Developing UNYSA Chatbot as Information Services about Yogyakarta State University

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Abstract. This study aims to (1) develop chatbot-based public relations communication media that are able to overcome the limitations of service in interacting and providing information about UNY to the public, (2) ensure the quality of software developed with the ISO/IEC 25010 model. The research method used is Research and Development (R&D) with the Agile: Scrum software development model. The results of this study are (1) a chatbot-based PR communication media named UNYSA as an information service about UNY, (2) UNYSA meets ISO/IEC 25010 quality standards on functional suitability characteristics with software developer experts at 0.86 (most features successfully implemented), material experts of 98.82% (Very Eligible), UAT of 83.95% (Very Good); performance efficiency has a latency response of 15 ms (faster than standard speed: 2 seconds); 100% portability (supports all planned frontend apps); usability of 83.81% (Very Eligible); reliability of 92% (Very Feasible), and maintainability with a maintainability index of 83.21 (very easy to maintain).

1. Introduction
Promoting higher education requires public relations personnel (PR), one of whose jobs is to create two-way communication with the public [1]. The presence of public relations is currently needed by every organization and institution, including in the world of higher education, especially the autonomy of higher education makes competition even tighter [2]. As one of the best University in Indonesia with a vision to become a World Class University in 2025, Yogyakarta State University (UNY) efforts to market its higher education include the establishment of the Cooperation, Public Relations, Protocol and Promotion Office (KKHPP). However, there are several problems faced by UNY PR in communicating with the public, such as lack of timeliness in answering questions from the public due to limited service time and public relations personnel, lack of efficiency in answering questions in the same and recurring context, many public questions that go outside their authority, so it cannot be responded well.

2. Literature Review
During the era of the industrial revolution 4.0, it demands public relations to take an active role in innovating, especially in developing public relations communication media. The presence of Artificial Intelligence (AI) technology is able to study and help human work such as writing, help desks, and looking for materials, which are available at any time [3]. Learning is the process of changing behavior towards better behavior and the effect is changing knowledge, understanding, attitudes, behavior, and skills [4]. However, learning must focus on the teaching process, not only knowledge transfer [5].
Technology will fill the gap of incompetent people and make systems more reliable. Humans will not do the same repetition of tasks again, so the tasks can be personalized according to the user's wishes. Public relations practitioners can focus on data analysis, make strategies and decisions to achieve organizational goals, while AI can help maintain the brand image and reputation of the organization [6].

Common problems such as delayed or unanswered response to user questions due to limited service time can be assisted by the role of machines through AI technology that can respond to user questions in real time and are available at any time [6]. However, chatbots also require testing to meet quality standards to make them fit for use and avoid operational errors such as irrelevant responses to user questions. The digital simulation subject must be obtained by the user maximally [7]. Based on the description of these problems, this study aims to develop a chatbot-based public relations communication media that is able to overcome the limitations of service in interacting and providing information about the UNY campus to the public. As well as ensuring the quality of chatbot-based software developed with the ISO / IEC 25010 model quality software on the characteristics of functional suitability, performance efficiency, portability, usability, reliability, and maintainability.

3. Research Methods
This study uses the Research and Development (R&D) method. The development model used is Agile: Scrum, namely by repeating and iterating gradually the Software Development Life Cycle (SDLC) standard process, namely Planning, Analysis & Design, Development, Test, and Deployment which is illustrated in Figure 1. It is hoped that the process is collaborative, transparent, and according to user needs [8].

![Figure 1. Scrum Development Model Illustration](image)

Research subjects for functional suitability testing require two expert respondents in chatbot-based software development, 1 material expert respondent (UNY PR), and UAT respondents consisting of usability testing respondents using a minimum of 20 people, consisting of all Diploma & Bachelor Degree level students in 7 faculties at UNY. In order to obtain a significant number in statistics, usability testing should use at least 20 respondents (Nielsen, 2012). In addition, in this study there were also 100 respondents for data collection of UNY’s public relations services and development needs.

The tests with the instruments used include 1) the reliability testing instruments using the Botium application, 2) the performance efficiency testing instruments using Google Stackdriver, 3) the portability testing to find out which frontend apps have successfully run the chatbot functionality, 4) the maintainability testing with the Radon application.

In functional suitability testing, there are three types of testing, namely testing by software development experts [9] to calculate feature completeness [10], material experts, and by end users through UAT. This study uses the USE Questionnaire [11] scale of five. Usability test data are analysed by calculating the answers based on the score for each answer from the respondent. To determine the reliability of the instrument, alpha Cronbach calculations can be used based on test data. Calculations were performed using PSPP software with the interpretation of the values [12] in five scales and it is reliable if the Cronbach's Alpha value is greater than 0.60 [13].
Other analyses include reliability, performance efficiency, portability, maintainability, and code complexity. Performance efficiency is analysed with Google Stackdriver which displays chatbot performance and resources, one of which is the speed of responding to user questions (response latency). The standard time for a chatbot to respond to questions from users is 2 seconds [14].

