HistoMind: AI-Based Historical Place Navigator

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***Abstract*—This research addresses a critical gap in Sri Lanka's tourism infrastructure: the absence of a comprehensive smart location-based recommendation system with a route planner and a multilingual AI chatbot. To date, no integrated solution has been developed to cater to the diverse preferences of tourists, offer community-validated recommendations, and bridge language barriers. This research is pioneering the creation of these novel systems, with a clear focus on enhancing the tourism experience and supporting the country's economy. The smart recommendation system harmonizes various recommendation techniques, encompassing user preferences, community-approved choices, and hidden gems. By integrating these aspects, the system aims to provide tourists with personalized, community-endorsed recommendations while introducing them to unique destinations, thus addressing the existing void in Sri Lanka's tourism landscape. Furthermore, the AI-based multilingual chatbot tackles the language barrier head-on, enabling tourists to communicate effortlessly in their native language, a feature hitherto unavailable in the Sri Lankan tourism sector. This innovation aims to break down language barriers, making the country more accessible to a global audience. Through advanced methodologies and cutting-edge technology, this research strives to fill these critical gaps, promising a brighter future for Sri Lanka's tourism and its economic prosperity.**

***Index Terms*—Smart Tourism, Location-Based Recommendation, Route Planner, Personalized Travel Experience, Community Preference, Historical Attractions, AI-based chatbot, smart communication, native speakers**

I. Introduction

The Histomind - AI-based Historical Place Navigator propels Sri Lanka's tourism and economy by fusing technology with culture to elevate site experiences and enhance connectivity. This innovation spearheads a revolutionary era in tourism, beckoning travelers to embark on an extraordinary expedition. In a swiftly evolving technological landscape, the tourism industry stands on the cusp of a transformative journey, driven by the fusion of cutting-edge recommendation systems [1] and intelligent route planning [2]. This initiative reshapes the traveler's odyssey. "Histomind - AI-based Historical Place Navigator" leads the way with a dual emphasis on the "Smart Location-Based Recommendation System with Route Planner" and the "AI-based Chatbot for Native Speakers.

A. Smart Location-Based Recommendation System with Route Planner

Modern travel thrives on personalization, merging individual choices with community insights. Our study combines various recommendation techniques, harmonizing personal inclinations [3], community sentiments, and uncharted destinations. This results in an advanced recommendation engine that caters to individual preferences while resonating with the travel community. At its core, this innovation includes an intelligent routing system that optimizes routes, promising enriched travel experiences [4]. Seamlessly integrated into the route planner [5], this novel recommendation system injects vitality into journeys with personalized attractions along selected routes. Our innovative approach blends technology and culture to redefine Sri Lankan travel. Addressing a unique gap in personalized recommendations, we see our system transforming tourism, enriching experiences, and boosting the economy.

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B. AI-based Chatbot for Native Speakers

This research introduces a unique AI-based chatbot [6] designed specifically for native speakers. This chatbot acts as a virtual tour guide, enhancing the tourist experience by providing detailed information about Sri Lanka's historical sites. Equipped with advanced natural language processing and machine learning algorithms, this chatbot engages users in conversational interactions. It supports both text and voice commands [7] [8] in multiple languages, including English, German, and Tamil, making it accessible to users from diverse linguistic backgrounds. What sets this chatbot apart is its ability to automatically detect the user's language and respond accordingly.

The chatbot's language detection and native responses enhance tourists' experiences exploring Sri Lanka's historical sites.

