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# Bot Innovation Realizing Service Excellence: Designing a WhatsApp Chatbot as a Customer Service Solution Using the Waterfall Method

Nia Budi Puspitasari[a,*], Asteria Noventi Ageta Br Ginting[a], Aditya Agung Fransiskus Dolok Saribu[a]

[a] Department of Industrial Engineering, Faculty of Engineering, Diponegoro University, Semarang, Indonesia

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**Abstract**

With the support of qualified employees, PT BPR Pijer Podi Kekelengen is a banking company that provides excellent customer service. According to interviews with Bank Podi employees and customers, customers are dissatisfied with the information they receive. Employees sometimes responded to customer inquiries about Bank Podi's products and banking within 1 to 2 weeks. Additionally, not everyone can access the website due to a lack of understanding of technology, particularly among older customers. As a result, customers require a more detailed, interactive, and easily accessible information system, mainly through integrating AI technology as a chatbot into the WhatsApp application. This research aims to make it easier for customers to access Bank Podi's banking information. The chatbot design employs the waterfall method, utilizing dialog flow tools and a decision tree chatbot type that aligns with the user's needs. According to black-box testing results, the chatbot system meets functional needs and follows the database. Meanwhile, the user satisfaction questionnaire yielded an average accuracy of 98.6%, demonstrating the chatbot's feasibility in providing customers with the necessary information. The chatbot system also received a positive response from users.

***Keywords***: Chatbot; Decision Tree-Based; Waterfall; WhatsApp; Customer Information Services

## 1. Introduction

The rapid development of technology has brought many changes to human life. Technological advances not only facilitate human work but can also reduce human involvement in carrying out activities. (Kristianto, 2021). Information technology plays a role in banking services. Information technology's role impacts company performance, namely maintaining their relationship with their customers through a service system (Mambang et al., 2009). Customer service is part of a system that aims to interact with and provide customer services. With the development of technology, companies can also maximize the role of customer service. Information systems can help manage and monitor customer service (Romdhane, 2021).

PT BPR Pijer Podi Kekelengen is one of the BPRs in Sibolangit, North Sumatra. PT BPR Pijer Podi Kekelengen continues to uphold its traditional door-to-door banking services, attracting many customers despite reportedly high interest rates. Bank Podi offers savings, loans, and deposits (OJK, 2017). However, Bank Podi is currently preparing itself for digital technology (Bank Podi, 2023).

Preliminary interviews with three employees and five customers at PT BPR Pijer Podi Kekelengen reveal dissatisfaction with the provided information system, such as procedures, benefits, conditions, and sanctions in the process of applying for savings, credit, and deposits, which are only obtained from field employees. Customers often receive answers to their questions about products and banking within 1 to 2 weeks. Moreover, the inefficiency of using the website for information retrieval stems from the lengthy, inflexible, and less interactive nature of email replies and the fact that not everyone can access and update the website's information. Therefore, an information system must be utilized for interactive, two-way communication and accessed by all ages.

The leading technology that will support the realization of information service systems is artificial intelligence (AI) technology (Digalaki, 2022). The virtual assistant chatbot is one of the most prominent AI technologies in the network technology innovation category (Mauldin, 1994). AI chatbots are first-rate services that can access information quickly and enable fast and uninterrupted interactions across multiple channels and platforms (Andrade & Tumelero, 2022). As predicted by Gartner, the chatbot market will continue to grow to the point where more

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than 50% of companies will focus more on using chatbots than mobile applications (Zaboj, 2022). By 2022, Alt et al. (2021) predict that the success rate of bot interactions in the banking sector will surpass 90%. According to research by the marketing agency We Are Social, WhatsApp users reached 92.1% in January 2023. Based on this percentage, WhatsApp is still Indonesia's most widely used social network. According to statistics from the Global Web Index, 75% of internet users use one or more messaging platforms. One of these applications is WhatsApp (Jindal et al., 2020). You can access banking information services with the WhatsApp chatbot (Winarso, 2015). Current banking companies such as PT Bank Rakyat Indonesia Tbk (BRI) have Sabrina (Smart BRI New Assistant), PT Bank Central Asia Tbk (BCA) has Vira (BCA Virtual Assistant Chat Banking), PT Bank Negara Indonesia TBK has Cinta (Chat with your Intelligent Advisor), and Bank Mandiri has MITA (Mandiri Intelligence Assistant), which uses a chatbot as a virtual assistant that can serve customers for 7 x 24 hours (Purnomo, 2018).

