

Development of Chatbot Application to Support Academic Staff Works for Academic Student Services

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Abstract

The use of chatbots nowadays is expanding in some fields in human life. It has been used in customer service, education, etc. In the educational area, a chatbot has been used to help students to learn, or to give information relates to the academic and non-academic area, it even helped students to choose the elective course for the next semester. Even though it has been used for many purposes, not all education institutions implement the chatbot. Seeing that challenge, in this paper, the researchers try to develop a chatbot to improve students' academic service in one of the study programs in Bina Nusantara University, namely Information Systems. The researchers want to give more improvement in the way students communicate with the department, whereas now it's only through social media like Facebook, Instagram, and Line. The methods for analysis and development of this chatbot use the foundation of Decision Support Systems (DSS). Other methods for collecting data are also being used to develop the flow of the Chatbot that is through the questionnaire and interview with some of the stakeholders. The result of the research is the chatbot flow that can be used as the first step to develop a chatbot.

Keywords

Chatbot, Education, Customer Services, University

1. Introduction

Chatbots come from the word chat and bot, chat means talk, and bot came from the word robot, which is a software that does automatization process, thus it's fair to say that chatbot as a part of bot that runs in various chat platforms. Chatbots provide a simulation platform for effective and intelligent communication with users. A chatbot is a conversational agent that interacts with users in specific subjects using natural language. Many chatbots have been used on the Internet for educational purposes, customer service sites, guidance, and entertainment. Chatbot replaces the role of marketers, salespersons, counselors, and other mediators and works to provide the services provided by the roles mentioned above. Nuruzzaman and Hussain (2018) conducts research on using Deep Neural Networks on better chatbots than the use of chatbots with only manual commands and templates. The use of AI (Artificial Intelligence) technology in chatbots is also recommended to improve the quality of discussion. The Chatbots market is on the rise, businesses will deploy chatbots in the next few years, especially via messaging apps or social media platforms (Acquire 2022). Companies that use chatbots will be faster to help customers overcome their problems in the 24/7 service application. Companies using Chatbot not only to serve customers, but they can also share their new product information using Chatbot to customers. This will not only make bots better at customer engagement but will also enable service teams to get more insight into customer behavior (Acquire 2022). The development of the research side of the chatbot also developing, Meyer von Wolf et al. (2019) found that since the year 2001, research on chatbots continues to increase, and drastically in 2017 can be seen a significant increase from the descriptive research of chatbots. Not only companies that use a chatbot, but lots of universities also do. George Washington University is the only university that uses a chatbot to create a more efficient side of academic and administrative duties (Brereton 2019). In India, Tiwari et al. (2017) also designed the chatbot for universities with three main modules namely, Admin Login, Bot Chat, and Text to Speech. Meanwhile, Bala et al. (2017) designed a chatbot using AI where Natural Language Processing technology is applied in parsing, tokenizing, stemming, and filtering complaint content from users in a campus management system.

To increase ties with prospective students, Benotti et al. (2014) used the chatbot to teach basic computer science to aspiring computer science students in Argentina. A Review of the needs and advantages of using chatbots in university student services became a destination in research (Srimathi 2019). Literature studies on chatbots in educational institutions are also conducted by Winkler and Sollner (2018). Villegas-Ch et al (2020) also, identify the needs of variables needed to implement a chatbot on smart Campus to enhance learning. In Indonesia, the Catholic University of Indonesia Atma Jaya also makes a bot named Savira by using the application LINE, which can help to provide information about Atma Jaya University to prospective students. Savira is designed to use artificial intelligence and naturalistic language so it is expected to welcome prospective students and parents in a friendly manner (Jaya 2018). In addition to being used in customer services, chatbots are also used in e-learning at universities (Colace et al. 2018). Smutny and Schreiberova (2020) in their research using a chatbot for e-learning, found that chatbots with Facebook Messenger have varying levels from just sending private messages to recommending learning materials. The research of Ho et. al (2018) designed a chatbot to help students choose an elective course, which previously can be gathered from direct discussions with their academic advisers. This shows that the use of chatbots can still be further enhanced for educational use.