II. Literature Review

Recent years have seen significant growth in smart tourism and personalized recommendations, driven by rapid technological advancements. This literature review explores evolving trends that have led to the development of the "Smart Location-Based Recommendation with Route Planner," poised to revolutionize modern tourism through personalization and innovative approaches. Recommendation systems are central to enhancing travel experiences. Within this context, the study conducted by U. Kanimozhi Ganapathy and her colleagues in 2022 [9] stands out as an exemplar. Their work explores personalized tour recommendations, aligning with our approach for catering to individual preferences. In today's tourism landscape, personalization through user-centric recommendations thrives, and our research aims to enhance the travel experience. In modern tourism, personalization is key through tailored recommendation systems. Our research focuses on a user-centric location-based approach for an enhanced travel experience. In the field of location-based recommendations, Renjith, Shini, and Sreekumar (2020) [10] laid the groundwork in 2013 [11] for context-aware intelligent recommendation systems in tourism. They championed the inclusion of diverse contextual factors, such as weather, time, and preferences, in their pioneering system, VISIT, which offers highly personalized recommendations, distinguishing it from traditional location-centric applications.

Similarly, Chia-Chen and ChenJia-Lun Tsai's 2017 study [12] explores user intentions regarding personalized location-based mobile tourism apps (PLMTA). Meanwhile, Yu and Chang's 2009 study [13] examines personalized location-based tour recommendations, proposing tailored suggestions for attractions, accommodations, and comprehensive tour plans. Our innovative system not only surpasses community preferences but also seamlessly merges them with individual choices. This hybrid approach crafts multi-dimensional recommendations, adept at catering to diverse needs while also offering serendipitous and unexpected suggestions that can truly enrich a traveler's journey. Additionally, the study by Bin Yang, Chenjuan Guo, Yu Ma, and Christian S. Jensen in 2015 [14] is significant. It explores personalized, context-aware routing for drivers by analyzing historical trajectories and considering various factors beyond time and distance. The study introduces innovative methods validated through actual trajectory data analysis. Another substantial contribution comes from Chenzhong Bin, Yanpeng Sun, Tianlong Gu, and Liang Chang's study in 2019 [15]. We present a personalized route recommendation system that combines tourism data and sequential pattern mining to enhance city tour planning, validated with Guilin City data, affirming its effectiveness. Smart concepts addressing sustainability are gaining traction, supported by online resources such as the UNESCO website [16], the Archaeology Travel web service [17], and the official website of the Sri Lankan Archaeological Department [18]. However, a significant challenge for tourists is the lack of information in their native language, hampering communication.

In a related context, Clarizia et al. [19] developed a chatbot capable of understanding the conversational context for sharing cultural heritage information with tourists. Similar to our approach, they emphasize cultural heritage's significance and the benefits of integrating modern technologies for an improved user experience. Our chatbot employs context and pattern recognition to provide contextually relevant responses. Furthermore, ACHUTHAN.s has developed a chatbot [20] designed to understand user inquiries related to health and medical issues, regardless of whether they are voice-based or text-based. The innovation here is that users can voice inquiries about dosage and medical concerns, with responses generated through the Google API. Natural language processing (NLP) techniques underpin this chatbot, enabling seamless computer-to-computer communication through the conversion of text-to-speech and speech-to-text.

A comprehensive examination of the field of chatbots, their application trends, and the fundamental architecture governing response generation is encapsulated in the research by [21]. This study contributes significantly to our understanding of chatbots and their versatile applications. Our research is centered on assisting the visually impaired with an innovative AI chatbot. Unlike traditional text-based chatbots, it accommodates voice notes, leveraging deep neural networks and speech-to-text and text-to-speech APIs [22]. Additionally, N. Boudjani introduces an interactive AI chatbot for conducting job interviews, with a focus on French-speaking candidates. This chatbot poses questions, detects incomplete responses, and prompts for more information, streamlining job interviews [23]. This review thoroughly examines location-based recommendations and route planning in the domain of smart tourism. It underscores the significance of personalized and diverse recommendations. Our AI chatbot, designed to address language barriers in archaeological tourism, provides multi-language information and adaptive responses, thereby enhancing the tourist experience and supporting Sri Lanka's tourism growth.

There are many researchers who has developed similar kind of chatbots for different applications [24] [25].

III. Methodology

A. Smart Location-Based Recommendation Mechanism with Route Planner

The methodology of the "Smart Location-Based Recommendation Mechanism with Route Planner" encompasses the integration of data acquisition, recommendations, route planning, and user engagement, creating an intelligent travel experience. This section details the components and novel approaches that constitute this system.