4. Results and Discussions

4.1. Planning

According to the results of interviews with UNY Public Relations staff and questionnaires to 100 UNY students, it shows that the communication media and public relations information used today are quite diverse, including Instagram, Facebook, Twitter, YouTube, Website, Telephone, and Email. In addition, users also use other media to get information about the UNY campus such as WhatsApp, Telegram, and Line by contacting relatives, lecturers, and UNY Public Relations. The following is the flow of public interaction with the PR of UNY which is presented in Figure 2.

![Figure 2. Public interaction with PR UNY](image)

Meanwhile, questions that are often asked by the public include information about scholarships, study programs, important contacts, achievements, campus environment, about New Student Admissions (PMB), lecture schedules, building locations, final assignment administrative matters, to publication of activities. However, not all questions can be answered because they are outside the authority or knowledge of the public relations. In addition, students considered it sufficient for the availability of information (61.8%) and timeliness in receiving answers (65.6%). This was admitted by Public Relations of YSU because of limited service time and personnel.

Public Relations of YSU assessed that the development of chatbots can be an alternative to help their work, especially in answering the same questions by the public and carried out repeatedly or in this case, as customer service that is available at any time or real-time. The hope is that the chatbot has a friendly character and avoids harmful mistakes, especially in the content of the information to be conveyed.

4.2. Analysis & Design

At this stage, the identification of the chatbot functionality (product backlog) is carried out based on the user stories in the planning stage. Then the scheduling is done according to the activities and features to be developed. In addition, there are several other activities with the following results.
4.2.1. **Character Design.** To improve the chatbot's personality, a special character is needed that represents both function and nature. Chatbot is named UNYSA (UNY Smart Assistant) with the main adjectives straightforward, technical, and friendly. The characters that embody this persona are public relations, lecturers, staff, and students themselves who know information about the UNY campus. The embodiment of the characters is presented in Figure 3.

![Figure 3. UNYSA Character Design](image)

4.2.2. **Conversation Design.** It aims to make the conversation between the user and the bot more focused and minimize errors. When a user asks about something, before the user's wishes are fulfilled, the bot will provide information or steps to the user so that the question can be understood and given the right answer. Conversation design refers to planning results with topics that are often asked by users including profiles, academics, scholarships, study programs, tuition fees, and registration at YSU.

![Figure 4. System Architecture Design](image)
4.2.3. *Data Source.* The chatbot response consists of two data sources, namely the scrapping results from the UNY official website and the Google Spreadsheet. The data may not be complete for the current research, and more sites will need to be added later.

4.2.4. *Architecture Design.* The architectural design describes the overall process of how the chatbot can work. Figure 4 shows that the user through the predefined frontend apps performs a query which is then processed by the agent on Dialog Flow to understand the context of the user query using natural language understanding technology components.

4.2.5. *Interface Design.* The user interface design basically follows the chat interface design of the frontend apps. The results of the interface design in the form of a wireframe, describing the types of responses that will be displayed to the user such as simple, media, list, and basic responses. In this study, all types of response views can be used in Google Assistant, while other applications only support simple responses.

4.3. *Development*  
At the development stage, Dialogflow is used to understand the context of the question or Natural Language Understanding (NLU). Among the activities carried out are making agents, entities, intents, parameters, and fulfillment responses. The agent on Dialogflow is a module where all natural language processing is done, besides that the agent can also be used to manage the flow of conversations based on the results of the designs that have been made. The agent processes requests coming from the user and mappings them to the intent. Making the agent on Dialogflow is presented in Figure 5.

![Figure 5. Creating Agent](image)

Entities are used to identify the meaning of user-submitted questions. Most of the entity types that researchers use are developer entities. Entities will be matched with a query sent by the user, whether the corresponding entity value is identified in the entities created, such as about academics, registration, scholarships, and UNY program. Intents are used to map queries from users in order to get relevant responses, the author creates intents based on topics such as academics, study programs, and so on. Inside the intent is given input training phrases which are approximate questions from the user, this also functions as a dictionary or initialization of what entities will be used in the intent.

