Development of an Integrated Chatbot on the Website Using IBM Watson Assistant

Andik Yulianto[1], Eric Lau[2], Sabariman[3]
[1,2,3]Program Studi Teknologi Informasi, Fakultas Ilmu Komputer, Universitas Internasional Batam
Email: [1]andik@uib.ac.id, [2]2132022.eric@uib.ac.id [3]sabariman@uib.ac.id

Abstrak. Penelitian ini mengembangkan chatbot terintegrasi menggunakan IBM Watson Assistant untuk meningkatkan interaksi pelanggan di situs web Martindo Fine Foods. Masalah utama yang diatasi adalah adanya inefisiensi dan inkonsistensi dalam respons layanan pelanggan. Menggunakan metode Waterfall, penelitian ini mengikuti lima tahap sistematis: analisis kebutuhan, desain, implementasi, verifikasi, dan pemeliharaan. Chatbot yang dilengkapi dengan sistem navigasi hibrida dievaluasi menggunakan pengujian Blackbox yang komprehensif dalam 12 skenario. Dengan tingkat akurasi 91,67%, 11 skenario berhasil, sementara 1 skenario gagal karena kesalahan tipografi. Selama satu minggu implementasi, chatbot berhasil menangani 50 dari 51 interaksi. Hasilnya menunjukkan bahwa chatbot secara signifikan meningkatkan kecepatan respons dan mengurangi pesan yang tidak terjawab.
Kata Kunci: Chatbot, Metode Waterfall, IBM Watson Assistant, Pengujian Blackbox, Pengalaman Pengguna

Abstract. This research develops an integrated chatbot using IBM Watson Assistant to improve customer interaction on the Martindo Fine Foods website. The main problem addressed is the inefficiency and inconsistency of customer service responses. Using the Waterfall method, the study followed five systematic stages: requirements analysis, design, implementation, verification, and maintenance. The chatbot, featuring a hybrid navigation system, was evaluated using comprehensive Blackbox testing across 12 scenarios. With an accuracy of 91.67%, 11 scenarios succeeded, while 1 scenario failed due to typographical errors. Over one week, the chatbot successfully handled 50 out of 51 interactions, the results show that the chatbot significantly enhances response speed and reduces unanswered messages.
Keywords: Chatbot, Waterfall Method, IBM Watson Assistant, Blackbox Testing, User Experience

1. Introduction

Technology has become part of our daily routine in today's digital era. One of the ways people utilize technology is in accessing information. Before the advent of digital technology, people obtained information by interacting with others or through print media. To get official information from a formal institution, one often had to be physically present and meet with the public relations staff (Agussalim & Nur Handayani, 2023). However, in a fast-paced digital era that demands operational efficiency, many tasks previously handled by dedicated personnel are now replaced by technology products (Zaoui & Souissi, 2020). A significant challenge arises in ensuring that customer interactions remain efficient and personalized as companies transition to digital solutions.

Companies greatly benefit from using chatbots because they can enhance operational efficiency while providing convenience and extra services to both internal staff and customers who ask questions in various patterns (Almustaqim & Toscany, 2022). Chatbots enable companies to respond to various client questions quickly and needs while reducing human involvement (Rugved Lola et al., 2021). Companies are now formulating new strategies to leverage technology to build close relationships with customers and enhance brand image, making chatbots increasingly popular, whether through phones or websites.

Chatbots are designed to respond to and interact with user inquiries (Cessa Agustin et al., 2024). When a company relies solely on human resources, it can only serve a limited number of people. Companies that depend on human resources are constrained to using standard models to maintain cost efficiency, limiting their ability to adopt proactive and personalized approaches (Yuwan Pangestu et al.,

2024). Chatbot is an AI-based computer program that uses AI to communicate with people and answer their questions. It can communicate with users through different ways like instant messaging, web chat, email, and web forums using natural language (Hafiz Aldwinarta et al., 2024). Chatbot technology is engineered to enable direct communication between humans and computers using natural language. As a tool for interactive and personalized customer service, chatbots are often used by companies to address customer inquiries because they are easier to use compared to other communication methods (Sihite, Suhendra, and Marini 2024). In school chatbot can be used to help the administrator to answer the questions about school registration and information from the students or prospective students effectively (Erlina et al., 2023).

Chatbot has been developed and implemented for various applications, for example in product promotion, health education, or virtual assistant. In (Elita Natalia Sugianto et al., 2022a), chatbot was developed as a virtual assistant to answer the customer questions in a running business. In this research, chatbot has been developed by using Program-O for three media, including a website, Telegram, and Line. Program-O is an AIML interpreter written in PHP, and uses a MySQL database to store chatbot information, including the AIML files used to formulate the chatbot's responses(Elizabeth Perreau & Dave Morton, 2014). This interpreter is easily used for developing a chatbot web-based application. However, Program-O is no longer available for active development and the features are limited.

Study by (Chow et al., 2023) showcased chatbot's ability to deliver information about radiotherapy in a user-friendly and informative way, aiming to increase public awareness about the treatment. The chatbot effectively meets its purpose, built on the IBM Watson Cloud platform and leveraging advanced AI techniques such as natural language processing and domain ontologies. However, the chatbot was designed as an actions-based assistant which equipped with a set of "actions" so the user can query by clicking the options provided. The users also can type the query but limited to steer the conversation to another direction.

