International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 7, Issue 10, pp 479-486, October-2023

https://doi.org/10.47001/IRJIET/2023.710063

Trip Planning Management System

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***Abstract* - This research introduces an advanced Trip Planning Management System aimed at revolutionizing the conventional approach of manual travel itinerary creation. The system integrates four pivotal components, each catering to a distinct aspect of travel planning automation. The Location Planning module takes the guesswork out of destination selection by leveraging traveler preferences to suggest optimal categories. Complementing this, the Route planning module employs real-time data and algorithms to automatically determine the most efficient routes between recommended destinations, optimizing travel time. Simultaneously, the Hotel Planning component eliminates the painstaking process of sifting through accommodation options by offering tailored suggestions based on a variety of factors, including budget and location. Lastly, the Extra Activities Planning module adds a layer of enrichment to the travel experience by algorithmically recommending leisure activities that resonate with traveler interests. This innovative system redefines travel planning, making it more convenient, personalized, and enjoyable through strategic automation.**

Keywords: Trip planning, hotel, budget, travel, hotel planning, automation, trip planning management.

I. INTRODUCTION

In today's fast-paced world, travel has become an essential part of our lives, whether it's for business, education, or leisure. With the advent of technology and online resources, planning a trip has become more accessible than ever before. However, existing travel recommendation systems often fail to provide personalized and reliable recommendations, leading to contradictory information and limited options for travelers. To address these limitations, a comprehensive Trip Planning Management System has emerged, encompassing four key components: location planning, hotel planning, route planning, and extra activities planning. This system leverages advanced technologies, including machine learning and real-time data analysis, to deliver tailored recommendations that cater to individual preferences and requirements, thereby enhancing the overall travel experience.

A) Location Planning

Location planning is a vital part of trip planning, as it involves selecting destinations that cater to travelers' preferences and requirements [1]. The Trip Planning Management System considers various factors, including traveler preferences and reviews. Unlike generic recommendation systems, this component incorporates dynamic variables and traveler-specific preferences [2]. The system can analyze extensive data, including traveler ratings and reviews, to predict the best locations [3]. Leveraging advanced matrix factorization algorithms, the system can provide precise and personalized location suggestions.

B) Hotel Planning

Modern travelers navigate a vast landscape of accommodation choices, seeking not just a place to stay but an experience that resonates with their preferences. Hotel recommendation systems have emerged as valuable allies in this pursuit, leveraging data-driven insights and advanced algorithms to streamline the decision-making process.[4] These systems serve as personalized guides, analyzing factors such as historical booking trends, guest reviews, and hotel attributes to suggest tailored options. As travelers increasingly prioritize convenience and relevance, these recommendation systems offer a solution that not only simplifies hotel selection but also enhances the overall travel experience. Our research focuses on refining the accuracy of such recommendations by introducing the "Preference-Weighted Recommender," which adeptly balances popularity and quality metrics, ensuring that travelers receive suggestions that truly align with their desires.

C) Route Planning

One of the challenges faced by travelers is identifying convenient routes, accessing assistance, and locating popular destinations. The route planning component of the Trip Planning Management System addresses these challenges by leveraging real-time data and advanced algorithms, It considers traveler preferences, traffic patterns, and other relevant factors to generate optimal travel routes [5] By avoiding congestion, suggesting alternative routes, and considering peak hours, this component aims to enhance the

ISSN (online): 2581-3048
Volume 7, Issue 10, pp 479-486, October-2023
https://doi.org/10.47001/IRJIET/2023.710063

convenience and maximize the pleasure of visiting tourist locations [8] Travelers can rely on the system to provide accurate and up-to-date route recommendations, ensuring a smoother and more efficient travel experience.

D) Extra Activities Planning

To offer a more immersive and authentic travel experience, the Trip Planning Management System includes a component dedicated to extra activities planning. This component recognizes the growing demand for unique experiences during travel and focuses on promoting various activities that complement the destination's attractions. Whether it's adventure tourism, eco-tourism, cultural tourism, community-based tourism, or gastronomy tourism, the system provides recommendations for activities based on travelers' preferences and interests. By considering factors such as the destination's natural features, cultural heritage, and available resources, this component enables travelers to explore a diverse range of experiences and create memorable moments.

In conclusion, the Trip Planning Management System revolutionizes the way we plan and experience travel. By leveraging advanced technologies and incorporating personalized recommendations, this system empowers travelers to make informed decisions, discover new destinations, and create unforgettable memories. With its focus on location planning, hotel planning, route planning, and extra activities planning, the system ensures that each aspect of the trip is carefully considered, leading to enhanced travel experiences, higher customer satisfaction, and increased loyalty.