The advantages of chatbots that can be seen in previous research become the reason for researchers in conducting the analysis and design of application model chatbots, especially for universities in the case studies at the School of Information Systems (SIS) BINUS University. SIS is the first faculty that applies the official Line channel in 2016 as "School IS BINUS" with high student chat transaction traffic (10-50 chats per day per student). The purpose of using the Line account in 2016 is to add new communication channels with students. One of the features from the official Line namely broadcast message is useful to disseminate information about the major. Line official has been used also to handle various student inquiries related to the academic services, where the inquiries will be responded to by the admin of the major's personnel in SIS. The image in Figure 1 below shows examples of the user interface of the current Line channel.

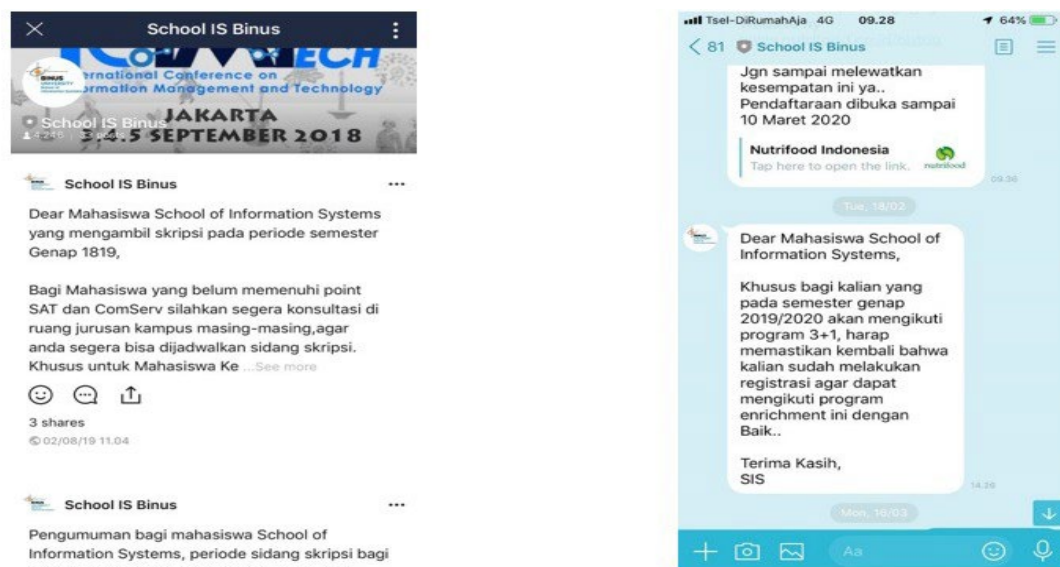


Figure 1: Example Line Channel (Source: Official Line School of IS BINUS, 2020)

The average number of chat queries from the SIS Line official application that must be responded to during the lectures (outside the time off) is 40-50 student chats per day (data obtained from June - Dec 2019), this does not include chat service to the personal number of the personnel in the majors (Head of Program, Deputy Head of Program, Head of Internationalization and Partnership Program, Enrichment Coordinator, and Head of Laboratory) and also does not include direct messages via social media (Instagram and Facebook). Currently, the major's personnel respond to each message every day with a reply time in the operational hours at 09:00 – 18:00 (Monday – Friday) and 09:00 – 15:00(Saturday).

With the number of the SIS active students' chat now, it raises some issues related to the academic services, especially in terms of handling student inquiries via the Line channel. Based on the interview with the admin of Line Channel

(Head of Program, Deputy Head of Program, Head of Internationalization and Partnership Program, Enrichment Coordinator, and Head of Laboratory) there are several problems from the current application including:

1. When handling inquiries from students, the response cannot be done in real-time.
2. Need more effort for the admin to reply one by one student messages, especially related to questions that are operational, routine, and structured, so it is very time-consuming for the admin to handle the routine administration problems.

The previous research about Chatbot for Universities can be seen in Table 1 below:

Table 1: The Previous Research about Chatbot

Year	Title	Result
2018	<i>Designing Chatbot for Higher Education Practice</i>	<i>The design of chatbot articulated by experiences in the design process but have still not been rigorously evaluated. Future work for this research includes the process of defining chatbot behavior for a particular course. (Sjostrom et al, 2018)</i>
2019	<i>Educational Chatbot with Learning Avatar for Personalization</i>	<i>This research focuses to create Learning Avatar, that can create a cognitive model by the user from on collected additional user-specific data. That so much helps to personalize further learning. The purpose, the chatbot can ask control questions in an informal conversation. (Vladova et al, 2019)</i>
2019	<i>Say Hello to 'Coding Tutor'! Design and Evaluation of a Chatbot-based Learning System Supporting student to Learn to Program</i>	<i>Focus on this research is deducing and evaluating design principles and assessing the student's evaluation. Then the future research, particularly analyzing the long-term effect of using the similar chatbot-based learning system in IS education pledges interesting insights effectiveness and long-term acceptance of chatbot-based learning systems. (Hobert, 2019)</i>
2019	<i>Evolution of Chatbots for Smart Assistance</i>	<i>This research focuses on a chatbot that must be useful and must be effectively comprehended, Chatbot that create to store the conversation and increase its knowledge base. (Aggarwal et al, 2019)</i>