Martindo Fine Foods is a prominent distributor in Indonesia with a rich history of innovation. Founded in 2011, they began by specializing in importing and distributing frozen food and dairy products. Martindo Fine Foods currently relies on manual replies to address customer inquiries, but due to limited staff and the time-consuming nature of manual processes, response times are often delayed and unanswered. Implementing a chatbot is seen as a promising solution to enhance efficiency and provide timely responses to customers. This research aims to develop an AI-powered chatbot using Watson Assistant and integrated into the Matindo's website to enhance response speed, reduce unanswered messages, and improve overall customer experience. This research implemented a hybrid action Chatbot to enhance users' interaction by giving users to *click* or *type* the actions, which is useful for improving the chatbot's conversational approach.

2. Literature Review

One interesting technology product is the Watson Assistant Chatbot which sparked a fundamental change in how we interact with machines and access information. Watson Assistant Chatbot is a product developed by IBM that uses artificial intelligence to provide communication services to humans through text or voice messages. With advanced natural language processing (NLP) capabilities, this chatbot can accurately understand user questions and requests and provide relevant answers and assistance based on the data it has been trained on (Simanullang & The, 2024). This assistant leverages a suite of algorithms and AI techniques to provide accurate and context-aware responses. At its core, the system uses NLP algorithms that help it understand and process human language. These models use self-attention mechanisms to comprehend the relationships between words in a sentence, enabling the system to grasp the context and extract meaningful information from user inputs (Kumar & Padma, 2022).

Entity recognition is a crucial part of Watson Assistant's functionality. It helps the system identify and categorize important details, like names, dates, and locations, from user input. Watson Assistant uses Named Entity Recognition (NER) algorithms to achieve this. These algorithms work by analyzing sequences of words to find and label relevant entities. To manage conversations effectively, Watson Assistant uses decision trees and rule-based systems that direct the flow of dialogue. This means the assistant can follow a set of rules to respond appropriately based on what the user says. It also uses

reinforcement learning to improve over time by learning from interactions and feedback (Fuchs & Krcmar, 2022).

There is research by (Mah et al., 2022) reveals that the NLP and AI system enables companies to understand customers' needs which achieves customer satisfaction. This research aligns well with my exploration of NLP applications and provides valuable insights into how businesses can leverage AI-driven approaches for better customer engagement. The research by (Syarof & Rasal, 2024) reveals that the chatbot successfully provides an intuitive and natural information delivery method. Black box testing confirms its functionality and user surveys show an acceptability score of 83%, indicating the chatbot is acceptable. These findings highlight the importance of natural and responsive interactions in enhancing user experience. Hence, our research also highlights the importance of natural and responsive interactions with chatbots.

3. Research Methodology

This research was conducted using the Waterfall method. The Waterfall method aims to develop software with sequential/systematic stages (Elita Natalia Sugianto et al., 2022b). This method consists of five systematic stages, where each process must be completed before moving on to the next stage without skipping any previous steps (Wahid Aceng, 2020). Figure 1 illustrates the five stages of the Waterfall method.

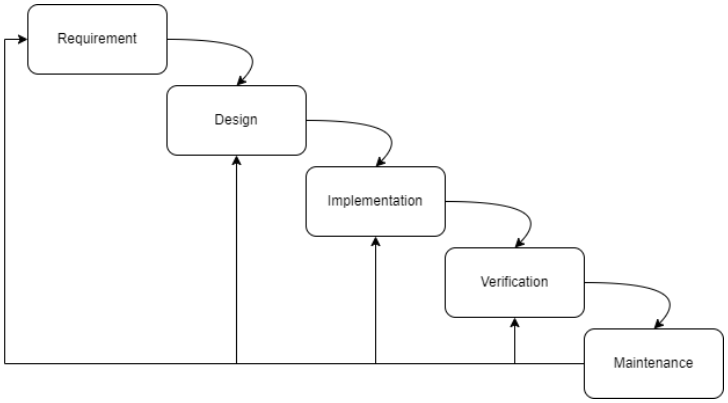

Figure 1. Waterfall Methodology

3.1. Requirement

During the requirement stage, communication is conducted between system developers to understand the user's expectations for the desired software and the existing limitations. Information is gathered through discussions and internet research and then analyzed to understand the requirements (Huberta & Wijaya, 2023). The data/information collection methods include reviewing literature related to chatbot case studies and similar topics, observing websites already integrated with chatbots, and surveying the company's director to determine what information the chatbot should be trained to convey.

3.2. Design

In the design stage, the system design is created to help establish the device and system requirements according to the specifications set in the previous phase (Cahya et al., 2021). It also involves defining the architecture of the chatbot application using a flowchart to understand its workflow and designing a simple initial interface for the chatbot.

Several important aspects are considered when designing the chatbot system. First, the chatbot's target persona is determined, including the profile of the intended users, such as their age, preferences, and communication needs. Second, how the chatbot navigates conversations is designed, including how it responds to questions and provides options based on the trained data.

Additionally, the chatbot interface is designed to be simple yet informative, focusing on clarity and ease of navigation for users. The designer chooses fonts and colors that align with the company's image and enhance the user experience. Finally, the language used by the chatbot, such as Indonesian or English, is determined based on user preferences and communication needs. All these aspects are

considered to ensure the chatbot provides an efficient and enjoyable communication experience for users while supporting the desired company image.

3.3. Implementation

In the implementation stage, the designed chatbot is integrated according to the architectural design and the required needs. The chatbot contains all the trained data related to Martindo Fine Foods, allowing it to respond to questions based on this trained data. The chatbot uses a hybrid navigation system, which can be operated by typing and clicking. This hybrid navigation provides users with greater flexibility when interacting with the chatbot. The chatbot is integrated into the company's website using HTML coding, including the API key and ID from Watson Assistant to be incorporated into the company's website.

