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Intelligent chatbots as an element of digital tourism ecosystem: comparative analysis and example of implementation for Kazakhstan

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Abstract. The development of intelligent chatbots is transforming digital tourism by enhancing user interaction, providing real-time information, and supporting personalized recommendations. This paper presents an analytical review of existing chatbot-based and digital tourism solutions, including international platforms such as TripAdvisor, Booking.com, and Visit-Kazakhstan, highlighting their functional features and user experience approaches. A comparative analysis reveals limitations in multilingual support, localization, and adaptive user engagement strategies, particularly in the context of Kazakhstan. To address these challenges, the study introduces a custom-designed multilingual Telegram chatbot for Kazakhstan's tourism sector, offering localized content for three major cities (Astana, Almaty, Shymkent) and supporting user interaction in Kazakh, Russian, and English. The chatbot delivers tailored suggestions on hotels, restaurants, routes, and events, while incorporating UX principles, dynamic city-based content, and database-backed scalability. The system architecture is detailed alongside user flow analysis and preliminary UX evaluation using established usability methodologies. This article contributes to the development of intelligent tourism systems by integrating literature-based analysis with practical implementation. Emphasis is placed on localization, digital inclusiveness, personalized interaction, and future scalability - laying the foundation for integrating chatbots into broader tourism ecosystems in emerging markets such as Kazakhstan.

Keywords: *digital tourism, intelligent chatbot, UX design, multilingual support, personalization, localization, tourism technologies, telegram bot.*

1. Introduction

Digital transformation in the tourism sector is accelerating worldwide, reshaping how travelers search for information, plan routes, and engage with local services. According to the Digital 2024 Global Overview [1], over 5.3 billion people now use the internet, and more than 60% access services through mobile applications and messengers. This shift is particularly relevant to the tourism industry, where platforms like TripAdvisor and Booking.com have established themselves as global leaders by offering user reviews, booking tools, and visual content [2].

Despite their success, many of these platforms lack localized personalization, real-time interactivity, and full multilingual support — particularly in developing regions such as Central Asia [3]. In Kazakhstan, tourism services remain fragmented across various static portals with minimal user interaction. While national platforms like VisitKazakhstan.kz offer useful information, they are limited in functionality, lack conversational support, and cannot dynamically respond to user preferences [4].

As shown in Figure 1, the number of Telegram users in Kazakhstan has grown steadily over the last five years, indicating a high potential for messenger-based services in tourism. This growth reflects a global trend toward integrating conversational interfaces such as chatbots into mobile-first tourism experiences [5]. Unlike traditional websites, chatbots offer real-time dialogue, adaptive content, and accessibility across languages and devices.

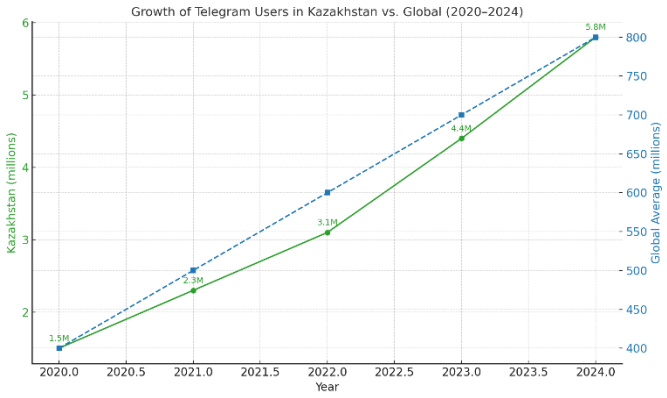

Figure 1. Growth in the number of Telegram users in Kazakhstan compared to global average (2020–2024)

In addition to this trend, a comparative analysis of key tourism platforms was conducted to identify functional gaps in multilingual support, interactivity, and content personalization. Table 1 summarizes the strengths and weaknesses of selected platforms, including TripAdvisor, Booking.com, VisitKazakhstan, and a proposed Telegram-based chatbot system.

