An Intelligent Knowledge-Based Chatbot to Mitigate Travel Anxiety

A Tourist-Centered Design and Evaluation

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***Abstract*—With the emergence of intelligent chatbots, AI-driven conversational agents are increasingly being used to help tourists manage travel challenges and obtain effective solutions. Travel anxiety constitutes a significant impediment to tourism, substantially influencing travelers' future intentions. Given its multifaceted nature, spanning from subjective experiences to complex logistical arrangements, this study developed a fully functional tourism chatbot system using a tourist-centered design method to provide targeted guidance for travel anxiety mitigation. The knowledge-based chatbot implemented user-centered evaluation methods by recruiting seven participants who were randomly assigned to scenarios across six major global travel regions. Results from the participants' short-answer responses and Likert-scale usability ratings indicated that this knowledge-based system delivers highly informative, context-aware, and expert-level recommendations through multifaceted strategy implementation. The findings suggest that such AI-driven interventions are effective in addressing specific travel challenges, with further implications for user-centered design discussed herein.**

***Keywords*—Tourist-centered design; user-centered evaluation; knowledge base; context-aware chatbot; travel anxiety**

I. Introduction

Over the past few decades, the tourism and hospitality industry has been significantly transformed by technological advancements across multiple functional areas, including management, marketing, operations, human resources, and customer service [1], [2]. While this evolution was already underway, the COVID-19 pandemic acted as a powerful catalyst, accelerating the adoption of cutting-edge innovations to meet new safety and efficiency standards. Specifically, technologies such as Artificial Intelligence (AI), Virtual Reality (VR), and advanced Information and Communication Technologies (ICT) have become central to modernizing service delivery [3]. These tools not only digitize the current tasks but also redefine the guest experience through contactless interactions, immersive travel previews, and data-driven personalization [4]. Based on the future AI research agenda in tourism and hospitality [4], robotic chatting (chatbots) serves as a pivotal element of smart tourism experiences. Chatbots function as an interface for personalization, translating complex AI-backed data into the real-time conversational assistance required for enhancing customers' experience.

Robot chatting is not a new concept, as it can be traced back to the 1920s with the first robot developed [5]. In the 2010s, the application of the voice user interface was widely developed and used in the communication process (such as Apple's Siri, Google Assistant, and Amazon's Alexa). AI has widely developed with advances in new technologies, natural language processing (NLP), and machine learning (ML), and has become a powerful tool for ICT [6]. Chatbots are widely used for customer service and online booking systems in the tourism and hospitality industry [7], [8]. As the first AI project was developed in the mid-1950s [9], [10], AI chatbots have widely been used to enhance customers' experience and increase the efficiency and effectiveness of services [10], [11] in various fields such as online retailing and e-commerce, financial services, and health services [12], [13].

The tourism and hospitality industry has benefited from advances in technology from various perspectives, including management, marketing, operations, human resources, and customer services over the past decades [1], [2]. The COVID-19 pandemic accelerated this process, making new technological innovations (such as Artificial Intelligence (AI), virtual reality (VR), and information and communication technology (ICT)) advance the service delivery process [3]. Furthermore, with its functional capabilities and social interaction presence [12], the AI chatbot is also utilized to serve as a coach to provide guidance [13]. This research project utilized the AI chatbot as a coach to provide guidance for relieving anxiety triggered during the pre-trip stage.

In the academic study of tourism, anxiety is conceptualized as a future-oriented mood state characterized by a "triple-response system" of cognitive worry, physiological tension, and avoidant behaviors [14], [15]. Despite the continued expansion of the global tourism industry, travel anxiety remains a significant psychological barrier that inhibits participation, particularly among disadvantaged and inexperienced groups. Furthermore, according to Fennell's [16] model, anxiety serves as the foundational component of travel fear. Current research suggests that travel anxiety is not limited to physical service encounters, such as transportation and accommodation, but is also prevalent in virtual environments such as social media. Consequently, studies have confirmed that the level of perceived anxiety is a critical factor in determining an individual's future intention to travel [17].

Despite travel anxiety remaining a prevalent phenomenon in the post-pandemic era, there is a lack of research exploring how chatbots can mitigate this issue. This study highlights the potential of AI-driven chatbots to provide precise and timely

solutions for tourists navigating unfamiliar environments. Therefore, this research examines how knowledge-based chatbots can serve as a strategic tool for mitigating travel-induced anxiety. By addressing these psychological barriers through automated support, this research represents a novel contribution to the field, as it is among the first academic inquiries to empirically test the efficacy of a travel AI chatbot in mitigating travel-specific anxiety. To evaluate the functionality and efficacy of knowledge-based chatbots, this study employed a multi-stage methodology. The process involved a comprehensive literature review of travel anxiety and chatbot development, followed by platform design, system testing, user experience evaluation, and subsequent data analysis.

II. Literature Review

A. Travel Anxiety

Anxiety is associated with subjective feelings regarding the fear of negative consequences, including tension, apprehension, nervousness, and worry [15]. Specifically, anxiety is exhibited as a future-oriented state characterized by three response systems [14]: the cognitive (e.g., worry), the physiological (e.g., heightened blood pressure or muscle stiffness), and the behavioral (e.g., avoidance or safety decisions). Central to this state is a perceived sense of uncontrollability [18], where individuals remain in a status of hypervigilance triggered by unpredictable, unknown, or distant threats. In a travel context, such anxiety manifests as a traveler's uncertain perception of events (hodophobia; [19]), encompassing perceived risks, safety concerns, transit-related distress, and general travel apprehension. Reisinger and Mavondo [20] investigated the relationship between travel anxiety and travel intentions by surveying Australian travelers, revealing that socio-cultural and terrorism risks directly affect anxiety levels, which in turn influence the sense of safety and intentions to travel. Similarly, a study of Chinese tourists in Australia [21] indicated that anxiety can be triggered by a lack of planning, inadequate research, limited time, cultural clashes, language barriers, and dining choices. This research also found that travel package types and the behavior of service staff significantly determine tourist anxiety levels.

Minnaert [22] further explored the connection between tourism and anxiety within the sector of social tourism for disadvantaged groups. Based on intensive interviews with focus groups, she identified travel inexperience as a major source of anxiety. Furthermore, the low social status of these tourists contributed to anxiety when encountering service staff, particularly during the accommodation check-in. Her findings suggest that different tourism products contribute to varying levels of anxiety. In his model of travel fear, Fennell [16] suggests that anxiety is a critical component of travel apprehension. Compared to concrete dangers, anxiety is an emotion focused on the future, making it difficult for travelers to accurately measure or predict actual risk. This unpredictable nature is supported by Çakar's [23] research on tourophobia, which emphasizes that travel-related anxiety is rooted in a lack of control and an inability to foresee specific outcomes. Xiong, Xu, Wen, Okumus, and Cai [24] proposed that travel-induced anxiety should be viewed as a continuous process, with fluctuating levels shaped by an individual's appraisals and coping strategies—a perspective that deviates from traditional definitions of anxiety as a purely future-oriented state. Their study also suggests that moderate travel anxiety can act as a positive force for enhancing personal self-efficacy during a trip. However, excessive travel anxiety serves to inhibit the desire for future travel [17], [25].

