

BERT-Based Chatbot for Wikifes Promoting Tourism in Fes through Digital Communication

Rachid ED-DAOUDI¹, Tayeb AISSAOUI²

¹Doctor of Commuter Sciences and Artificial Intelligence, Marrakech-Morocco

²Doctor of Information and Communication Sciences and Content Analysis, Marrakech-Morocco

Email address: ¹eddaoudirachid88@gmail.com, ²Aissaoui.ta@gmail.com

Abstract— This paper outlines the development and evaluation of an AI chatbot integrated into the Wikifes website to promote tourism in Fes, Morocco. Using BERT for Natural Language Processing and a Deep Q-Network for dialogue management, the chatbot provides real-time, personalized responses to user queries about Fes’s landmarks, events, and attractions. Test results showed a response accuracy of 92% and positive user engagement, with an average of 3-5 interactions per session. While users appreciated the chatbot’s personalized recommendations, challenges with handling complex queries were identified, pointing to areas for future optimization. The paper concludes with suggestions for improving the chatbot’s knowledge base, dialogue management, and language support to further enhance its effectiveness in promoting tourism.

Keywords— AI chatbot; BERT; Dialogue management; Tourism promotion; Natural Language Processing; Digital communication.

I. INTRODUCTION

The city of Fes, renowned for its rich cultural heritage, historical significance, and vibrant tourism scene, has long been a key destination for visitors seeking to explore the heart of Moroccan history. In recent years, the rise of digital communication tools has significantly transformed how tourism information is accessed and disseminated. Digital platforms such as websites and social media have become essential for promoting tourist destinations and engaging with potential visitors. Among these tools, Artificial Intelligence (AI) chatbots have emerged as a revolutionary means of enhancing digital communication by providing real-time, personalized interaction between users and tourism services [1].

Chatbots, leveraging Natural Language Processing (NLP) and machine learning technologies, are increasingly used in various industries to improve customer service, automate responses, and offer personalized recommendations. In the tourism industry, chatbots can play a critical role in enhancing visitor experience by providing instant access to information about local attractions, accommodations, events, and services. This is particularly important for destinations like Fes, where tourists often seek detailed and real-time information on historical sites, cultural events, and local amenities [2].

The development of a chatbot for the Wikifes website [3] aims to leverage these capabilities to promote tourism in Fes by offering an AI solution that can respond to tourists inquiries, recommend attractions, and facilitate deeper engagement with the city’s rich history. By integrating advanced AI techniques, the chatbot is designed to improve user interaction on the platform and support Fes's digital tourism strategy. [4].

The rest of the paper explores relevant research on AI chatbots, particularly their role in digital communication. It outlines the process of designing and developing the chatbot for the Wikifes website, focusing on the use of AI technologies. The results are discussed in terms of the chatbot’s effectiveness in promoting tourism and enhancing user engagement, followed by concluding suggestions for future improvements.

II. BACKGROUND AND RELATED WORKS

A. How Chatbots Have Revolutionized Digital Communication Across Sectors

Chatbots are intelligent conversational software systems designed to mimic human speech in order to provide automated online guidance and support. Chatbots appear to be more engaging to the user than the static Frequently Asked Questions (FAQ) page of a website [5].

The use of chatbots has grown significantly, with one of the most impactful applications being intelligent personal assistants. Virtual assistants like Microsoft’s Cortana, Google Assistant, Apple’s Siri, Amazon’s Alexa, IBM’s Watson, and ChatGPT enable users to perform tasks such as setting reminders, controlling smart devices, and retrieving information through voice commands or text. These assistants enhance convenience and provide seamless interactions between users and technology [6]. Figure 1 provides a timeline and categorization of the evolution of chatbots and conversational agents, from basic chatbots to advanced generative AI chatbots.



Fig. 1. Evolution of chatbots from ELIZA to Bard
Source: www.techtarget.com

For instance, in retail, companies like Tudespena.com have developed chatbots to assist customers with online grocery shopping through platforms like Facebook Messenger. Their chatbot, TiDi, offers features such as product catalog browsing, delivery schedule tracking, and real-time order updates, streamlining the user experience [7]. Similarly, the cinema chain Cinépolis has launched a chatbot named Robin to facilitate ticket purchases, movie trailer previews, and seat selection, making the movie-going experience more efficient and personalized.

