Perancangan Chatbot Widget sebagai Asisten Virtual untuk Layanan Informasi dan Pemesanan Kamar Asrama di Universitas Klabat

Chatbot Widget as Online Virtual Assistant for Dormitory Room Information and Reservation Service at Klabat University

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Abstract

Klabat University provides residential facilities for students, better known as a dormitory. Information services regarding dormitories and reservation rooms at Klabat University are still managed manually between the dormitory and students. Some problems occur when students want to find information and/or reserve a room at the same time. From the problems that have been observed, researchers have designed a Chatbot to facilitate the students to find information as well as reserve dormitory rooms. The development method used in this research is the prototyping model consisting of several stages, namely communication, quick plan, modeling quick design, construction of prototype, and deployment delivery and feedback. To design a chatbot by implementing two-way communication, researchers implemented Natural Language Processing technique with a Machine Learning approach. The result of this research is a new Chatbot widget as a virtual assistant for information services and reservation rooms in the dormitory at Klabat University.

Keywords - Klabat University, Chatbot, Natural language processing, Machine learning.

Abstrak

Universitas Klabat merupakan perguruan tinggi yang menyediakan fasilitas hunian bagi mahasiswa atau lebih dikenal dengan sebutan asrama. Layanan informasi mengenai asrama dan pemesanan kamar asrama Universitas Klabat masih dilakukan secara manual antara pihak asrama dan mahasiswa. Terdapat permasalahan dan hambatan jika ada banyak mahasiswa ingin mencari informasi dan/atau memesan kamar dalam waktu yang bersamaan. Dari masalah yang ditemukan, peneliti merancang chatbot yang dapat memudahkan dalam pencarian informasi sekaligus pemesanan kamar asrama. Metode yang digunakan dalam penelitian adalah prototype model yang terdiri dari komunikasi, perencanaan yang cepat, pemodelan secara cepat, membangun prototipe, serta evaluasi dan perbaikan. Untuk merancang chatbot dengan menerapkan komunikasi dua arah tersebut, peneliti menggunakan Natural Language Processing dengan pendekatan Machine Learning. Hasil dari penelitian adalah sebuah chatbot widget sebagai asisten virtual untuk layanan informasi dan pemesanan kamar asrama di Universitas Klabat.

Kata kunci - Universitas Klabat, Chatbot, Natural language processing, Machine learning.

1. INTRODUCTION

Klabat University (UNKLAB) provides residential facilities for students or better known as a dormitory. Currently, conducting information services regarding dormitories and reservation rooms in a dormitory at UNKLAB is still done manually between the dormitory and students. Students must come to the room booking location and will then be served by the dormitory. The same thing is also done when inquiring about dormitory information, where students get their information by word of mouth or come to the dormitory directly. Of course, there are problems and obstacles if many students want to find information and/or book a room at one time. Therefore, a system is needed in doing these services such as chatbots.

A Conversational bot (Chatbot) is a type of Artificial Intelligence (AI) program that can interact like a human [1]. This AI program has dominated as it can be used to help humans to perform daily activities [2]. Chatbot can write a chat or spoken conversation (voice-based) [3]. Various chatbots have been created, but a few of them are still traditionally implemented where users are given a list of topics related to user questions or statements and those topics don't always contain the necessary information they're looking for [4].

In this study, the researchers designed a chatbot to make it easier for a student to find information as well as reserve a dormitory room. A chatbot is a bot system that acts as a virtual assistant for replying to messages automatically and has two-way communication. Two-way communication is a complete communication process involving the sender and receiver, where the information provided by the sender will be received by the recipient so that it will give feedback, as it is shown in Figure 1. The purpose of this two-way communication is to ensure the smooth running of information in which the recipient can respond to the information it receives [5]. The communication flow is smooth and comes from two directions. Existing virtual assistant technologies such as Alexa, Siri, and Google Assistant have two-way communication as well as communicating with humans, but it's not that rare for a virtual assistant to respond incorrectly to a user's question.

