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Tour Enhance: A Novel Rule-Based Travel Planning System

Zihan Guan

Department of Computer and Information Science, University of Macau, Macao, 999078, China
Corresponding author: dc22826@umac.mo

Abstract:

Tourism significantly contributes to economic growth, particularly evident from China's rapid post-recovery increase in travel demand. This surge underscores the necessity for accessible, well-organized tourist information. Given the vast number and broad distribution of tourist sites, intelligent filtering and visualization of these locations are crucial. This paper introduces Tour Enhance, an interactive system designed to dynamically exchange information between the system and its users. Unlike traditional static methods, Tour Enhance utilizes real-time processing to tailor travel recommendations to individual user preferences, thereby improving user engagement and satisfaction. This study undertakes three key tasks: statistical analysis and visualization of tourist data, rule-based recommendation generation, and user survey-based evaluation of these recommendations. The effectiveness of Tour Enhance was assessed through a user study with 57 participants, who highly rated the system on interface usability, functionality, and accuracy of recommendations. The results demonstrate that Tour Enhance effectively enhances the travel planning process, highlighting the significant advantages of integrating interactive systems and personalized data visualization in tourism. This research contributes to the advancement of human-computer interaction applications in tourism and lays the groundwork for future studies focused on enhancing user experiences through technological innovations.

Keywords: Travel Planning; Tour Enhance; Data Visualization.

1. Introduction

China's rapid economic recovery in recent years has led to a significant upsurge in tourism demand. This growth has catalyzed a crucial need for accessible, reliable, and comprehensive tourist information that can adapt to a dynamic market [1]. Traditional methods of delivering tourist information have heavily relied on static visual charts and graphs, which, although useful for straightforward data presentation, often fall short in engaging users and addressing individual preferences. This lack of interactivity and personalization in tourist information services has highlighted a significant gap in the current tourism literature and practice [2].

To address these challenges, this paper introduces Tour Enhance, a novel interactive system designed specifically to enhance the travel planning experience through a dynamic two-way exchange of information. Unlike previous approaches that offer static data presentations, Tour Enhance leverages cutting-edge technology to process real-time user inputs and respond with personalized information and recommendations. This capability to adapt instantaneously to user queries and preferences marks a substantial advancement in the field of tourist information systems.

The design of Tour Enhance centers around key functionalities essential for optimizing user experience: capturing user inputs, accessing, and processing up-to-date datasets, performing complex computations, and presenting data through intuitive, interactive visualizations. These features are crucial for providing tailored travel recommendations that are both relevant and timely, thereby significantly enhancing user engagement and satisfaction.

Furthermore, the effectiveness of Tour Enhance was rigorously tested through a user study involving 57 volunteers who evaluated various aspects of the system, including the user interface, functionality, accuracy of recommendations, and overall user experience. The feedback received was overwhelmingly positive, with the system achieving high satisfaction ratings across all evaluated metrics. This initial validation not only confirms the utility of Tour Enhance but also underscores the transformative potential of interactive, personalized information systems in the tourism industry.

In subsequent sections of this paper, the work will first delve into the datasets utilized by the system, covering data acquisition, processing, and visualization (Chapter 2). Following that, the author will outline the design of the Tour Enhance system, which includes a detailed discussion on the system overview, the rule-based travel plan recommendation mechanism, and the human-machine interface (Chapter 3). Next, the document presents the experimental results and the performance evaluation of

the system (Chapter 4). Finally, the author will conclude on the findings and future research directions (Chapter 5). This structure aims to thoroughly present how Tour Enhance introduces significant advancements in the domain of tourist information systems, setting a new benchmark for effectively utilizing tourism data to meet the evolving needs of modern travelers.

2. Data Acquisition and Visualization

2.1 Dataset Overview

This study utilizes three meticulously curated datasets that are central to the operational capabilities of Tour Enhance. The standard dataset forms the backbone of the system‘s intelligent recommendation features, while the supplementary datasets enhance its output visualization functions. The assembly of the standard dataset was an extensive process, involving the aggregation of substantial quantitative data, to construct a robust foundation for the analyses.

To accurately portray the daily costs associated with tourism in China‘s diverse provinces, this work developed a comprehensive dataset referred to as standard. The primary data sources for this dataset were twofold: first, the system incorporated monthly average expenditure data from the National Bureau of Statistics, providing a macroeconomic view of tourism expenditure [3]. Second, the system integrated average hotel prices, which were meticulously extracted through web scraping techniques from well-established travel service platforms.

