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Utilization chatbot for Indonesian tourism: a post-pandemic solution of information accessibility

Hesti Fibriasari*), Bakti Dwi Waluyo, Baharuddin, Tansa Trisna Astono Putri, Savitri Rahmadany
Universitas Negeri Medan, Indonesia

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ABSTRACT

Indonesia is a renowned tourist destination worldwide. However, the COVID-19 pandemic has resulted in a decrease in both foreign and domestic tourist visits. Therefore, this research aims to develop a Telegram-based ChatBot application to increase post-pandemic tourist visits. The ChatBot is designed to make it easier for tourists to obtain information related to transportation and accommodation at tourist attractions. The ChatBot is built using the Knuth-Morris-Pratt (KMP) algorithm and web scraping method. The ChatBot's response to the keyword matching is then presented to tourists. To measure travelers' perceptions of ChatBot, the System Usability Scale (SUS) was used. SUS is a questionnaire consisting of 10 questions that were answered by 20 anonymous users. Based on the calculations, the average SUS score is 71, which indicates that the developed ChatBot is in the good category and suitable for use. Using this ChatBot will make it easier for tourists to obtain tourism information in Indonesia. With its ability to retrieve relevant information related to transportation and accommodation at tourist attractions, the ChatBot can serve as a useful tool to increase post-pandemic tourist visits.

Corresponding Author:

Hesti Fibriasari
Universitas Negeri Medan, Indonesia
hesti@unimed.ac.id

Introduction

Indonesia is one of the most popular tourist destinations in the world because of its beautiful natural resources and high hospitality values (Pham & Nugroho, 2022). Therefore, tourism is one of the most significant contributors to the country's economy. According to the 2018 World Travel & Tourism Council (WTTC) data, Indonesia's total contribution to the gross domestic product (GDP) from the travel and tourism sector reached 6.6% of the total GDP in 2018 (Qomariyah et al., 2020). However, due to the COVID-19 situation (Horton, 2020). Indonesia's tourism industry has experienced a decline because the nature of COVID-19 is highly contagious, leading to the suspension of activities that involve human interaction (García-Milon et al., 2021).

Global socioeconomic disruptions were caused by the COVID-19 pandemic (Buheji et al., 2020) and the lockdowns that followed resulted in significant limitations on people's ability to travel for leisure (Snuggs & McGregor, 2021). With a projected 62 million jobs lost globally in the tourist sector as of February 2022 (Lock, 2020), the travel and leisure sector placed fourth among the industries most affected by COVID-19 (Kaczmarek et al., 2021). As the epidemic slows down and travel restrictions are relaxed globally, it is critical to investigate consumer attitudes and worries around travel safety in order to increase travel. Since the pandemic is likely to have an impact on leisure travel demand in the medium to long term (Bressan et al., 2021), it is important to

research the factors that influence consumers' intent to travel for leisure or lack thereof, as well as their behavioral indicators, such as willingness to pay more for safe travel. When recommending proactive steps to promote leisure travel, practitioners and politicians can greatly benefit from the insights gleaned from such studies.

After the Covid-19 pandemic, commonly referred to as the 'new normal,' many people are looking forward to experiencing traveling for leisure because they have been confined to their homes for a long time and have been deprived of outdoor activities (Susanto & Kiswantoro, 2021). Consequently, many potential tourists will seek information related to tourism, especially accommodations and transportation information. However, most potential tourists still face difficulties in finding information about tourist attractions. Even though many (Martins et al., 2022) potential travelers spend a considerable amount of time visiting multiple websites and installing various apps, the revival of the post-COVID-19 tourism industry depends not only on the number of tourist attractions but also on quality human resources, good management, and an accurate and easily accessible tourism information system (Irmanti et al., 2017)(Cahyadi & Newsome, 2021).

Innovative technologies such as Chatbots can revolutionize the tourism industry (Tussyadiah, 2020)(Pillai & Sivathanu, 2020). Chatbots are intelligent virtual assistants that use artificial intelligence (AI) to help users obtain the information they require (Naik et al., 2020)(Khanna et al., 2020). The term Chatbot is derived from the phrase "chatter robot," which refers to chat services that use robots or virtual characters (Suhaili et al., 2021)(Caldarini et al., 2022). These computer programs utilize natural language processing to communicate with users (humans) via text, voice, and visual media (Alotaibi et al., 2020)(Ahmed et al., 2022). Chatbots are designed to interact with humans through various platforms, such as mobile messaging apps like Slack, Facebook, Twitter, and instant messaging apps (e.g., WhatsApp and Telegram) (Brandtzaeg & Følstad, 2017).