II. LITERATURE SURVEY

A) Location Planning

Today, travel is a necessity of life. Travel is done for a variety of objectives, including business, education, and pleasure. Planning is necessary in every situation. There are numerous things to think about, including the time of year, the weather, safety, finances, costs, and distance. To organize their vacations, many individuals turn to online resources and tools like Google Maps. Even while these systems use resources like satellite images to continuously improve the mapping of locations, they have a generic outlook that does not always give a traveler the greatest options. Due to this, travelers frequently end up finding information from numerous travel blogs and websites, much of which contain contradictory information.[9]

This is mostly because most current recommendation algorithms only consider the distance or time between two destinations, ultimately recommending either the quickest locations or shortest routes [7] Additionally, the recommendation systems are very impersonal.

They don't implement dynamic variables based on individual traveler preferences. Additionally, most recommendations consider geographical maps and actual road networks. According to Seyidov and Adomaitiene (2016) [6], other well-known travel websites either rely on traveler evaluations or historically popular places [11]. A recommender algorithm that incorporates the aspects discussed above and makes predictions based on a traveler's reviews and ratings can provide more personalized and reliable recommendations.[10]

B) Hotel Planning

The evolution of personalized travel experiences has been significantly shaped by the emergence of intelligent recommendation systems, with hotel recommendations standing as a prominent domain of exploration. Existing research has encompassed an array of methodologies, from collaborative and content-based filtering [16], [19] to the integration of deep learning techniques [18], and the development of preference-based hotel selection models [17].

Our research, however, introduces a pioneering perspective through the "Preference-Weighted Recommender" (PWR). This innovative approach strategically bridges the gap between average ratings and the number of votes, effectively enhancing the recommendation accuracy. Unlike conventional systems that predominantly rely on popularity, PWR considers the holistic quality of each hotel, ensuring that travelers are provided with tailored, comprehensive recommendations.

Furthermore, our study contextualizes the PWR within the larger framework of comprehensive travel planning. We recognize that an enriching travel experience transcends hotel selection, extending to location planning, optimized route mapping, and personalized activity suggestions. By synergistically integrating these components, we envision an all-encompassing travel application that caters to the diverse preferences and requirements of travelers.

The culmination of our research envisions a cohesive travel planning solution, where the amalgamation of accurate hotel recommendations, optimal location planning, route optimization, and tailored activity suggestions converge to create a superlative traveler experience. This integrated approach, aimed at harmonizing recommendation accuracy with a broader travel context, strives to elevate the journey and overall satisfaction of modern travelers.

ISSN (online): 2581-3048
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C) Route Planning

The evolution of tourism management systems has led to the exploration of personalized route planning strategies that consider traveler preferences and employ advanced algorithms. In comparing this research approach with existing studies, several notable differences and innovations emerge.

While previous studies have touched on traveler preferences in travel planning [12], this research stands out by allowing travelers to rate various location categories based on a 0 to 10 scale. By leveraging this dynamic input, the system tailors' recommendations in a granular manner. This approach differentiates itself from traditional systems that often rely on a simple selection of predefined preferences.

The incorporation of nearest neighbor graph theory for both starting and destination locations is a distinctive feature. This consideration accounts for the holistic journey, ensuring that suggested attractions are strategically positioned along the entire route [13]. This holistic view of travel planning marks a departure from studies that predominantly focus on proximity to the starting point.

The application of utility theory for recommendation enhancement by employing unique ratios [14] showcases an innovative means of adjusting preferences based on traveler behavior. This surpasses conventional methods that might solely rely on linear adjustments or fixed weightings.

By incorporating practical time constraints and waiting periods into the itinerary creation process [15], this research addresses a common shortcoming of existing models. This innovation aligns with the evolving travel landscape where time efficiency is paramount.

In essence, this research propels the field of personalized travel planning by amalgamating advanced techniques to craft holistic, data-driven itineraries. By integrating traveler preferences, harnessing graph theory, employing utility-based recommendations, accommodating time constraints, and enhancing data management, this approach redefines the travel planning experience for modern explorers.

D) Extra Activities Planning

This collection of studies delves into diverse aspects of Sri Lanka's tourism sector. "Adventure Tourism in Sri Lanka" [20] examined activities like hiking and rafting, finding overall satisfaction but pinpointing safety and facility improvements. "Ecotourism in Sri Lanka" [21] focused on wildlife and nature experiences, revealing motivations for nature exploration and the need for better site management. "Cultural Tourism in Sri Lanka" [22] centered on temple visits, revealing a content visitor base but a desire for improved interpretation. "Community-Based Tourism in Sri Lanka" [23] explored homestays and tours, highlighting the potential benefits for both visitors and communities, despite infrastructure and marketing challenges. Lastly, "Gastronomy Tourism in Sri Lanka" [24] investigated culinary experiences, noting the attraction of local cuisine and culture, while recommending enhanced promotion and infrastructure. These studies collectively showcase a comprehensive view of Sri Lanka's adventure, ecotourism, cultural, community-based, and gastronomy tourism segments, offering insights for enhancement and addressing potential hurdles.

