Intelligent Human-Computer Interaction in Innovative Al Solutions in Travel and Its Impact on the E-Society*

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Abstract

The use of artificial intelligence to revolutionize travel and tourism has sparked significant interest in recent years. A chatbot, a computer program that mimics human responses and can understand and communicate in multiple languages through Natural Language Processing, is a prime example of intelligent Human-Computer Interaction. Our system, a web application with a backend housing a centralized knowledge database and a GUI front end accessible via the Internet, is uniquely designed to elevate virtual sightseeing experiences in the tourism industry. The growing preference for chatbot interactions over traditional methods is a testament to their potential to be as effective as humans, if not more.

Keywords

AI, chatbot, Natural Language Processing, virtual guide, E-Society, Human-Computer Interaction

1. Introduction

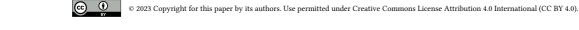
Artificial intelligence (AI) is becoming increasingly important in our daily lives, as it enhances our everyday activities, such as finding the quickest route to work. A chatbot, a typical example of an artificial intelligence system, is one of the most basic and widely used examples of intelligent Human-Computer Interaction (HCI). A computer program interacts almost like a human, enabling communication through text or voice and understanding one or more human languages through Natural Language Processing (NLP) [1]. The system can improve over time by adding more data through a machine-learning architecture. What's truly remarkable about chatbots is their adaptability. They can be used in various aspects of life, serving as personal assistants on mobile devices, providing technical support, and even for online sales. By September 2016, Facebook Messenger had 30,000 chatbots [3] on its platform, and by 2018, there were over 300,000 active bots, which indicates the increasing popularity and versatility of chatbots [4]. Google is also developing AI-powered personal assistants that could help users book or reserve services via telephone. This system will communicate with a human clerk or receptionist to assist the user in completing a booking or reservation task, just like a human assistant would.

Due to the worldwide pandemic crisis, traveling has become less comfortable. Statistics show that with increasing virus infections, the number of people traveling has dropped rapidly [5].

This paper will focus on creating a chatbot to provide a virtual tour guide for sightseeing in Lodz city. The number of tourists was approximately halved in 2020 compared to 2019 [6]. We aim to help people explore Lodz from home using a chatbot as a tour guide, enabling them to experience the city from their homes.

Solutions using artificial intelligence already exist to assist with travel and tourism. These solutions help people choose destinations and activities and automate processes such as buying tickets. However, we are aiming for a different solution. We came across an article where someone discussed an application that allows users to find attractions, read information about them, and plan

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travel routes between them. Our system is designed to provide a sightseeing experience with a chatbot virtual assistant that acts as a tourist guide instead of just helping users choose a destination and travel to it. We selected Lodz as our focus because it is a city dear to our hearts, and we want to conveniently showcase its true beauty to people. In 2017, Lodz became part of the UNESCO Creative Cities Network as the City of Film, thanks to its renowned Lodz Film School. The city's tourism organization describes it as a place of contrasts that captivates at every turn. It is characterized by its numerous factories, yet it is also very green and diverse, with a touch of avant-garde. Lodz impresses with its abundance of palaces belonging to former factory owners and surprises with its artistic installations. There are many free-to-visit places in Lodz listed on a single online portal, further solidifying the city as our top choice. In our project, we can include all of them and train AI to suggest one of these places when someone asks about free-to-see attractions.

2. Model

Our sightseeing chatbot system is composed of five main components:

- 1. Natural Language Understanding (NLU) responsible for understanding the user's intent
- 2. Dialog Manager (DM) responsible for maintaining the dialog state and accessing a knowledge database
- 3. Database (DB) stores information about attractions in Lodz
- 4. Natural Language Generation (NLG) generates output for the user based on the data provided by the DM
- 5. Chat a text interface between the user and the chatbot, used to receive commands and display chatbot responses.

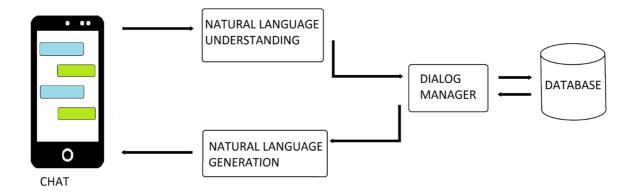


Figure 1: Components Diagram of chatbot model

The application will extract information from user messages using natural language processing, which consists of five phases. Each phase will be handled by a specific module part [12]. First, the Lexical Analyzer will divide the text received from the user into sentences and words. The Syntactic Analyzer will carry out the second phase, which will analyze the relationships among words. Next, the Semantic Analyzer will focus on the literal meaning of phrases, sentences, and words. Finally, the program will determine the users' intentions and what they want to see, and this information will be sent to the next application module.