According to previous research, chatbots have successfully created a sound service information system. Previous research used a WhatsApp chatbot to recommend movies using Dialogflow (Baizal et al., 2023). PT XYZ (Sunarto et al., 2021) researched to manage Key Performance Indicator assessments from drivers and customers via WhatsApp Chatbot, facilitating user interaction with the system. The use of telegram chatbots to promote student voice production to improve the learning process in MOOCs (Massive Open Online Courses) with the implementation of P2P (peer-to-peer) evaluation (Pereira et al., 2019). Previous research also used a chatbot as an auto-responder at an open university, Suk Hohai Thammathirat (Sakulwichitsintu, 2023). Parents use a chatbot (Con Sejero) as an inquiry to uncover a design goal and constraints when utilizing their everyday assets (Wong-Villacres et al., 2019). The Department of Informatics Engineering ITS (Mursidah et al., 2022) also uses a chatbot to implement Information Services for New Student Registration. Chatbot Auto Reply on WhatsApp is also used as a Practicum Information Center using AIML (Ramadhan et al., 2020). The IPI student information service center also uses a WhatsApp chatbot to ask questions about lectures (Bariah et al., 2022).

Therefore, research on the design of chatbot-based information systems was conducted by utilizing Dialogflow tools that support the WhatsApp application at PT BPR Pijer Podi Kekelengen. The purpose of this research is to identify the needs of information systems at PT BPR Pijer Podi Kekelengen, produce a prototype in the form of a WhatsApp chatbot-based information system to help information services at PT BPR Pijer Podi Kekelengen and test the WhatsApp chatbot system to see if it is following the scenario that has been prepared. In addition, using a WhatsApp chatbot can facilitate the work of BPR Pijer Podi Kekelengen in responding to customer questions so that the information service system becomes more interactive and practical. Thus, the information system of PT BPR Pijer Podi Kekelengen is increasingly influential in reaching customers.

## 2. Literatur Review

### *2.1. Information System*

According to Husein and Wibowo, an information system is a collection of software and hardware on computers, procedures, documentation, forms, and people responsible for obtaining, using, managing, and sharing data and information. An information system contains essential information from people, places, and others related to the organizational and non-organizational environment. (Srinita & Christina Catur Widayati, 2018).

### *2.2. Chatbot*

A chatbot is a computer program that interacts with users using natural language (natural language processing). The 1960s saw the birth of chatbot intelligence technology. The purpose of creating a chatbot is to test whether it can trick users into thinking it interacts with a human. This test is called the "Turing Test" (Mauldin, 1994).

### *2.3. Decision Tree-Based Chatbot*

A decision tree-based chatbot is a type of chatbot that uses decision tree algorithms to make decisions and respond to user input. Decision trees are a popular machine-learning technique for classification and regression. Chatbots can use decision trees to create a simple yet efficient conversation flow. (Puspitasari et al., 2022). Based on user needs analysis, the majority of customers are aged 40 - 54, an older adult age. This age finds it difficult to adapt to AI technology, so designing chatbots makes it easier for them to access it without difficulty formulating questions for the bot to understand. Therefore, the decision tree method can handle decisions based on questions and answers supported by a simple display and more precise guidance.

### *2.4. Dialog Flow*

Dialog Flow is a unique language understanding stage that makes planning and coordinating user interface conversations easy into versatile applications, web applications, gadgets, bots, intelligent voice reaction frameworks, etc. Google owns Dialog Flow as one of its frameworks. To construct chatbots, Google often uses Dialog Flow's natural language processing and natural language understanding (NLP/NLU) services. Dialog flow includes integration features (one click) with several

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popular messaging platforms such as WhatsApp, Line, Facebook Messenger, Telegram, and services such as Google Assistant and Amazon Alexa. Using Dialogflow can give users a new approach and image for communicating with created items (Gosjen et al., 2023).