Chatbots have the potential to enhance customer engagement and satisfaction by providing accurate and timely information about travel-related services and destinations (Leung & Wen, 2020). By automating routine tasks, such as answering frequently asked questions and making reservations, Chatbots can save time and reduce operational costs for businesses (Cui et al., 2017) (Almansor & Hussain, 2020). As a result, the implementation of Chatbots in the tourism industry could improve overall efficiency and profitability. However, it is essential to ensure that the Chatbots are user-friendly and have a natural conversational style to maximize their effectiveness (Naik et al., 2020) (Khanna et al., 2020).

Chatbots have been widely used in various fields, such as customer service, education, sales, entertainment, and tourism (Cui et al., 2017) (Almansor & Hussain, 2020). One of the factors that hinders the development of tourism is pattern Promotion and tourism information management systems are not yet good, so that tourist attractions become unknown and certainly do not become destinations for tourists to travel. Apart from limited information about tourist destinations, tourist attractions interesting, products or results of crafts, local culture and traditions as well as serana and available infrastructure, as well as transportation problems to reach an area tourism makes tourist attractions not develop well. In the hospitality and tourism industry, chatbots are used for travel planning, booking, customer service, and providing recommendations and advice related to tourism travel issues (Pillai & Sivathanu, 2020). Chatbots help travel and tourism service providers to serve customers non-stop, 24 hours a day (Bowen & Morosan, 2018).

ChatBots offer convenience in tourism activities, providing tourists with offers for hotels, restaurants, and other activities with the best choices and customizable prices (Nama et al., 2021). The ChatBot concept provides one-on-one interaction with humans (Zahour et al., 2020) (Ukpabi et al., 2019), which is achieved through chat-based communication, such as questions and answers, or sharing information with tourists, with the aim of solving individual tourist problems. The development of tourism does not only depend on the number of places tourism, beauty, naturalness and unique culture and traditions of the people in tourist area. However, human resources, management systems, and information is a very important domain in tourism development in an area. Quality human resources, good management well, as well as accurate and easily accessible tourism information will be able to develop tourism potential much better. The results will provide positive impact on increasing community welfare and regional income.

The creation of this ChatBot aims to answer tourists' questions related to travel and tourism (Kim et al., 2022). Typically, tourists ask for general information, such as addresses, ticket prices, accommodations, transportation, and available facilities (Rafiq et al., 2022). Therefore, to comprehend the intended question, the ChatBot needs to recognize the specific intent and context of the question. By understanding the context of the traveler's inquiry, the ChatBot can provide an appropriate response (Albrecht et al., 2022). The ChatBot application is built on the Telegram Messenger platform. The main advantage of using Telegram Messenger is that there is no need to build a chat application interface. Additionally, the Telegram Messenger platform offers high levels of security and fast access (Makhortykh et al., 2022)(Schlette et al., 2022) . It also features an ever-evolving Bot API that makes it easy to exchange data across platforms (Schlette et al., 2022). A Telegram Bot is

a third-party application that can run inside Telegram, enabling users to send messages, requests for information, and receive rules and information (Sarker et al., 2022).

The ChatBot application works by collecting information from various websites based on the keywords searched by tourists. The system uses web scraping techniques to collect semi-structured documents from the internet (Muehlethaler & Albert, 2021). The documents are extracted to obtain specific data from certain websites. Web scraping enables the retrieval of more focused and easily obtainable data (Hajikhani et al., 2022) (Knuth et al., 1977). Moreover, the data collected through web scraping is extensive and random and requires further processing to convert it into specific information. Thus, string matching plays a vital role in information retrieval at this stage. One of the string-matching techniques utilized in this ChatBot system is the Knuth-Morris-Pratt (KMP) algorithm (Rafiq et al., 2022) (Rexie et al., 2022).