3.4. Verification

In the verification stage, the system is evaluated to determine how well it meets the established requirements. The testing conducted includes black box testing and data accuracy verification. Black box testing is a method that focuses on the external functionality of the program without examining its internal structure (Sidik et al., 2021). This helps identify how effectively the chatbot interacts with users and whether its responses meet expectations.

Additionally, testing the accuracy of the data the chatbot uses ensures that the data for training the chatbot reflects a sufficient variety of possible user interactions. This allows the chatbot to provide accurate and relevant responses in various conversational situations.

During testing, it is crucial to identify errors in conversation sessions based on predefined scenarios. These scenarios involve checking whether the responses align with the questions or if the chatbot correctly understands the inputs. These steps help ensure the chatbot functions properly and delivers a satisfying user communication experience. The scenarios are based on the data trained into the chatbot and aim to test its accuracy and identify any response failures so they can be corrected.

3.5. Maintenance

In the maintenance stage, the system that has been developed and implemented undergoes ongoing maintenance. This maintenance involves fixing any errors (bugs) that arise in the system or are discovered during black box testing. Any errors identified during black box testing are corrected according to the issues encountered. Additionally, the chatbot is updated whenever there are changes or additions to the data to ensure that the information provided remains accurate and relevant.

4. Results and Discussion

Here is an explanation of the results and discussion regarding the chatbot's design aimed at improving response speed, reducing unanswered messages, enhancing the overall customer experience, and incorporating hybrid actions to enhance user experience further.

4.1. Requirement

As shown in Table 1, to design a chatbot (Watson Assistant), we need a laptop/computer with a stable internet connection and a browser installed. Additionally, an IBM ID is required to access IBM Cloud. Table 2 has 6 data categories, each trained with different functions. These data categories were obtained through a survey of the company director regarding the data the chatbot can display.

Table 1. Hard / Software System Requirements

No	Name	Description
1	Laptop / Computer	*Laptop* / *Computer* with a stable connection
2	Browser	Google Chrome / Firefox / Edge / dll
3	ID IBM	A registered IBM ID for cloud access

Table 2. Chabot Data Requirements

No	Trained Data	Function
1	Definition	Provide a brief, clear, and detailed description of the company.
2	Products	Display various major product categories offered by the company.
3	Brands	Provide information about the brands owned or managed by the company.
4	Contact	Offer contact information for the relevant point of contact (PIC) as needed by users.
5	Apply as Agent	Provide a QR code for users to register as company sales agents.
6	*Recommendation*	Offer recommendations for different major product categories provided by the company.

4.2. Design of Appearance and Program Flow

The target persona for this chatbot design is Martindo Fine Foods customers. The goal is to enhance response speed in customer service and reduce unanswered messages. The chatbot features a hybrid navigation system, allowing users to type queries or click on available options. The design includes a simple interface with IBM's default font and a dark green color scheme with hex code #273825. The chatbot is trained and designed using English.

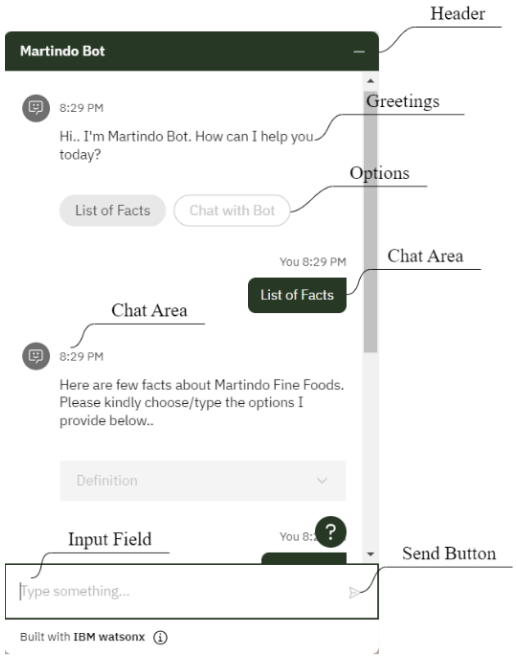

Figure 2. Design of First Appearance

Figure 2 illustrates the initial design for starting a chat session. This design features: **Header** at the top of the display that shows the bot's name, "Martindo Bot," in dark green (hex code #273825). The **Greetings** section displays the first message from the bot when the chat session starts. **Options** are provided as buttons or choices for users to interact with the chatbot without typing, making responses

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easier and guiding the conversation along a structured path. The **Chat Area** is the main part where the conversation occurs, showing chat history and the chatbot's responses in real-time. The **Input Field** allows users to type their messages or questions, while the Send Button is used to send the typed message.

To understand the system flow of the chatbot application, the following shows the flowchart design of the chatbot system:

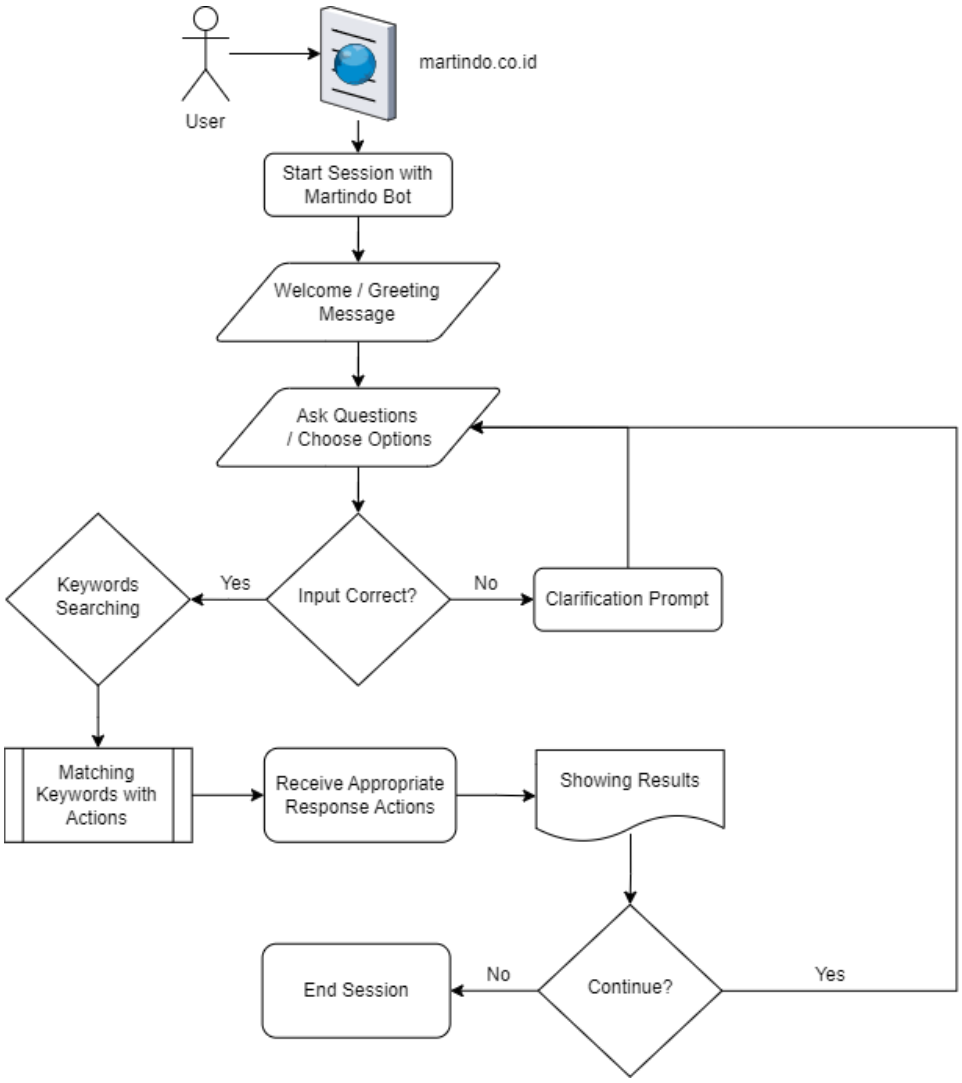

Figure 3. Flowchart of Chatbot

The flow shown in Figure 3 starts with the chatbot greeting the user and offering two options: selecting from available options or typing a question directly. If the user selects an option, the chatbot processes it and provides a response based on the training data. If the user types a question, the chatbot analyzes it using trained keywords. The chatbot politely asks for clarification if no keywords are found or the question is irrelevant. However, if keywords are found or the question is relevant, the chatbot searches for a response by matching the keywords with the trained data. After presenting the result or appropriate response, the chatbot offers two choices to the user: continue the conversation or end the session. If the user chooses to continue, the process returns to the initial step for further interaction. If the user ends the session, the chatbot will bid farewell warmly.

4.3. Implementation

The chatbot is integrated into the Martindo Fine Foods website using a combination of HTML and JavaScript. While HTML provides the structure for embedding the chatbot interface, the main functionality is handled using JavaScript. We embed the JavaScript code into the HTML homepage file. Since Martindo's website is a Wordpress-based web, we embed the JavaScript code using WPCode in the footer section. Figure 4 shows that the script sets up the integration with IBM Watson Assistant by defining options such as the integrationID, region, and serviceInstanceID to connect the chatbot to the appropriate service. The onLoad function ensures the chatbot widget is rendered after the homepage is loaded. JavaScript dynamically loads the Watson Assistant Chat script and injects it into the HTML document, enabling the chatbot to interact with users on the website (IBM, n.d.). By embedding this script into the HTML, the chatbot becomes fully functional, enhancing the web-based application by providing real-time customer interaction through the chatbot system.

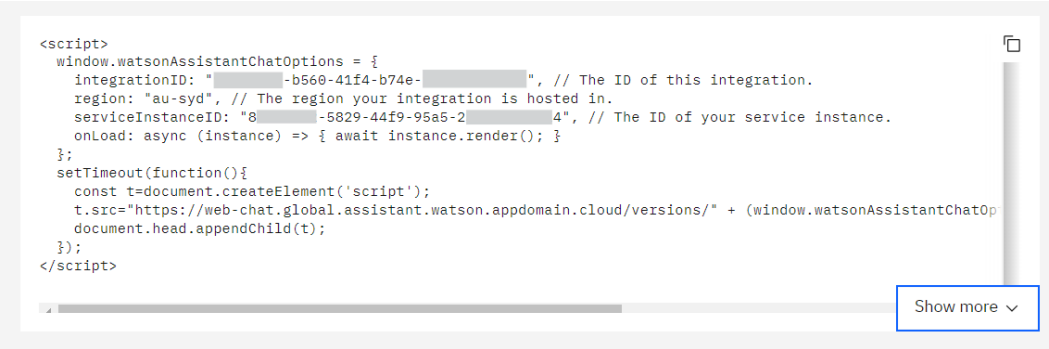

Figure 4. Website Script Deployment

The system is designed to respond to user questions based on trained data using IBM Watson Assistant. To ensure the chatbot provides accurate and helpful responses, IBM Watson Assistant uses a machine learning and Natural Language Processing (NLP) approach to train the system. The training process includes (IBM, n.d.):

1. Entity Identification, entities are specific pieces of information the chatbot needs to extract from a user's query. For instance, in a query like "What is the brand of company X?", the brand of company "X" is an entity. These entities are trained to allow the chatbot to identify relevant details within a user's request.
2. Training Dataset: The training dataset consists of 79 sample queries and phrases that reflect how users are likely to interact with the system. These data samples are continuously refined as more conversations take place. The chatbot uses supervised learning, where developers label the data with entities. Figure 5 illustrates how the chatbot's training involves inputting a wide range of potential user keywords and phrases.