III. METHODOLOGY

A) Location Planning

The way we develop the Location Planning part in the Trip Planning Management System involves a step-by-step process to make sure travelers get better and more personalized location suggestions. We use smart computer methods and techniques to do this, making sure we consider things that change, like traveler preferences and specific needs. We start by gathering information from various sources, like reviews from travelers. We then carefully organize this data, fixing any missing parts. After that, we use a smart technique called collaborative filtering, with a special algorithm named SVD++. This helps us figure out patterns in how people like things. We teach this algorithm with the historical interactions between travelers and places, making sure our suggestions are accurate and personal. To see how well our system works, we test it with travelers and predict how they might rate different places. If a place gets a higher rating than normal, we suggest it to the traveler. All of this brings us to a list of personalized recommendations that fit each traveler's preferences. By mixing different aspects, smart tools, and collaboration, our approach improves how we plan trips, making them more unique and enjoyable. This method fixes the problems of basic suggestions and focuses on what each traveler really likes, making trip planning systems much better.

Our key method involves using advanced techniques, especially collaborative filtering with the SVD++ algorithm. This algorithm figures out patterns in what people like. It uses a "traveler-item" rating chart as a base, predicting missing ratings, which is crucial for personal suggestions.

To explain SVD++, think of it as breaking a matrix into two parts. One part describes what travelers prefer; the other how important certain things are for a place. Combining these parts helps predict missing ratings.

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The SVD++ power comes from including past interactions between travelers and places. This adds authenticity. We test the system with travelers, predicting their ratings for places. If a place gets a higher rating than usual, we suggest it. All of this leads to a list of personalized recommendations based on each traveler's preferences.

By blending data, smart tools, and history, we improve trip planning, making it more enjoyable. This fixes the issues with basic suggestions and focuses on what each traveler truly likes.

B) Hotel Planning

The Hotel Planning system is designed to offer travelers a personalized and efficient method for selecting their ideal accommodations. With the ability to explore multiple options, travelers can seamlessly choose the perfect hotel that caters to their specific requirements. Once travelers have selected a hotel through our intuitive interface, they can take advantage of an additional feature that enhances their experience even further. By clicking on their chosen hotel, they will be seamlessly redirected to Google Maps, where they can visualize the hotel's precise location. This integration with Google Maps not only provides travelers with a clear understanding of the hotel's surroundings but also makes it incredibly convenient to assess its proximity to key landmarks, transportation hubs, and other points of interest. This innovative feature aims to provide travelers with a comprehensive perspective, ensuring they can confidently make an informed decision about their lodging. By combining the power of recommendation models and seamless map integration, our system facilitates an effortless and enjoyable hotel selection process, ultimately contributing to a memorable and satisfying travel experience. Our approach revolves around the integration of machine learning techniques, with a particular focus on two primary recommendation models: the Preference-Weighted Recommender and Content-Based Filtering. These models work in tandem to provide travelers with highly tailored hotel options, ensuring a satisfactory and customized experience.

The Preference-Weighted Recommender (PWR) plays a pivotal role in our recommendation framework, tailoring hotel suggestions based on traveler preferences. It calculates a weighted score for each hotel by considering factors such as the average rating and the number of ratings received. The mean rating and a minimum vote requirement are used to filter out less popular hotels. The formula for calculating the score involves both the hotel's average rating and the minimum vote requirement. Afterward, the script allows travelers to search for hotels by city, set a maximum price, and sort the results based on the calculated score.

The Preference-Weighted Recommender Equation

$$PWR = \frac{c}{c+m} .R + \frac{m}{c+m} .H$$

where:

c: vote count

m: minimum vote requires

R: rating mean each hotel

H: all hotel rating

The second case involves content-based filtering, which leverages textual information about hotels to make recommendations. Using the TF-IDF (Term Frequency-Inverse Document Frequency) vectorization technique, the script transforms the hotel descriptions into numerical vectors. Cosine similarity is then used to calculate the similarity between hotels based on their descriptions. Travelers input a hotel name, and the script provides recommendations of hotels with similar descriptions, sorted by their price per night.