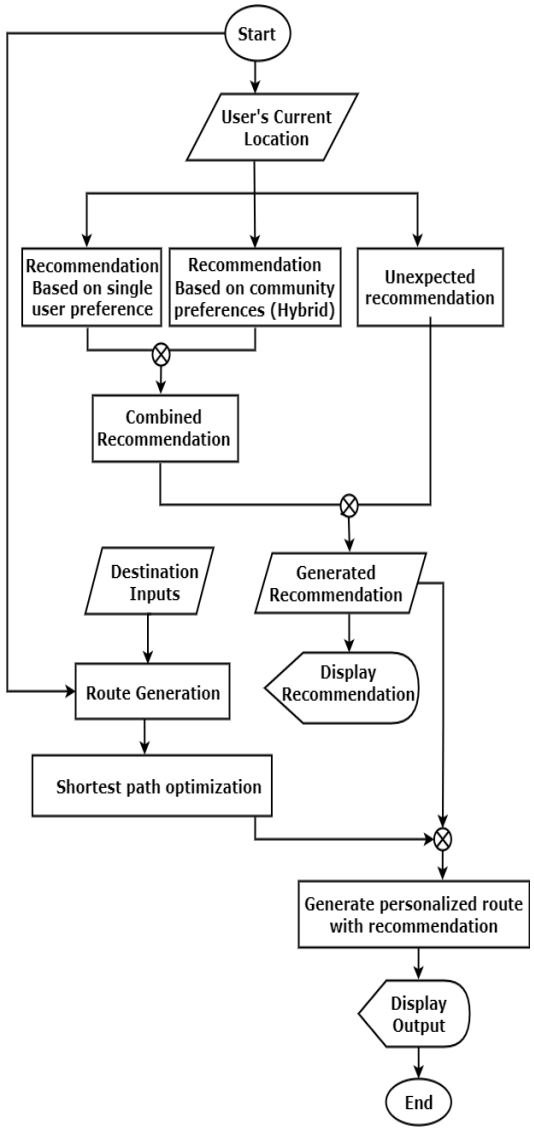

Fig. 1: Flowchart of the Smart Location-Based Recommendation Mechanism with Route Planner

B. Recommendation Mechanism

1) Dataset Description: Our research used a carefully curated dataset of 15 historically significant sites in Sri Lanka. The dataset includes attributes like historical importance, coordinates, accessibility, ratings, and reviews from government-validated sources, ensuring accuracy and reliability.

2) Location-Based Recommendation Based on Single User Preferences: Utilizing collaborative filtering techniques [26], the system tailors recommendations to users' preferences, considering factors like the type of places they want to visit, accessibility, landmarks, and more. These inputs are processed by a content-based algorithm, resulting in personalized, location-based recommendations, prioritized by proximity.

3) Location-Based Hybrid Recommendation Based on Community Preferences (Ratings/Reviews): Default recommendations are based on the user's current province. Users can modify the range for suggestions. Ratings and reviews from sources like Google Reviews are gathered. Hybrid recommendations combine community ratings with location and historical attributes. Highly rated places take priority in the list.

4) Combined Recommendation: This mechanism combines recommendations from the previous two approaches, assigning weights to each recommendation. A hybrid model, potentially based on machine learning or ensemble techniques, merges these recommendations to provide tourists with a comprehensive set of options. This combined approach ensures that users receive suggestions that align with their preferences and enjoy social validation from the community.

5) Location-Based Unexpected Recommendation: An innovation lies in surprising users with recommendations for nearby, lesser-known places [27]. Analyzing historical data and user behavior, the system suggests unique attractions users may overlook. These real-time notifications activate while users are on the move, introducing offbeat but worthwhile tourist spots.