In the financial sector, ImaginBank, a mobile bank targeting millennials, created a chatbot to help users select the best financial offers. The chatbot provides assistance through text or voice, guiding users through personalized banking options. Health-related chatbots, such as Health Tap and Humana Brain, offer medical consultations and patient monitoring services. Health Tap, for example, allows users to input symptoms and receive potential diagnoses or consult with live doctors through a chatbot interface. Humana Brain assists with medication reminders and chronic patient monitoring, NLP to communicate with users and provide healthcare insights [8].

Entertainment platforms have also adopted chatbots. For example, the chatbot for the mobile game Pokémon Go helps players locate nearby Pokémon, while others like Hello Jarvis provide notifications based on user preferences. Additionally, the media industry has seen chatbots become integral to real-time news updates. Platforms like CNN and Politibot use chatbots to deliver daily news summaries or provide interactive political analyses, giving users easy access to relevant information on demand.

The education sector also benefits from chatbots, using them for administrative support and learning enhancement. Universities, such as Georgia State University, use chatbots to assist with course information, registration, and financial aid, significantly reducing student dropout rates.

Moreover, tourism businesses such as hotels, tour operators, and local attractions have begun to embrace chatbots as essential tools for both engagement and promotion. Chatbots can act as virtual tour guides, offering instant information about the best attractions, dining spots, and events available in a city or region. Many tourism platforms now rely on AI chatbots to assist travelers in multiple ways. For example, airlines and travel agencies use chatbots to help customers book flights, track their reservations, and receive updates about their journeys. KLM Royal Dutch Airlines has introduced a chatbot that allows customers to get tickets, check flight status and receive travel vouchers via Facebook Messenger. Similarly, travel agencies like Expedia use chatbots to assist with booking hotels, flights, and car rentals, offering users a seamless and interactive travel planning experience [9].

In destination-specific tourism, chatbots have been designed to offer localized information. The "Visit Dubai" chatbot, for instance, helps tourists discover the best places to visit, events, and activities by answering questions and providing personalized recommendations based on user preferences. Chatbots like this play a crucial role in enriching the visitor experience by offering real-time, accurate information, and helping tourists plan their trips with ease. For cities like Fes,

where history and culture are key attractions, such chatbots can serve as virtual guides, offering insights into local landmarks, cultural heritage, and special events [10]. By interacting with potential tourists on platforms like social media, websites, and travel apps, chatbots can guide users through the booking process, provide recommendations for lodging, dining, and sightseeing, and even offer personalized travel itineraries.

These examples highlight the widespread application of chatbots across various industries, showcasing their ability to improve customer experiences by offering timely and relevant services. The tourism industry is no exception, with chatbots being used to enhance the overall travel experience by providing personalized recommendations, real-time assistance, and interactive engagement with tourist

B. The benefits of using chatbots

Chatbots have become essential tools for businesses looking to improve customer service and streamline operations. With AI, these virtual assistants offer numerous benefits in terms of business efficiency and customer satisfaction. Below are key advantages of using chatbots across industries:

- Multiple customer interactions are performed simultaneously, eliminating waiting time and improving business efficiency.
- Costs reduced compared to hiring additional staff or developing complex apps, while minimizing human error.
- Repetitive tasks automated, freeing up employees for more important duties and reducing customer wait times.
- Conversations initiated, users guided through websites, and tailored assistance provided to improve customer experience.
- Valuable feedback and data collected from interactions, optimizing services, enhancing marketing efforts, and understanding consumer behavior.
- Instant, interactive responses offered, enhancing engagement across platforms, including social media, for easier customer connections.
- Multilingual communication enabled, allowing businesses to cater to a global audience and remove language barriers.
- Round-the-clock access to services provided, supporting customers across time zones without interruptions.

C. AI and NLP in Enhancing Chatbot Interactions

AI and NLP are playing a pivotal role in transforming chatbot technology, significantly improving the way these systems interact with users. By utilizing these techniques, chatbots can now understand and process natural language more effectively, thereby offering more human-like interactions.

Figure 2 explains the architecture of a chatbot, and shows the flow of data across different layers.

According to Satheesh and Samala (2020), AI-induced chatbots improve customer interaction by applying speech recognition and NLP technologies, enabling the chatbot to handle even complex queries. This application has proven particularly beneficial in customer service sectors, such as banking, where AI-powered chatbots reduce the response time and enhance the overall user experience [11].