### *2.5. SDLC Waterfall Method*

General systems engineering processes were the basis for the first published software development process models. The waterfall model is an example of a plan-oriented process. Before starting work on these activities, this model must plan and schedule the entire process (Sommerville, 2011).

## 3. Methodology

This research uses the waterfall method to conduct software development. Then, the software was tested using the black box testing method, and user satisfaction with using information systems was measured through a user satisfaction questionnaire.

The first stage of this research begins with a preliminary study, including field and literature studies. Field studies, namely interviews with employees and customers of BPR Pijer Podi Kekelengen, namely credit analysts and accounting officers, were conducted to find out the flow of BPR's business activity processes, the condition of Bank Podi's information system, and customer needs. In the next stage, secondary data from the company is collected and collected. The waterfall method (Sommerville, 2011) then guides the development of the chatbot. The initial stage in the waterfall method is requirement, which is a system development stage aimed at understanding the software expected by users, including current system analysis, user needs analysis, and functional and non-functional analysis. The second stage is system design, where developers create a system design that can help define the overall system architecture, such as flowcharts, use cases, activity diagrams, and conversational flow (Satzinger et al., 2012). The third stage is implementation, which is the programming stage for creating a database with the help of Dialog Flow tools. The fourth stage is integration and testing, where the chatbot system will be integrated into WhatsApp (Rahartri, 2019). Then, testing is carried out to determine whether the system meets the requirements. System testing uses black box testing, while customer satisfaction uses a user satisfaction questionnaire. The last stage is operation and maintenance, which is the maintenance of the finished software.

## 4. Result and Discussion

### *4.1. Result*

The current system analysis at Bank Podi is assessed based on limited operational time, service speed and efficiency, service consistency, multitasking capabilities, scalability, and information system availability (Banjarnahor, Astri, 2023). The current system analysis can be seen in Table 1.

Table 1. Analysis of the Current System

| No | Aspect | Explanation |
|---|---|---|
| 1 | Operational Time Limitations | The BPR office's operational hours typically dictate the manual information provision system. Customers can only get information during working hours; even questions are answered within 1 to 2 weeks. |
| 2 | Speed & efficiency of Service | BPR manual services take longer because they directly interact with employees, particularly when conveying information. |
| 3 | Service Consistency | Service consistency varies due to employees' varying abilities and knowledge, resulting in inconsistent customer experiences. |
| 4 | Multitasking Capabilities | If there are many requests or questions at once, it takes more time, so a system is needed that can help with human tasks simultaneously. |
| 5 | Scalability | The range of activities is also limited, usually only around the head and branch offices. Traveling long distances will also increase operational costs, among other things. |
| 6 | Information System Availability | Market share and customer access to Bank Podi's website are minimal. Most of them use WhatsApp to communicate. |

- Analysis of User Needs

We conduct a descriptive analysis using a demographic segmentation approach to determine users' needs. Demographic segmentation factors used are age, educational background, occupation, and residence location. According to 117 customers' demographic segmentation analysis, a decision tree-based chatbot suits user needs (Van der Goot & Pilgrim, 2020). A decision tree-based chatbot uses a decision tree algorithm to make decisions and respond to user input (Puspitasari et al., 2022). Based on user needs analysis, the majority of customers are aged 40 - 54, an older adult age. This age finds it difficult to adapt to AI technology, so designing chatbots makes it easier for them to access it without difficulty formulating questions for the bot to understand. Therefore, the decision tree method can handle decisions based on questions and answers supported by a simple display and more precise guidance.

- Analysis of Functional and Non-Functional Requirements

1. Functional Requirements
   Functional requirements contain what information must exist and be produced by the system. These needs include:
   - The Chatbot system can work 24 hours
   - Fast service can make it easier for users to get Podi Bank products and banking information.