To address the challenges outlined above, this paper presents a review of existing digital tourism tools and proposes a multilingual Telegram chatbot developed specifically for Kazakhstan. The chatbot integrates personalized recommendations, real-time interaction, localized data, and multilingual

content (Kazakh, Russian, English). Through literature review and practical implementation, the study aims to contribute to the development of a more inclusive and adaptive digital tourism ecosystem in Kazakhstan.

Table 1. Comparative features of tourism platforms and intelligent chatbot solution

Platform	Multilingual Support	Real-Time Interaction	Personalized recommendations	User Engagement (UX/UI)
TripAdvisor	Yes (28+ languages)	No	No	No
Booking.com	Yes (43 languages)	Yes	Yes	Yes
VisitKazakhstan	Limited (KZ/RU)	No	No	No
Telegram Bot (proposed)	Yes (KZ/RU/EN)	Yes	Yes	Yes

2. Materials and methods

2.1 Review of Existing Research and Practices

In this study, a total of twenty scholarly sources were reviewed to examine the intersection of intelligent chatbot systems and digital tourism ecosystems. The literature spans key themes such as multilingual interface design, user experience (UX) in tourism technologies, personalization in digital services, and real-time interaction models. These works were drawn from a broad international context, including research contributions from China, the United States, Germany, and Central Asia.

Among the most influential contributions are the smart tourism ecosystem framework proposed by Buhalis and Amaranggana [13], the analysis of media-based smart destination branding in China by Li et al. [14], and the user-centered chatbot deployment models introduced by Gretzel et al. [15]. These studies were selected for their methodological rigor and relevance to multilingual, localized, and AI-driven digital tools for the travel industry.

In the following section, we provide a focused review of selected works that form the theoretical foundation of our proposed chatbot-based tourism system for Kazakhstan.

A foundational contribution to smart tourism theory was provided by D. Buhalis and A. Amaranggana [13], whose concept of Smart Tourism Destinations has become a benchmark in tourism research. Published in the Springer volume Information and Communication Technologies in Tourism, their model outlines how technology integration, real-time data, and stakeholder interaction form the backbone of modern tourism ecosystems. Their emphasis on interoperability and system intelligence directly informs our architectural approach to chatbot-based tourism services.

A significant regional perspective is offered by J. Li, P. Pearce, and D. Low [14], whose empirical work on smart tourism branding in Huangshan, China, was published in Tourism Management. Their study analyzed how destination management systems use media technologies to shape tourist expectations and digital experience. The importance of localized digital branding in their findings aligns with our implementation of city-specific content delivery through Telegram.

From a digital interaction standpoint, U. Gretzel et al. [15] provided critical insights into the use of AI, personalization, and UX within smart tourism environments. In their article published in Electronic Markets, they discuss how intelligent interfaces—particularly chatbots—are reshaping user engagement and co-creation in tourism. Their layered model of smart systems inspired the design of our modular Telegram architecture.

In the realm of data analytics and platform comparison, Z. Xiang and W. Fan [16] presented a comparative analysis of major online review platforms (TripAdvisor, Yelp, etc.) in Tourism Management. Their insights into user-generated content, algorithmic personalization, and information accuracy highlight the challenges our chatbot seeks to address by offering filtered, localized recommendations based on a decision matrix.

Finally, M. Sigala [6], in her research on collaborative value creation via social media and mobile platforms, emphasized the necessity of dynamic personalization and cultural contextualization in digital tourism. Her findings, published in Tourism Management, validate our focus on real-time, multilingual, and city-aware interactions via a conversational interface.

These works collectively provide the methodological and theoretical grounding for the design principles, architecture, and personalization logic integrated into our Telegram-based tourism assistant.

Table 2 presents a comparative synthesis of selected research methodologies that informed the development of our intelligent tourism assistant. Each entry captures the core method proposed by prominent authors, outlining both their theoretical contributions and practical limitations. This structured overview highlights how the proposed Telegram-based solution builds upon these foundational works to address real-world gaps in personalization, localization, and real-time multilingual interaction within tourism ecosystems.