After inputting the training phrases, the required parameters will be adjusted according to the entity values contained in the training phrases. This means that the user must enter several keywords according to the intent criteria in order to get relevant answers. The author uses a Flask microframework (Python based) to manage the response of the agent by collecting data through web scraping and integrating Google Sheets.
4.4. Testing

4.4.1. Functional Suitability

- Software Developer Expert
  Two software development expert testers perform the test. There are three characteristics of functionality testing in chatbots, namely conversation design, entities, and fulfilment testing. Testing is done by providing 15 function items that need to be tested. Each function that runs according to the examiner is given a value of 1, and those that do not run properly are given a value of 0. The calculation of the results of the chatbot functional test is carried out with the following formula:

\[
X = \frac{I}{P} = \frac{26}{30} = 0.86
\]

Details:
I = Number of features that were successfully implemented
P = Number of features designed

The test results show that most (0.86) chatbot features have been implemented successfully and run well as planned. So that the chatbot can meet the requirements of functional suitability characteristics.

- Material Expert
  Material experts validate the material which aims to assess the appropriateness of the material presented as a source of information for the general public through chatbots. Validation was carried out by one Public Relations staff of UNY. The assessment is carried out by reviewing all the material on the chatbot and trying several question scenarios, then assessing the aspects of the questionnaire. The results of the material validation fall into the Very Appropriate category for use.

- User Acceptance Test (UAT)
  UAT is implemented by directly testing the chatbot function to limited users using certain scenarios that have been provided by Alma Bot. In addition, the alma bot also plays a role in accumulating the results received from users and classifying them into 7 characteristics of the chatbot's ability level, namely Personality, Onboarding, Navigation, Understanding, Answering, Error Management, and Intelligence. The results of the UAT conducted by 21 UNY students produces an average value of 83.95% in the Very Good category. However, chatbots still need further development to improve all chatbot characteristics, especially in the characteristics of navigation, understanding, and intelligence.

4.4.2. Performance Efficiency

The performance efficiency characteristics were analysed using Google Stackdriver when the reliability test took place using 395x2 questions which were carried out for 15 minutes. The results of performance efficiency testing for the chatbot response speed (response latency) are presented in Figure 6.
Figure 6. Response latency graph

The figure shows the average chatbot response time (response latency) is 15 ms. This means that it is faster than standard time (2 seconds). Meanwhile, the memory usage on the app engine is an average of 509 MiB and an average CPU is 426 megacycles, with a maximum capacity that can be scaled up automatically according to usage needs. Thus, the resources meet performance eligibility.

4.4.3. Portability. Portability characteristic testing is carried out together with functionality testing by running chatbots on the planned frontend apps, namely Google Assistant, WhatsApp, Telegram, Line, and Facebook Messenger. The test result is that 100% of all planned frontend apps have successfully run the chatbot functionality.

4.4.4. Usability. Usability testing on the chatbot is carried out after the user implements UAT in order to get to know the function and usage of the chatbot. The usability characteristics of the UNYSA chatbot were tested with the USE Questionnaire using a 5-point Likert scale with a total of 30 questions divided into four aspects, namely Usefulness, Ease of Use, Ease of Learning, and Satisfaction. The questionnaire was filled in by 21 respondents from seven faculties at Yogyakarta State University.

The results of the calculation of the percentage of usability testing resulted in 83.81%. This shows that UNYSA is very feasible and meets the criteria in the usability aspect. Meanwhile, to measure the reliability value of the usability test results is done by calculating Alpha Cronbach using PSPP software. The test results on 30 items of usability statements resulted in a Cronbach's Alpha value of 0.92. This shows that the research instrument is in the Excellent category. All items in the usability instrument are reliable or consistent because the Cronbach's Alpha value of 0.92 exceeds the standard limit (0.60) and exceeds the r table value (0.361 with a significance of 5%).

4.4.5. Reliability. Testing the reliability characteristics uses a software called Botium to perform end to end testing automatically against planned conversation scenarios. Tests are carried out 10 times to produce optimal values. It is proven in the regression graph presented in Figure 7 that the chatbot can get better every time it is tested, this is because it will indirectly provide training to the chatbot for answers that cannot be understood.
In testing, we need datasets that contain 395 conversation scenarios, consisting of several variations of questions with expected answers. The categories of questions in the scenario include introduction, profile, academic, scholarship, study program, tuition fees, enrolment, cover, and error handling. In the testing process, Botium validates between the chatbot's answers and the expected ones in the dataset. If it does not match then Botium will assume that the scenario failed to implement the chatbot. From all the results of the scenario testing, the success rate of the chatbot was 92%. This data shows that most of the conversation scenarios that have been designed are successfully responded to and understood by the chatbot.

**4.4.6. Maintainability.** The maintainability characteristics of the chatbot were tested using the Radon software specifically used for the Python programming language. The Maintainability Index (MI) test on Radon uses the following command: $ radon mi unysa / * -s. The MI test results get an average score of 83.21% which falls into the Very High Maintainability category.