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- The chatbot system can display information according to user requests based on number codes.
- Chatbot systems can reach a broader range of users.
- The chatbot system does not need to be installed because it is integrated into WhatsApp.
- Chatbot system in the form of a decision tree

2. Non-Functional Requirements
   Non-functional requirements include hardware and software requirements, namely:
   - Hardware using a laptop and tab/Android
   - The software required is Google Cloud Console, Dialog Flow, WhatsApp Messenger, Javascript, and Node.Js.

- Chatbot System Design (Flowchart, Usecase, Activity Diagram, and Conversational Flow)

Chatbot design uses United Model Language (UML). The flowchart, use case, activity diagram, and conversational diagram in designing the chatbot are shown in Figures 1, 2, 3, and 4.

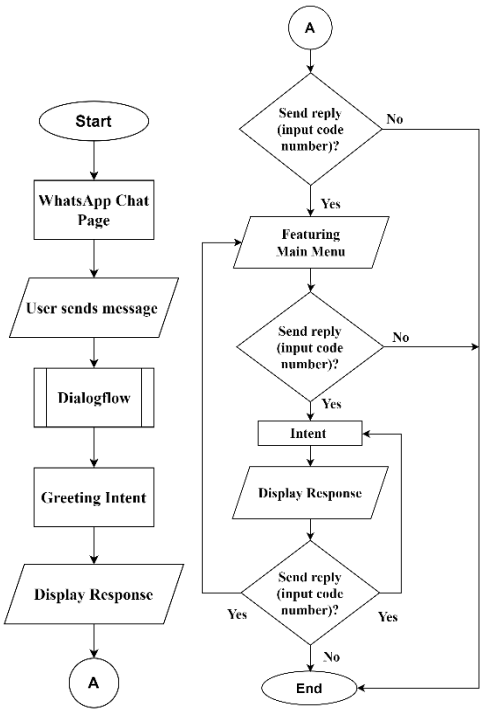



Figure 1. Flowchart

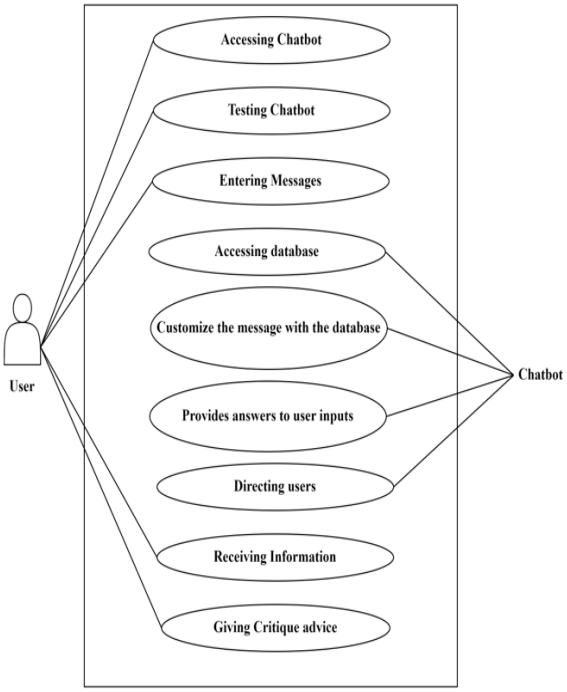



Figure 2. Usecase Diagram

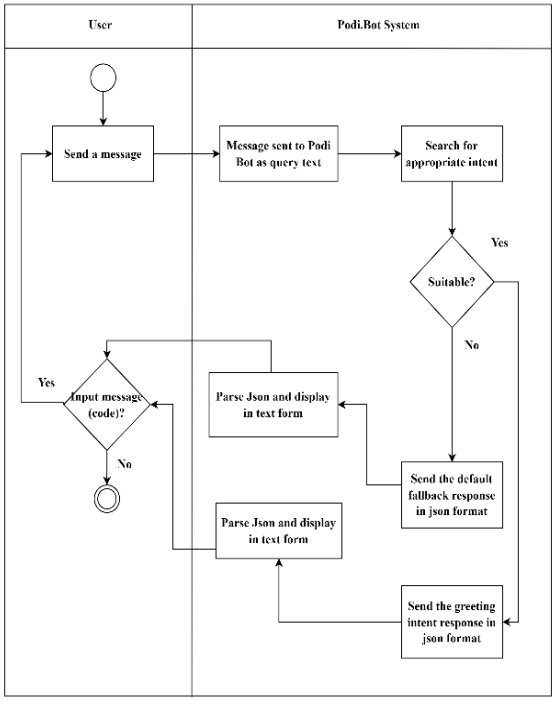



Figure 3. Activity Diagram

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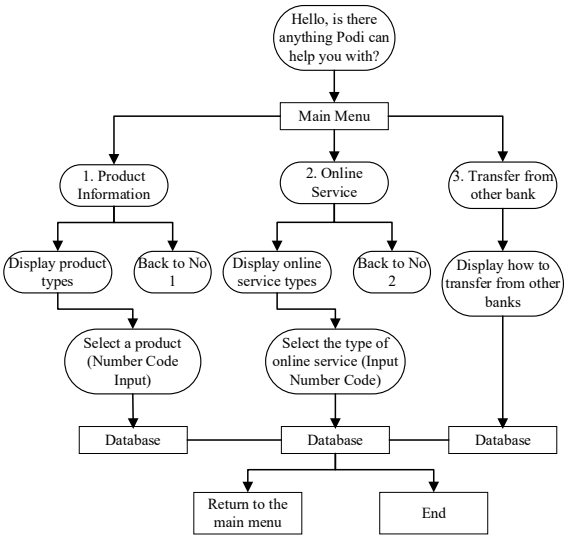



Figure 4. Conversational Flow