Based on the limitation of services as explained above and compared to the previous research about chatbots in the education sector, SIS needs chatbots application to automatically give answers or explained some procedure or information related to academics to the students.

The objectives of this research are:

1. Analyzing the problems and needs of chatbot application from the School of Information Systems, BINUS University as best practice.
2. Build a Chatbot system model to help support the academic services from the School of Information systems, BINUS University.

2. Methods

Data Collection Methods through performing a secondary data collection one to determine the data patterns of services that students need by analyzing the student's line chat data for one semester and through the online questionnaire to the student, the other data collection also being done through an online questionnaire to the Chatbot expert. From the chat's data and student questionnaire, it's expected to be analyzed the categorization of the academic services needed by students, especially for questions that have the routine nature of the time-side and definite (structured). The Online questionnaires that have been spread in cross-sectional time horizons are used to get more information directly about the phenomenon and the problems. The researcher used fit-gap analysis to see the needs and problem, while AHP (Analytical Hierarchy Process) is used to process the result of the questionnaire from the expert (12 experts work as chatbot developers). The researcher uses AHP because there is a need to decide what type of chatbot will be modeled and developed on the research and there are some criteria as the boundaries (Maintenance, Modification, Error Rate, Performance, Cost). SDLC (Software Development Life Cycle) is used as the research framework that align also with systems development. This SDLC includes the Planning, Analysis, Design, and Implementation phase of the research.

The analysis and development of this chatbot use the foundation of Decision Support System (DSS), where the concept of DSS consists of 3 main components, namely user interface, model, and database as shown in Figure 2 below:

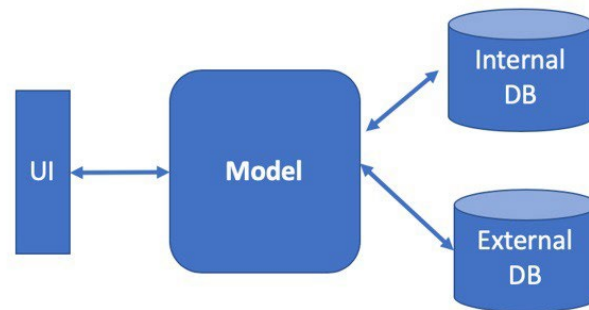


Figure 2: DSS Model as a chatbot development reference

The Database components (internal and external DB) are where the data needed by the systems is provided or stored. The Model components show how the data from Database Component is being modeled to provide a solution within the system. While the User Interface component shows how the user can interact with the system.

3. Results and Discussion

The development of the chatbot in the year 1964-1966 with the name ELIZA can provide user response by matching the pattern and substitution of sentences with the rules that have been made humanly in a script called MAD-Slip. Later in 1995, there was also a researcher who developed ALIZE as a chat robot by using XML as a scheme called Artificial Intelligence Markup Language (AIML), in which the system is built with category based on the pattern compiled by accompanying the existing answer template. Knowledge of this chatbot can be enriched by adding question and response categories to the answer template. However, at the beginning of the development, this method is far from the natural language where the limitations of the response that only follow the specified XML schema at the beginning, while based on research from Adam (2020), Chatbot response to the user is a significant effect for the user's willingness to use the chatbot.

To choose the type of Chatbot that will be developed in this research, the researchers use AHP (Analytical Hierarchy Process) that starts with creating the model including:

1. Purpose: what is the main goal of using AHP (Chatbot Category)
2. Criteria: Terms and conditions or parameters to choose the best option (Easy Maintenance, Easy Modification, Error Rate, Performance, Cost)
3. Alternative: Options, or in this case, is the models of the chatbot (Flow Chatbot, Artificial Intelligence)

These levels of AHP can be seen in Figure 3 below.