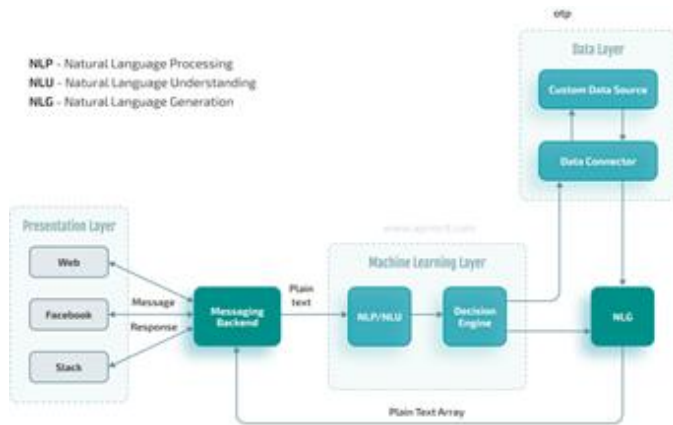


Fig. 2. AI-based chatbot matrix
Source: www.apriorit.com

Furthermore, AI and NLP are revolutionizing marketing strategies, particularly for small and medium-sized enterprises (SMEs). Kedi et al. (2024) describe how AI chatbots have evolved from simple, rule-based systems to more sophisticated platforms. Initially, chatbots were limited to simple, rule-based transactions that could only handle basic searches. However, modern AI chatbots utilize advanced NLP and machine learning algorithms to support complex and personalized customer interactions. This allows businesses to improve service efficiency while offering tailored experiences to their clients [12].

In the field of education, AI chatbots are also being enhanced through advanced NLP technologies. [3] notes that the use of NLP platforms, such as Wit.ai, can improve chatbot semantics, thereby increasing clarity in communication. As Qaffas (2019) explains, using a new NLP platform referred to as Wit.ai improves chatbot semantics, minimizes ambiguity, and increases productivity by facilitating clearer interactions between students and the chatbot. These improvements are particularly important, as they help deliver more accurate and useful information to students [13].

The impact of AI chatbots in customer service is also noteworthy. Kaur et al. (2019) discuss how AI-enabled chatbots can significantly improve user interaction and satisfaction. The authors state that chatbots, particularly those powered by NLP, are capable of managing a wide range of customer queries effectively, reducing customer aggravation and enhancing service quality. This capability allows businesses to provide efficient and scalable customer support while improving the overall service experience [14].

Thus, the combination of AI and NLP is not only enhancing the functional capabilities of chatbots but is also improving user satisfaction across various domains.

III. METHODOLOGY

This section outlines the process of designing, developing, and testing the AI chatbot for the Wikifes website. The chatbot was designed with the primary goal of promoting tourism in Fes by offering real-time, accurate, and personalized information to potential tourists. The methodology is divided into several key phases: platform selection, chatbot design, data collection, AI training, and evaluation.

D. Wikifes platform: a digital space to promote tourism in Fes

The Wikifes website is a digital platform designed to promote Fes in Morocco, as a top tourist destination by providing comprehensive information about the city’s cultural heritage, historical landmarks, and local events. Fes, with its ancient medina, vibrant souks, and rich history, attracts visitors from around the world [15].

This digital encyclopedia is a significant step towards promoting Fes as a tourist destination, providing rich content that delves into the city's monuments, mosques, historical schools, and traditional hammams, all of which reflect the deep history of Fes.

Managed by a team of young Moroccans from this spiritual and cultural capital of Morocco, Wikifes is committed to providing a reliable resource for researchers and those passionate about the city's history. Their vision is to make the encyclopedia the primary digital destination for those interested in learning about the history of Morocco and Andalusia, given the close connection between Fes and the broader history of the country, as well as its long-standing ties with the northern Mediterranean. The platform strives to bridge generations by offering a comprehensive look at this rich history, connecting today's youth with their cultural heritage.

Through written and visual content, Wikifes provides a detailed overview of Fes’s historical legacy, making it a unique platform that targets tourists and researchers from all over the world.

In addition to its website, Wikifes actively promotes Fes as a tourist destination through its social media presence. On Instagram, the managing team posts engaging reels that showcase Fes's vibrant cultural events, stunning landmarks, and local craftsmanship, providing an immersive visual experience for potential tourists. On Facebook, Wikifes shares high-quality images of the city’s historical and architectural marvels, helping to bring its heritage to a global audience. Furthermore, the platform publishes in both Arabic and English, ensuring that its content reaches a diverse and international readership.

To enhance its digital communication efforts, Wikifes is integrating an AI chatbot into its platform. This chatbot will serve as a virtual assistant, offering real-time responses to user inquiries, personalized recommendations, and guidance on navigating the city. By improving tourist engagement through interactive digital tools, the chatbot aligns with the platform’s goal of making Fes more accessible and enhancing the overall visitor experience.