The KMP algorithm works by matching patterns per character from left to right one by one until one of the conditions is met (Yin & Shi, 2022). That is why the KMP algorithm is highly compatible with all types of string searches. The KMP search technique has been used in many applications because it can minimize computation time, especially in big data (Faid et al., 2021). Constructing this ChatBot has facilitated users in accessing travel and tourism information in Indonesia rapidly, precisely, and efficiently. The ChatBot applies web scraping techniques for searching and collecting data from the internet. Moreover, the KMP algorithm is used to process the data to obtain specific information, which is crucial in determining the most appropriate answer to the user's question. The goal is to make it easier for tourists to obtain information related to transportation and accommodation at tourist attractions.

Method

In the process to develop an application, the study used a waterfall research method (SDLC). Waterfall is a method for designing applications that already has framework containing the stages carried out to develop software. The stages of the waterfall method can be seen in Figure 1.

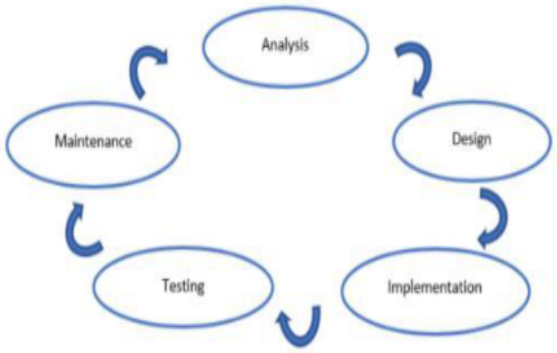

Figure 1. Stage of SDLC Method
Source: (Cahya et al., 2021)

Analysis stage carried out an analysis of the structure and flow of the fault one tourism service website in North Sumatra, then researchers trying to develop it into an application for tourism in North Sumatra. Researchers collect data for development this chatbot application in several ways as follows; (1) Conduct a literature study by collecting similar case studies. (2) Make direct observations with one of the tourist information chatbot car applications that have been downloaded via Playstore. (3) Conduct an interview with one of the tourism service owners at North Sumatra. After the researcher has succeeded in collecting the necessary related data, the next step is to process the data and classify the types of tourism data and types of culinary data.

After the data has been classified, the data will be tidied up and reformatted for further processing. Design stage creates the process and appearance of the application features that need to be displayed based on the analysis and data collection in the previous stage. Implementation stage carries out the coding process according to the design that was created in the previous stage, namely the design stage. Testing stage the results of the application that has been coded, whether there are still errors or results that are not as they should be. Maintenance stage the application can run well and is in accordance with its function and the researcher has published the designed application, but the researcher continues to carry out maintenance on the application and pay attention to responses and problems that may be found by other users. In develop this study, design is

required, namely a general description of the design of each display contained in the system being developed. The part in design on the chatbot, namely:

System Overview

The system overview aims to provide a physical layout of the system by displaying the software parts that run on the hardware system. Fig. 2 provides an overview of the Telegram ChatBot designed to provide travel and tourism information. Users can access the Telegram ChatBot using different hardware devices, such as mobile phones, laptops, and tablets (Barthelmäs et al., 2021). Users send their questions through the hardware, and the Telegram server receives the message and forwards it via the Telegram API to the Bot Server. The Bot Server is the hardware equipped with web scraping and KMP algorithms that serve the users. The PHP-based Bot Server receives the message forwarded from the Telegram API and processes it on the python side for natural language processing (NLP). The python side performs NLP to obtain the results, which are forwarded back to the user/client as a response (answer to the question).

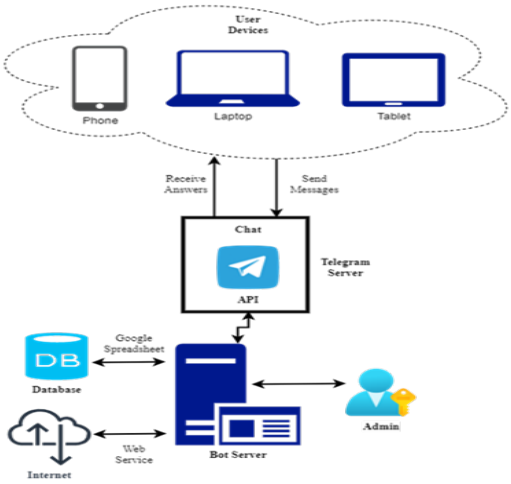

Figure 2. System overview

Web Scraping

Web scraping is a method of retrieving data and information from websites on the internet based on keywords or user questions. The general architecture of the web scraping system, as shown in Fig. 3, involves retrieving data from the internet through the scraping process. The data generated from the scraping process is then saved to a Google Spreadsheet.