C. Route Planner

The route planning component seamlessly integrates with the recommendation mechanism, enhancing the overall travel experience. It includes the following features:

1) Route Planner with Shortest Path Optimization: Our "Route Planner with Shortest Path Optimization" method excels in crafting efficient and engaging tourist journeys. We begin with geospatial data collection and employ the A* algorithm for route calculations, with real-time traffic data for dynamic adjustments. Routes and attraction details are displayed interactively on maps for user customization. Our novelty lies in combining established algorithms with real-time data, ensuring a delightful tourist experience, backed by rigorous testing for reliability.

2) Integration with Personalized Recommendation: The route planner and personalized recommendation system work in harmony, suggesting personalized attractions along the route, ensuring tourists visit places aligned with their interests. This methodology uniquely combines various recommendation techniques and data sources, providing personalized suggestions, and community validation, and surprises users with unique and unexpected places, enriching their exploration of Sri Lanka's historical and lesser-known attractions.

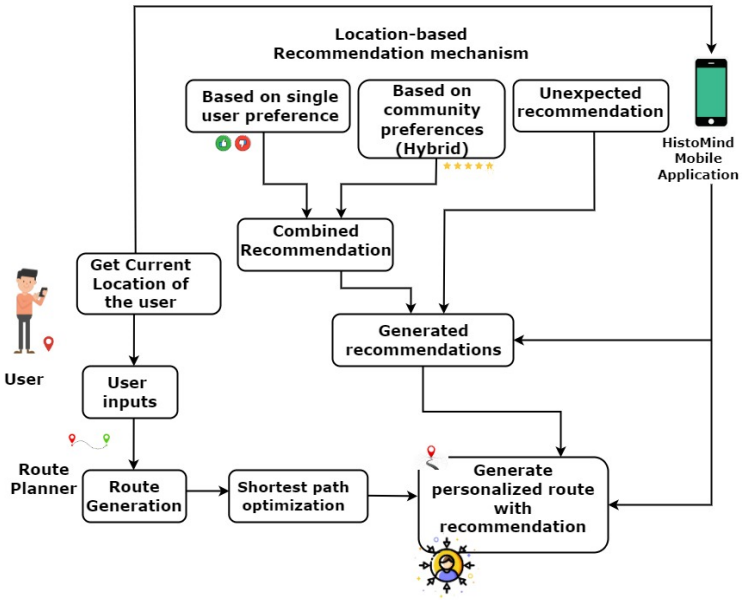

Fig. 2: Overview Diagram of the Smart Location-Based Recommendation Mechanism with Route Planner

D. AI-Based Chatbot

The HistoMind chatbot is designed to enhance communication for native speakers through the integration of AI, ML, and NLP technologies.

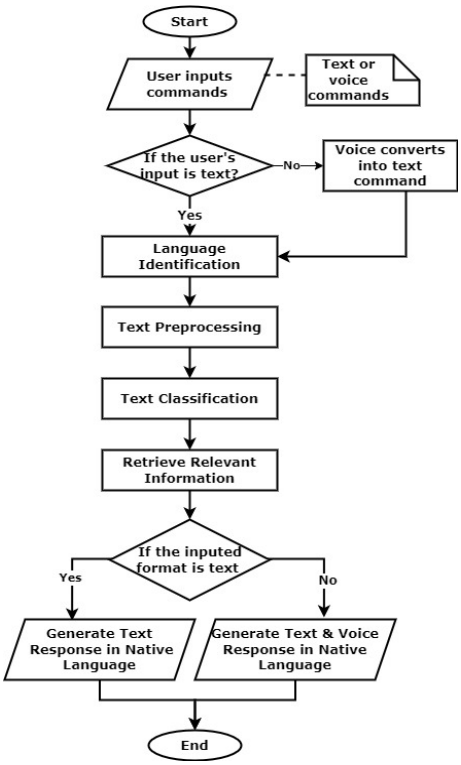

Fig. 3: Flowchart of the AI-based chatbot

To build a strong foundation for the chatbot, we gathered a dataset containing questions and answers, typically inquired by foreign tourists about historical sites. This dataset was collected from 15 of Sri Lanka's most frequently visited historical sites, ensuring the chatbot's responses are contextually relevant.