Regarding specific triggers, Cheng [26] found that rail transportation significantly contributes to travel anxiety through factors such as crowding, delays, station accessibility, and the complexities of transferring. These findings echo Minnaert's [22] observation that transport issues are a primary source of holiday-related stress. Finally, given the current popularity of social media, constant exposure to idealized travel experiences and an overload of information can heighten travel anxiety and diminish intentions to travel (Huang, Qian, & Tu, 2025) [27]. Ultimately, travel anxiety is a multifaceted, future-oriented state driven by a perceived lack of control and heightened uncertainty. This emotional response is fundamentally triggered by diverse issues, such as travel inexperience, socio-cultural or safety risks, transport-related stressors, and the modern phenomenon of social media information overload.

B. Artificial Intelligence and Chatbots in Tourism and Hospitality

1) Definitions and industry fit: Artificial Intelligence (AI) is broadly conceptualized as "the study of agents that receive percepts from the environment and perform actions". Within the service sector, this definition is refined to encompass technological capabilities capable of executing tasks that traditionally necessitated human intelligence. In [8], the authors argue that these intelligent systems represent a "perfect fit" for the tourism and hospitality sectors, effectively streamlining multifaceted decision-making processes through tailored information retrieval.

2) Computational framework and evolution: Although the foundational concepts of chatbots emerged in the mid-20th century to replicate human cognitive functions and mediate interpersonal interactions, their industry-specific utility has evolved significantly. Doborjeh, Hemmington, Doborjeh, and Kasabov [28] characterize Machine Learning (ML) as the fundamental computational framework for these systems, positioning chatbots as specialized, service-oriented applications of ML algorithms that transform the information-seeking phase from a static procedure into a dynamic, conversational experience. Driven by advancements in ML, Natural Language Processing (NLP), and sophisticated algorithms, AI-driven chatbots now offer increasingly anthropomorphic interfaces. These technologies have been integrated into various commercial platforms, including Google Assistant, Amazon Alexa, and specialized service applications such as Macy's On Call and My Starbucks Barista.

3) Service delivery and automation: By facilitating interactions through natural language, these agents create a perceived sense of human engagement; consequently, the industry has transitioned to a state where approximately 85% of customer interactions are managed without human mediation. AI-generated service encounters represent one of the four

distinct modes of technology-based service delivery—alongside AI-supplemented, AI-mediated, and AI-facilitated modes—and are specifically characterized by the autonomous provision of services where the technology functions as a direct substitute for human staff [29].

4) Knowledge base: Tourism chatbot design is unique as it has to focus on tourists' specific travel situations. To solve this problem, Sano et al. (2018) carried out a case study to enrich their chatbot's knowledge base by analyzing tourism sites and incorporating the sites' data into the system. The chatbot helped tourists explore information about the most optimal sites to visit when their travel time is limited [30]. Knowledge-based travel chatbot design plays an important role in supporting tourists' decision-making processes.

In conclusion, AI has evolved from a theoretical concept into a sophisticated driver of the modern tourism and hospitality industry. Through frameworks like ML and NLP, chatbots have transitioned from static tools into dynamic, anthropomorphic agents that provide real-time assistance. However, there is little research on chatbot design regarding the special requirements of tourists, such as tourist anxiety and unique travel situations. Our study aims to design and evaluate a tourism chatbot that provides tourists with knowledge-based, expert-level, contextual recommendations to mitigate their anxiety.

III. Design

To design a capable AI chatbot program, this study employed three steps: defining area-specific travel anxiety, developing an AI chatbot prototype, and completing usability, to fulfill its purpose, utilizing the AI-chatbot program to provide practical solutions for area-specific travel anxiety.

A. Knowledge-Based Design

In the first step, defining area-specific travel anxiety, two major approaches were adopted to ensure effective calibration of the Juji Chatbot program and the concept of travel anxiety: conducting a pilot study and collecting travel anxiety information. A pilot study surveyed 46 voluntary informants (17 males, 29 females) regarding their past and future destination preferences, providing empirical justification for the subsequent data structure. The dataset was strategically organized around six significant tourism regions—the Caribbean/South Americas, East Asia, Europe, Middle East, Oceania, and a dedicated domestic areas category—to balance the need for scalable generalizability with the delivery of context-specific travel anxiety information. Participant preferences, which included top past international destinations like Canada (9.5%), Mexico (9.5%), and the Dominican Republic (8%), and top future international destinations like Italy (11%), Japan (10%), and Spain (10%), validated the relevance of the global macro-regions. The high prevalence and future preference for domestic trips (e.g., Florida (17%) and New York (16%) in the past; Arizona (29%) and Florida (11%) in the future) confirmed that the domestic environment warranted its own distinct focus within the chatbot's knowledge base.

The content for the Chatbot's travel anxiety solutions was developed based on established literature and practical guides, drawing specifically from Reisinger and Mavondo [20], Fennell [16], Kepnes [31], Reinberg [32], Snelling [33] and, Headspace [34]. Following the initial drafting, the solutions were subjected to calibration by two subject matter experts (SMEs) to ensure the specific anxiety types and corresponding solutions were accurately programmed into the chatbot agent.

Data regarding various types of travel anxiety and their corresponding remedies are organized into six tables, categorized by six global regions. These tables provide a comprehensive summary of potential anxiety triggers and practical solutions encountered during a journey. Throughout this stage, several primary sources of travel anxiety were identified across the six regions, specifically encompassing language barriers, cultural discrepancies, transportation disruptions, extreme weather conditions, health risks, and navigational challenges.

The solutions developed for each identified concern consist of actionable steps that travelers can implement during the planning phase or while in transit. This body of area-specific travel anxiety data serves as the critical foundation for the knowledge-based construction of the chatbot program. In the context of domestic travel, the predominant sources of anxiety were found to stem from transportation issues, inclement weather, health-related risks, criminal activity, planning-induced stress, and difficulties with navigation (Table I). For domestic travel, the major travel anxiety is derived from transportation disruption, extreme weather, health risk, crime, planning stress, and navigation difficulty.

TABLE I. Domestic Travel Anxiety Source

Travel Anxiety Concerns	***Solutions***
Flight delays and cancellations	1. Extra buffer time for unexpected situations 2. Extra money for convenience 3. Familiar with rebooking steps
Fear of driving/highway phobia (Texas/Arizona)	1. Taking breath: When anxiety peaks, use deep breathing to calm down quickly 2. Focusing on the current issues 3. No overthinking
Extreme weather	1. Insurance: Buying insurance covering natural disasters 2. Constantly monitoring local situations
Health risks	1. Staying hydrated 2. Identifying local medical resources 3. Identifying virtual medical access
Petty crime and security	1. Watching personal belongings 2. Travel document preparation 3. Enrolling in STEP
Planning stress & lack of control	1. Post-trip preparation 2. Adjustment preparation 3. Practicing self-care skills
Navigating unfamiliar situations	1. Preparing local maps (paper or digital copies) in hands 2. Be familiar with local laws 3. Understanding locals' perspectives on different issues

Table II summarizes the anxiety sources and solutions specifically for individuals traveling to the Caribbean region. In contrast to the previous area, concerns regarding personal and

property safety, food safety, and an unfamiliar support system are more prominent than other factors. The offered solutions align with these specific shifts in focus. These consist of practical actions, such as methods for protecting personal property, addressing food-related issues, or other strategies centered on individual preparation and the available choices travelers may utilize in unfamiliar environments. This table provides the necessary support for the knowledge-based construction tailored to Caribbean travel.