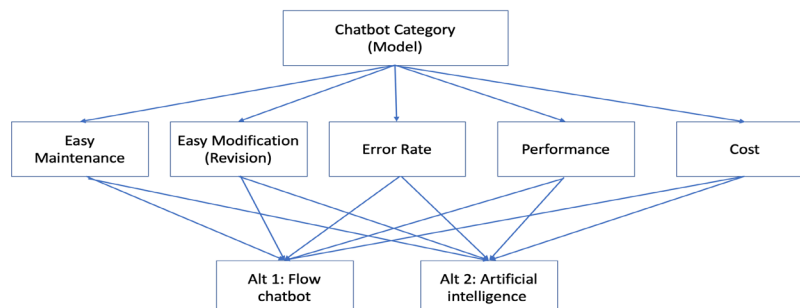


Figure 3: AHP Model

The next step is to assess the expert's questionnaire result, where the experts need to do pairwise of the criteria using the function below on Equation 1.

$$S^* = \frac{M - \exp(H_{amin}) / \exp(H_{ymax})}{1 - \exp(H_{amin}) / \exp(H_{ymax})}$$

$$M = 1 / \exp(H_{\beta})$$

Equation 1. AHP Consensus Indicator

Using the function above can be seen that the weight for every criterion is in Figure 4 below.

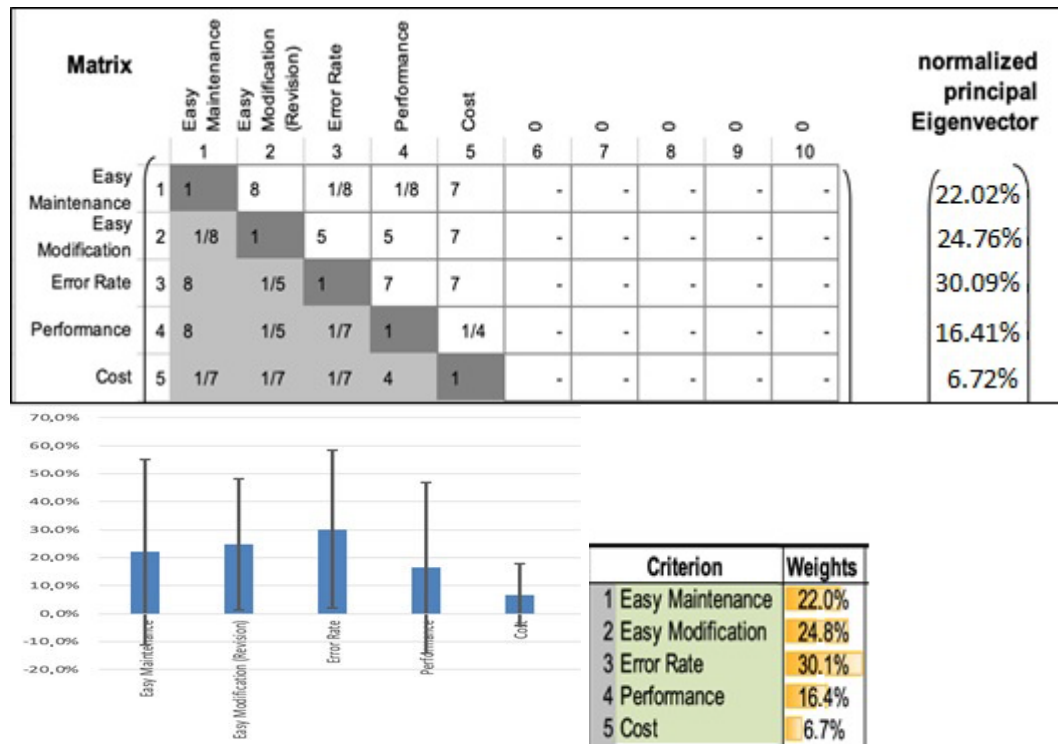


Figure 4 The Result of Weight Calculation for each criterion

Based on the comparison of the pairwise model for the criteria, Table 2 below shows the average score with the assessment given, the scale that is used is 9 for alternative 1 and alternative 2.

Table 2: The Pairwise Comparison for Each criterion

The Criteria	Alt 1	Alt 2
Easy Maintenance	7.3	1.2
Easy Modification (Revision)	6.8	2.5
Error Rate (Possibility)	5.9	3.4
Performance	7.4	4.8
Cost (Limitation)	7.8	4.5

Continuing the calculation based on Table 2, the researcher used the average score from the experts to the weight from Figure 4, Table 3 below shows the final calculation between the two alternatives.