2.2 Data Processing

Data integrity is the cornerstone of reliable analysis. To uphold this principle, the data processing strategy was multifaceted. It encompassed a thorough cleaning process to remove any incomplete entries and eliminate redundancy. This was achieved by meticulously identifying and excluding duplicate records, which are detrimental to the integrity of statistical analyses.

Moreover, this work standardized the nomenclature within the datasets to ensure consistency. For instance, in the dataset comprising national tourist sites, this work harmonized the regional names by removing provincial and city suffixes. The aim was to achieve a uniform naming convention across all datasets, which was particularly challenging when aligning with the Grade-A sites dataset that employed abbreviated names for certain regions. By expanding these to their full, official designations, this work aligned the datasets with formal naming standards widely recognized in academic and governmental circles.

The final step in the data processing journey involved discarding any records with missing values, further enhancing the reliability of the datasets. These preparatory measures were critical for setting the stage for meaningful, subsequent analyses and were pivotal in evaluating the economic impact of tourism across different locales. Upon culmination of the data cleaning and standardization processes, this work preserved the datasets in a structured Excel format, ensuring that they remained easily accessible and usable for future research endeavors.

2.3 Data Visualization

Our visualization efforts were comprehensive, employing advanced data analysis libraries to create informative and engaging graphical representations of the datasets. This work sought to unravel the complexity of tourism distribution across China by creating visual aids that could communicate the findings effectively. Results are visualized in Fig. 1 and Fig. 2.

This work will showcase the visual output of the analysis. These figures are poised to illustrate the spatial distribution of A-class scenic areas and the wider landscape of tourist attractions across various provinces. Through meticulous data preparation, this work has generated bar charts that not only capture the volume of tourist spots but also elucidate the regional characteristics that shape the development of tourism infrastructure in China.

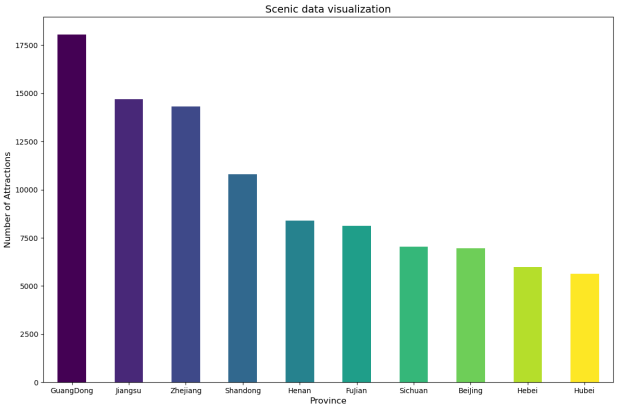

Fig. 1 Scenic data visualization (Figure Credit: Original).

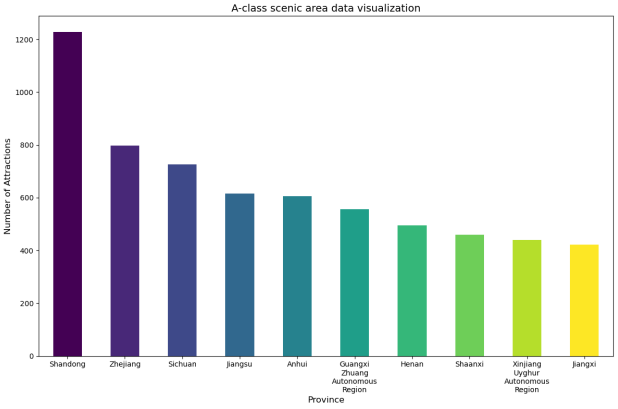

Fig. 2 A-class scenic area data visualization (Figure Credit: Original).

These visualizations are integral to this study; they not only reveal the disparate allocation of tourist resources but also provide empirical support for policy formulation and the strategic planning of tourism development. By presenting a clear visual narrative, this work enables stakeholders to discern patterns and insights that may otherwise remain hidden in raw data. It is through these visual representations that this work facilitates a deeper understanding of the tourism sector and its distribution across the Chinese landscape.

3. Design of Tour Enhance System

3.1 System Overview

The Tour Enhance system presents a user-friendly graphical interface, meticulously designed to facilitate personalized travel planning. Utilizing Python's Tkinter library, the interface is laid out with entry fields prompting the user to specify the month of travel, budget, and duration of their trip. These inputs act as critical parameters, steering the system's internal mechanisms to churn out customized travel recommendations that resonate with the user's financial scope and seasonal considerations. Through a continuous and responsive Graphical User Interface (GUI), users are navigated through the nuances of travel planning, making it an efficient and interactive experience.