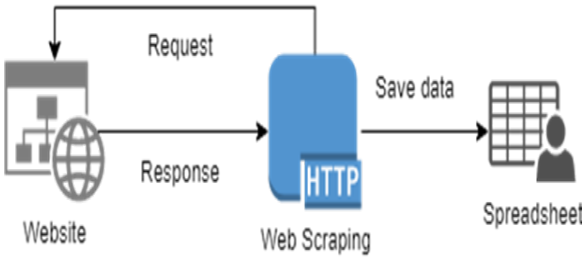

Figure 3. Overview of web scraping

Telegram Messenger

Telegram is one of the most widely used chat or messaging platforms in the world (Kulik & Sofronov, 2022). It offers an instant chat platform and an application programming interface (API) service that developers can use for various needs, such as creating a chatbot. The Bot Telegram API is an API released by Telegram that enables the connection between the Bot and the Telegram system. To use the Telegram API, we must create a chatbot account through Telegram. This account can be created via the @botfather account (https://telegram.me/BotFather) (Kulik & Sofronov, 2022). Upon creation, we receive a token that can be used to access the Telegram API.

Fig. 4 illustrates the interaction between the chatbot and the user. The overview of the Telegram bot consists of three parts: The Bot interface, the Bot API, and the Bot backend. The Telegram bot interface acts as a user interface, which is the Telegram application itself, whereas the Telegram bot API links the backend program

and the Telegram bot interface. The Telegram Bot API resides on the Telegram server, while the backend is installed on the researcher's server.

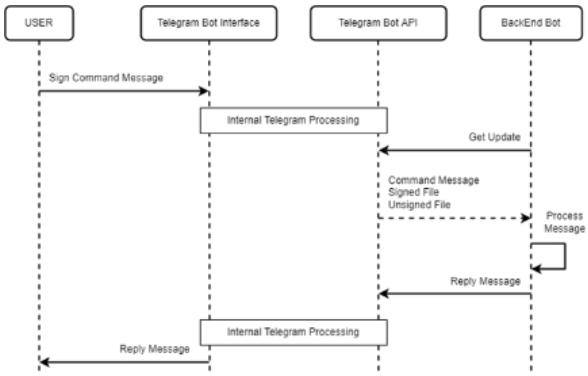

Figure 4. Telegram bot API

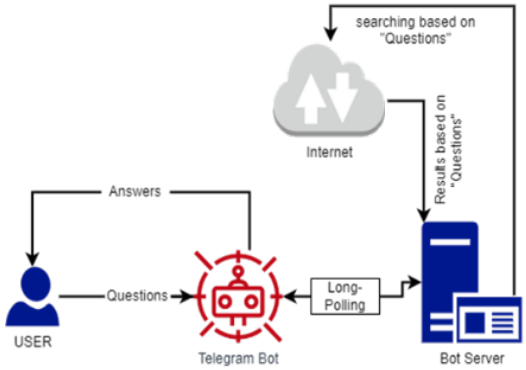

Figure 5. Illustration of the long-polling method

In this chatbot, the long-polling method is utilized. Long-polling is one of the methods used to obtain updates on Telegram bots (Manikandan & Ramyachitra, 2018) where the server waits for the requested data to be available with loops or sleep. The server continuously opens a connection to receive data. With the long-polling method, the server will periodically check whether there are incoming messages with the Telegram bot. If there is an incoming message, the server will execute based on the request message sent by the user. The long-polling method requires a local computer to run and manage data exchange between applications through APIs. Fig. 5 illustrates a Telegram bot using the long-polling method.

Knuth-Morris-Pratt Algorithm

The time complexity of the KMP algorithm, which detects all occurrences of a pattern in a text of length m, is O (m+n). If the text is read from an external file, the KMP algorithm's internal memory requirements are only O (n) space. All O quantities are independent of the size of the alphabet space. Based on the pseudocode in Algorithm 1, the steps of the KMP method can be explained, as seen in Fig. 6. In the simulation process, the search is carried out from string 0 to string n. If the mismatch condition is up to string n, a fixed search is performed.