Table 3: The Calculation Score for Alt 1 and Alt 2

The Criteria	Alt 1	Alt 2	Weight	Alt 1 Cal.	Alt 2 Cal.
Easy Maintenance	7.3	1.2	22.0%	1.606	0.264
Easy Modification (Revision)	6.8	2.5	24.8%	1.6864	0.62

Error Rate (Possibility)	5.9	3.4	30.1%	1.7759	1.0234
Performance	7.4	4.8	16.4%	1.2136	0.7872
Cost (Limitation)	7.8	4.5	6.7%	0.5226	0.3015
Total			100%	6.8045	2.9961

The total score for Alt. 1 is 6.8045 and for alt.2 is 2.9961. So, then the research will choose to develop a Flow Chatbot. Based on the secondary data collected, online conversation data that is obtained through Line official in June – December 2019 in Table 4 below, show the conversation categories and several chats communicated using the official Line account of School of Information Systems. As can be seen below, for category about the thesis is the most often chat category followed by Registration as 38 Chat. There are also 51 uncategorized chats, which means there are still a lot of chats that need to be categorized, and the use of this social media (Line) is one of the communication channels between the faculty and student.

Table 4: number of online conversation categories

No.	Category	Total (Count Chat)
1	Payment	7
2	3 + 1 (Enrichment Program)	29
3	College	29
4	Thesis	82
5	Registration	38
6	Information about Seminar	5
7	Thesis Defense	4
8	Graduation	2
9	Dream Talent	8
10	Others	51

To define the structure of the Flow Chatbot, this research used decision tree analysis to depict math's logic from every condition for every available use case. The structure can be seen in Figure 5 below.