- Chatbot Implementation in Dialog Flow

Dialog flow is a unique language understanding stage that makes planning and coordinating User Interface conversations easy into versatile applications, web applications, gadgets, bots, intelligent voice reaction frameworks, etc (Grosjean et al., 2023). The agent in Podi Bank is named "Podi Bot". Podi Bot uses the Indonesian language. Agent Podibot contains a database. Figure 5 illustrates the process of creating an agent. Podi Bot has many intents that contain conversations and responses. We will assign a name to each intent, describing the purpose or intention for recognition. Figure 6 illustrates the intentions.

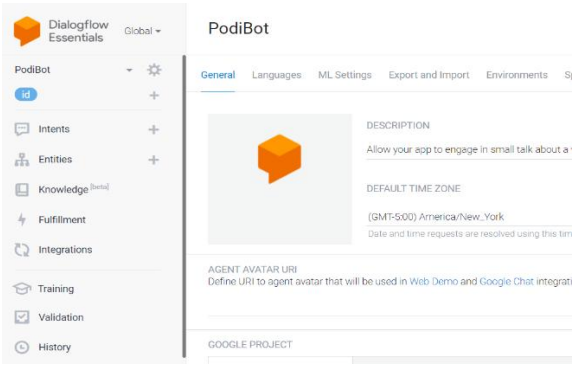



Figure 5. Create Agent

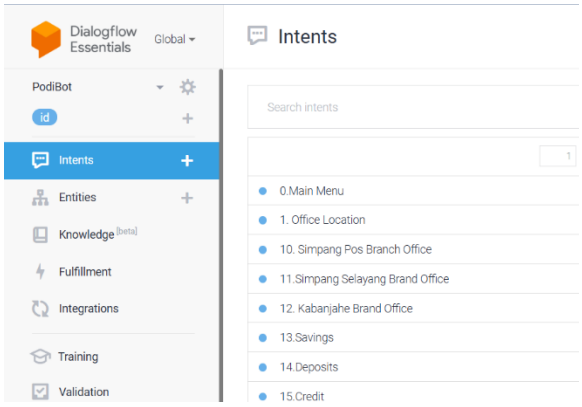



Figure 6. Intents Podibot

- Integration of Dialog Flow into WhatsApp

To integrate dialog flow into WhatsApp Messenger, it must be activated in the Google Cloud Console (GCP) to obtain the service account key shown in Figure 7. After that, it will receive a JSON file containing credential information that authenticates the WhatsApp API. Then, the chatbot integration with WhatsApp using node.js is shown in Figure 8.