Algorithm 1 Pseudo-Code of The KMP Algorithm [41], [42]

```
j = 0;
for (i = 0; I < n; i++)
for (;;) {        // loop until break
    if (T[i] == P[j]) { // matches?
    J++;      // yes. Move on to text state
    If (j == m) { // may be that was the last state
        Found a match;
        J = overlap [j];
    }
    break;
    } else if (j == 0) break; // no match in state j=0 give up
    Else j = overlap [j]; // try shorter pertial match
}
```

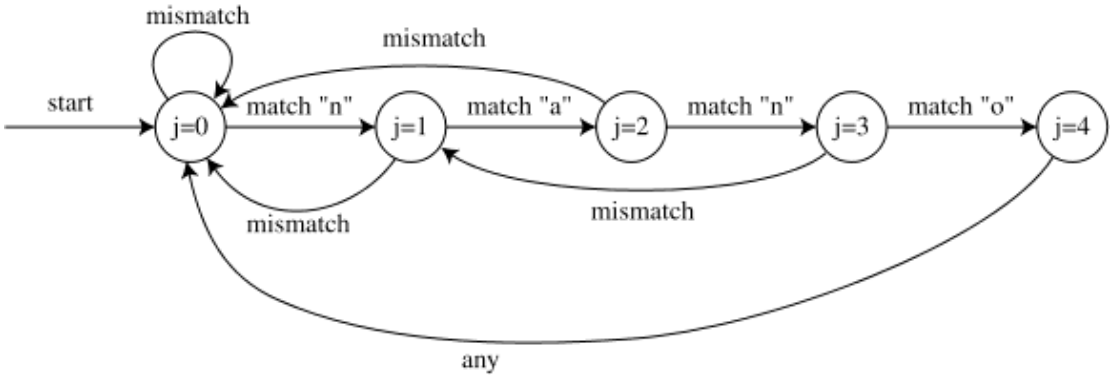

Figure 6. KMP and finite automata algorithms
Source: *(Borsci et al., 2023)*

Usability Testing

SystemUsability Scale (SUS) is a standardized tool that assesses and compares user satisfaction with chatbots to support the development of usable conversational systems (Rafiq et al., 2022) (Rexie et al., 2022). Usability testing is utilized to determine the system's usefulness for users. The user is then involved in responding to the system, and recommendations for improvements are produced. This research employs the SUS to measure the usability of the ChatBot. SUS is a quick measurement tool used to determine the users' perception of the usefulness of the built ChatBot system (Yin & Shi, 2022). SUS has been proven to be a straightforward and reliable tool for conducting usability evaluations and comparing systems. SUS scores range from 0 to 100, with acceptance ratings described in Figure 7.

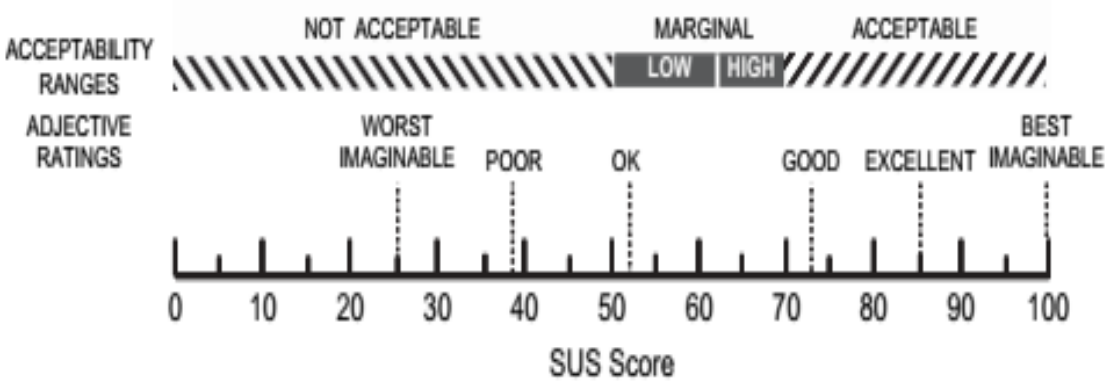

Figure 7. A comparison of mean SUS
Source: *(Kamińska et al., 2022)*

According to Fig. 7, products that users can use well should have SUS scores above 70. Products with scores of 70 to above 80 are considered better, while truly superior products have scores above 90. Products that score less than 70 should be considered candidates for continuous monitoring and improvement and cannot yet be widely used by users. SUS is composed of ten questions, presented in Table I (Barthelmäs et al., 2021) (Kulik & Sofronov, 2022). Responses are scored on a scale of 1 to 5. For questions 1, 3, 5, 7, and 9, the contribution score equals the chosen scale value minus 1. For questions 2, 4, 6, 8, and 10, the contribution score equals 5 minus the chosen scale value. Then, the contribution score is multiplied by 2.5 to obtain the overall value of system usability. The SUS calculation is shown in Equation 1.