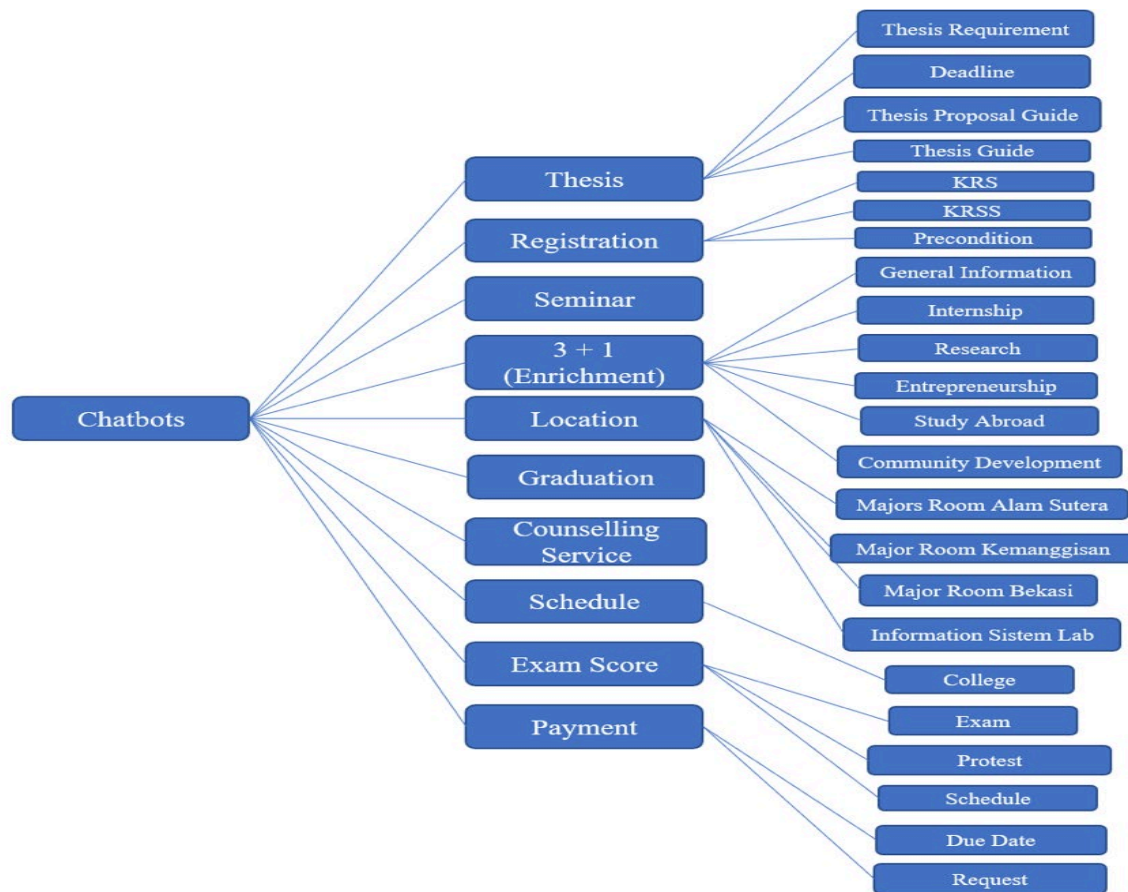


Figure 5: Decision Tree for Flow Chatbot

Figure 6 below illustrated how the basic work of the proposed chatbot with the following stages:

1. First, the user will give input according to the client chat menu that has been specified in a form of a list of categories of what to ask
2. Next, the user input will be forwarded to the Chatbot system which will then be forwarded from the system layer to extract the user input to be understood by Chatbot.
3. Then the extraction result will be returned to the chatbot to be processed whether these results require data withdrawal from the database or not to be returned the results directly to the user
4. If the data extraction and retrieval stages are enough, then the response will be re-thrown to the user.



Figure 6: Rich Picture of how the chatbot works

Based on data from Hootsuite (2019) in January 2019, WhatsApp (WA) became one of the most active social media used by Indonesian people with a penetration of 83%. This means that as much as 83% of Internet users or about 124 million users are recorded using WhatsApp on their gadgets. WhatsApp ranks second for the most active social media in Indonesia. While the first position is held by YouTube with a penetration of 86%. The next highest position for social networking media is filled by Facebook (81%), Instagram (80%), and Twitter (52%). While for messaging applications other than WhatsApp, followed by Line (59%), Facebook Messenger (47%), Blackberry Messenger (38%), Skype (28%), and WeChat (28%). So, the initial step of this chatbot application will start with the use of the WA application. In general, the features included in this chatbot are depicted in the use case diagram in Figure 7 below:

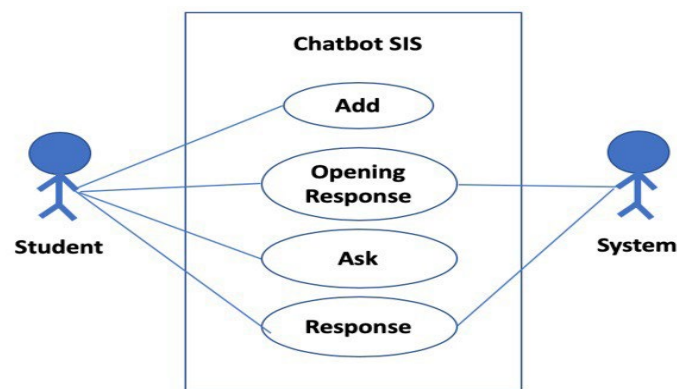


Figure 7: Use Case Diagram Chatbot (Student Perspective)

Figure 7 shows two users there are student and system, where the student can do Add, Opening Response, Ask, and Response. While the systems can do Opening Response, and Response. So, the main actor of the system is the Student, while the systems will react by the option chosen by the student.

Technically, the following (Figure. 8) is the design of the chatbot that will be implemented as a pilot project.

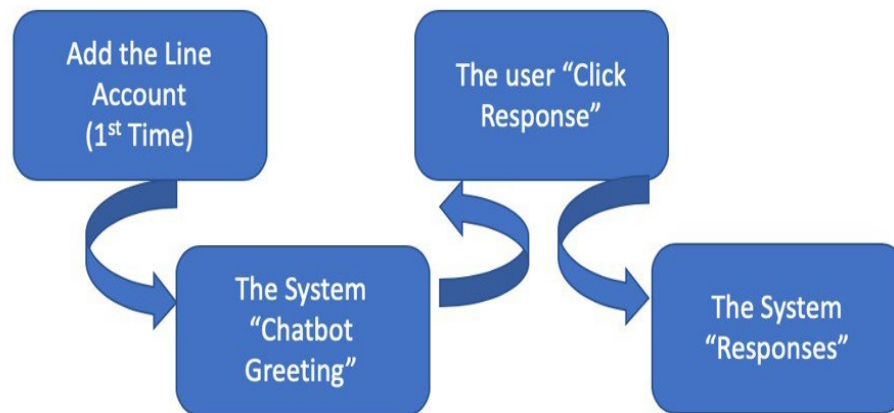


Figure 8: Desain Chatbot Flow (The User Perspective)

Chatbot or Auto reply is a program designed to automatically respond to messages. The Auto-reply feature is not available in the regular version of WhatsApp but only on the Business version. It even has a limited function, so, in this research, the chatbot in WhatsApp is created using the WhatsApp MOD application (GBWhatsApp).