Meanwhile, the test is tested using the following command: $ radon cc unysa / * -s --total-average. Based on the CC test score, the overall average score is 3.25 (Rating A). So it can be concluded that chatbot has a low risk level (low) with simple blocks. Thus, the MI and CC test results show that the UNYSA chatbot meets the standard maintainability criteria.

**4.5. Deployment**

At the deployment stage, researchers installed the fulfillment code in the Github repository to be integrated into the Google Cloud: App Engine. This is because it supports the agile development model with the CI/CD feature. The program code can be accessed via the following link: [https://github.com/andrimuhhidin/unysa](https://github.com/andrimuhhidin/unysa). In addition, researchers integrated between Dialogflow and frontend apps. The integration works so that users can contact agents or bots using supported frontend apps.

**5. Conclusions**

Based on the results of the research that has been done, it can be concluded that this research produces a chatbot-based public relations communication media called UNYSA (UNY Smart Assistant) as an information service around the Yogyakarta State University campus. Chatbot development uses Dialogflow as a component of Natural Language Understanding and Microframework Flask (Python) for managing Fulfillment Responses. The software development model uses Agile: Scrum by repeating the standard stages of the SDLC process, namely Planning, Analysis & Design, Development, Testing, and Deployment. Users can interact with the UNYSA Chatbot in real-time from various frontend apps, namely WhatsApp, Telegram, Line, Messenger, and Google Assistant. In this study the chatbot can...
serve questions about registration, tuition fees, academics, scholarships, profiles, and study programs sourced on the UNY official website and the use of google forms for responses filled out by contributors.

The UNYSA chatbot has been tested using the ISO / IEC 20510 software quality model. On the functional suitability characteristics: (1) the software developer (chatbot) scores 0.86 (most of the features are successfully implemented), (2) material validation is 98.82 % (Very Eligible), and (3) UAT of 83.95% (Very Good). Performance efficiency characteristics values: (1) response latency of 15 ms, which means it is faster than standard response time (2 s), and (2) the resources used for memory are an average of 509 MiB and an average CPU is 426 megacycles with capacity that can be scaled-up automatically. The portability characteristic value is 100% (supports all planned frontend apps). The usability characteristic value is 83.81% (Very feasible) with a Cronbach's alpha value of 0.92 (Excellent). The average reliability characteristic value is 92% (Very feasible). While the value of maintainability characteristics: (1) Maintainability Index (MI) of 83.21 (very easy to care for), and (2) Cyclomatic Complexity of 3.25 (low risk program). The test results show that the UNYSA chatbot meets ISO/IEC 20510 quality standards.

References
[1] Musyarrofah M 2018 PERAN HUMAS DALAM PENGEMBANGAN PENDIDIKAN TINGGI Idaarah J. Manaj. Pendidik. 2 11–23
[2] Brown R E 2003 The Fall of Advertising & the Rise of PR: Al Ries; Laura Ries; New York, Harper Business, 2002, 295 pp., hardcover, $24.95 US ($37.95 in Canada) Public Relat. Rev. 29 91–3
[3] Perhumas 2018 Era Industri 4.0 – Apa Tantangan Hubungan Masyarakat Di Masa Depan? – PERHUMAS
[4] Basori B, Isnaini R, Setyowati A and Phommavongsa D 2018 Development of an Android-Based Reward System to Enhance the Activity of Learning J. Pendidik. Teknol. Dan Kejur. 24 116–24
[5] Rahdiyanta D, Hargiyarto P and Asnawi A 2017 Characters-Based Collaborative Learning Model: Its Impacts on Students’ Attitude and Achievement J. Pendidik. Teknol. Dan Kejur. 23 227–34
[6] Binsar A and Salamah U 2018 Anticipating the Post Human Era in Public Relations
[7] Winatha K R and Abubakar M M 2018 The Usage Effectivity of Project-Based Interactive E-Module in Improving Students’ Achievement J. Pendidik. Teknol. Dan Kejur. 24 198–202
[8] PMI 2018 Agile Practice Guide | Project Management Institute
[9] Sudaryono 2015 Metodologi Riset di Bidang TI : Panduan Praktis, Teori dan Contoh Kasus (Andi)
[10] Acharya A and Sinha D 2013 Assessing the Quality of M-Learning Systems using ISO/IEC 25010
[11] Lund A 2001 Measuring Usability with the USE Questionnaire Usability User Exp. Newsl. STC Usability SIG 8
[12] Gliem J A and Gliem R R 2003 Calculating, Interpreting, And Reporting Cronbach’s Alpha Reliability Coefficient For Likert-Type Scales
[13] Sujarwensi V W 2014 SPSS untuk Penelitian / V. Wiratna Sujarwensi ; editor, Florent (Pustaka Baru Press)
[14] Jurczyk L 2018 Rule the speed of your chats with the new conversation delay