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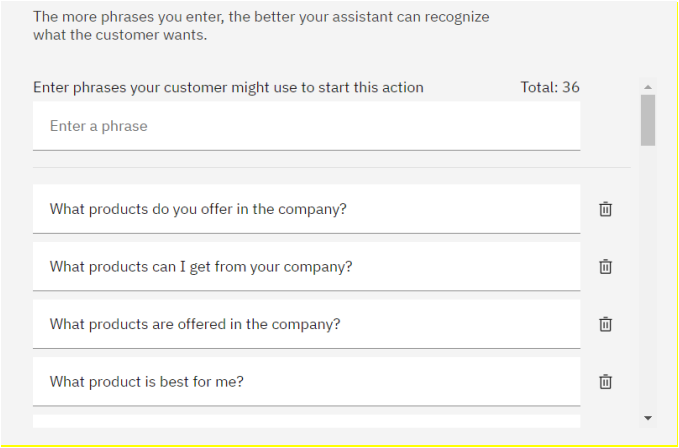


Figure 5. Training Dataset Examples

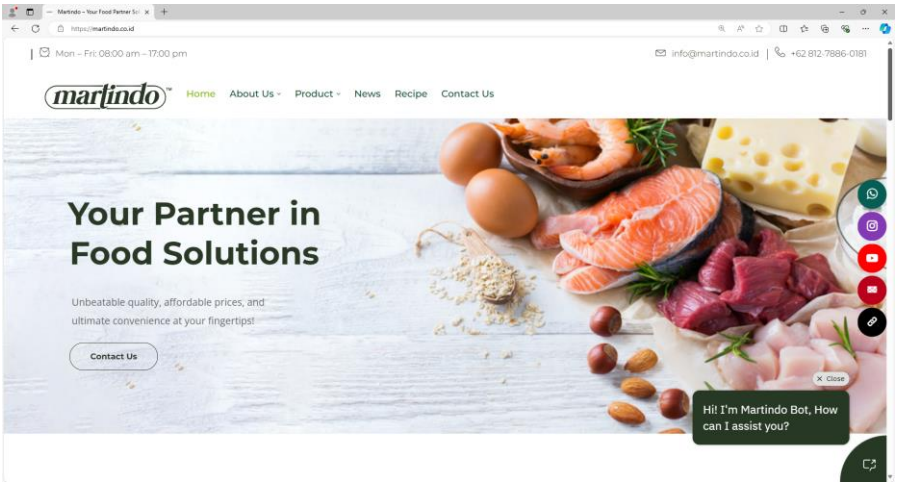


Figure 6. Chatbot Greeting Screen

Figure 6 illustrates the initial greeting screen of the chatbot when entering the Martindo Fine Foods website. The chatbot is located at right bottom of the page and designed to greet users with the message, “Hi! I’m Martindo Bot. How can I help you today?”.

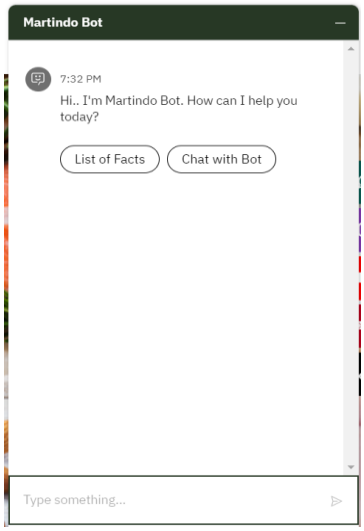
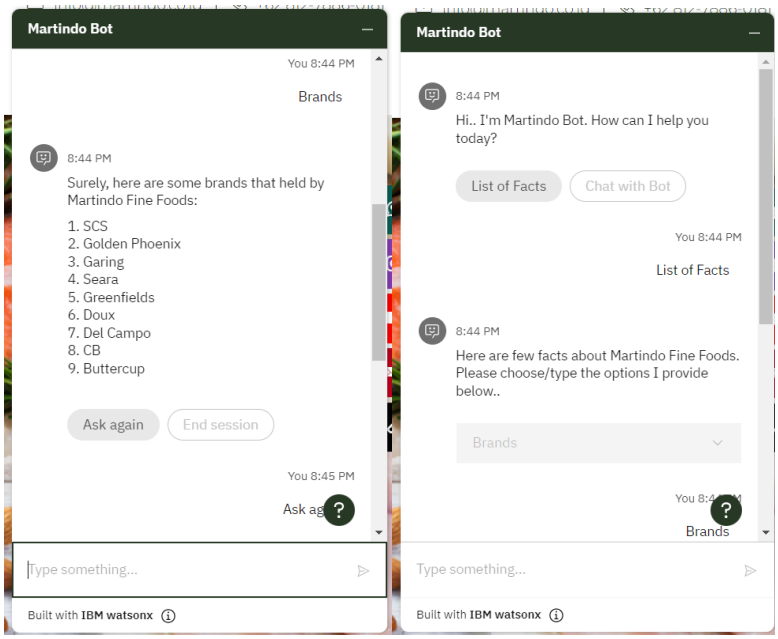