$$SUS\ Score = \begin{pmatrix} (R1-1)+(5-R2)+ \\ (R3-1)+(5-R4)+ \\ (R5-1)+(5-R6)+ \\ (R7-1)+(5-R8)+ \\ (R9-1)+(5-R10) \end{pmatrix} * 2.5 \square$$

Source: *(Pham & Nugroho, 2022)*

Table 1. System Usability Scale Question Items

Code	Question Item
R1	I think that I would like to use this ChatBot frequently
R2	I found the ChatBot unnecessarily complex
R3	I thought the ChatBot was easy to use
R4	I think that I would need the support of a technical person to be able to use this ChatBot
R5	I found the various functions in this ChatBot were well integrated
R6	I thought there was too much inconsistency in this ChatBot
R7	I would imagine that most people would learn to use this ChatBot very quickly
R8	I found this ChatBot very complicated to navigate
R9	I felt very confident using this ChatBot
R10	I needed to learn many things before I could explore this ChatBot well

Results and Discussions

Telegram Bot Account Creation

Initially, it is necessary to create an appropriate bot account to obtain the name and API of the bot account. The creation request is made through the Botfather account on Telegram Messenger, which is the official bot account from Telegram that manages all the bots created. To find the Botfather account, users can use the search field and type @Botfather. The original Botfather account has a blue tick. Figure 8 shows a screenshot of the original Botfather account.

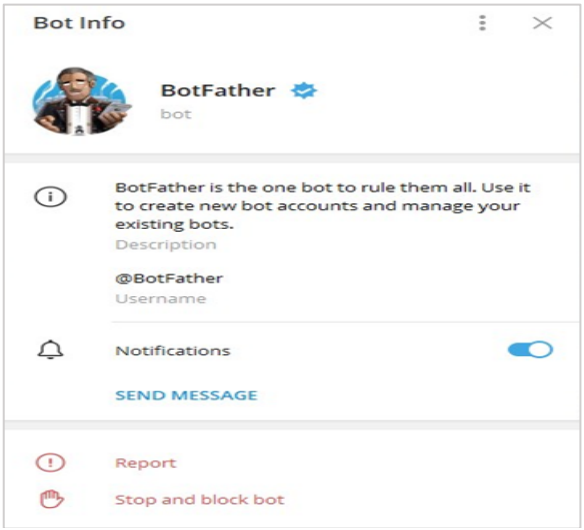

Figure 8. Telegram view of @BotFather account

Next, select "/start" in BotFather or type it into Telegram. The next step is to create a new Bot, as shown in Figure 9, by sending the message "/newbot" and filling in the Bot's name and username. In this ChatBot system, the given username is "ParaSumutBot". After creating the Bot, the system will provide a token to access the HTTP API. The token provided by BotFather, shown in Figure 9, is used to program the Bot (token censored).

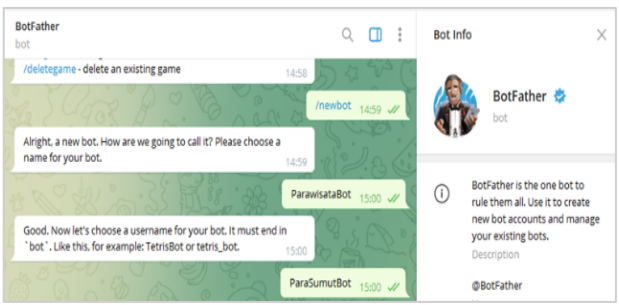

Figure 9. Creating a new bot with BotFather

Long-Polling Method

After creating a bot account in Telegram Messenger, the next step is to implement the Long Polling communication method to receive updates from the Telegram Bot API. The implementation of the Long-Polling method can be seen in the program snippet shown in Figure 10.

```php
include("token.php");

function request_url($method){
    global $TOKEN;
    return "https://api.telegram.org/bot" . $TOKEN . "/". $method;
}

function get_updates($offset) {
    $url = request_url("getUpdates")."?offset=".$offset;
    $resp = file_get_contents($url);
    $result = json_decode($resp, true);
    if ($result["ok"]==1)
    return $result["result"];
    return array();
}

function process_one(){
    $update_id  = 0;

    if (file_exists("last_update_id")) {
        $update_id = (int)file_get_contents("last_update_id");
        echo '-';
    }
    $updates = get_updates($update_id);
    foreach ($updates as $message){
        $update_id = process_message($message);
        echo '+';
    }
    file_put_contents("last_update_id", $update_id + 1);
}

while (true) {
    process_one();

}
```