This Case focuses on filtering hotels based on desired amenities. Travelers can specify amenities they are looking for, such as "Wi-Fi" or "pool," separated by commas. The script then filters hotels based on whether their descriptions contain the specified amenities. Hotels with matching amenities are ranked by their previously calculated weighted scores and displayed as recommendations.

In conclusion, the methodology presented above forms the foundation of our research on developing an innovative Hotel Plan Management System. By leveraging techniques and focusing on the Preference-Weighted Recommender (PWR) and Content-Based Filtering, our system endeavors to provide travelers with the best-suited lodging options based on their preferences, budget, and individual feedback. This approach aims to address the limitations of conventional hotel recommendation systems, offering greater personalization and ensuring continuous improvements in the recommendation process over time.

C) Route Planning

This section outlines the systematic approach employed to create a personalized route planning system that incorporates traveler preferences, location categories, graph theory, utility theory, and modern APIs. The aim is to generate efficient travel itineraries that consider individual preferences, temporal constraints, and real-world travel distances. The research methodology is structured as follows:

To initiate the process, travelers provide preference ratings ranging from 0 (no preference) to 10 (highest

ISSN (online): 2581-3048
Volume 7, Issue 10, pp 479-486, October-2023
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preference) for distinct location categories. The study focuses on specific categories: Temples, Beaches, Parks, historical places, and art galleries within the Galle district. Utilizing the "Google Places Autocomplete" API, travelers specify their starting and destination locations. This input gathering yields essential data, including geographical coordinates for both locations and preference ratings associated with each category.

Upon obtaining traveler input, the system commences by evaluating the provided ratings for each location category. Categories with a rating of 0 are excluded from consideration. The category with the highest rating is identified as the focus. Employing nearest neighbor graph theory, the nearest locations within this category are selected, accounting for their proximity to both the starting and destination points. This information contributes to the construction of a matrix based on the average distances for the selected category.

Enhancing the accuracy of route suggestions is paramount. Therefore, the matrix is enriched with real-world travel distances obtained through integration with the Open-Source Routing Machine (OSRM) API. This integration ensures that the recommended route reflects actual travel times, ultimately yielding more practical and efficient travel plans.

To further refine recommendations, the methodology introduces utility theory. The preference ratings are adjusted using category-specific ratio values. Each category is assigned a unique ratio; for instance, a beach category might have a ratio of 0, signifying that only one beach is recommended. Conversely, a ratio of 0.75 for Temples implies a 25% reduction in the initial rating. This approach prevents an excessive concentration of recommendations within specific categories. Additionally, waiting times tailored to each category are factored in, adhering to a 10-hour time limit between 8.00 a.m. and 6.00 p.m.

The route generation process is iterative, with emphasis on adjusted ratings and waiting times. This iterative process continues until the allocated time limit is reached or preference ratings dwindle to zero. The final recommended locations are ordered based on proximity to the starting point, ensuring the feasibility and efficiency of the suggested itinerary.

The outcomes of the model, comprising latitude, longitude, and place names, are systematically stored in a MongoDB database. Subsequently, these results are seamlessly integrated into the front-end interface. Through the front end, travelers can visualize recommended locations on a map. The front-end leverages direction APIs to plot the shortest routes between identified locations, offering travelers a clear and interactive representation of their customized travel plans.

In summation, this research methodology presents a holistic approach to personalized route planning, integrating traveler preferences, location data, graph theory, utility theory, and contemporary APIs. The methodology not only optimizes travel recommendations but also forms a foundation for future advancements in dynamic real-time integration, sophisticated algorithm enhancements, and an enriched traveler experience.

D) Extra Activities Planning

The two key elements of this study's exploration of improving leisure activities are a smart location suggestion engine and an avant-garde chatbot interface. Starting with thorough data preparation, the location suggestion system takes a multidimensional approach. Numerical characteristics are extracted to capture the essence of distinct site types via the lens of TF-IDF vectorization. Through the calculation of cosine similarity, this numerical representation serves as the cornerstone for measuring the similarities across location categories. With its deep awareness of location type similarities, the K-Nearest Neighbors (KNN) algorithm effortlessly enters the fray and orchestrates the development of suggestions. The chatbot feature is equally compelling as it painstakingly creates the groundwork for easy communication.

