &= (69 \times 5) + (59 \times 4) + (8 \times 3) + (0 \times 2) + (0 \times 1) = 605 \end{aligned} \tag{4}$$

To get the usability percentage, it is calculated using the following formula (5).

$$Percentage = \frac{605 \times 100\%}{680} = 88.97\% \tag{5}$$

The results of the calculation of the percentage of usability testing were 88.97%, and it could be stated that it was very feasible and met the criteria in the usability aspect. Figure 3 is a Chatbot feature displaying a response after a question is inputted by the user. The response is in the form of text and image answers.

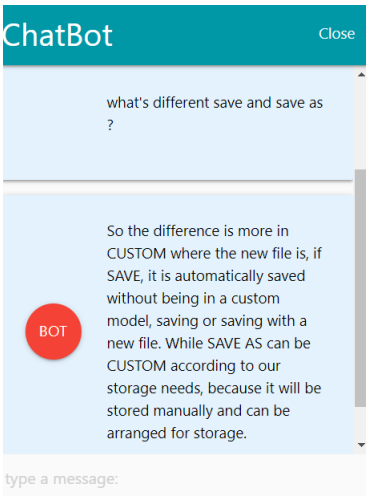

Figure 3: Chatbot with a text response

4 Conclusion

From the results of the development that has been carried out, it can be concluded that for implementation, by creating a platform in the form of a website with a Chatbot feature that aims to increase the efficiency and effectiveness of the distance learning process. Questions originating from the database produced 100% accuracy, and then free question sentences were with 72% accuracy. The results of the calculation of the percentage of usability testing produced 88.97%, it can be stated that it was very feasible and met the criteria in the usability aspect.

Acknowledgements

The authors would like to thank the Indonesian Directorate General of Higher Education (DIKTI) and the State Polytechnic of Malang who have supported this research project.

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