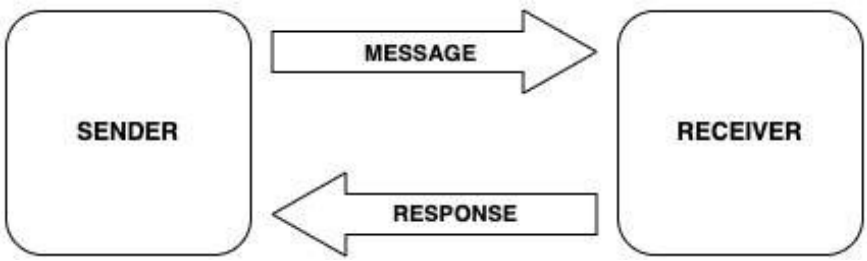


Figure 1 Two-way Communication Process (*feedback from the receiver to sender*).

Therefore, in this study, the design of the Chatbot only emphasizes two-way communication that regulates the flow of the conversation. Furthermore, it extracts important information and knows the intention of the user. For that reason, the researchers designed the chatbot using Natural Language Processing (NLP) and machine learning algorithm.

NLP is the field of AI that simulates the computer systems to understand and produce natural language [6]. However, more understanding is needed to enable the system to understand the natural language of the human being and provide an appropriate response. NLP focuses on the application of tasks such as natural language translation, information retrieval, question answering, text summarization, information extraction, and etc. [7]. In this study, the NLP technique are carried out to extract the information using a pattern-matching process by the NLP library that has been created. In the pattern matching process, matching is carried out and looking for the appropriate pattern component. This process was performed to let the Chatbot know every entity included in the sentence pattern for each user input. In the sentence, the pattern searches are performed using Regular Expression (ReGex) which is further useful for string validation [8].

Each pattern compiled using ReGex will extract predetermined information or can be called an entity. Furthermore, validation is implemented by the system where information in the form of entities will be searched in the NLP library and ascertained whether the user input is under the existing library [9]. Finally, the content of input will be carried out, text input included in common words will be omitted and important words will be taken only [10].

Machine Learning is a branch of artificial intelligence which focuses to imitate the way that humans learn by using computer programming, data and algorithms this capability can be performed [11]. Machine learning allows a program to work better on some human tasks like conversation, using the given data [12]. The performance of the classification for understanding the input using a machine learning model depends not only on the algorithm used but also on the quality of the data . Therefore, the data processing is quite important as the first step of machine learning process, one of the process is feature extraction technique. However, before feature extraction is performed, the data should be ensured that it is clean, safe, and organized is the correct way. When inaccurate data are trained using machine learning algorithm, the model will be less than optimal [13]. Therefore, preprocessing data that includes tokenizing to cut sentences into a collection of words is required. Feature extraction is a method used to represent text or data in numeric vector form or commonly called vectorization. Labeling data is necessary because most Machine Learning models for the prediction cannot learn raw data. A frequently used approach to extracting features of the text is TF-IDF (Term Frequency – Inverse Document Frequency) [14]. Once the feature has been extracted correctly, the feature data can be processed using machine learning algorithm to generate machine learning model.

The application of NLP with a Machine Learning approach provides the ability for chatbots to understand the conversations of the student during dormitory reservation and even to understand, analyze and more to manipulate the text data provided so that the Chatbot can respond to questions from students precisely and accurately. The Chatbot widget is designed to integrate into the website. The use of chatbot widgets can certainly make it easier for users for accessing and obtaining services related to dormitories. The location of the widget chatbot is easy to find, located in the lower right corner of the official website [15]. In addition, chatbot widgets are flexible because it can be implemented on other websites by using just a link.

Restrictions on a problem are used to prevent deviations or widening of the subject matter so that the discussion will be more focused on one research and research objectives. In this case, the limitations of this research are the Chatbot was designed and limited to the information and booking of the Klabat University dormitory room only, and the knowledge and response that the Chatbot has pre-defined. First, the user cannot cancel when the order has been confirmed, and the chatbot widget has not been integrated or connected to the Klabat University website during this experiment.

To design the proposed Chatbot widget as a virtual assistant for information services and booking dormitory rooms at Klabat University, we used natural language processing with a machine learning approach. In this study, the Support Vector Machine (SVM) algorithm was used as a intent classification of the Chatbot, it is supported by previous studies that the performance of this algorithm is undoubtedly in the multiclass classification [16] [17].

The programming languages used are Python, JavaScript, and PHP. Python is specifically used for operating machine learning and natural language processing algorithms because it is considered flexible to be used in multiple programming languages [18] [19]. Meanwhile, PHP is used for web development as it can shorten the script base programming and can be used for database connectivity [20]. JavaScript, on the other hand, serves as a connector to embed chatbot widgets into websites, making them more interactive [21].