Figure 7. Initial Chatbot Session Screen

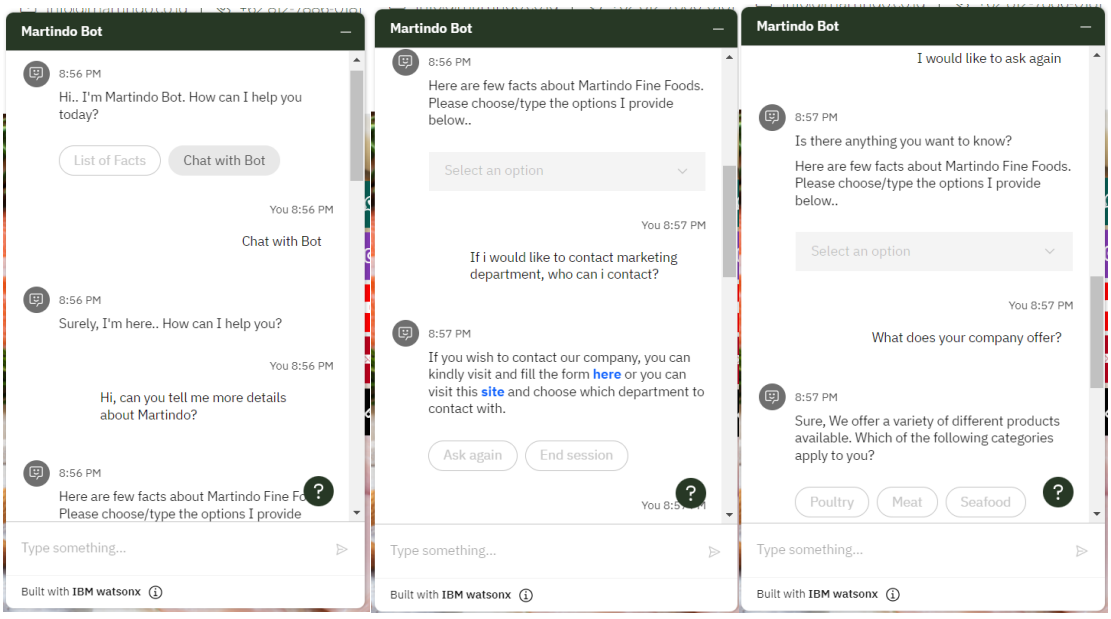
Figure 7 illustrates the initial screen of the chatbot session that appears when a user clicks on the chatbot's pop-up greeting. On this screen, users are presented with two options: "List of Facts" and "Chat with Bot." They can select one option by clicking or typing their questions directly. This setup represents Hybrid Action, combining click and type interactions. Click Action involves choosing an option the developer provides, while Type Action allows the chatbot to analyze typed questions using trained keywords and respond based on its training data.



(a) (b)

Figure 8. Chat Session Display with Click Action in Images (a) and (b)

Figures 8a and 8b show examples of chat sessions with the bot using click actions. In these sessions, users select from the available options, and the chatbot responds with relevant data based on their choices.



(a) (b) (c)

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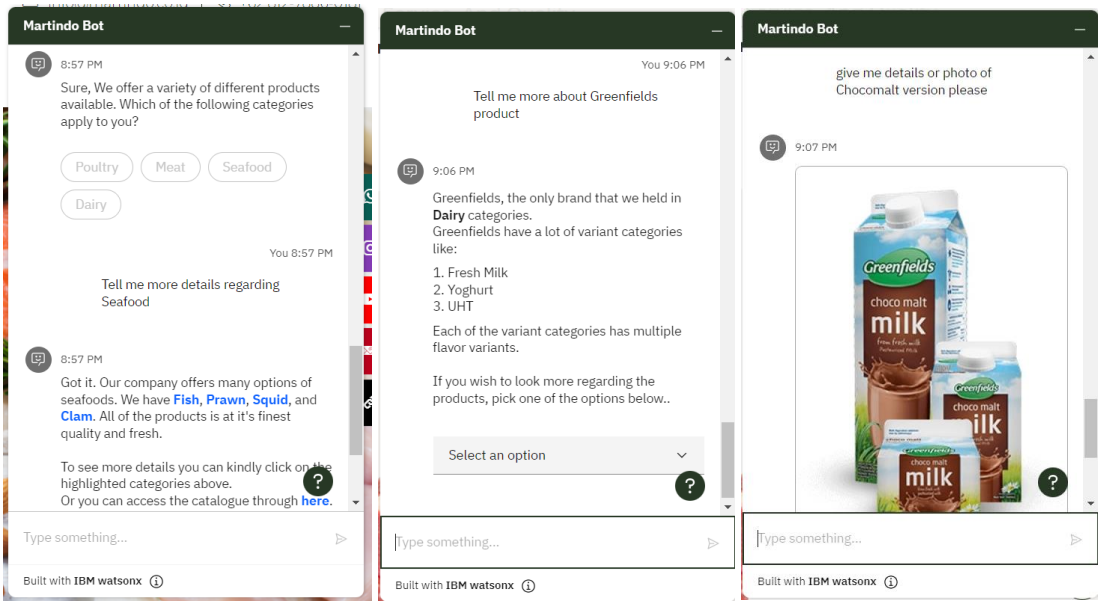

(d) (e) (f)

Figure 9. Chat Session Display with Type Action in Images (a), (b), (c), (d), (e), and (f)

In Figure 9a, the user requests details about Martindo-related facts, and the chatbot responds by providing a list of factual options related to Martindo. In Figure 9b, the user inquires about contacting the marketing department. The chatbot responds by offering two choices: filling out a form or visiting a site with contact numbers for each department. In Figure 9c, the user asks what Martindo Fine Foods offers. The chatbot replies in four major categories: poultry, meat, seafood, and dairy. In Figure 9d, the user seeks details about the seafood category. The chatbot responds by listing items within this category, such as Fish, Prawn, Squid, and Clam, and provides a link to access the catalog. In Figure 9e, the user inquiries about products from the Greenfields brand. The chatbot provides several category options from Greenfields, including Fresh Milk, Yoghurt, and UHT Milk. In Figure 9f, the user requests details about the Chocomalt milk variant. The chatbot responds with a photo of the Chocomalt milk product from Greenfields.