3.2 Rule-based Travel Plan Recommendation

In the heart of Tour Enhance lies the rule-based recommendation algorithm, an intricate component meticulously crafted to align travel recommendations with user-defined parameters. This system component springs into action following a user's submission of travel dates, budget, and desired trip duration. Python's pandas library processes this information, accessing an extensive 'standard.xlsx' dataset which captures the daily standard expenses across various Chinese provinces, adjusted for seasonal variations during peak months such as January, February, July, August, and October. The DataFrame, a central pandas construct, is employed to apply conditional logic that recognizes and responds to user input.

Upon entry, the system first adjusts for seasonal price inflation in metropolitan hotspots—namely Beijing, Shanghai, and Guangzhou—by augmenting the 'standard' cost within the dataset to mirror the increased travel costs during high-demand periods. This nuanced adjustment is pivotal, as it ensures that the recommendations remain as realistic and timely as possible. Following this, a daily budget is calculated by dividing the total budget by the number of days intended for the trip. The algorithm then embarks on a meticulous filtration process, segmenting potential destinations into three affordability tiers, defined by the daily budget.

For each destination, the 'standard' cost is scrutinized against the daily budget. Destinations falling comfortably under this threshold are earmarked for luxury accommodation suggestions, offering the traveler options for a star-rated stay within their means. Conversely, the algorithm identifies regions slightly surpassing the budget, recommending budget hotels, ensuring travelers can enjoy their sojourn while adhering to their financial constraints. Finally, areas where expected expenses substantially exceed the budget are flagged, suggesting that the traveler either adjusts their financial plans or reconsiders their destination choice.

This entire process is made tangible to the user through the Tkinter list box, a simple yet effective GUI component that presents the tiered recommendations. Users interact with the system via buttons that trigger backend functions, bringing the algorithm's decision-making to life. The list box populates with destinations, each associated with a clear financial implication, ensuring the user can make an informed decision in alignment with their budgetary and travel aspirations.

Thus, this rule-based recommendation algorithm stands as the cornerstone of the Tour Enhance system, exemplifying the harmonious blend of user input, data-driven logic, and interactive interface design to elevate the travel planning experience to new heights of personalization and user engagement.

3.3 Human Machine Interface

The human-machine interface of Tour Enhance is a testament to the system's commitment to user interactivity. Upon selection of a recommended province from the Tkinter list box, the system, through a set of labeled buttons and additional Tkinter widgets, prompts the user to express their interest in focusing solely on star-rated tourist attractions. In alignment with this preference, an interactive Folium map is generated, depicting the scenic spots with markers color-coded according to their star grade, leveraging geographic data to furnish the user with a visual guide for planning their itinerary.

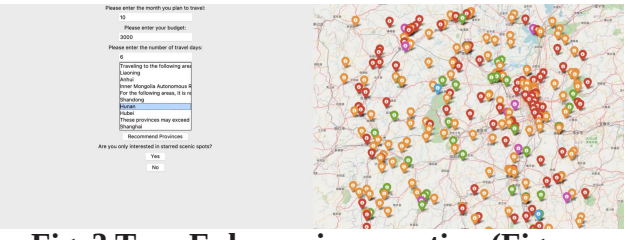

Fig. 3 Tour Enhance in operation (Figure Credit: Original)

As shown in Fig. 3, the user interface, thus, not only simplifies the selection process but also enriches the user's

planning experience with visual data representations. By interlinking advanced Python libraries with a thoughtful interface design, the system ensures that travel planning transcends mere utility to become an engaging, adaptive, and user-centric journey.

4. Evaluation of Tour Enhance System

4.1 Evaluation Details

A comprehensive evaluation study of Tour Enhance was conducted with the participation of 57 volunteers. These individuals were sourced from an array of demographic backgrounds, thereby providing a representative sample of the system's target user base. The volunteers were recruited from diverse geographic locations and varied in terms of age, gender, and previous travel planning experience. The purpose of the evaluation was to systematically assess critical facets of the system: the user interface design, the functionality and utility of the features, the accuracy of the recommendations generated, and the overall user satisfaction with the experience.

The user study deployed an array of data collection methods, including surveys for quantitative feedback and focus groups for qualitative insights. Participants were asked to engage with the system, performing a series of tasks designed to assess how intuitively they could navigate the interface and how useful they found the travel planning features. Each participant's interaction was logged for detailed analysis, with the specific aim of understanding the real-world applicability of the system's functionalities.

4.2 Performance Evaluation

The evaluation yielded a nuanced dataset, which provided a rich basis for a thorough analysis of the Tour Enhance system's performance from a user-centric perspective. Representative examples are shown in Table 1, with overall evaluation in Fig. 4. Detailed examination of the user feedback revealed a strong endorsement of the system's interface, with participants rating its intuitiveness and ease of use highly, averaging at 4.5 out of 5. This suggests that the user interface design effectively met the usability expectations of most users.