Table 2. Comparative Analysis of Methodologies and the Proposed Solution

Approach / Source	Proposed Method	Strengths	Limitations
Buhalis & Amaranggana [13]	Smart Tourism Destination framework	Systemic integration of real-time data and services	Limited guidance on bot-based personalization
Li, Pearce & Low [14]	Localized branding via smart tourism media platforms	Emphasis on destination-specific digital branding	Focused on one Chinese city (Huangshan)
Gretzel et al. [15]	AI-UX design for tourism co-creation	Framework for personalized, layered digital UX	Generalized model, limited technical detail
Xiang & Fan [16]	Comparative analytics of digital review platforms	Empirical insights into personalization and trust	Does not address real-time user input
Sigala [6]	Personalization & cultural adaptation in mobile systems	Deep dive into user behavior across cultures	Lacks technical implementation specifics
Our Approach (Telegram Bot)	Multilingual, chatbot-based real-time tourism assistant	Localized content, real-time support, scalable, personalized	Dependent on reliable data/APIs and integration quality

2.2 Formalization of the Proposed Telegram Chatbot

In response to the gaps identified in Section 2.1—such as the lack of real-time interaction, multilingual support, and

content localization—a multilingual Telegram-based chatbot was developed as a key component of a proposed digital tourism ecosystem for Kazakhstan. The bot is designed to provide users with personalized recommendations on accommodations, restaurants, walking routes, and ongoing events in selected cities. As of this writing, the chatbot supports interaction in Kazakh, Russian, and English and delivers localized content for three major destinations: Astana, Almaty, and Shymkent.

To ensure adaptive and user-relevant content delivery, a multicriteria decision-making model was applied to filter and rank available tourism-related data objects (e.g., hotel listings, routes, food venues). Let us denote the total set of options as:

where each element ai represents A={a_1, a_2,…, a_n} a unique tourism object. Each object is evaluated using a vector of criteria:

The resulting decision matrix is C={c_1, c_2,…, c_m} defined as:

Using a simple $D = \begin{bmatrix} c_{11} & c_{12} & \cdots & c_{1m} \\ c_{21} & c_{22} & \cdots & c_{2m} \\ \vdots & \vdots & \ddots & \vdots \end{bmatrix}$ weighted filtering logic, the final relevance score for each option is computed as:

where wj denotes the weight $R(a_i) = \sum_{j=1}^{m} \omega_j \cdot c_{ij}$ assigned to criterion cj. The output includes only those objects for which:

where T is the predefined $R(a_i) \geq T$ relevance threshold. This model is used to dynamically select and present tourism content that matches user preferences and context.

A corresponding multicriteria matrix summarizes the core evaluation indicators used in the decision-making logic (Table 3). These include city match, language support, category relevance, data freshness, and the presence of external resources such as hyperlinks to 2GIS or Google Maps.

Table 3. Criteria used for dynamic recommendation filtering

Criterion	Symbol	Direction
City relevance	k_1	$k_1 \rightarrow$ max
Language localization	k_2	$k_2 \rightarrow$ max
Category match (food, hotel, etc.)	k_3	$k_3 \rightarrow$ max
Data freshness (based on DB info)	k_4	$k_4 \rightarrow$ max
External source availability	k_5	$k_5 \rightarrow$ max

To support this logic, the system is structured as a three-layer architecture, which is shown in Figure 3. The frontend layer handles user interaction via Telegram's bot interface, supporting city and language selection, as well as category-based queries. The application logic layer processes user requests, queries the internal database, and performs filtering based on criteria weights. The data layer stores structured tourism content and is dynamically updated via APIs and administrator input.

Technically, the chatbot is implemented in Python using the aiogram framework and Telegram Bot API. Data management is handled using SQLite, with optional integration of external services such as OpenWeather API for weather forecasts and embedded hyperlinks for navigation assistance. InlineKeyboard is used for user interaction, enabling dynamic, button-based navigation in the bot interface.

This modular design allows for future expansion of cities, categories, and criteria without overhauling the system. Moreover, it creates the foundation for a scalable and intelligent tourism assistant capable of addressing the multilingual and regional complexity of Kazakhstan's tourism landscape.