The results shown in all the images from Figure 6 illustrate chat sessions using Type Action. The images and explanations show that the chatbot analyzes user questions and matches them with the trained data.

4.4. Verification

In the verification stage using Blackbox testing, several steps must be observed: First, analyze the testing requirements. This includes identifying the application to be tested, the Martindo Fine Foods chatbot, and the operating system used, in this case, Windows 11 64-bit. Second, select the inputs for Blackbox testing. These inputs are chosen based on the keywords designed for the chatbot and those that do not match the established keywords. Third, determine the outputs or responses generated by the chatbot after analyzing the designed keywords. These responses will serve as a basis for evaluating the chatbot's performance. Fourth, test the specified inputs and outputs on the Martindo Bot. The results of this testing will be used to evaluate the chatbot's performance in responding to the given inputs. The results of the Blackbox testing can be seen in Table 3.

Table 1. Blackbox Testing Results

No	Scenario	Expected Result	Actual Result	Result
1	The user inputs a question/sentence	The chatbot responds with several options related to	The chatbot responds and provides several options	Success

	containing the keyword "Facts."	the facts about Martindo Fine Foods.	related to facts about Martindo Fine Foods.	
2	The user inputs a question/sentence containing the keyword "Martindo company."	The chatbot responds with the definition/description of Martindo Fine Foods.	The chatbot responds with the definition/description of Martindo Fine Foods.	Success
3	The user inputs a question/sentence containing the keyword "Brands."	The chatbot responds with a list of brands held by Martindo Fine Foods.	The chatbot responds with a list of brands held by Martindo Fine Foods.	Success
4	The user inputs a sentence containing the keyword "Thank you."	The chatbot responds by ending the chat session with "Thank you for using Martindo Bot."	The chatbot responds by ending the chat session with "Thank you for using Martindo Bot."	Success
5	The user inputs a random sentence/question, for example, "Just testing."	The chatbot responds with a validation question by providing several option choices.	The chatbot responds with a validation question by giving several option choices.	Success
6	The user inputs a random sentence/question, for example, "Test 1 2 3."	The chatbot responds with a validation question and provides several options.	The chatbot responds with a validation question with several option choices.	Success
7	The user inputs a typo, for example, "prduct."	The chatbot responds with a validation question and provides several options.	The chatbot provides the options that were previously given.	Failed
8	The user selects the option "Lists of Facts."	The chatbot responds with several options related to the facts about Martindo Fine Foods.	The chatbot responds and provides several options related to facts about Martindo Fine Foods.	Success
9	The user selects the option "Products."	The chatbot responds with several product categories available at Martindo Fine Foods.	The chatbot responds and provides several product categories that are available at Martindo Fine Foods.	Success
10	The user continues the product selection with the name "Greenfields."	The chatbot responds with a brief description of Greenfields and provides several product options from Greenfields.	The chatbot responds with a brief description of Greenfields and offers several product options from Greenfields.	Success
11	The user selects "Ask again" after completing the question.	The chatbot responds by asking a follow-up question on the same topic.	The chatbot responds by asking a follow-up question on the same topic.	Success
12	The user selects the option "End session."	The chatbot responds by ending the chat session with "Thank you for using Martindo Bot."	The chatbot responds by ending the chat session with "Thank you for using Martindo Bot."	Success

Based on Table 3, it can be concluded that all scenarios from all scenarios 11 scenarios were successful, and 1 scenario failed. The failed scenario is scenario number 7, where the user typed a typo, while the chatbot has been trained on various phrases and word variations, some types of typos remain difficult for the system to recognize. Examples of typos that may cause failure include:

1. Missing Important Letters, when users type "prduct" instead of "product," the chatbot may fail to identify the word, particularly if this variation hasn't been included in the training dataset.
2. Swapped or Reversed Letters, typos like "prdouct" for "product" may result in failure, as the incorrect letter order might not be close enough to any recognized pattern.

This limitation occurs because the chatbot is not designed to validate or correct the input when a typo is detected. However, if this typo occurs it defaults provide options that have already been offered. Using the accuracy formula (1), we can calculate the accuracy of the chatbot's performance (Muliyono & Sumijan, 2021).

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$$Accuracy = \frac{11}{12}\ x\ 100\% = 91.67\% \quad (1)$$

Therefore, out of the 12 scenarios tested, 11 were successful, and 1 failed. Therefore, the Blackbox testing of the chatbot has an accuracy of 91.67%.