The chatbot's intelligence is driven by a powerful machine learning model, built using a Python-based framework that includes TensorFlow, Keras, and scikit-learn. This model guarantees effective communication, responding accurately to user queries. Moreover, the chatbot's advanced voice recognition capabilities, enabled by the Python SpeechRecognition module, facilitate the conversion of user voice inputs into text, enhancing accessibility and convenience. For voice interactions, we've employed the Pyttsx3 library for efficient text-to-speech conversion.

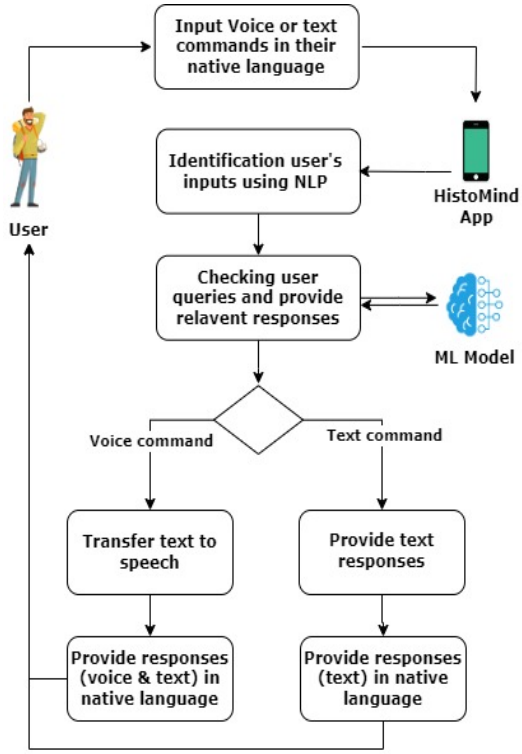

Fig. 4: System overview diagram of the AI-based chatbot

This chatbot uses AI, ML, and NLP to enhance user experiences. It detects the user's language and adjusts responses, bridging language gaps for tourists exploring Sri Lanka's historical sites.

IV. Results and Discussion

A. Smart Location-Based Recommendation Mechanism with Route Planner

The "Smart Location-Based Recommendation Mechanism with Route Planner" was subjected to rigorous testing to

evaluate its performance in suggesting personalized travel routes. The assessment aimed to determine the accuracy of recommended attractions in alignment with actual user preferences and satisfaction levels.

Table I presents the test results and accuracy percentages:

TABLE I: Test Results and Accuracy.

Test case	Actual Satisfaction	Accuracy(%)
01	Very Satisfied	98.89
02	Satisfied	97.95
03	Not Satisfied	98.90
04	Not Satisfied	99.00
05	Satisfied	98.69

The accuracy percentages offer valuable insights into the performance of the recommendation mechanism. Notably, Test Case 4 achieved an outstanding accuracy rate of 99.00% when users initially expressed dissatisfaction. In Test Case 1, an accuracy rate of 98.89% was attained for users who reported being "Very Satisfied." These results suggest that the system effectively identifies attractions that improve user satisfaction, even when the initial sentiment is less favorable.

Consistency in system performance was observed in Test Cases 2, 4, and 5, with accuracy rates of 97.95%, 99.00%, and 98.69%, respectively. These findings underscore the system's ability to provide recommendations that closely align with users' preferences, ultimately resulting in gratifying travel experiences.

However, it is important to acknowledge that the system's accuracy is influenced by several factors, including data quality, evolving user preferences, and real-time updates. Continuous refinements in these aspects present opportunities for further enhancement.

The test results affirm the success of the "Smart Location-Based Recommendation Mechanism with Route Planner" in delivering tailored and accurate recommendations, ultimately enhancing travel experiences by catering to individual preferences.

B. HistoMind Chatbot: Smart Communication for Native Speakers

HistoMind chatbot's performance in enabling smart communication for native speakers is nothing short of remarkable, offering seamless handling of text and voice inputs to facilitate versatile user interactions.