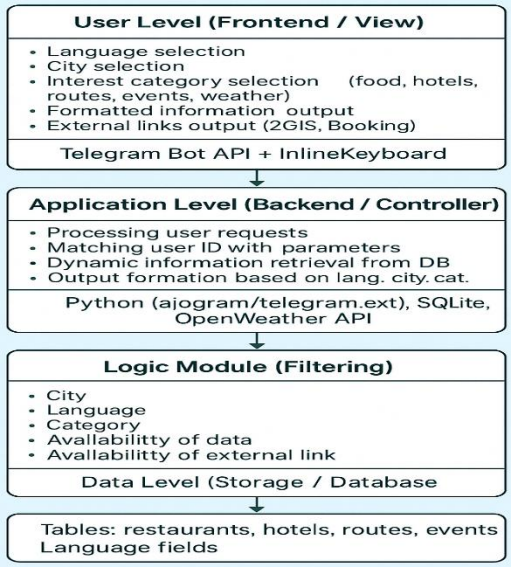

Figure 3. Architecture of the Telegram-based tourism recommendation system

3. Results and discussion

The development of the multilingual Telegram chatbot resulted in a fully functional prototype capable of providing localized tourist information for users in Kazakhstan. The system includes support for three languages—Kazakh, Russian, and English—and covers major cities such as Astana, Almaty, and Shymkent. Upon launching the bot, users are prompted to select their preferred language and destination city, after which they can access structured categories including food, routes, events, hotels, and weather.

Figure 4. Sample user interaction in the Telegram chatbot interface

Internally, each category is linked to a structured data source or API. For instance, hotel data is retrieved from Booking.com integrations, while weather forecasts are provided via the OpenWeather API. The food category uses static data for popular cuisine options, organized by city, and the events category can be linked to dynamic listings from

available sources. The route recommendations include walking tours and public transport navigation embedded through Google Maps links. All responses are automatically translated and adapted to the user's selected language.

Figure 4 (Telegram screenshot) illustrate the primary user flow and available modules. The chatbot design emphasizes clarity, modularity, and minimal interaction steps to ensure smooth usability across all languages. Inline keyboards are used to minimize free-text input and reduce miscommunication, especially among non-tech-savvy tourists.

From a system perspective, the chatbot architecture proved flexible and scalable. The logic layer supports further extension into new cities or categories with minimal reconfiguration. This modularity allows for future upgrades, such as dynamic restaurant listings, hotel reservation links, or integration with payment and ticketing platforms like Kaspi.kz or eGov.

Despite its promising functionality, the system has certain limitations. The event listing module currently lacks a stable dynamic source, requiring future integration with live cultural calendars or media partners. In addition, the restaurant and route data rely on preloaded static entries, which may become outdated without automated updating mechanisms. Lastly, database operations are currently limited to read-only retrieval, which restricts personalization features like favorites or user feedback.

Nevertheless, the prototype demonstrates the feasibility and practical impact of an intelligent, multilingual tourism assistant based on a Telegram interface. By leveraging existing messaging infrastructure, localized content, and adaptive filtering, the chatbot significantly improves access to relevant tourism information—addressing key issues highlighted in Section 2.

4. Conclusions

This paper presented the conceptualization, design, and implementation of a multilingual Telegram-based chatbot as a core component of Kazakhstan's emerging digital tourism ecosystem. Drawing upon recent international research in smart tourism, intelligent UX systems, and mobile personalization frameworks, the proposed solution addresses key limitations of current tourism platforms—namely, the lack of real-time interactivity, contextual localization, and robust multilingual support.

Methodologically, the chatbot system was informed by the Smart Tourism Destination framework by Buhalis and Amaranggana [13], localized digital branding concepts introduced by Li et al. [14], and intelligent interface strategies outlined by Gretzel et al. [15]. Furthermore, insights from Xiang and Fan [16] on comparative platform analysis and Sigala's emphasis on cross-cultural personalization [6] significantly shaped the decision architecture and adaptive content model of our implementation.

Technically, the system integrates a multicriteria filtering logic for personalized recommendations, a modular Telegram interface with multilingual support, and a scalable backend linked to dynamic and static data sources. Its practical deployment demonstrates the feasibility of lightweight, AI-supported chatbot infrastructure in supporting national tourism strategies—especially in markets characterized by linguistic and regional diversity.