TABLE II. CARIBBEAN TRAVEL ANXIETY SOURCE

Travel Anxiety Concerns	*Solutions*
Being a victim of crime (theft/robbery)	1. Fitting local styles 2. Raising awareness levels 3. Using reliable transportation
Health risks (food/water safety)	1. Follow the "Boil It Cook It, Peel It or Forget It " Rule [35] 2. Get vaccinated 3. Buy travel and health insurances
Running out of money/accessing funds	1. Assistance from financial institutions 2. Taking more than one credit/debit cards 3. Tracking spending
Losing valuables or documents	1. Digital copies ready 2. Using under-cloth pouch 3. Extra important document copies at home
Uncertainty of local transport	1. Booking local transportation services in advances 2. Reviewing local accommodation services 3. Using local well-known transportation services
Stress and apprehension	1. Establishing a at-home support network 2. Extra buffer time 3. Learning stress relief skills

Table III illustrates the potential anxieties and their solutions for individuals traveling to East Asia. For destinations that differ significantly from one's hometown, cultural clashes and language barriers emerge as primary concerns for travelers. Furthermore, these factors increase navigational difficulties and hinder accessibility to local systems, such as transportation, medical care, or financial services. Solutions based on reality and applicability are provided to assist travelers in their preparation, such as maintaining a respectful attitude, utilizing translation applications, and planning for potential emergencies. This table provides the necessary context to generate the knowledge base for East Asian travel.

Table IV summarizes the potential sources of anxiety associated with traveling to Europe, where travelers encounter diverse societal environments. Discrepancies in social behaviors emerge as a primary concern. Furthermore, although many Europeans are fluent in English, a language barrier persists due to varying levels of English proficiency. Other sources of anxiety, specifically crime and financial burdens, further increase the uncertainty of such trips. The provided solutions practically address these issues through strategies such as maintaining a low profile, utilizing simplified English or translation software, and remaining vigilant in crowded areas. These identified concerns and solutions contribute to the development of the chatbot's knowledge base.

TABLE III. EAST ASIA TRAVEL ANXIETY SOURCE

Travel Anxiety Concerns	*Solutions*
Culture clash / making faux pas	1. Respecting local cultures 2. Realizing local customs 3. Some human errors
Language barrier anxiety	1. Using translation apps 2. Key survival phrases in hands 3. Using simple local conversations
Complex navigation & getting lost	1. Getting local transportation cards 2. Downloading local mapping apps 3. Accepting the wrong direction moments
Money and payment anxiety	1. Carrying cash 2. Keeping your own bank(s) posted 3. Finding local ATM machine information
Natural disasters	1. Downloading apps for emergency information 2. Familiar with facilities' emergency plans 3. Identifying and saving information regarding the local embassy
Health risks	1. Purchasing travel insurance 2. Checking local medication regulations
General apprehension & disorientation	1. Adding buffer time 2. Relaxing yourself occasionly 3. Identifying trustworthy travel-related information center

TABLE IV. EUROPE TRAVEL ANXIETY SOURCE

Travel Anxiety Concerns	*Solutions*
Negative perception & loudness	1. Maintaining a low key 2. Low speaking volume in the public place 3. Being cultural awareness
Language barrier anxiety	1. Understanding key phrases 2. Simplify your own English 3. Using the translation apps
Navigating complex public transit	1. Using the local tour apps 2. Using local transit passes 3. Asking locals
Pickpocketing and theft	1. Using under-clothing pouch 2. Being alert in the public 3. Only carrying the limited cash
Financial burden & value	1. Accessing to the local ATM machines 2. Limiting the usage of the ATM machines 3. Avoiding the tourists' restaurants
Feeling overwhelmed/restless	1. Setting up the downtime 2. Building personal support system 3. Simplifying items in the travel baggage

Table V lists prospective travel anxiety sources for trips to the Middle East. The region's stability differs significantly from other global areas, often eliciting more serious travel concerns. Regional conflicts and airspace risks are categorized as high-priority anxiety sources. Additionally, medication access, social customs, language barriers, navigational difficulties, and constant apprehension require careful consideration during the travel planning process.

Practical solutions for mitigating these anxieties include monitoring government advisories, maintaining flexibility in travel plans, and preparing for scenarios where medication access may be limited. Travel insurance, navigation techniques, and translation tools are also recommended to address these concerns. Ultimately, this table provides the essential knowledge base for constructing the chatbot platform regarding travel to the Middle East.

TABLE V. MIDDLE EAST TRAVEL ANXIETY SOURCE

Travel Anxiety Concerns	***Solutions***
Regional conflict and airspace risk	1. Monitoring current situaions 2. Buying refundable tickets 3. Buying travel insurance
Strict legal penalties for medications	1. Identifying lawful medication 2. Keeping doctors' notes in hands 3. Extra prescription stocks
Violating social customs/laws	1. Dressing modestly in public 2. Avoiding displaying affection publically 3. Understanding local taboos
Language barrier	1. Learning some local oral languages 2. English speaking in some tourist zones 3. Using some translation apps
Constant apprehension	1. Using anxiety-relief skills 2. Positive thinking 3. Enough buffer time
Getting lost or navigating	1. Available paper or digital copies of local map 2. Arranging local transportation services 3. Familiar with local areas

Table VI summarizes the travel anxiety concerns and corresponding solutions for travel to the Oceania region. Physical exhaustion during transit is identified as a primary concern, predicated on the assumption that journeys originate from North America. Other prominent anxieties involve local wildlife, travel costs, and specific climatic conditions.

TABLE VI. OCEANIA TRAVEL ANXIETY SOURCE

Travel Anxiety Concerns	***Solutions***
Severe jet lag and exhaustion	1. More natural light exposure 2. Adjusting personal biological clock 3. Drinking enough water and limiting consumption of coffee and alcoholic beverages
Separation anxiety/homesickness	1. Setting up the communication plan 2. Setting up a regular check-in 3. Using wellness apps
Cost of living/budget anxiety	1. Budgeting responsibly 2. Using the best exchange rates 3. Reducing daily expenses
Underestimating size and distance	1. Reasonable numbers of attraction visiting 2. Finding the best transportation rate for the inter-city travel 3. Setting up the buffer time
Extreme sun exposure and heat	1. Using the sunscreen as much as possible 2. Using the shade areas frequently 3. Drinking enough water
Fear of wildlife	1. Collecting local wildlife information 2. Staying at the safe areas 3. Joining a guided tours
Long-haul flight stress	1. Doing exercise during the long flights 2. Wearing compression clothing for better blood circulation 3. Simplifying items in the luggages

The proposed solutions are tailored to the environmental context of Oceania; these include advanced preparation for climate and wildlife encounters, the development of comprehensive budget plans, and the self-regulation of physiological conditions during long-haul travel. Collectively, these data provide empirical support necessary for the knowledge-based construction of the chatbot's Oceania travel advisories.