E. Chatbot Design

The design phase focused on creating a user-friendly chatbot capable of engaging users in natural conversations about Fes tourism. The chatbot was designed with the goal of providing tourists with a smooth and intuitive interaction. User flows were created to anticipate the most common inquiries from tourists, such as information about historical sites, local events, accommodations, and dining options.

F. Data Collection and Preprocessing

To develop the chatbot for the WikiFes platform, we sourced data from multiple resources focused on the history,

culture, and heritage of Fes. This process involved scraping content from WikiFes itself, along with additional open-source websites such as Wikipedia, Journey Beyond Travel, and African Sahara. The data gathered covered a range of topics, including Fes's architectural history, artisanal crafts, key landmarks, and cultural traditions.

The raw text from the scraped pages often contained unnecessary HTML tags, metadata, and irrelevant symbols. To ensure clean data for the model, the following preprocessing steps were applied:

- **HTML Tag Removal:** All HTML tags and associated elements were stripped from the text using parsing tools like BeautifulSoup to retain only the readable content.
- **Lowercasing:** The text was converted to lowercase to maintain uniformity and remove any case-related discrepancies.
- **Tokenization:** The cleaned text was split into individual words or phrases, a critical step for further NLP tasks such as entity recognition.
- **Stop-word Removal:** Common stop-words (e.g., "and", "the", "is") were filtered out, as they do not contribute meaningfully to the chatbot's response formulation.
- **Entity Recognition:** Key entities such as landmarks, historical figures, and cultural practices were identified and tagged using Named Entity Recognition (NER) methods to ensure accurate and relevant responses from the chatbot.

A sample of cleaned and preprocessed data gathered is presented in table 1. This table highlights how the structured dataset will serve as input for training the NLP model to generate relevant responses for the chatbot.

TABLE I. Sample of Preprocessed Data for Training

Context	Intent	Response	Entities
"fes is a hub of learning and religious scholarship."	History	"Al-Qarawiyyin University was founded in 859 by Fatima al-Fihri, making it one of the oldest existing, continually operating universities in the world."	Al-Qarawiyyin, Fatima al-Fihri, 859
"fes is famous for its artisanal leather production."	Culture and Crafts	"You can visit the Chouara Tannery in Fes, where leather tanning techniques have been used for centuries to produce high-quality goods."	Chouara Tannery, leather, Fes
"the medina of fes is home to many historic buildings."	Landmarks	"Medersa Bou Inania, built in the 14th century by Sultan Abu Inan Faris, is one of the few religious buildings in Morocco open to non-Muslims."	Medersa Bou Inania, Abu Inan Faris
"tourists visit the medina of fes all year long."	Tourism	"The best time to visit the Medina of Fes is during the spring or fall, when the weather is mild and allows for comfortable exploration of the city's vibrant markets."	Medina, spring, fall, Fes

G. AI Model Training

The core of the chatbot's functionality relied on AI models capable of understanding and processing natural language. The AI model training phase involved two key components:

- **Natural Language Processing:** The chatbot was trained using Bidirectional Encoder Representations from Transformers (BERT) to understand user inputs, identify relevant keywords, and match them to pre-defined intents. proposed approach utilizing BERT is presented in figure.

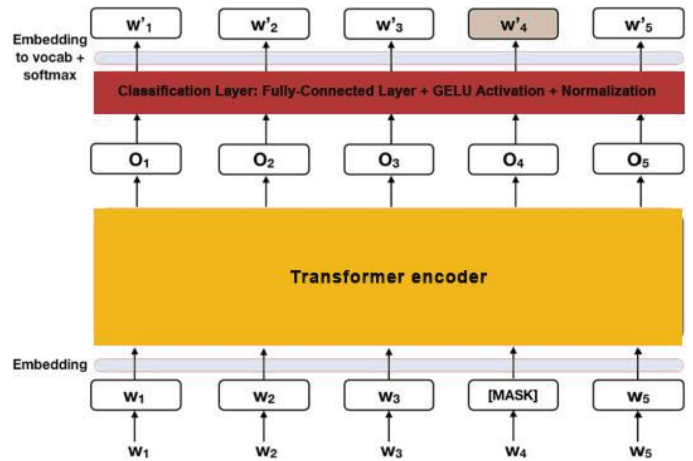


Fig. 3. General BERT framework.