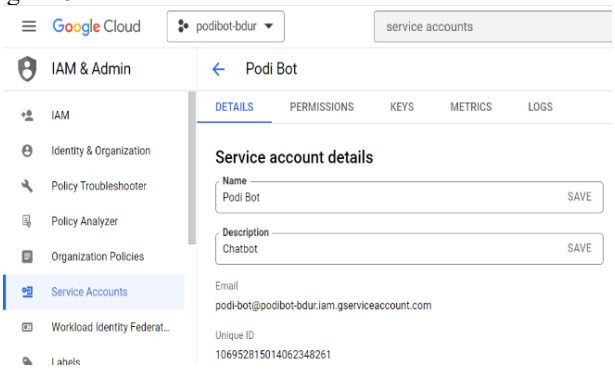



Figure 7. Service Account Key

```
example.js
File  Edit  View

const { Client, LocalAuth } = require('whatsapp-web.js');

const dialogflow = require('@google-cloud/dialogflow');
const uuid = require('uuid');

const projectId = 'podibot-bdur';
const sessionId = uuid.v4();

const sessionClient = new dialogflow.SessionsClient({
        keyFilename: "podibot-bdur-8184d0df3b24.json"
  });

  const sessionPath = sessionClient.projectAgentSessionPath(
    projectId,
    sessionId
  );

const cron = require('node-cron');
```

Figure 8. Node js. Podi Bot Code

- Chatbot Results

The Podi Bot display through the WhatsApp chat page is shown in Figure 9.

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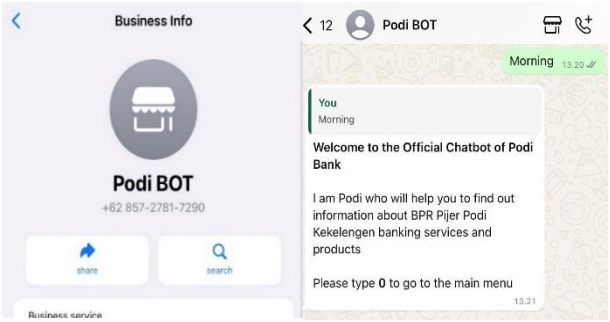



Figure 9. Chatbot Initial Display

When the user sends the initial message, the chatbot will respond with a greeting. The chatbot will respond with the default fallback if it does not match the database, as shown in Figure 10. Then, the chatbot also directs the user to type a number to go to the main page, as shown in Figure 11. Based on the response given by the chatbot, the user can select the sub-menu according to their needs. The response from the chatbot if the user chooses a sub-menu can be seen in Figure 12.