2.1. Natural Language Understanding module

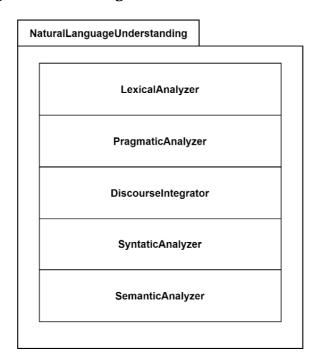
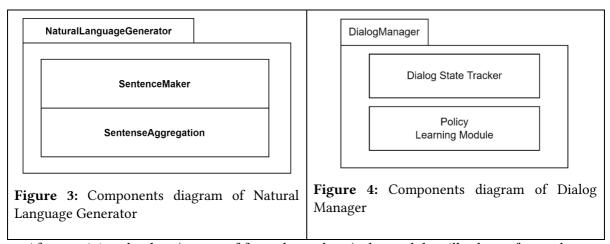


Figure 2: Components diagram of the Natural Language Understanding module

2.2. Natural Language Generator module



After receiving the data (groups of facts about places), the module will select a few and create sentences that are understandable for the recipient. We need to design AI for each part of this module. The first AI will be responsible for creating sentences from groups of facts concerning city attractions or simply responding to another form of user message. The second AI should create a logically correct paragraph from single sentences and send it to the GUI as a message.

2.3. Dialog Manager

The Dialog Manager (DM) is responsible for managing the flow of the conversation with the user. It consists of two trainable subcomponents: the Dialog State Tracer and the Policy Learning Module [13].

The Dialog State Tracker is in charge of creating a dependable snapshot of the conversation's current state. This snapshot forms the foundation for all system actions. It records the history of user inputs, system actions, and database query results. Additionally, it generates a vector based on a feature extracted from the current dialogue state. The Policy Learning module then utilizes this vector.

The Policy Learning Module chooses specific system actions to help the user reach their goal in the fewest steps. This module receives a new state (embedding vector) from the Dialog State Tracker and then performs a new action using implemented Deep Q-Networks [14].

2.4. Database

Literature also serves as a knowledge database. Initially, it may seem like a primary database containing information about sightseeing locations, history, and photos of Lodz. However, upon closer examination, additional contextual information about these places is necessary. Users may inquire about locations near the center of Lodz, requiring data about the surrounding neighborhoods. For instance, someone might request information about the most popular places, necessitating the inclusion of a popularity index.

3. Practical implementation and tests

Tests. Chatbot systems must behave as closely to humans as possible to make the conversation more pleasant for the user. Let us break an example conversation into pieces:





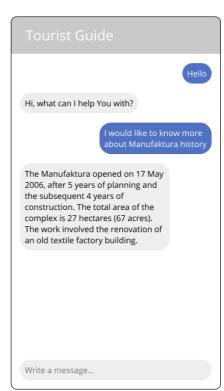


Figure 6: Chatbot's response to a user asking about Manufaktura

In this scenario, the user initiates the conversation with a greeting, which the Natural Language Understanding (NLU) component correctly identifies. The Dialog Manager then searches for the best response, and the Natural Language Generation (NLG) generates the appropriate greeting for the user. Next, when the user requests specific information (history) about a particular place (Manufaktura), the NLU identifies the intent. Subsequently, it provides the Dialog Manager with keywords such as "History" and "Manufaktura," the Dialog Manager queries the database for this information. The NLG then produces a response for the user.



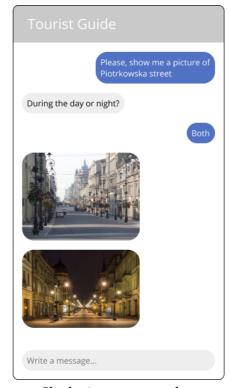


Figure 7: Chatbot's response to the user's continuing dialog and asking about Freedom Square

Figure 8: Chatbot's response to the user asking for photos of Piotrkowska Street

In this scenario, the user does not explicitly state their intent by saying, "Show me history." However, "and" suggests that this phrase refers to a previous user interaction. As a result, the Dialog Manager is responsible for tracking the dialog state. By doing so, the dialog manager replaces "Manufaktura" in the previous database query with "Freedom Square." The chatbot determines the user's intent by asking a question [15]. Thanks to the Dialog Manager system, it understands the user's meaning by typing "Both" and provides the correct response.

3.1. Technologies Used

Our system is designed to work as a web application with a backend containing a centralized knowledge database and a GUI front end that can be accessed through the Internet. This approach allows for easier deployment and better control of the chatbot and the assets it serves.

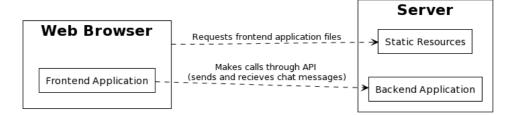


Figure 9: Simplified diagram of system architecture

We have chosen the Python programming language for the backend, as it is well-suited for working with artificial intelligence due to the availability of publicly supported libraries for data analysis and AI. The backend can receive user messages and send appropriate responses through the network. Deploying the backend to the cloud will make the API easily accessible online. We plan to use Google Cloud for this purpose. The front end's main tasks include displaying the conversation to users, accepting user input, and sending messages to the backend. We can create a React.js application to run in the user's web browser, or we may consider developing a mobile application. This application can be hosted as a static resource that is accessible online.

4. Conclusions

Our technology is designed to offer the best experience in virtual sightseeing. The growing number of users who prefer interacting with chatbots instead of traditional communication methods shows that they can be as effective as humans. With the advancements in AI and machine learning, it is becoming increasingly difficult to distinguish between a chatbot and a conversation with a human. The project aimed to develop an application that would act as a virtual tourist guide, providing information to the user based on received questions. Machine learning will enhance the accuracy of the information provided over time, thus improving the overall experience.

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