Table 1. Representative examples of user evaluation

Gender	Age	Education	Overall Experience	Functionality	Interface Design	Accuracy	Functionality
Male	18	Bachelor	4	5	5	2	5
Female	20	Master	4	5	5	5	4
Male	17	Bachelor	5	4	4	5	5
Male	23	Doctorate	5	5	3	4	5

Functionality was another area where Tour Enhance excelled, with participants finding the range of features comprehensive for their travel planning needs, which led to a robust rating of 4.3 out of 5. However, the insights also pointed toward a demand for additional personalization options within the system, which could further streamline the travel planning experience.

Recommendation accuracy, rated at 4.2 out of 5, was reflective of the system's ability to generate relevant and useful travel suggestions, although this dimension exhibited room for improvement. Users indicated occasional discrepancies between their preferences and the system's recommendations, suggesting a need for refinement in the underlying algorithm to better align with user expectations.

The overall user experience stood out with a strong positive rating of 4.4 out of 5. This highlighted the system's potential in significantly enhancing the process of planning travel, aligning with the users' desire for an efficient, responsive, and satisfying planning tool. Notably, the feedback captured through the study was not merely quantitative but also rich with qualitative insights, which provided depth to the numerical ratings and painted a clearer picture of the user journey within the system.

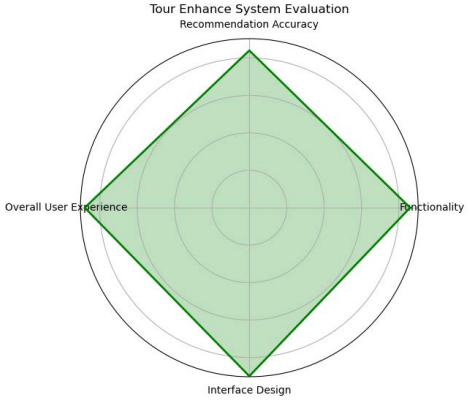

Fig. 4 Overall user experience evaluation (Figure Credit: Original).

The aggregation and visualization of this data in a radar chart provided a holistic view of the system's multifaceted performance, allowing for an at-a-glance assessment of

where the system stands in terms of meeting user needs and where it can evolve. The chart served as a pivotal tool for summarizing the complex feedback, translating the diversity of user experiences into a format that was both interpretable and actionable for system developers.

In summation, the collected data underscores the successes of Tour Enhance in several key areas while also providing constructive pathways for future enhancements. With these insights driving the next phase of system development, there is a clear opportunity to refine the system's algorithms and personalization capabilities, with the goal of delivering an even more tailored and user-friendly travel planning experience in future iterations.

5. Discussion and Prospects

The Tour Enhance system introduced in this thesis marks a significant advancement in tourism information systems, significantly enhancing traditional services through interactive features and personalized data visualization. Designed with a user-centric approach, it enables dynamic two-way communication essential in the rapidly evolving tourism sector. The system's successful deployment and positive evaluations suggest its potential to revolutionize travel planning, setting a new benchmark for future systems in the industry [4,5]. Despite these promising outcomes, the study faced limitations, notably the use of secondary processed data sources, which could impact data accuracy. This necessitated estimations, particularly in predicting travel costs and budget elasticity, not based on comprehensive big data models but rather on the author's calculations, pointing to areas for future enhancement [6,7]. The user study provided invaluable feedback, with high ratings in interface design, functionality, and recommendation accuracy, highlighting the system's strong user approval while also revealing opportunities for improving its predictive capabilities and refining the user interface [8,9]. Looking ahead, the research will focus on enhancing the algorithm with machine learning techniques for more accurate prediction of user preferences and expanding the dataset to enable more detailed analyses and cater to a broader range of preferences. Prioritizing the acquisition of raw data from primary sources will address concerns over data precision, ensuring that Tour Enhance remains at the forefront of technological innovation in the tourism industry [10].

6. Conclusion

In conclusion, Tour Enhance has emerged as a significant innovation in the domain of tourism information systems. It addresses the long-standing need for interactivity and personalization in travel planning, as evidenced by the positive outcomes of the user study. The research presented in this paper not only underscores the potential of Tour Enhance to revolutionize travel planning but also provides a benchmark for future advancements in the field. Despite the system's successes, there is an exciting avenue for future enhancement, particularly through the integration of machine learning to refine the accuracy of personalized recommendations. The prospect of utilizing comprehensive big data analytics in tourism, also presents an opportunity to further elevate the travel planning experience.

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