Sources of travel anxiety across the six tourism regions — Domestic Area, Caribbean, Europe, East Asia, Middle East, and Oceania — laid foundation for building the knowledge base prototype of the chatbot. These concerns are prioritized with thorough consideration of the culture, environment, political factors, and security of the region. The practical solutions were proposed based on the various types of travel anxieties. These solutions are not universally applicable but vary by region. The most common solutions for foreign trips involve planning ahead of time/self-preparation as a normal support system might possibly be unavailable. Generally, most travel anxieties would be mitigated with the incorporation of personal pre-trip preparation and the knowledge of the area-specific solutions while maintaining feasibility and convenience during the journey.

B. Chatbot Prototype Development

1) Chatbot design overview: The travel anxiety chatbot is designed to provide users with meaningful, expert-reviewed information. Operationally, the system first identifies the user's destination to activate the specific anxiety categories compiled in the preceding research stages. Subsequently, the chatbot provides the corresponding pre-defined solutions based on the user's articulated concerns. The conversational logic is structured to elicit the destination and specific travel stressors in sequence, delivering targeted interventions thereafter.

For the development of the prototype and subsequent experimentation, the study utilized Juji, a platform that enables the creation of sophisticated agents without a programming background. The platform allows developers to utilize specific "topics" to design and govern the dialogue flow, accommodating various request types to fulfill diverse design specifications. Due to its accessibility and efficient project management capabilities, Juji served as an appropriate choice for this study.

2) Information integration: In the preliminary stage, travel anxiety mitigations are organized into a categorized index of concerns and corresponding solutions tailored to each targeted region. Each geographic area presents distinct variables that trigger anxiety. These concerns carry varying levels of priority

based on cultural norms, geographic environments, political climates, and social stability. Consequently, a universal solution set is insufficient, as the relationship between concerns and solutions is unique to each region.

To address this, we integrated these specialized datasets into the chatbot, ensuring that each region operates with a distinct logic. Within the Juji platform, the conversational architecture is organized by region to facilitate the precise integration of these variables. Fig. 1 illustrates the user's view of the regional solution sets. Each region contains a specific list of stressors, and each stressor is linked to a targeted solution set. When users engage with the chatbot, the feedback regarding their travel concerns is specifically tailored to the culture, environment, and political context of their chosen destination.

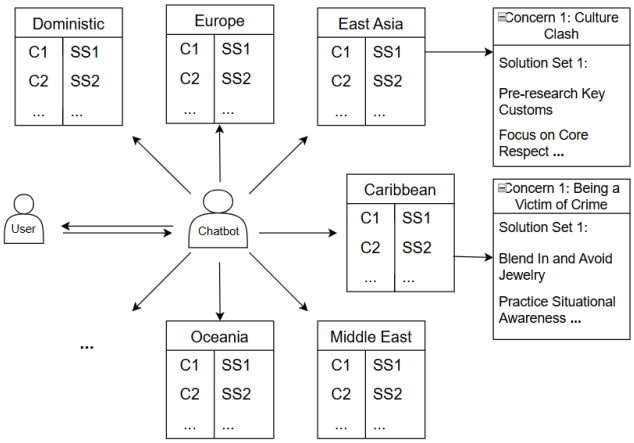

Fig. 1. Travel anxiety chatbot structure.

The Juji platform utilizes triggers as the primary mechanism for decision-making within the conversational flow. These triggers allow developers to employ keywords, sample user inputs, or intention detection, supported by Juji's proprietary models to extract user intent from natural language inputs. The prioritized list of regional concerns compiled in this study aligns effectively with this trigger-based architecture.

Specifically, these prioritized concerns provide a roadmap for the chatbot to guide the dialogue toward actionable solutions, which constitute the system's primary output. For instance, in the domestic travel branch, primary anxiety factors include temporal unpredictability, such as flight delays or cancellations, and the fear of highway driving. Secondary factors encompass extreme weather, health risks, and security concerns related to petty crime. The third tier involves the psychological stress associated with the planning and organization of the itinerary itself. Finally, the fourth level addresses navigational challenges within unfamiliar public transit systems.

These categorized concerns dictate the quantity and technical configuration of the triggers required within the platform's "topics". Fig. 2 illustrates a sample trigger configuration from the domestic travel branch of the Juji design. Once a specific concern trigger is activated, the system generates a "quick acknowledgement" response, which contains the targeted solution set for that particular anxiety factor.

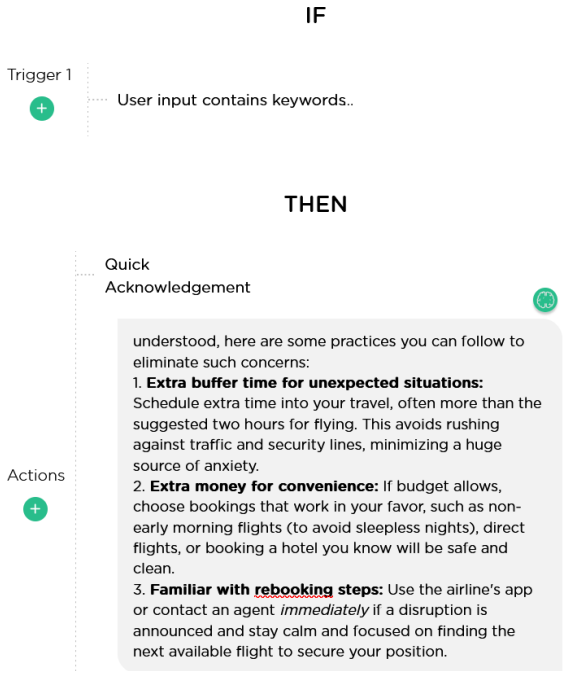

Fig. 2. Trigger example.

The development process utilized keyword detection as the primary triggering mechanism to determine the appropriate solution output. To ensure the accuracy of these outputs, a comprehensive list of keywords was integrated into each trigger. This lexicon incorporates both AI-generated terms and manually curated human inputs. These keywords are natural language-based and are designed to be mutually exclusive across all triggers within a specific topic; this exclusivity is intended to increase the activation rate beyond standard word selection and to prevent computational collisions between triggers.

Fig. 3 represents a subset of the keywords utilized for the two aforementioned example triggers. When a user's textual input includes any of these designated terms, the corresponding trigger is activated, prompting the system to deliver the appropriate solution-based response.

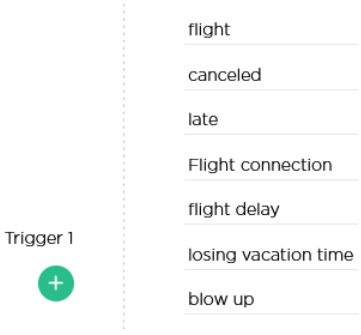

Fig. 3. Trigger keyword example.