Figure 10. Long-polling method program snippet

Telegram ChatBot Implementation

Implementation of Graphic User Interface (GUI) using Python integrated with the Telegram instant messaging application to provide tourism information service. To access this ChatBot, users must have an account on the Telegram application and search for the ChatBot's account ID. In this ChatBot, the ID is @ParaSumutBot. The appearance of the tourism information ChatBot can be seen in Figure 11.

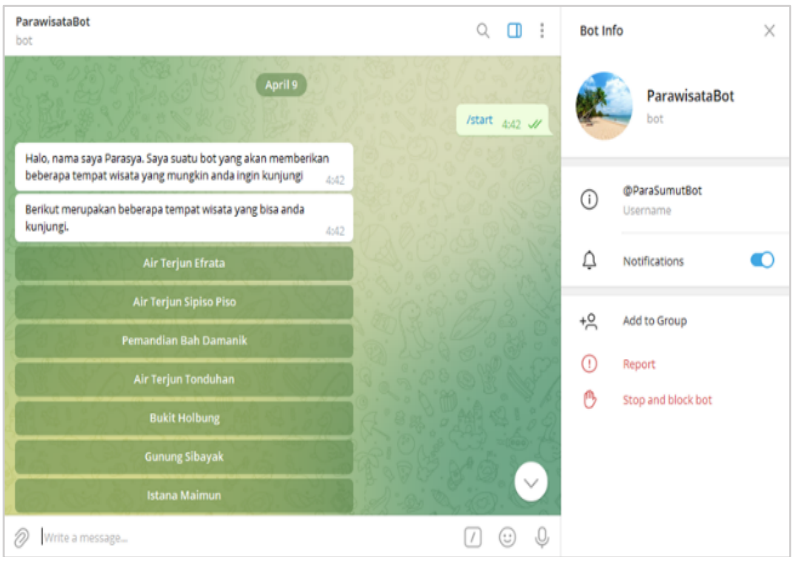

Figure 11. Starting the bot by typing "/start"

To initiate a conversation with the ChatBot, users need to type "/start". The ChatBot will respond with a welcome message, indicating that the user is now connected to the ChatBot, as shown in Figure 11. Users can interact with the ChatBot by entering questions or selecting options provided. For instance, if the user selects "Air Terjun Sipiso Piso," the system performs the text preprocessing stage. The KMP algorithm is used to match the sentence "Air Terjun Sipiso Piso" with the stored data. Then, the system searches for the answer by utilizing web scraping techniques and saves the results in the database. Information about "Air Terjun Sipiso Piso," such as names, photos, descriptions, and tourist attractions, is stored in Google Sheets. As part of the ChatBot system, the KMP algorithm is utilized to extract keywords from information related to "Air Terjun Sipiso Piso". These keywords are then used to query the Google Sheets database for relevant user inquiries about the waterfall. Once a suitable response is identified using the database query rules, the ChatBot displays the answer to the user. If

the user wishes to return to the main menu of tourism information, they can select the [Return to Menu] option, as illustrated in Figure 12.