2. RESEARCH METHODS

2.1 System Conceptual Framework

In this study, researchers used a software development life cycle (SDLC) approach to set up a widget chatbot as a virtual assistant for web-based boarding room information and booking services. There are various methods of software development, but the researchers choose to use the Prototype Model. Understanding what is often called the Prototype Model, this model is a software development process with fast and iterative planning where there is feedback so that the software is continuously improved to meet user needs [2 2] . In this study, the common steps in the prototype model were applied, and the process consists of some steps including Communication, Quick Plan, Modeling Quick Design, Construction of Prototype, and Deployment Delivery & Feedback. Further information on designing the chatbot widget is as follows:

1. Communication
   At the first stage, the researchers collect data and information to analyze user needs or requirements (*features and information*) through questionnaires. The researchers then determine process to build a good system and program to use in designing a web-based widget chatbot. In addition, the researchers conducted interviews with the dormitory (head of dormitory and monitor) to obtain information about the dormitory such as the name of the head of the dormitory, the name of the dormitory, the location of the dormitory, the model of the room, the number of dormitory rooms, the number of beds, and the facilities available in each room.
2. Quick Plan
   The Researchers design the plans based on the requirements that have been obtained at the communication step.
3. Modeling Quick Design
   At this stage, the modeling quickly through the information obtained and planning was conducted to develop the Chatbot widget.
4. Construction of Prototype
   The formation of the prototype was made based on the modeling design that had been carried out previously. Prototypes include how to input and output in the application of chatbot widgets and existing features.
5. Deployment Delivery & Feedback
   At this stage, the prototype chatbot widget is tested as a whole whether it runs well or not. If there is still a problem, feedback will be received so that it can help the development of the widget chatbot to be better. All stages are organized repeatedly the desired target on the widget chatbot is reached.

2.2 Conceptual Framework of Chatbot Widget

The conceptual framework of the chatbot widget illustrates how the chatbot widget works as follows:

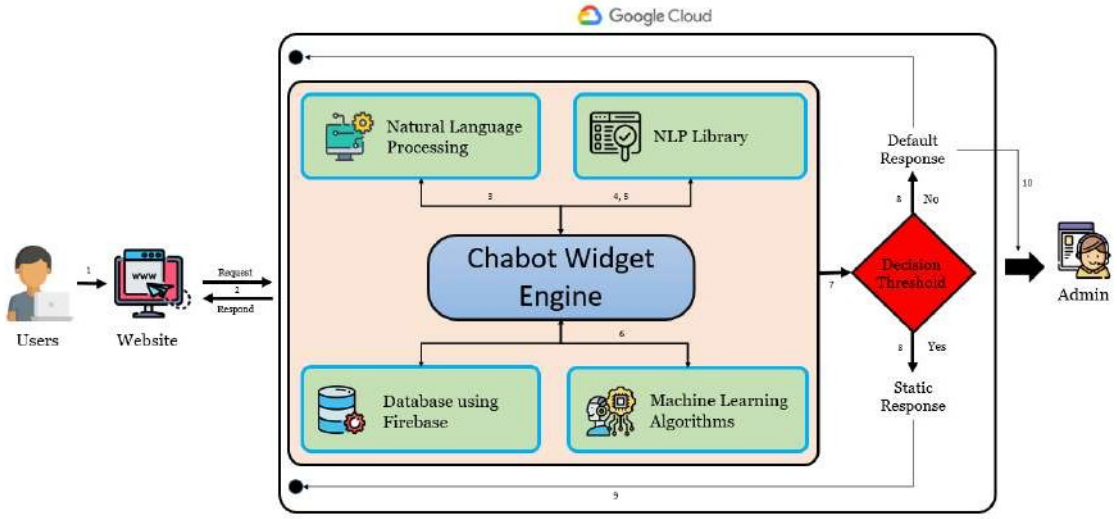


Figure 2 Conceptual Framework of Chatbot Widget

Figure 2 represents the conceptual framework of the chatbot widget which shows how the chatbot widget works, the process is shown as follows:

1. Users can access the websites integrated with the chatbot widgets through a browser.
2. After accessing the website, users can directly use the chatbot widget which acts as a virtual assistant and will carry out a series of processes located in the lower right corner of the web. The operation of the chatbot widget utilizes google cloud as a virtual server.
3. When the user inputs the question in the form of text on the widget Chatbot, the input will be processed by Natural Language Processing. Each user input is automatically saved to Firebase as a database during the development of this Chatbot widget.
4. Natural Language Processing was used to extract text information in the form of student names, phone numbers, dormitory names, room numbers, and bed positions based on the NLP library that has been created.
5. When the user input contains information that is under the NLP library, the information will be extracted so as not to affect the classification model in the next step, namely Machine Learning.
6. After extraction, the content of the text will be inserted into Machine Learning for intent classification or to see the intention of the input. The task will be performed by the classifier model to predict the tag/class/label of the input. The label in question is in the form of room messages, dormitory information, and other intents that have been predefined.
7. After the prediction of tags/classes/labels is carried out, the intent of the prediction results based on user input has been determined. Each intent has a pattern, therefore the user's input will be checked or calculated for similarity to the pattern from the previous intent prediction. In the process of checking similarity, a similarity prediction score or confidence level will be displayed between the user's input and the pattern in the intent prediction.
8. If a prediction score or confidence level is found to be above the specified threshold (70%), AI Chatbot will automatically respond to the user according to the predefined response.
9. If the predicted score or confidence level is below the specified threshold (70%), it means that the user's input cannot be recognized, or the user's input has not been answered correctly. The response to be sent is also a default response that has been determined to be predefined.
10. The user input response from the static response and default response will be displayed.
11. The admin will handle unrecognizable input by accessing the user's chat history. From this history, the admin can see the confidence level found in each user input and then enter the input in the model to be done manually according to the existing intent so that the system becomes smarter so it can increase the confidence level.

3. RESULTS AND DISCUSSION

3.1 Interface Implementation

3.1.1 Chatbot Widgets

Users can access the interface implementation of the chatbot widget by pressing the widget logo in the lower right corner of the website.

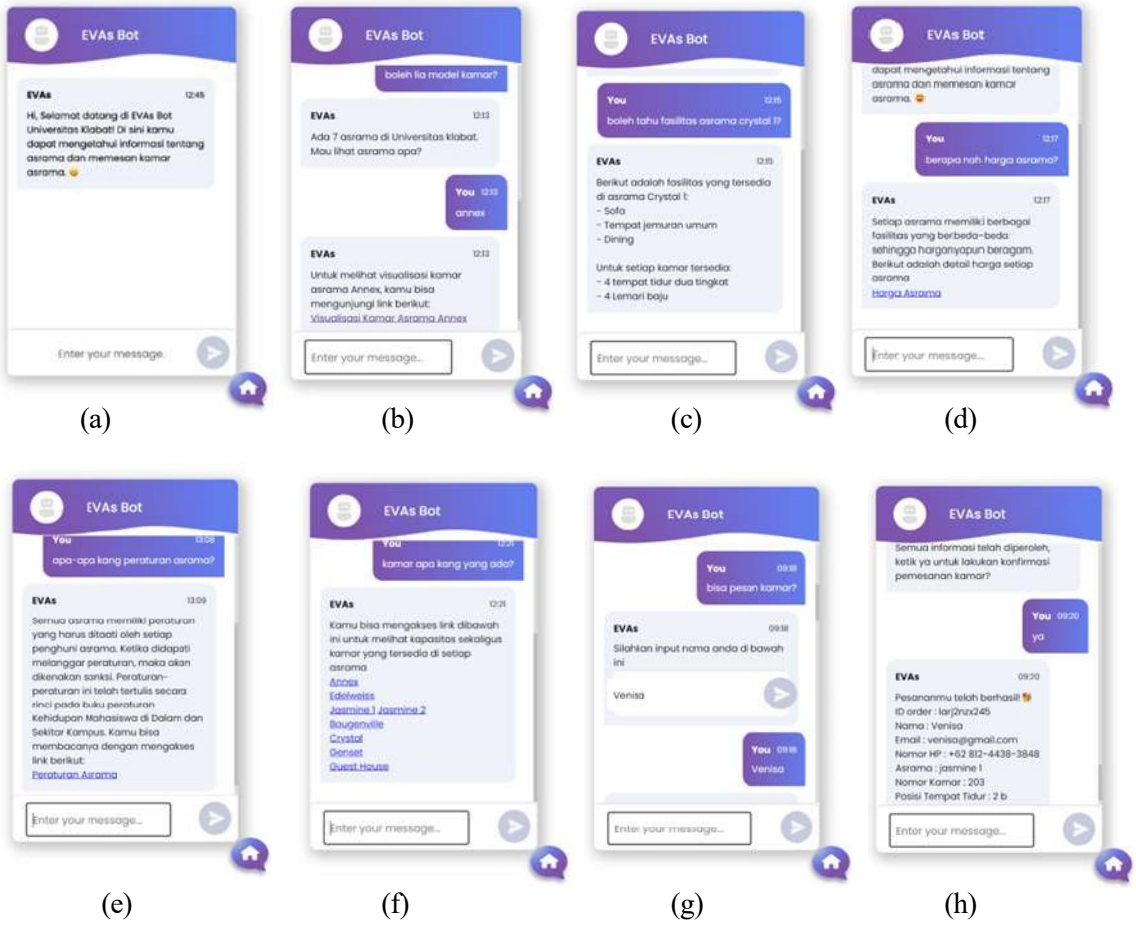
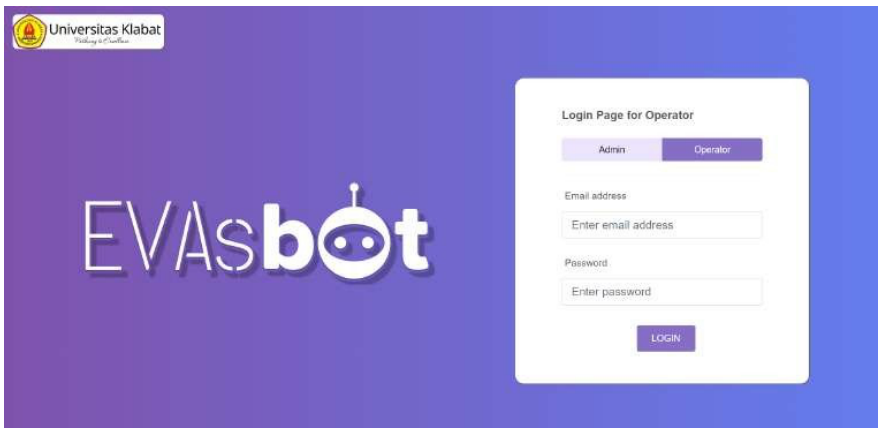