3) Conversation flow: The overarching conversational architecture is informed by the synthesized catalog of travel anxiety concerns and their corresponding remedial suggestions. The chatbot is designed to elicit the user's destination and specific stressors through a structured dialogue. By identifying the user's destination, the system is able to isolate the relevant

regional concern list; subsequently, by identifying the user's specific anxieties, the system allocates the appropriate solution output. These two primary data points provide sufficient parameters for the chatbot to fulfill its functional objectives (Fig. 4).

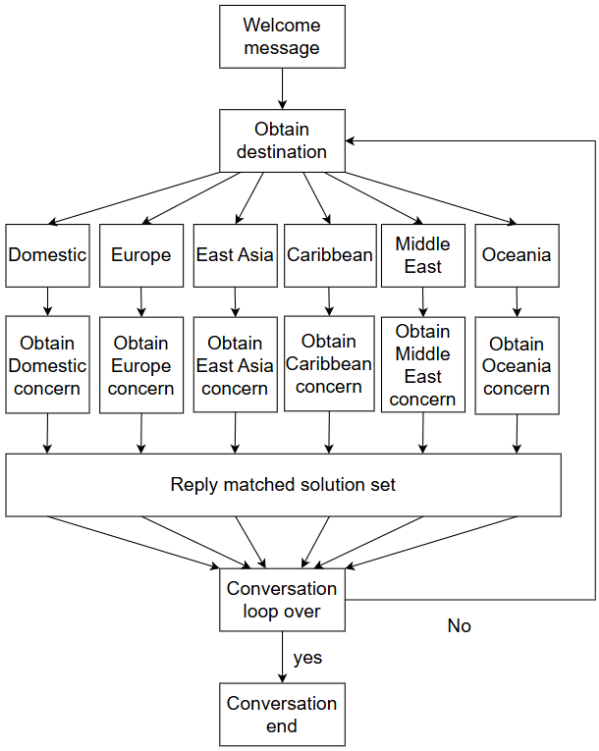

Fig. 4. General conversation flow.

The conversation commences with a welcome message that defines the intended purpose of the chatbot. This ensures the user understands that the system is designed to provide recommendations for potential travel anxiety concerns. Following the introductory message, the chatbot prompts the user to select their destination directly from a predefined list (see Fig. 5 and Fig. 6).

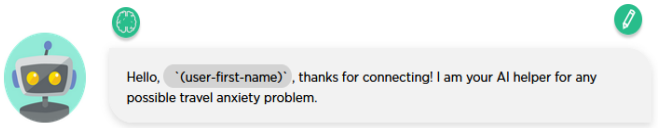

Fig. 5. Chatbot welcome message.

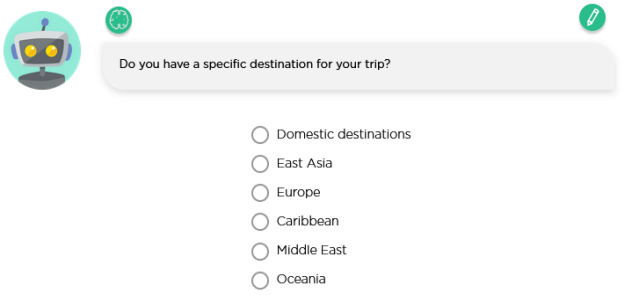

Fig. 6. Region selection.

After the user selects a destination, the conversation transitions to the corresponding topic containing the concern list for that region, where a set of triggers awaits activation. If a trigger is activated, the chatbot provides the associated solution to the user. For instance, in the case of domestic travel, suppose a user asks, 'I am afraid to drive on the highway during a domestic trip; do you have any suggestions?' The keyword 'highway' or the phrase 'drive on highway' will activate the trigger, prompting the system to deliver the solution as demonstrated in Fig. 7, Fig. 8 and Fig. 9.

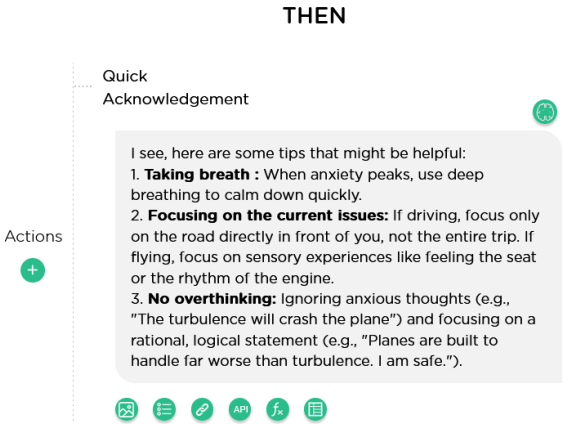

Fig. 7. Solution set example.

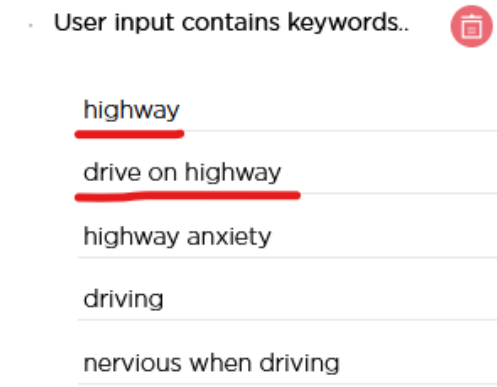

Fig. 8. Fired keyword example.

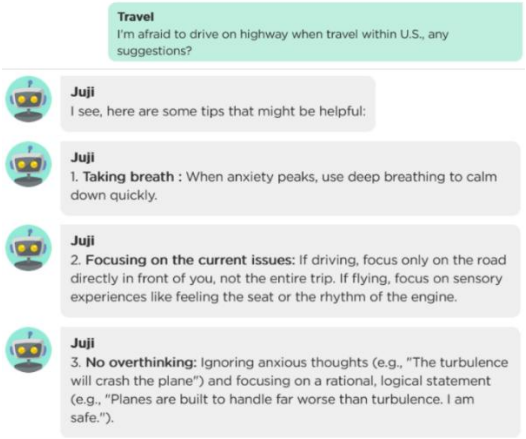

Fig. 9. Result demonstration.

After each interaction, the user can choose to initiate another round for additional requests. Users may continue to consult the chatbot regarding further concerns by replying "yes" to the system's recurring prompt, or they may conclude the session by replying "no" (Fig. 10 and Fig. 11).

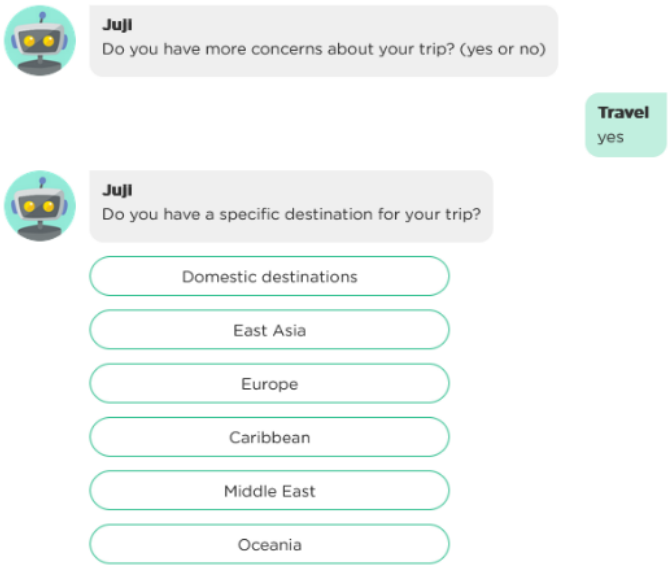

Fig. 10. Recurring question example for "yes".