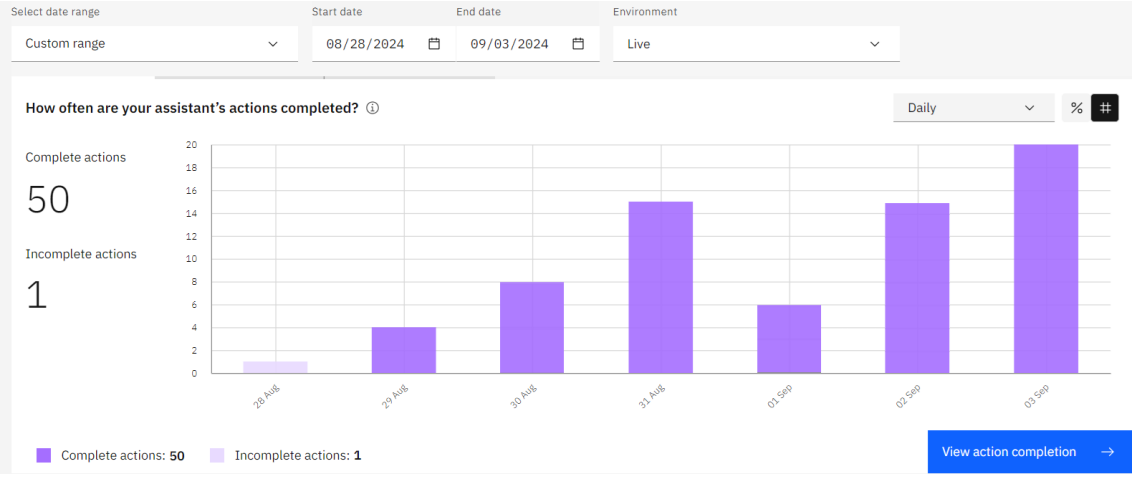

Figure 10. Actions Graph of Bot

Based on Figure 10, the graph shows 50 completed actions and just 1 incomplete action over a span of one week, clearly demonstrates the substantial benefits of implementing the chatbot on the Martindo website. This high success rate underscores the chatbot's efficiency in managing customer inquiries, significantly reducing the need for human intervention. By handling a large volume of interactions smoothly and accurately, the chatbot not only improves response speed but also minimizes the number of unanswered questions. This leads to a more consistent and reliable customer service experience. Furthermore, the chatbot's ability to consistently deliver accurate responses enhances user satisfaction and builds trust in Martindo Fine Foods' digital services. This efficiency in customer interaction supports the company's goals of operational efficiency by reducing the workload on human staff, allowing them to focus on more complex tasks. Additionally, the improved user experience contributes to a stronger brand image and customer loyalty, as clients are more likely to return to a website where their inquiries are promptly and effectively addressed.

4.5. Maintenance

In the maintenance phase, maintenance is carried out based on problems identified during testing and user interactions with the chatbot. When an issue arises, the developer thoroughly identifies and analyzes the problem to find the root cause. However, a failed scenario which occurred when a user typed a typo, has not been specifically addressed through maintenance. This is since the chatbot is designed to automatically provide alternative options even when a typo is detected. Therefore, rather than focusing on correcting the typo itself, the system defaults to offering previously available responses to guide the user.

Additionally, the chatbot is updated whenever there are changes in data, as shown in Figures 11 and 12. Figure 11 shows the chatbot's response to the keyword 'contact us' before updating the chatbot data. Figure 12 shows the chatbot's response to the 'contact us' keyword after maintenance or data update.

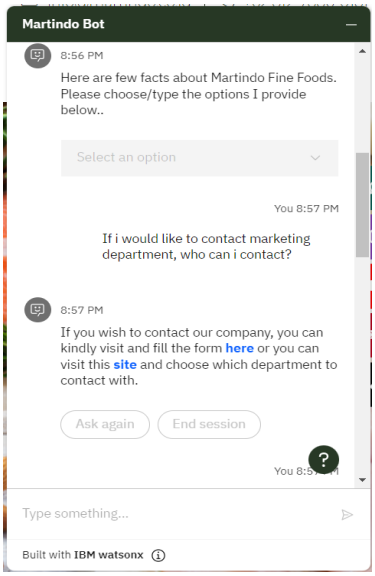

Figure 11. Contact Us Display Before Update

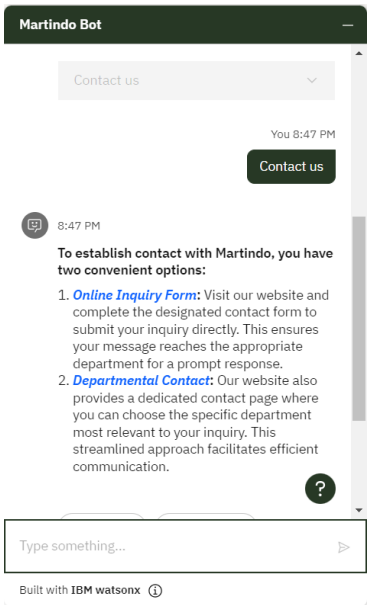

Figure 12. Contact Us Display After Update

5. Conclusion

The development of the chatbot for Martindo Fine Foods has successfully integrated Watson Assistant technology, significantly enhancing response speed, reducing the number of unanswered messages, and improving the overall customer experience. The average response speed of the chatbot is recorded at 2.5 seconds, and the rate of unanswered messages has decreased to approximately 1.96% of total interactions stated. The chatbot's performance was validated by Blackbox testing, achieving a 91.67% success rate across various scenarios. Over a one-week period, the chatbot completed 50 out of 51 actions, highlighting its efficiency in handling customer interactions and contributing to operational efficiency. Despite these successes, the research identified some areas for improvement, particularly in handling typographical errors. To further improve its effectiveness, ongoing training and monitoring are essential, along with improving its ability to handle typos and expanding its natural language processing capabilities to manage more complex queries. Continuously updating the user interface based on feedback will also ensure it remains user-friendly and accessible.

While this research has made significant strides, there remains a gap in exploring how chatbots can be adapted to handle more complex, context-aware conversations that require deeper understanding beyond predefined keywords. Additionally, exploring multilingual capabilities and real-time learning from user interactions could provide further insights into improving chatbot performance in diverse and dynamic environments. By addressing these areas, the chatbot can provide an even more seamless and effective customer interaction experience, helping Martindo Fine Foods achieve its strategic goals of operational efficiency and enhanced customer engagement.

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