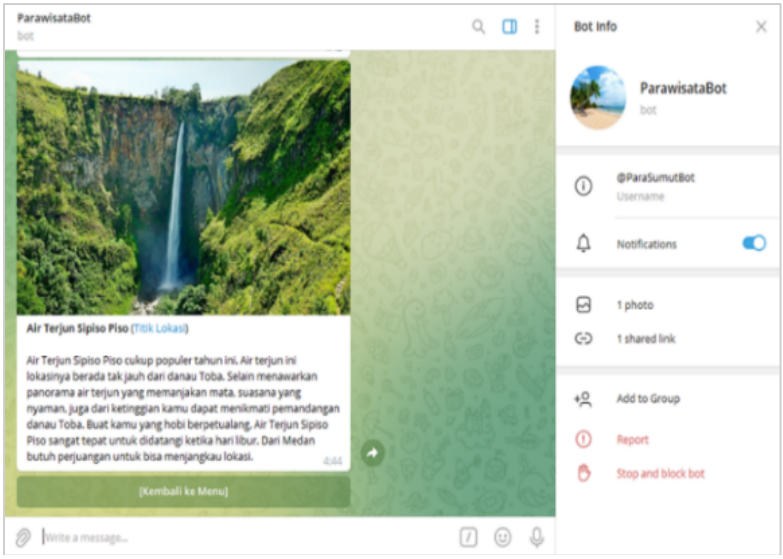

Figure 12. ChatBot displays the result of air terjun sipiso piso.

System Usability Scale Score

Within a week, users utilized the ChatBot application for tourism purposes. They were subsequently asked to complete a questionnaire regarding their experience with the ChatBot. The questionnaire, consisting of 10 questions, was anonymously completed by 20 users. The SUS scores for each respondent are summarized in Table 2 for calculation.

Table 2. SUS Questionnaire Results

Respondent	R1	R2	R3	R4	R5	R6	R7	R8	R9	R9	R10	SUS Score
1	5	1	5	3	5	1	4	1	4	5	5	80
2	4	2	5	4	5	1	5	1	5	1	4	87.5
3	2	2	4	3	4	2	5	1	5	2	2	75
4	4	3	4	2	4	2	4	2	3	4	4	65
5	4	1	5	2	5	1	5	1	5	1	4	95
6	5	4	4	5	5	2	5	2	5	2	5	72.5
7	4	3	4	1	5	2	5	1	4	4	4	77.5
8	5	5	5	4	5	2	3	2	3	4	5	60
9	5	1	5	1	5	1	5	2	3	1	5	92.5
10	3	1	4	4	1	4	3	3	4	2	3	52.5
11	4	3	5	2	3	1	5	1	5	3	4	80
12	5	3	1	2	4	1	3	5	5	4	5	57.5
13	4	2	3	5	3	5	2	1	3	1	4	52.5
14	5	5	4	2	3	2	3	1	4	1	5	70
15	5	4	3	1	4	3	1	2	3	5	5	52.5
16	4	1	5	4	4	1	5	4	3	1	4	75
17	4	2	5	3	4	2	4	2	4	3	4	72.5
18	4	5	4	1	3	1	2	1	3	2	4	65
19	5	1	2	3	2	1	2	1	4	1	5	70
20	3	1	4	2	4	5	4	3	4	1	3	67.5
Average SUS Score												

The calculation results show that the average SUS score is 71, indicating that the built system is in the suitable category and feasible to use. The value of 71 falls within the acceptable range according to the acceptability range comparison described, which means that this ChatBot is feasible for use.

Conclusions

This paper presents the application of a ChatBot for the tourism industry, which can assist users in providing information related to tourism activities, such as hotels or inns, restaurants, transportation, and other facilities. Additionally, the ChatBot can operate 24/7 without interruption. The ChatBot was built based on the Telegram Messenger application due to its high level of security, fast access, and Bot API. The system uses the KMP algorithm to search strings and web scraping to retrieve website information. Web scraping collects data from the internet based on user search keywords, and the acquired information is stored in the database. The KMP algorithm matches the characters entered by the user with the characters in the database, based on the shift value. A total of 20 users tested the ChatBot by asking random questions related to tourism, particularly in Indonesia. Based on the trials conducted on the ChatBot, users asked 219 questions. The ChatBot was able to answer 195 questions correctly, and 24 questions were incorrect or inappropriate. From these results, it was determined that 89% of the questions were answered correctly, and 11% were answered incorrectly.

To test and measure the ChatBot's usability, the system usability scale (SUS) was used involving 20 users as respondents. SUS testing yielded a score of 71, which indicates that the ChatBot is acceptable. Thus, it can be concluded that the KMP algorithm and web scraping method can help answer questions automatically with answers that are relevant to user expectations. Quality human resources, good management, and accurate and easily accessible tourism information will be able to develop tourism potential much better. For further researchers hopes, this study is expected to add a voice recognition feature, so that input from users can be more varied, and the chatbot can provide more interaction to users. To make it more practical, future researchers can develop a system in the form of a mobile application.

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