This journey starts with preprocessing the input, moves on to encoding and lexicalizing traveler communications, and concludes with a trained neural network's ability to decipher intentions and provide replies that are compelling. The location recommendation system is ready to make significant leaps amid the horizon of novelty; hybrid tactics may be used to combine discrete similarity metrics, while the addition of contextual subtleties like traveler preferences and spatiotemporal aspects beckon. Deep learning methods have the appeal of promising more accuracy and sophisticated recommendation landscapes. Like this, the world of chatbots embraces novelty through the incorporation of attention processes, strengthening the neural network's ability to provide relevant replies. While transfer learning appeals, inviting pre-trained language models to harmonize with the chatbot's character, reinforcement learning paradigms provide opportunities for conversation enhancement as the story develops. A tapestry rich with pictures and videos is imagined for multimodal interactions, which casts a larger net and enhances the traveler’s experience. The project aims to rethink traveler experiences inside recommendation systems and chatbot interfaces by orchestrating an artistic interplay of various approaches. It also aims to open new perspectives that recalibrate the fundamentals of performance benchmarks and traveler engagement dynamics.

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IV. RESULTS AND DISCUSSIONS

A) Location Planning

In this section, we present the outcomes of our implemented location management system that incorporates traveler preferences for location categories. The system allows travelers to rate various locations such as monuments, beaches, viewpoints, gardens, swimming pools, malls, parks, churches, theaters, museums, gyms. Based on these preferences, the system generates the locations and displays them in the map to the traveler by their corresponding icons.

B) Hotel Planning

In evaluating our Hotel Plan Management System, we tested two key components: the Preference-Weighted Recommender (PWR) and Content-Based Filtering. For the Preference-Weighted Recommender, input preferences for well-rated yet popular city center hotels were provided. The system accurately balanced these factors, yielding recommendations aligned with traveler preferences. In the Content-Based Filtering evaluation, inputs included a hotel name, moderate budget, and specific amenities. The system successfully generated tailored recommendations within the specified criteria. These results highlight the system's capability to offer personalized hotel suggestions, addressing the limitations of traditional recommendation methods.

C) Route Planning

In this section, we present the outcomes of our implemented route management system that incorporates traveler preferences for location categories. The system allows travelers to rate various location categories such as Beaches, Historical sites, Temples, Parks, and Art Galleries. Based on these preferences, the system generates a customized travel itinerary from the starting location to the end destination, optimizing the route according to the nearest location to farthest location.

D) Extra Activities Planning

Presenting our tailored leisure recommendation system, finely crafted to match individual preferences. By amalgamating travelers' choices across diverse categories like adventure, culture, shopping, and nature, our system crafts curated itineraries. Tourists rate preferences for activities like games, shopping, adventure, and whale watching. Leveraging these, our solution offers personalized programs, guiding seamless transitions between activities, optimizing efficiency. This innovation guarantees immersive leisure journeys, aligning with travelers' passions.

V. CONCLUSION

In this research, we have presented an innovative Trip Planning Management System designed to revolutionize the traditional approach to manual travel itinerary creation. The system comprises four essential components, each addressing specific facets of travel planning through automation. The Location Planning module leverages traveler preferences to offer optimal destination suggestions, eliminating the uncertainty associated with choosing destinations. In conjunction, the Route Planning module employs real-time data and algorithms to calculate the most efficient routes between recommended destinations, thereby enhancing overall travel time optimization.

Furthermore, the Hotel Planning component streamlines the often-laborious process of selecting accommodations by providing tailored suggestions based on variables such as budget and location. Lastly, the Extra Activities Planning module enhances the travel experience by algorithmically proposing leisure activities aligned with the traveler's interests. By seamlessly integrating these components, our system redefines the landscape of travel planning, making it more traveler-friendly, customized, and enjoyable through strategic automation.

The effectiveness of our proposed system was validated through rigorous testing and evaluation. Traveler feedback and performance metrics indicate that the system excels in simplifying the travel planning process, saving time, and delivering personalized itineraries that align closely with individual preferences. Moreover, the incorporation of real-time data ensures that the generated recommendations are not only accurate but also adaptable to changing circumstances.

As future work, we intend to expand the system's capabilities by incorporating machine learning techniques to enhance the accuracy of personalized suggestions and recommendations. Additionally, traveler-centric feedback will guide further refinements to ensure a seamless and intuitive traveler experience. We firmly believe that our advanced Trip Planning Management System has the potential to transform how individuals approach travel planning, fostering more enjoyable and memorable journeys.

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ISSN (online): 2581-3048

Volume 7, Issue 10, pp 479-486, October-2023

https://doi.org/10.47001/IRJIET/2023.710063

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Citation of this Article:

Ms. Chethana Liyanapathirana, Dr. Lakmal Rupasinghe, Ranathunga H R V H, Abeykoon A M K B, Dhanushanka A K L, Shanika P G A, “Trip Planning Management System” Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 7, Issue 10, pp 479-486, October 2023. Article DOI https://doi.org/10.47001/IRJIET/2023.710063

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