BERT consists of multiple encoder layers, each with a multi-sensory self-aware algorithm and a feed-forward neural network [16]. Word, segment, and position embeddings are used to represent individual words, distinguish between text segments, and encode word positions in a sequence. Fine-tuning BERT for downstream NLP tasks such as text classification, entity recognition, or query response adapts the model to specific tasks. In chatbot applications, BERT tokenizes user queries into sub-word tokens, with the attention mechanism represented as:

$$Attention(Q, K, V) = Softmax\left(\frac{QK^T}{\sqrt{d_k}}\right)V$$

where Q, K, and V are the query, key, and value matrices, and \$d_k\$ is the dimension of the key vectors. Multi-head attention is expressed as:

$$MultiHead(Q, K, V) = Concat(head_1, \dots, head_2)W^0$$

Each head output is \$Attention(QW_iQ, KW_iK, VW_iV)\$. BERT's multi-layer Transformer encoders produce contextual embeddings, with the output from a single encoder layer given by:

$$H' = LayerNorm(H + MultiHead(H, H, H))$$

For dialogue response generation, a decoder takes the contextualized embeddings and produces token sequences. Fine-tuning BERT involves optimizing the model parameters on task-specific labeled data using cross-entropy loss:

$$Loss = - \sum_i Y_i \log(\hat{Y}_i)$$

with optimization done using Adam. This process updates BERT's parameters for the task while leveraging pre-trained knowledge.

- **Dialogue Management:** The chatbot uses a Deep Q-Network (DQN) reinforcement learning algorithm to manage conversation flow and optimize responses based on user interactions. Each conversation is modeled as a sequence of states (current context) and actions (possible responses), with the chatbot selecting the best response by maximizing the Q-value, which estimates the expected reward for each action [17]. The Q-value is updated using the Bellman equation:

$$Q(s_t a_t) = r_t + \gamma \max_{a_{t+1}} Q(s_{t+1}, a_{t+1})$$

The process in figure 2 allows the chatbot to learn from user feedback, refining its policy over time.

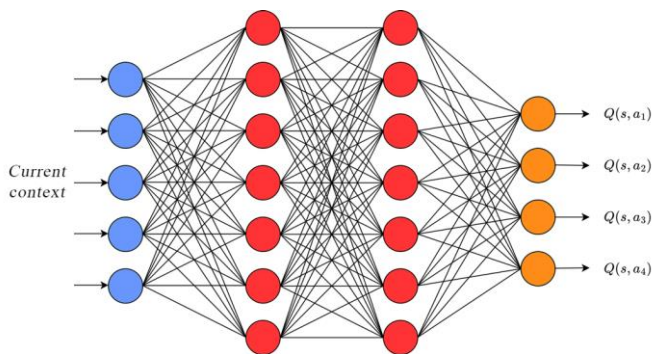


Fig. 4. Deep Q-Network Architecture for Dialogue Management

An experience replay buffer and target network are used to stabilize training, helping the chatbot continuously improve its decision-making and maintain engaging interactions [18].

H. Integration and Testing

Once the AI model was trained, the chatbot was integrated into the Wikifes. The integration process involved embedding the chatbot widget on the website’s homepage for seamless access. Customized user interface was designed as presented in figure, to reflect the platform’s branding and maintain a cohesive user experience.

Rigorous testing followed, with both local users familiar with Fes and tourists participating. The testing phase focused on ensuring the chatbot could handle a wide range of queries, from simple requests about local attractions to more complex interactions such as personalized recommendations. Key performance metrics, including response accuracy, engagement, and user satisfaction, were tracked during the testing period to identify areas of improvement.

I. Evaluation

The final phase of the methodology focused on evaluating the chatbot’s overall performance. The following metrics were analyzed:

- **Accuracy of Responses:** The chatbot’s ability to provide correct and helpful answers to user queries was measured and evaluated.
- **User Engagement:** The level of user engagement, including how many users completed interactions with the chatbot and whether they found the information useful, was tracked.



Fig. 5. Example Interaction Between User and Wikifes Chatbot

- **Personalization:** The effectiveness of the chatbot’s personalized recommendations was assessed based on user feedback and interaction history.

User feedback was collected to refine the chatbot’s functionality, and improvements were made based on recurring issues or gaps identified during testing [19].

IV. RESULTS AND DISCUSSION

This section presents the results of the chatbot’s performance in key areas such as response accuracy, user engagement, and overall impact on user experience. It also discusses the chatbot’s ability to manage conversations and deliver personalized recommendations.