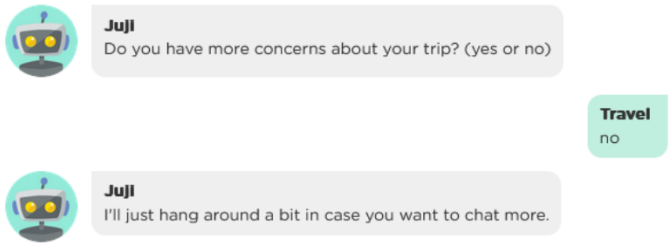

Fig. 11. Recurring question example for "no".

4) Domestic travel interaction demonstration: The following is a demonstration of a travel consultation for a domestic destination (Fig. 12). The conversation commences with a welcome message. Immediately following this introduction, the user is prompted to select their destination from the six regions listed by the chatbot. In this example, 'Domestic destinations' has been selected.

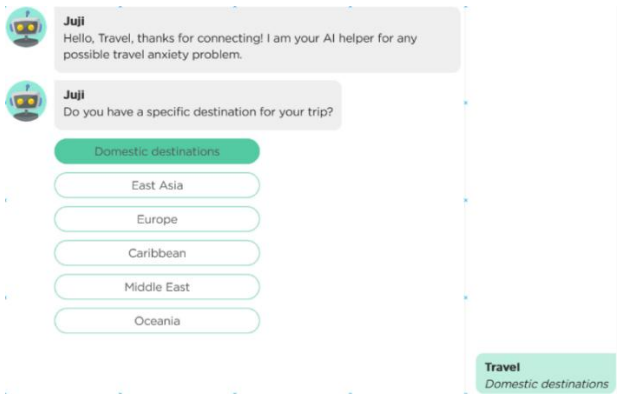

Fig. 12. Showcase 1 welcome message and region selection.

Once the user selects a domestic destination, the conversation transitions to a specific topic containing all predefined anxiety triggers for domestic travel. When user input incorporates multiple keywords, such as "delayed" or "canceled", the corresponding trigger is activated, prompting the chatbot to return the relevant remedial message as a response (Fig. 13 and Fig. 14).

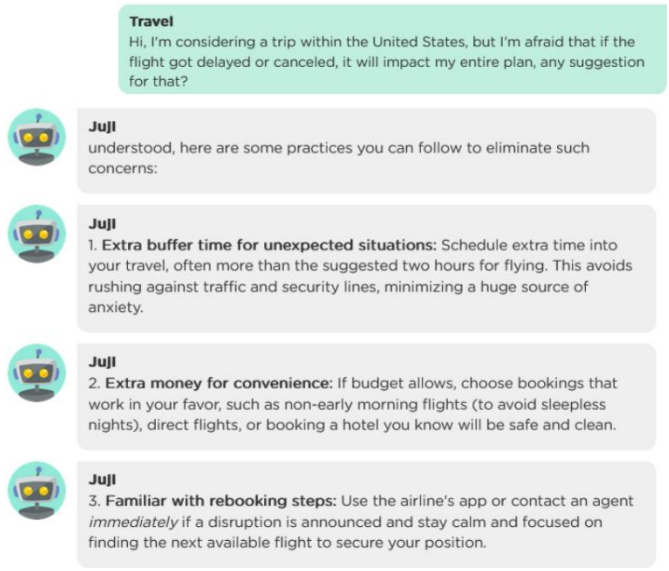

Fig. 13. Domestic showcase solution reply.

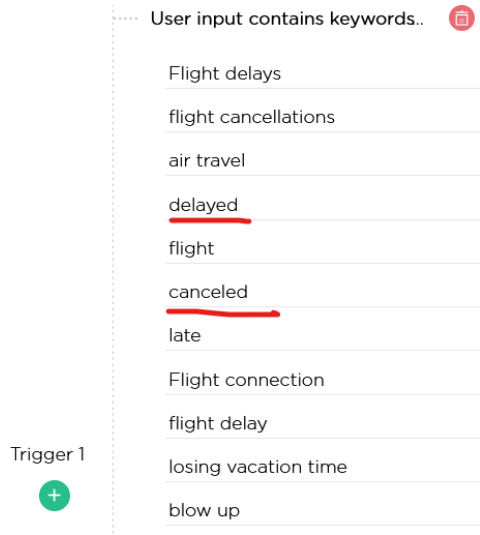

Fig. 14. Domestic showcase keyword detected.

Ultimately, the chatbot presents a recurring prompt to determine if the user requires further consultation. In this demonstration, the user selects "yes" to address an additional concern regarding a different geographic region (Fig. 15).

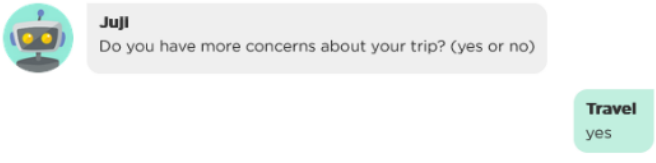

Fig. 15. Domestic showcase recurring confirmed.

5) European travel interaction demonstration: The second demonstration presents a consultation regarding European travel concerns. Following the introductory welcome message, the user selects "Europe" as the target destination for the interaction (Fig. 16).

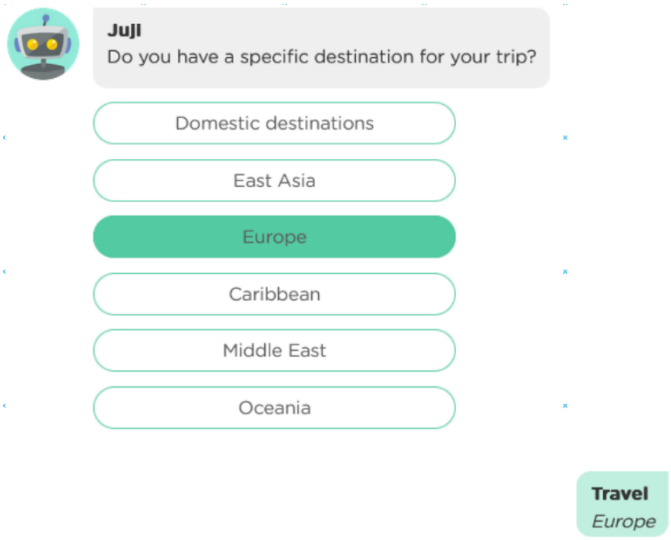

Fig. 16. European showcase region selection.

After the user selects "Europe" as the destination, the conversation transitions to the topic containing the specific anxiety triggers for European travel. In this instance, the user input includes keywords such as "money" and "expensive". Once these keywords are detected, the chatbot responds by delivering the corresponding solution message to the user within the chat interface (Fig. 17 and Fig. 18).