Figure 3 Implementation of Chat Interface Information and Booking of Boarding Rooms

Figure 3a shows the implementation of the chat initial display interface, where in this section the user can type and send messages to the Chatbot. Figure 3b is an interface implementation when the user asks for room model information. When the users (*students*) does not specifically mention the name of the dormitory, the chatbot can directly ask for the user wants. Then, the Chatbot give a response by sending a link to be accessed by the user containing details of the desired dormitory room model. Figure 3c is the implementation of the interface when the user asks for dormitory facilities, after knowing the specifics of the dormitory, the chatbot immediately display a response containing details of the dormitory facilities. Figure 3d is an implementation of the interface when the user wants to see the price of the dormitory, the Chatbot then immediately display a response in the form of a link that can be accessed by the user containing details of the price of the entire dormitory. Figure 3e is the implementation of the interface when the user wants to see the dormitory rules. Figure 3f is an interface implementation when the user wants to see the availability of the rooms, the Chatbot can provide a response accompanied by a link that can be accessed by the user containing the capacity and availability of rooms for each dormitory. Figure 3g image is an interface implementation when the user wants

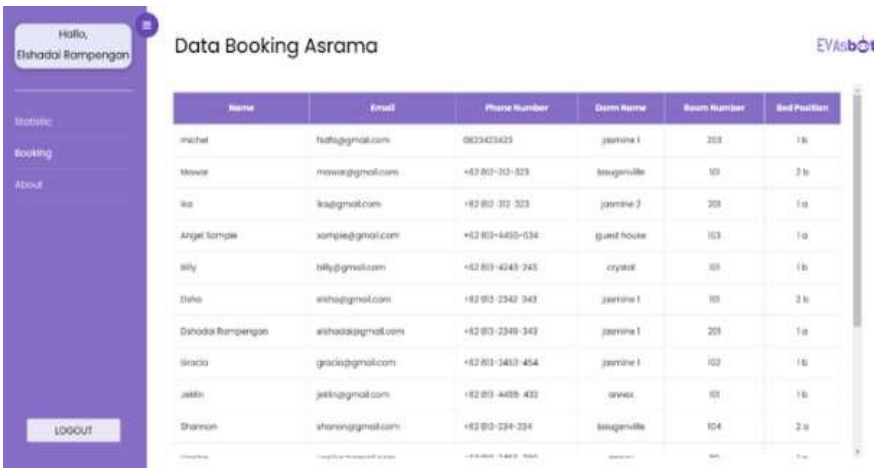
to book a room, the Chatbot asks for the data or information needed during the room reservation process which begins with asking for a name then email, phone number, dormitory name, room number, and bed position. After all the information was complete, the Chatbot will confirm the reservation room to the user. Figure 3h is the implementation of the interface when the user confirms the order, the chatbot can display the user's order details.