The settings that can be adjusted for the Auto Reply function are:

1. Reply to messages containing/equal/all predefined words
2. Words will be sent automatically as replied
3. Snooze messages that you want to answer in a matter of seconds
4. All recipients, groups, or contacts.
5. The active time of this feature, the start time, and the end time
6. Auto reply with certain contacts/groups
7. Exclude auto-answer with specific contacts/groups.

4. Conclusion

This research came with the results that the chatbot flow needed in the research project as a first step because the data on the academic issues is well structured. The benefit of this research can certainly be a reference for best practice for the development of Chatbot for other Majors to start using the chatbot, because some of the benefits that can be gained with the use of this chatbot, such as the responses' speed in interacting with students, including services that can respond to student inquiries within 24 hours. Although it has some benefits, of course, there is a limitation of a chatbot which is certainly not able to answer all complaints that are unstructured or in the university environment known with the general term as policy. The other limitation is also this development result has not yet been evaluated because it will be done in the next part of the research.

Further research is done through the development of this chatbot application by implementing the concept of machine learning to obtain an existing online pattern, so it is expected to improve the accuracy of this chatbot application. Using the concept of Natural Language Processing (NLP) for further research will also be able to improve user satisfaction because users can communicate with daily language including bots can also reply with languages that are easily understood by users or students in this case.

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Biographies

Dr. Ir. Yohannes Kurniawan, S.Kom., S.E., MMSI., CSCA, CBDMP is an associate professor at Bina Nusantara University, he has more than 10 years of experience in academics and industries, he has helped a lot of organizations to accelerate their digital transformation. Yohannes’ extensive expertise in Knowledge Management, Digital Business, User Experience, Information System Security, and Information System Development makes him become the Subject Matter Expert for UX and Educational Technology at BINUS CREATES. His research interests vary from Implementing Human Information Behavior concepts for Design and Knowledge Management Systems impact in hospitals.

Devyano Luhukay received his bachelor’s degree in information technology from Bina Nusantara University, Indonesia; a Magister Degree in Management from Trisakti University in 2011 and is currently become a Ph.D. student in Doctor of Computer Science at Bina Nusantara University. He served in the Department of Information Systems, Bina Nusantara University in Jakarta as a faculty member (2011 - Now) and as Head of Program (2019-Now). As a lecturer, his area of teaching includes database systems, data and information management, Applied Databases. The research areas are digital business, knowledge management, database systems development. He has published research articles in the Journal of Theoretical and Applied Information Technology about Online Community Development (2019), the International Journal of Mechanical Engineering and Technology about social media analytics and IS

monitoring for agricultural business(2018), he also becomes presenter in some international conference such as International Conference on Information and Communication Technology(2014), International Conference on Science in Information Technology: Big Data Spectrum for Future Information Economy(2015), International Conference on Information Management and Technology(2016 – 2020).

Yuliana Lisanti has been teaching Information System subjects such as Applied ERP (SAP), Management Information Systems, IS concepts, etc. at Bina Nusantara University for almost 15 years. Her BSc in Information Systems was completed in 2000 and graduated from Wollongong with a master's in IT management in 2005. Publications in Conference and National/International Journal such as ICIMtech namely Analysis of product, product delivery service, and product assurance in e-commerce on purchase intention during the covid-19 pandemic (2021), Exploration of software implementation on cloud accounting and security system towards accounting practices case study from a private company in Indonesia(2020), Unified Theory of Acceptance and Use of Technology (UTAUT) model perspective to enhance user acceptance of fintech application(2020), The Evaluation of Impact Sharing Economy Critical Success Factor Implementation (case study: Online hospitality)(2019), IT risk and service management in SMEs (2017), SMEs online business strategy (2016), And ICSItch on IT impact on creating positions with study case companies in Jakarta (2015), then Journal of Theoretical and Applied Information Technology on the design of knowledge management system model for SME (UKM) (2014), were results from some of her research. Her achievements also can be acknowledged from her professional career role. She is currently holding one of the strategic positions in Bina Nusantara.