A. Response accuracy

One of the primary objectives of the chatbot was to provide accurate, relevant information in response to user queries. During the testing phase, the chatbot achieved an accuracy rate of approximately 92%, based on interactions with local residents and international tourists. The use of BERT for NLP contributed significantly to this high accuracy, allowing the chatbot to understand and process complex queries.

For instance, when users asked about specific historical landmarks or events in Fes, the chatbot was able to provide detailed responses, such as the founding history of Al-Qarawiyyin University or recommendations for visiting the

Chouara Tannery. However, there were occasional limitations when users posed highly specific or uncommon queries not covered by the chatbot's knowledge base. In such cases, the chatbot responded with general information or redirected users to other resources, highlighting the need for ongoing data updates.

B. User Engagement

User engagement is a critical metric for evaluating the chatbot's effectiveness [20] in enhancing the Wikifes platform. Feedback from users indicated that the chatbot was both easy to use and helpful in guiding them through various tourism options in Fes. On average, users engaged with the chatbot for approximately 3-5 interactions per session, demonstrating sustained interest in exploring more information about the city.

The chatbot's ability to personalize interactions by recommending tourist attractions based on user preferences increased user satisfaction. For example, users who expressed an interest in cultural landmarks received recommendations for visiting Fes's medina, historic madrassas, and artisanal workshops. This feature proved especially valuable for first-time visitors seeking tailored experiences. The engagement rate was higher when the chatbot provided follow-up questions, such as offering further details or asking users if they were interested in nearby events, which created a more dynamic conversation.

C. Dialogue Management Performance

The chatbot's dialogue management, powered by a DQN reinforcement learning model, enabled it to effectively handle multi-step conversations. Through learning from past interactions, the chatbot improved its responses over time. It demonstrated the ability to adapt, offering more personalized recommendations, such as suggesting the best time to visit Fes based on user preferences. However, the chatbot faced challenges with more complex scenarios, like handling rapid topic changes or multiple questions in one query, indicating the need for further optimization in dialogue management.

D. Summary of Performance Metrics

Table 2 summarizes the key performance metrics for the chatbot, highlighting its success in several areas:

TABLE II. Chatbot Performance Results

Metric	Result	Comments
Response Accuracy	92%	High accuracy in answering most queries
User Engagement (avg. interactions/session)	3-5 interactions	Users typically interacted for multiple rounds
Multilingual Support	English, Arabic	Supports both local and international tourists
User Satisfaction (%)	85%	Positive feedback from users about chatbot interactions
Dialogue Management Performance	Improved over time with learning	Handling complex queries and improving with more data

The chatbot performed well across all key metrics, demonstrating its ability to handle user queries, manage conversations effectively, and engage users through

personalized recommendations. The high level of user satisfaction (85%) suggests that the chatbot is a valuable addition to the Wikifes platform for promoting tourism.

E. Future Improvements

While the chatbot performed well in most scenarios, several areas for improvement were identified. Expanding the chatbot's knowledge base to cover more niche topics, such as lesser-known historical sites or local events, would enhance its ability to respond to a wider range of queries. Additionally, integrating social media platforms could broaden the chatbot's reach and allow users to share recommendations or receive updates about events directly on their social networks [21].

Further developments in dialogue management, such as incorporating a more advanced context-tracking mechanism, would improve the chatbot's ability to handle complex conversations and offer more seamless transitions between topics. Finally, expanding the chatbot's support to additional languages would increase its utility for a broader audience of tourists visiting Fes.

V. CONCLUSION

The development and implementation of the AI chatbot for the Wikifes platform successfully demonstrated its potential to enhance tourism promotion in Fes through digital communication. By integrating advanced NLP techniques, such as BERT, and reinforcement learning models like DQN, the chatbot was able to provide real-time, accurate, and personalized information to users. The chatbot's ability to handle a variety of tourist queries, deliver relevant recommendations, and improve through user interactions made it an effective tool for engaging both local and international visitors. The positive feedback from users, high response accuracy, and strong user satisfaction rates confirmed the value of such digital tools in promoting Fes as a top tourist destination.

While the chatbot performed well in most areas, the evaluation highlighted several opportunities for further improvement. Expanding the chatbot's knowledge base to cover less common topics and improving dialogue management for complex conversational scenarios will further enhance user experience. Additionally, integrating the chatbot with social media platforms and adding support for more languages will help reach a broader audience. These advancements will ensure the chatbot continues to play a vital role in promoting Fes and supporting the city's tourism industry through innovative digital communication.

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