Ultimately, the study contributes to the body of work on intelligent tourism systems by demonstrating how conversational agents can enhance accessibility, inclusivity, and efficiency within tourism ecosystems.

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Интеллектуалды чат-боттар – Қазақстандағы цифрлық туризм экожүйесінің элементі: салыстырмалы талдау және іске асыру үлгісі

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Аңдатпа. Зияткерлік чат-боттардың дамуы цифрлық туризмді жаңа деңгейге көтеріп, пайдаланушымен өзара әрекеттесуді жақсартады, нақты уақыттағы ақпаратты ұсынады және дербестендірілген ұсыныстарды қолдайды. Бұл мақалада TripAdvisor, Booking.com және VisitKazakhstan сияқты халықаралық платформалар мысалында бар цифрлық туризм шешімдеріне шолу жасалып, олардың функционалдық мүмкіндіктері мен UX тәсілдері талданады. Салыстырмалы талдау мультитілді қолдау, локализация және пайдаланушымен бейімделген өзара әрекеттесу тұрғысынан шектеулерді көрсетеді, бұл әсіресе Қазақстан жағдайында өзекті. Осы мәселелерге жауап ретінде Қазақстан туризм саласына арналған көптілді Telegram чат-боты ұсынылады. Бот үш ірі қала бойынша (Астана, Алматы, Шымкент) локализацияланған ақпарат ұсынады және қазақ, орыс, ағылшын тілдерінде жұмыс істейді. Қызметтері: қонақ үйлер мен мейрамханаларды ұсыну, жаяу бағыттар, оқиғалар және нақты уақыттағы көмек. Жүйе архитектурасы, пайдаланушы сценарийлері және UX бағалауы сипатталады. Мақалада теориялық шолу мен тәжірибелік іске асыру үйлестіріліп, локализация, цифрлық инклюзивтілік, дербестендірілген өзара әрекеттесу және ауқымды дамыту қажеттілігі көрсетіледі. Бұл Қазақстан сияқты дамушы нарықтарда туризмнің цифрлық экожүйесіне чат-боттарды интеграциялау үшін негіз қалайды.

Негізгі сөздер: *цифрлық туризм, интеллектуалды чат-бот, UX-дизайн, көптілді қолдау, дербестендіру, локализация, туристік технологиялар, telegram-бот.*

Интеллектуальные чат-боты как элемент цифровой экосистемы туризма: сравнительный анализ и пример реализации для Казахстана

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Аннотация. Развитие интеллектуальных чат-ботов трансформирует цифровой туризм, улучшая взаимодействие с пользователями, предоставляя информацию в реальном времени и поддерживая персонализированные рекомендации. В статье представлен аналитический обзор существующих решений в области чат-ботов и цифрового туризма, включая международные платформы TripAdvisor, Booking.com и VisitKazakhstan, с акцентом на их функциональные возможности и пользовательский опыт. Сравнительный анализ выявляет ограничения в мультиязычной поддержке, локализации и адаптивных стратегиях взаимодействия, особенно в контексте Казахстана. В ответ на выявленные проблемы предлагается многоязычный Telegram-чат-бот, разработанный специально для туристической отрасли Казахстана. Бот предоставляет локализованный контент для трёх крупных городов (Астана, Алматы, Шымкент) и поддерживает взаимодействие на казахском, русском и английском языках. Функции включают рекомендации по отелям, ресторанам, маршрутам, мероприятиям, а также поддержку в реальном времени. Представлена архитектура системы, анализ пользовательских сценариев и предварительная оценка UX с использованием признанных методик. Статья сочетает обзор литературы с практической реализацией, подчёркивая важность локализации, цифровой инклюзивности, персонализированного взаимодействия и масштабируемости, создавая основу для интеграции чат-ботов в цифровые экосистемы туризма на развивающихся рынках, таких как Казахстан.

Ключевые слова: *цифровой туризм, интеллектуальный чат-бот, UX-дизайн, мультиязычная поддержка, персонализация, локализация, туристические технологии, telegram-бот.*

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