3.1.2 Web Portal



(a)

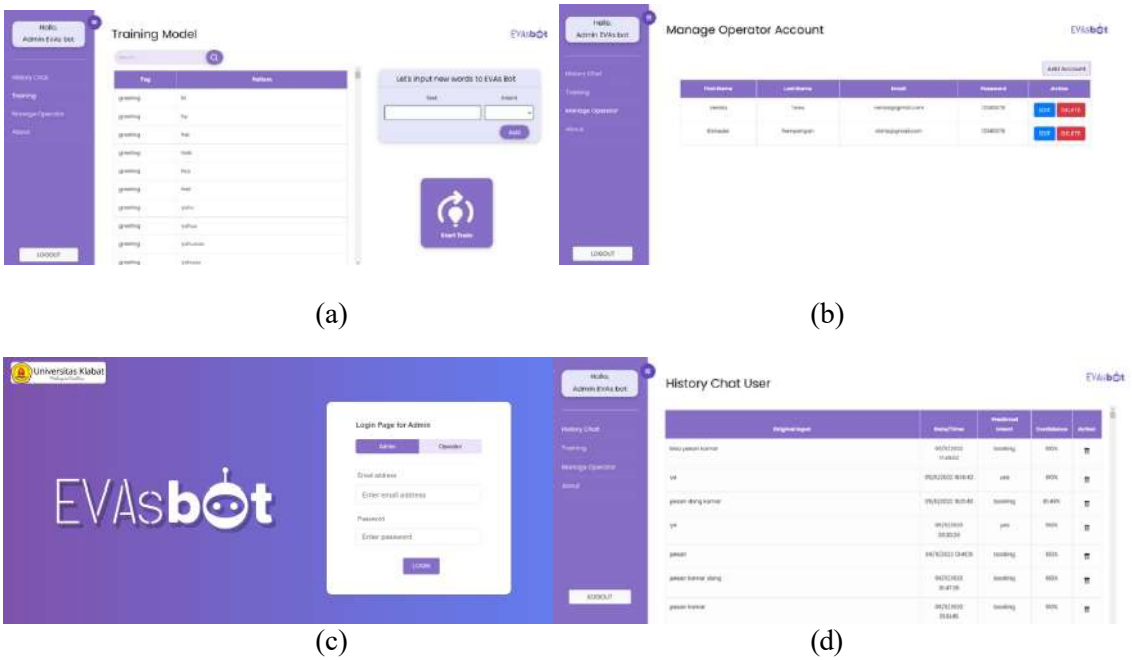
(b)



(c)

Figure 4 Implementation of the Operator Web Portal Interface

Figure 4a shows an interface implementation of the operator login. Before accessing certain pages and features, the operator must first log in. Figure 4b shows the operator's statistics interface implementation. After the operator has logged in, the first page displayed is statistics. This page displays a visual overview of the intended users who appear the most when having conversations with chatbots. Statistics can be used for displaying some information in the form of a WordCloud and Pie Chart. In addition, there is an update button to generate the latest data statistics. Figure 4c is an interface implementation of booking. On this page, the operator can view and monitor the list of students who reserved a room as well as information such as email, phone number, name of the selected dormitory, room number, as well as the position of the designated bed. On this page, admins can view developer information as well as a brief description of the EVAsBot.