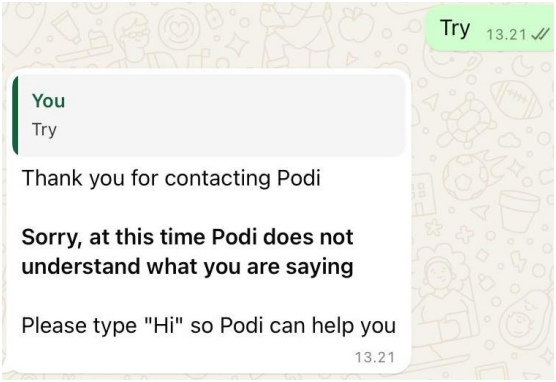



Figure 10. Default Fallback Response

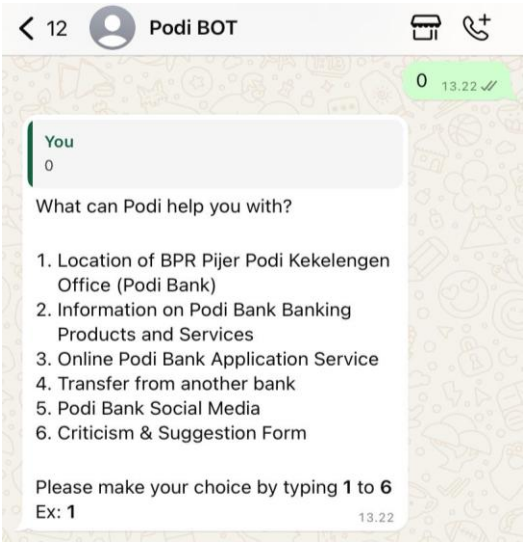



Figure 11. Main Menu Response

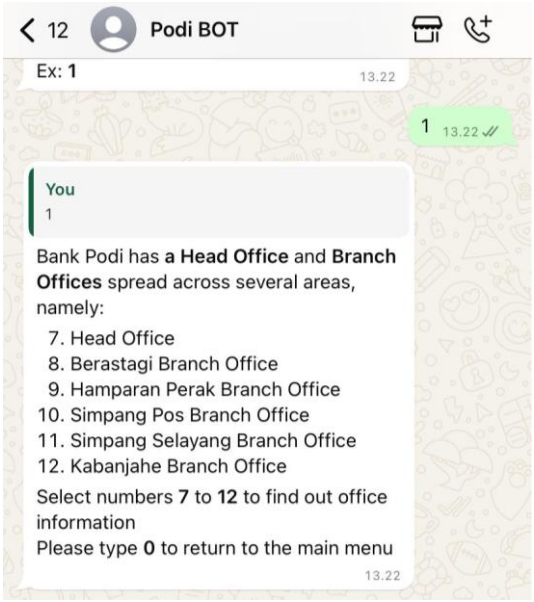



Figure 12. Sub-menu 1 Response

- Blackbox Testing Method

Chatbot testing is done using the Blackbox testing method. Blackbox testing aims to show that the chatbot system carries out the task as expected and can help find if there are defects in the chatbot system. This test is based on the conversational flow in Figure 4. Chatbot testing using black box testing is shown in Table 2.

Table 2. Blackbox Testing Method

| Scenario | Expectation | Result |
|---|---|---|
| **Start** Greeting Intent | | Suitable |
| **0. Main Menu Category** Users select the main menu, and bots can reply to messages by attaching information that the user can access. | | Suitable |
| **1. Office Location Category:** The user selects a location, and the Bot can reply to messages by attaching office location information. | | Suitable |
| **2. Product Information Category** Users select product information, and bots can reply to messages by attaching product information. | | Suitable |
| **3. Online Service Category** Users select online services, and bots can reply to messages by attaching online service information. | | Suitable |
| **4. Category Transfers from Other Banks** Users select transfers from online banks, and bots can reply to messages by attaching information related to transfers from other banks to Podi Bank. | | Suitable |
| **5. Social Media Category** Users select social media, and bots can reply to messages by attaching information related to social media owned by Podi Bank. | | Suitable |
| **6. Criticism and Suggestion Form Category** Users select criticism and suggestions. The bot can reply to messages by attaching information about the criticism and suggestions they wish to convey to Podi Bank. | | Suitable |

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- User Satisfaction

User satisfaction is a measure that evaluates the extent to which users are satisfied using a product or service according to their experience (Apriadi & Saputra, 2017). 60 Podi Bank customers who had accessed the chatbot filled out the user satisfaction questionnaire, which consisted of eight questions based on six factors (Baizal et al., 2023). The factors of user satisfaction are EOU (ease of understanding), PRQ (perceived recommendation quality), PE (perceived efficiency), INF (informative), TR (trust), and ETU (easy to use). The EUO factor measures how easily users can understand its interface and software features and see how healthy users evaluate them. Users can quickly understand how to use the software, how navigation is carried out, and how the display of information is organized. PRQ factors to assess the quality of device recommendations or suggestions gently. It also involves user assessments of relevance and the usefulness of the recommendations provided to meet the needs of user preferences. The PE factor measures the extent to which users feel that they are immediately on board with the development and achieve goals with minimal effort when using the software. PE testing involves evaluating the time required by user 26 to complete tasks and how efficient the interaction with the device is. INF factor measures the extent of the software produced and provides transparent, relevant, and helpful information for users. The TR factor refers to the user's trust in the user software. TR also measures how well the software complies with user expectations. The ETU factor measures how easy the software is for the user. ETU testing involves user assessment of the software's security, reliability, and accuracy. Each question represents a factor in user satisfaction. Overall, the percentages of the user satisfaction questionnaires, EOU, PRQ, PE, INF, ETU, ETU, TR, and TR, are 100%, 100%, 98%, 98%, 97%, 98%, 98%, and 100%. The results obtained from a questionnaire can be seen in Figure 13. Based on eight questions, the average results obtained are above 80% and 98.6% and included in the "feasible" category. These results indicate that the chatbot system design can provide a positive experience for users. Therefore, it can be concluded that the design of a decision tree-based chatbot system can be used as an information system for Bank Podi to improve customer service by conveying information about Bank Podi's products and banking.