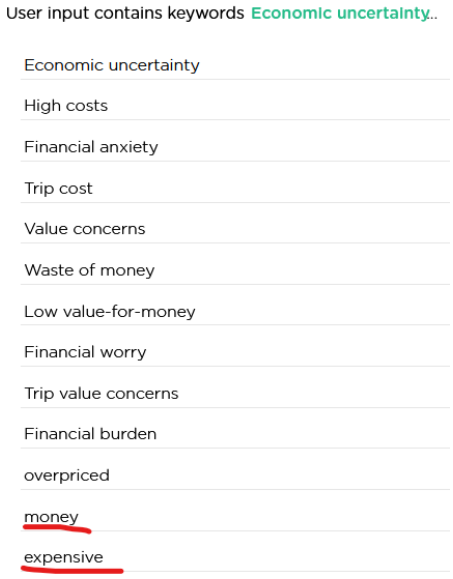

Fig. 17. European showcase keyword detected.

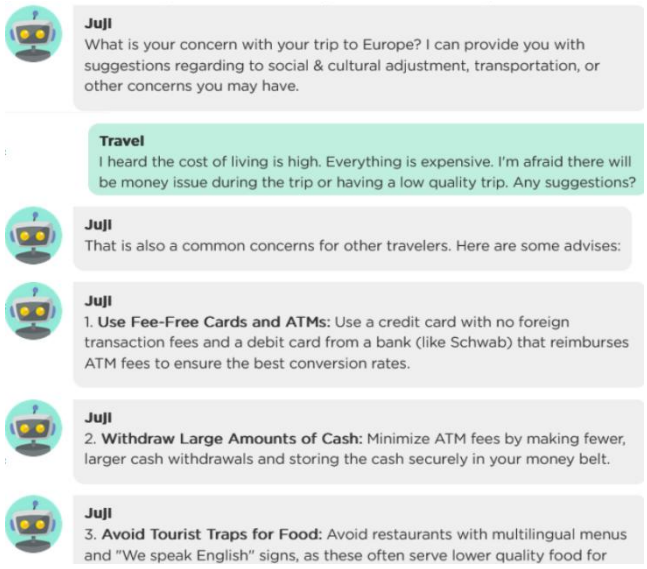

Fig. 18. European showcase solution reply.

As with all interactions, the chatbot presents a recurring prompt to determine if the user requires further consultation. In this demonstration, the user selects "no" to conclude the conversation, and the chatbot terminates the session (Fig. 19).

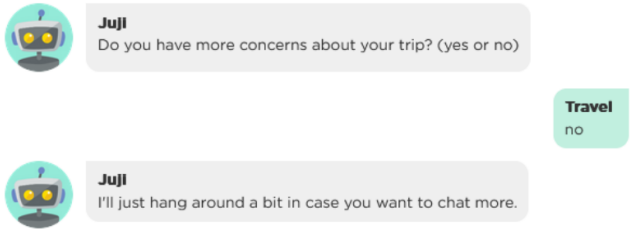

Fig. 19. European showcase recurring denied.

IV. Usability Evaluation

A. Usability Testing

The design of the tourist well-being chatbot is to provide information to tourists to ease their anxiety and to offer them professional advice through its expert-level knowledge base. Based on this goal, we designed the high-fidelity prototype and ran a usability test.

1) Evaluation participants: Seven participants were invited to participate in our experiments. Nelson (1993) recommended that as few as five users can effectively identify 85% of the usability issues associated with a particular technology [36]. Therefore, five college students from an East Coast university and two students from a Midwest university performed the tasks, filled out questionnaires and answered interview questions. They ranged in age from 21 to 28 (M=25.29, SD=4.96), and among them, four were male, and three were female.

2) Evaluation tasks: The experiments were conducted in the participants' natural environments to allow the participants' natural interaction with the chatbot. The participants were instructed to follow the guidance document to perform three tasks. We designed two parallel task sets: Version A (Europe, domestic, and Oceania) and Version B (Caribbean, East Asia, and the Middle East). The participants were randomly assigned to either Version A or Version B. Below is an example of Version A.

- Task 1: You are getting ready for a one-week trip to Europe. You've done some planning, but you still feel worried about something going wrong or something you don't know about this area.
- Task 2: You are planning a week-long trip to another city in the U.S. You are currently setting up your schedule and thinking about everything that could go wrong or be an unpleasant surprise on a big domestic trip.
- Task 3: You are imagining a ten-day trip to Oceania next summer. Since this is a huge, long trip far from home, you are super excited, but you are also very nervous about some big, unexpected things that could happen before or during the trip.

In order to further explore the participants' interaction with the chatbot, eleven short-answer survey questions were presented to each participant. The usability questions encompassed topics such as the chatbot's acceptance, usefulness [37], ease of use and memorability, emotional support, interaction flow, and improvements. The participants answered the questions with their experiences, thoughts, and feedback on the chatbot.

Usability-related inquiries aligned with Norman's usability goals were also presented in the following Likert-scale questions (7 is the highest) in order to retrieve quantitative data [38]. The questionnaire emphasized ease of use, effectiveness, problem-solving usefulness, learnability, emotional impact, and life and study support.

By exploring these questions, we aimed to demonstrate that the knowledge-based chatbot design provides users with effective and emotionally supportive information to help them solve problems and make decisions. By gathering valuable insights from the participants, we can also enhance the chatbot design, focusing on user needs and preferences to develop a user-centered tool for tourism purposes.

3) Pilot study: We conducted a pilot test to ensure the effectiveness of the tasks and questions. The purpose of the pilot test was to identify ambiguities in instructions and questions to enhance the clarity of the descriptions. One pilot participant was invited to complete the tasks and answer the questions. Updates were made based on the participant's feedback, such as rephrasing instructions, reordering questions, and removing similar questions.

4) Data analysis: The usability study collected qualitative and quantitative data through mixed methods, including empirical tasks and short-answer and Likert-scale survey questions. The short-answer data analysis followed the grounded theory and used the open-coding method. We used descriptive data analysis for the Likert-scale answers to determine the usefulness and ease of use of the chatbot. These qualitative and quantitative data analysis methods allowed us to obtain a comprehensive understanding of user feedback and needs for tourist-focused AI chatbot design.

V. Evaluation Results

We invited seven participants to evaluate the usability of the chatbot. The results from quantitative and qualitative analyses were consistent and reinforced one another. The results indicated that the participants confirmed the ease of use of this chatbot. They also reported the knowledge-based usefulness of the chatbot. They had diverse emotional experiences with the chatbot and tourist-centered improvement requirements.

A. Descriptive Data Analysis Results

The results from the Likert-scale questions indicated that the chatbot's usability was confirmed by the participants, for example, through its strong ease of use, which aligned with Davis (1989) usability goals [37]. The relatively small standard deviations demonstrated that the participants agreed with each other that the chatbot was easy to use. Participants believed the chatbot was useful, but not as strongly as its ease of use. Some participants felt emotionally supported, while emotional reassurance was inconsistent (see Table VII).