(a) (b)

(c) (d)

Figure 5 Admin Web Portal Interface Implementation

Figure 5a shows an interface implementation of the admin login. Before users can access certain pages and features, admins must first log in. For admins, the account has been pre-defined. Figure 5b is an interface implementation of the chat history. After the admin logs in, the first page displayed is the chat history. This page displays the chat history of the users. Every chat sent to the chatbot will be stored and displayed on the chat history page. Figure 5c is an implementation of the training interface that can only be performed and accessed by admins. This page displays all the intents along with the existing patterns. In addition, on this page, admins can add intent patterns, search for intents and patterns, and perform the training process to generate a new Chatbot model. Figure 5d is an implementation of the manage operator interface. This page is only accessible to admins. On this page, admins can add, change, or delete operator accounts. On this page, admins can view developer information as well as a brief description of the Chatbot.

3.2 Testing

In the final stage, the black box testing was conducted by researchers to find out whether the proposed Chatbot widget is functioning properly or not. In addition to testing conducted by researchers, the testing is also carried out by some students which are lived inside and outside of the campus.

Table 1 Testing Chatbot Widgets for Users

No.	Feature	Output	Result
1	Inquire about room availability	The chatbot successfully displays room availability.	OK
2	Ask for room facilities	The chatbot successfully displays the room facilities.	OK
3	Asking for room capacity	The chatbot successfully displays the room capacity.	OK
4	Ask for the price	The chatbot successfully displays the dormitory price.	OK
5	Ask about the regulations	The chatbot successfully displays the dormitory rules.	OK
6	Booked a room	The user successfully booked a room through the chatbot widget.	OK
7	Understand the Indonesian language and Manado dialect/language	The chatbot successfully understands user input using Indonesian language and Manado dialect/language.	OK
8	Widgets are integrated into the website	Chatbots successfully integrate chatbot widgets into a website.	OK
9	Extract user input information	The chatbot successfully extracts user input information using NLP.	OK
10	Know the context of the conversation	The chatbot manages to find out the context of the user's conversation such as booking a room or not.	OK
11	Save chat history	The chatbot successfully saves each user's conversation history into the database.	OK
12	Multiuser chatbot	Chatbots can be used on more than one user at a time.	OK

Table 2 Feature Testing the Chatbot Web Portal Widget for Operators

No.	Feature	Output	Result
1	Login	The operator enters the portal.	OK
2	Displays statistics	The system successfully displays statistics from the most frequently appearing intents.	OK
3	View Booking	The system successfully displays a list of students who have booked a room along with their information.	OK
4	View About	The system successfully displays the about page.	OK

Table 3 Feature Testing the Chatbot Web Portal Widget for Admins

No.	Feature	Output	Result
1	Login	The operator enters the portal.	OK
2	Manage Operators	The manage operators page is successfully displayed and admins can make additions, changes, and deletions to the operator's account.	OK
3	View History Chat	The chat history page is successfully displayed.	OK
4	Manage History Chat	The system successfully displays the chat history page and the admin can perform chat history deletion.	OK
5	Training Model	The admin successfully performed model training on the Training page.	OK
6	Search Intent	The admin successfully performed an intent search as well as an existing pattern.	OK
7	Add Pattern	The admin successfully added data to the Training page.	OK
8	View About	The system successfully displays the about page.	OK

4. CONCLUSIONS

From the results of designing a widget chatbot as a virtual assistant for information services and booking dormitory rooms at Klabat University, the following conclusions were obtained:

1. The chatbot widget as a virtual assistant for information services and boarding room reservations at Klabat University is created by utilizing Natural Language Processing to extract information and Machine Learning to find out the intention of user input.
2. The chatbot presents the information needed by prospective dormitory residents and parents of prospective dormitory residents before finally booking a room.
3. The chatbot widget can serve dormitory room reservations by chatting like a human.
4. The chatbot widget has a web portal that can be used by operators who are boarding parties and admins with different access rights and tasks.

5. FURTHER STUDY

The design of this Chatbot widget is certainly not perfect. Therefore, the researchers want to give some suggestions for the further development of this Chatbot widget. The suggestion given are:

1. Add a Frequently Asked Questions (FAQ) feature in the chatbot widget in the beginning of a conversation with the users.
2. Create a real-time chat feature with the operator, this feature may help the operator to handle some unexpected question from the users in dormitory.
3. Implement the website’s framework for the front-end and back end system to achieve the information security of the whole system.

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REFERENCE

[1] D. J. C. Sihombing and A. Wirapraja, "Trends in the Application of Artificial Intelligence in the Fields of Accounting, Renewable Energy and Process Manufacturing Industries," *Jurnal EKSEKUTIF*, vol. 15, no. 2, pp. 302–315, 2018.