1) Text-Based Responses: Precision and Relevance: We conducted an exhaustive evaluation of HistoMind's text-based responses by subjecting the chatbot to inquiries about historical sites in Sri Lanka, comprising a total of 155 sentences. Our analysis of accuracy and relevance led to the following key findings:

The high accuracy rate of 84.5% reflects HistoMind's proficiency in recognizing and responding to user queries effectively, enhancing the overall user experience.

2) Voice-to-Text Conversion: Multilingual Capabilities: We assessed HistoMind's voice recognition capabilities through tests encompassing various languages, including English, German, and Tamil. The chatbot's accuracy in converting voice inputs to textual transcripts yielded the following results:

TABLE II: Text-Based Response Metrics.

Metric	Value
Sentences Tested	155
Correctly Recognized	131
Incorrectly Recognized	24
Accuracy	84.5%

TABLE III: Voice-to-Text Conversion Accuracy.

Language	Sentences Tested	Correctly Recognized	Accuracy (%)
English	50	46	92
German	50	43	86
Tamil	50	42	84

HistoMind demonstrates impressive accuracy in recognizing voice inputs across multiple languages, affirming its role as a versatile and multilingual communication tool for tourists and users from diverse linguistic backgrounds.

3) Multilingual Support: User Satisfaction: To further evaluate HistoMind's multilingual response capability, we collected user satisfaction ratings regarding the reception of responses in their preferred languages. The summarized results in Table III provide insights into user satisfaction:

TABLE IV: User Satisfaction for Multilingual Support.

Language	User Satisfaction (%)
English	94
German	92
Tamil	90

HistoMind's multilingual support significantly enhances user accessibility, fostering high levels of user satisfaction, and thereby contributing to an inclusive and accommodating user experience.

4) User Feedback: Intelligent Communication and Historical Information Dissemination: Gathering user feedback from surveys and interviews, we found that HistoMind earned high praise for its ease of use and response quality. Its multilingual support and positive feedback validate its effectiveness in enhancing cultural exploration and historical experiences.

V. Conclusion

Our study showcases the remarkable accuracy of our "Smart Location-Based Recommendation Mechanism with Route Planner." Notably, Test Case 1 achieved a remarkable 98.89% accuracy for "Very Satisfied" users, while Test Case 3 improved "Not Satisfied" preferences, reaching an impressive 98.90% accuracy. These results highlight our system's positive impact on user satisfaction.

Our innovative solution has the potential to revolutionize the tourism industry. It enhances visitor satisfaction through personalized recommendations and efficient route planning.

Real-time updates and alternative routes ensure a seamless travel experience, even during disruptions.

The success of our system depends on data quality, diversity, and user feedback. Its adaptability makes it a valuable asset in an ever-evolving tourism landscape, benefiting tourists and industry stakeholders.

With "HistoMind," we're personalizing travel in Sri Lanka. It goes beyond efficient navigation, revealing hidden gems, and creating unique experiences. As the tourism industry evolves, our system remains ready to enhance unforgettable journeys.

The HistoMind chatbot excels in both text and voice interactions, achieving an impressive 84.5% sentence recognition accuracy. Multilingual support receives high user satisfaction rates of 94.0%, 92.0%, and 90.0% for English, German, and Tamil. This enhances accessibility and cultural experiences for native speakers.

Our research and technologies lay the foundation for an exciting future in travel and tourism. The combined strengths of our recommendation system and chatbot promise a more immersive and culturally diverse travel landscape, setting new standards in smart communication and user experience.

VI. Future Work

Our future work focuses on enhancing tourism experiences and technology solutions. This includes Enhanced User Profiling for personalized recommendations based on user profiles enriched with travel history and reviews. User Engagement Analytics offers insights for recommendation system refinement and adaptation to changing preferences. The cross-destination expansion aims to broaden our system's global reach, catering to diverse travel preferences and the global tourism market. For HistoMind, our AI chatbot, we aim to achieve Enhanced Multimodal Interaction, expand Language Support, and develop Contextual Understanding, ensuring smarter, personalized, and culturally enriching travel through advanced technology.

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