TABLE VII. Likert-Scale Questions

Likert-scale questions	*Mean*	*SD*
Easy to learn how to use the agent	6.43	1.13
Easy to get the agent to do what I want	5.29	0.95
Interacting is clear and understandable	5.86	0.90
Flexible to interact	5.00	0.82
Easy to become skillful at using the agent	6.00	1.53
Easy to use	6.29	0.95
Eases anxiety/ stress/ depression/ insomnia efficiently	4.29	1.89
Helps achieve student success	4.00	1.73
Improves problem solving	4.43	0.98
Enhances life quality	3.71	1.38
Provides better support for study/life	4.43	1.27
The agent is useful.	5.29	1.98

B. Themes from Short Answer Questions

The results of the short answer questions supported and further elaborated the Likert-scale answers. The participants strongly agreed that the chatbot was easy to use, learn, and remember. They also confirmed that it was useful, especially with its informative, context-based expert-like recommendations and multiple strategies. However, sometimes there was generic information due to technical limitations. There were diverse opinions about the chatbot's emotional support. Some participants believed it was helpful for travelers.

1) Ease of use: All the participants expressed that the usability of the chatbot was high with low effort.

Participant 4: "Not much effort, easy and quick."

Participant 3: "The process was very easy and simple to get a quality answer."

Participant 2: "The process was easy to get used to and understand."

2) Knowledge-based usefulness: The participants felt knowledge-based emotional assurance within the interactions. They also found strong informative problem-solving suggestions. They expressed that the chatbot provided them with contextually appropriate guidance.

For example, Participant 2 found that the chatbot's knowledge created trust and emotional comfort to him.

Participant 2: "The chatbot helped me in assuring myself and overcoming some of my anxieties. It explained what to do and why, and that made the situation feel more manageable."

The participants also expressed that the chatbot provided expert-depth answers. It also provided detailed, informative suggestions and different solutions to handle one situation.

Participant 5: "Yes, the Chatbot did give insightful answers. It gave suggestions for jet lag, such as adjusting sleep ahead of time, staying hydrated, and planning rest when you arrive, so once you're off the plane, you can prepare for the time difference."

Participant 4: "The 3rd gave the best advice because it was the most detailed. It didn't just say 'be careful,' it broke down what to do, what to expect, and what would actually help."

Participant 3: "Yes… it gave me many different solutions instead of just one answer, which I thought was really good because it considered different ways someone might handle the situation."

The participants expressed that the chatbot responded according to their specific travel situations and was tailored to the travel context.

Participant 7: "The first one… was the most helpful because it answered exactly what I asked and what I needed. It felt like it knew what travelers really go through and responded like someone experienced."

Participant 2: "The Oceania chatbot scenario gave me the best solutions. It addressed my worry directly and gave options I could realistically do while traveling."

However, due to technical limitations, Participant 1 found the answers were generic. These design flaws can be improved in future studies.

Participant 1: "They were generic answers… when I asked for something more specific… it restated my question, then moved on."

3) Emotional experience: The participants had diverse emotional experiences with the chatbot.

Participant 5: "I felt secure while talking with the Chatbot. It didn't ask for any deeply personal questions and it seems unbiased."

Participant 3: "The Chatbot made me feel less scared about travel… like someone was trying to talk me off the ledge."

Participant 7: "Simple and secure."

Participant 4: "Indifferent."

Participant 1: "It felt nonpersonal."

The results indicated that emotional impact was diverse. This aligned with our descriptive analysis that emotional support scores had higher variability.

4) Tourist-focused improvements: The chatbot was designed to focus on tourists' needs. Therefore, improvements were requested from the participants. They expressed that they would like more precise responses, smoother interaction flow, and richer functionality.

Participant 3: "Maybe have it budget trips for you and help you with the planning process."

Participant 2: "Maybe an addition of a precise location feature instead of a general area feature."

Participant 5: "The most helpful advice I received was how to stay away from high traffic areas, and the least helpful advice I received was how to engage in local activities because most of the time you can find that specific information on a website."

Participant 5: "The smoothest interaction was initially chatting with them, but reloading to a different chatbot was less smooth."

Participant 4: "To me, it seems like an extra feature for those who have anxiety when traveling."

Participant 1: "I think this could be sold as an added feature to a larger product, but not as a stand-alone tool. I'm not sure that travel anxiety is a large enough problem, that people will think of using a chatbot to help relieve anxiety, or that the chatbot has useful enough information to create demand."

In summary, through the usability testing, we confirmed that the chatbot could assist tourists by providing professional and informative suggestions and helping them make context-appropriate decisions. The participants' suggestions for improvements provided valuable insights to enhance the chatbot's functionality and usability.

VI. Discussion

Our study developed a knowledge-based chatbot to provide tourists with expert-level context-aware solutions. We also conducted usability testing to collect user feedback through short-answer and Likert-scale questions. The quantitative and qualitative data demonstrated that users strongly agreed that this chatbot was easy to use. They stated its usefulness derived from its informative, expert-level, contextually appropriate, multifaceted strategies.

However, the participants reported varied emotional experiences toward the chatbot. Some of the participants

indicated that the chatbot provided emotional reassurance. Some participants reported that the chatbot felt impersonal. We acknowledge that part of the reason was due to the technical challenges we encountered, which actually limited the functions of the chatbot. Yet our purpose was to demonstrate a tourism chatbot that can mitigate tourist anxiety through knowledge-based design. In addition, our design highlighted the importance of context-sensitive design that could support users in making decisions when context is a serious challenge to most chatbots.

One of the limitations of this study lies in the small sample size. However, as mentioned in the previous paragraph, Nelson (1993) stated that only five participants could identify 85% of the usability issues [36]. Therefore, these seven participants were enough to evaluate the chatbot system. The participants' diversity was limited to only university students. However, this young group represents an active and frequent group of tourists. They are also sophisticated in AI technologies, which makes them a suitable group to evaluate an AI chatbot. Moreover, four of the participants were tourism-major students. Their insights from their expertise were valuable for the design. We believe the findings may inform broader tourism applications.

VII. Conclusion

Our work aims to provide tourists with a knowledge-based expert-level chatbot to ease their travel anxiety and help them make decisions. Based on the qualitative and quantitative user feedback results, we confirmed that the chatbot was easy to use and perceived as useful due to its knowledge base, context awareness, and multifaceted strategies. However, users reported different emotional experiences while interacting with the chatbot. They also expressed expectations for precise responses, smooth interactions, and rich functions.

Future work will focus on advancing the knowledge-based prototype integrated into GPT. It will enable us to provide expert-level recommendations while retaining the generative function of the large language model. Future work aims to combine structured domain knowledge with prompt-based control. Moreover, some participants pointed out that this chatbot could serve as an additional feature within a broader integrated travel chatbot system. Therefore, future development will aim to integrate our travel anxiety design with existing travel platforms. This approach is practical for real-world adoption, enabling existing travel chatbots to incorporate anxiety modules.

This study demonstrates how a knowledge-based chatbot system supports tourists' decision-making with a user-centered approach. It contributes empirical evidence to AI research that a knowledge-based chatbot can provide expert-level, context-aware, multifaceted suggestions to tourists. We hope these findings will inspire designers and researchers to continue advancing knowledge-based, context-aware tourism support systems.

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