[2] S. Nahavandi, "Industry 5.0-a human-centric solution," *Sustainability (Switzerland)*, vol. 11, no. 16, 2019, doi: 10.3390/su11164371.

[3] T. Lalwani, S. Bhalotia, A. Pal, S. Bisen, and V. Rathod, "Implementation of a Chat Bot System using AI and NLP," *International Journal of Innovative Research in Computer Science & Technology*, vol. 6, no. 3, pp. 26–30, 2018, doi: 10.21276/ijircst.2018.6.3.2.

[4] T. Lopez and M. Qamber, "The Benefits and Drawbacks of Implementing Chatbots in Higher Education," no. March, 2022.

[5] S. Fer, "Verbal Communiton as a Two-Way Process in Connecting People," pp. 1–7, 2018, doi: https://ssrn.com/abstract=3128115.

[6] E. Malinowski *et al.*, "Natural Language Processing," *Data Vault 2.0*, pp. 1–15, 2019, doi: 10.1007/978-3-322-94873-1.

[7] P. Chowdhary, *Fundamentals of Artificial Intelligence*. 2020.

[8] Migunani and Kevin Aditama, "Utilization of Natural Language Processing and Pattern Matching in Learning Through Virtual Teachers," *Elkom : Jurnal Elektronika dan Komputer*, vol. 13, no. 1, pp. 121–133, 2020, doi: 10.51903/elkom.v13i1.187.

[9] D. Khurana, A. Koli, K. Khatter, and S. Singh, "Natural language processing: state of the art, current trends and challenges," *Multimedia Tools and Applications*, vol. 82, no. 3, pp. 3713–3744, 2023, doi: 10.1007/s11042-022-13428-4.

[10] V. R. Prasetyo, N. Benarkah, and V. J. Chrisintha, "Implementasi Natural Language Processing Dalam Pembuatan Chatbot Pada Program Information Technology Universitas Surabaya," *Teknika*, vol. 10, no. 2, pp. 114–121, 2021, doi: 10.34148/teknika.v10i2.370.

[11] R. K. Dinata and N. Hasdyna, "Machine Learning." 2020.

[12] T. Tuomi and I. Ilkka, *The Impact of Artificial Intelligence on Learning, Teaching, and Education Policies*. 2018.

[13] J. Hurwitz and D. Kirsch, *Machine Learning For Dummies*, Limited. John Wiley & Sons, Inc, 2018.

[14] W. Yulita, M. C. Untoro, M. Praseptiawan, and I. F. Ashari, "Automatic Scoring Using Term

Frequency Inverse Document Frequency Document Frequency and Cosine Similarity," vol. 10, no. 2, pp. 93–104, 2023, doi: 10.15294/sji.v10i2.42209.

[15] E. Sohn, "Chatbot and Slide Widget-based Classroom Response System to Promote Classroom Participation," *Journal of Korea Multimedia*, vol. 22, no. 8, pp. 940–949, 2019, doi: https://doi.org/10.9717/kmms.2019.22.8.940.

[16] D. Alita, Y. Fernando, and H. Sulistiani, "Implementation of the Svm Multiclass Algorithm in Indonesian Public Opinion on Twitter," *Jurnal Tekno Kompak*, vol. 14, no. 2, p. 86, 2020, doi: 10.33365/jtk.v14i2.792.

[17] I. A. Ropikoh, R. Abdulhakim, U. Enri, and N. Sulistiyowati, "Implementation of the Support Vector Machine Algorithm for Web Phishing Classification," *Journal of Chemical Information and Modeling (JAIC)*, vol. 5, no. 1, pp. 64–73, 2021.

[18] S. Raschka and V. Mirjalili, *Python Machine Learning and Deep Learning with Python, scikit-learn, and TernsorFlow2*. 2019.

[19] *TIOBE Programming Community Index for May 2023. .*

[20] K. Tatroe, P. Maclntyre, and M. Stowe, "Programming PHP," 2020.

[21] A. Firdaus, S. Widodo, A. Sutrisman, S. G. Fadhilah Nasution, and R. Mardiana, "Design and Build a Library Information System Using WEB Service at the Police Computer Engineering Department," *Jurnal Informatika*, vol. 5, no. 2, pp. 81–87, 2019.

[22] A. Susanto and Meiryani, "System Development Method with The Prototype Method," *International Journal of Scientific and Technology Research*, vol. 8, no. 7, pp. 141–144, 2019.