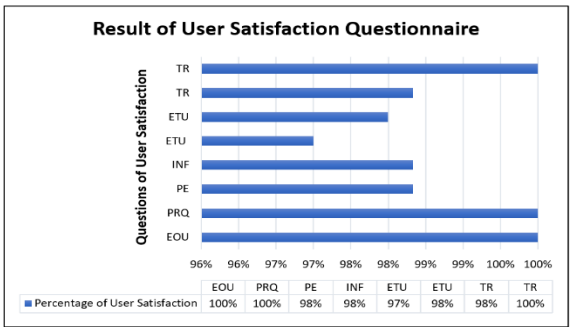


Figure 13. Result of User Satisfaction Questionnaire

*4.2. Discussion*

Based on the results of comparing the current system and the proposed chatbot system, the chatbot design helps overcome current system problems at Podi Bank, so the presence of the chatbot helps customers get complete and fast information and has easy access for all ages. Based on brainstorming sessions with Podi Bank's central leadership, we identified shortcomings in implementing this chatbot. Specifically, we found that some users still require emotional closeness, as the chatbot's responses may appear standard and stiff. However, based on functional requirements, we designed the chatbot to provide comprehensive information about products and banking, enabling staff and customers to resolve personal cases through direct interaction. There are some shortcomings in the implementation of the decision tree chatbot system. Based on the results of comparing the current system and the proposed chatbot system, the chatbot design helps overcome current system problems at Podi Bank, so the presence of the chatbot helps customers get complete and fast information and has easy access for all ages. Based on brainstorming sessions with Podi Bank's central leadership, we identified shortcomings in implementing this chatbot. Specifically, we found that some users still require emotional closeness, as the chatbot's responses may appear standard and stiff. However, based on functional requirements, we designed the chatbot to provide comprehensive information about products and banking, enabling staff and customers to resolve personal cases through direct interaction. There are some shortcomings in the implementation of the decision tree chatbot system (Caldarini et al., 2022):

- Chatbots have limitations in handling complex scenarios. The structure of a decision tree becomes increasingly complex as the number of scenarios or choices increases. Each new scenario adds new branches, which makes the tree significant and challenging to maintain.
- Chatbot systems tend not to be able to adapt quickly because responses only match the database.
- Chatbots with the decision tree type have limitations in understanding the broader context.

Decision tree chatbots provide an interaction experience that feels "structured" or too robotic. This makes it less suitable for conversations that require natural, more human responses.

The presence of chatbots can improve service to customers and prospective customers, as well as increase customer loyalty and trust in using Podi Bank products and services.

## 5. Conclusion

Based on the results of the final research project, "Designing a Whatsapp Chatbot-Based Information System to Improve Customer Information Services, several things can be concluded, including the user's need for the Whatsapp Chatbot as a system used to convey information about BPR Pijer Podi Kekelengen products and banking identified through demographic segmentation. So, a decision tree-based chatbot is the type of chatbot that suits the user's needs. The WhatsApp Chatbot system is designed based on user needs, which are adjusted to flowcharts, use cases, and conversational flow. Then, using the waterfall method, the WhatsApp chatbot system was designed according to user needs. The user satisfaction results also show that the chatbot got a score of 98.6%, which shows that the chatbot system is suitable for use by users and has received a positive response from users. Suggestions for future AI development include using a Hybrid Chatbot (Rule-Based + ML Model). This method combines a rule-based approach with machine learning. The advantages of this method are better flexibility, faster and more accurate response, continuous improvement of the model, and ease of adapting to business needs.

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