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# NAVIGATING INNOVATION: A LITERATURE REVIEW ON DESIGNING LOCATION-BASED RECOMMENDATION SYSTEMS

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***Abstract :*** The advent of location-based recommendation systems has revolutionized the way individuals explore and interact with their surroundings. These systems utilize geospatial data and algorithms to deliver personalized recommendations tailored to users' locations and preferences. This paper presents a comprehensive literature review on the design aspects of location-based recommendation systems, focusing on the innovations, methodologies, and challenges prevalent in this dynamic field. Through an extensive analysis of existing research, this review aims to provide insights into the evolution of location-based recommendation systems, identify key design principles, and outline future research directions.

***IndexTerms*** **- Location-based recommendation systems , geospatial data, personalized recommendations.**

## I. INTRODUCTION

Bhaarat, the First largest country by population, people loves to travel within or out of boundaries. In the past few years, with the explosion of mobile devices people are experiencing frequent communication and information exchange. Mobile internet growth is increasing rapidly to find the route from source to destination. Now days it increased the interest to build mobile applications for tourist as mobile data use and day to day traffic increased.

The tourism industry is on the rise and it has attracted user to use their systems for comfortable and convenient traveling. A recommendation system, this research is proposed to provide user not only the shortest and safe route between source to destination but also to find their interested area like, food, rest area, restaurants, shopping mall, cinema hall etc., based on their past data preferences.

A recommendation system is an algorithm that uses data analysis and machine learning techniques to suggest relevant information (movies, videos, items) to users that they may find interesting[4].

Absolutely! Recommendation systems play a crucial role in various online platforms like Netflix, Amazon, and Spotify, enhancing user experience and engagement. These systems leverage various machine learning algorithms to analyze user data and generate personalized recommendations. Here's how each of these platforms utilizes recommendation systems:

1. Netflix: Netflix employs recommendation algorithms to suggest movies and TV shows to its users based on their past viewing history, ratings, and preferences. These recommendations are often generated using collaborative filtering techniques, where the system identifies users with similar tastes and suggests content that those users have enjoyed. Netflix also utilizes content-based filtering, which recommends content similar to what a user has previously watched or rated positively.
2. Amazon: Amazon's recommendation system is perhaps one of the most widely recognized examples. It suggests products to users based on their browsing history, purchase history, items they've added to their shopping cart, and products they've rated or reviewed. Amazon employs various techniques including collaborative filtering, content-based filtering, and contextual recommendations to tailor suggestions to individual users.
3. Spotify: Spotify's recommendation system analyzes user data such as listening history, liked songs, playlists, and user-generated playlists to suggest new music. It uses collaborative filtering to recommend songs and artists based on what similar users have listened to. Additionally, Spotify's recommendation system incorporates natural language processing (NLP) techniques to analyze song attributes and user-generated metadata to offer personalized playlists and recommendations.

Overall, recommendation systems have become integral to the success of many online platforms by providing users with personalized and relevant content, products, or services, thereby enhancing user satisfaction and engagement. .

## II. NEED OF THE STUDY

Recommender systems are one of the most popular data science applications today. A recommender system is a data science application that is used to predict or offer products to customers based on their past purchase or browsing history. At the core, a recommender system employs a machine learning algorithm whose job is to predict user's ratings for a particular entity. It is based on the similarity based on the entities or users that previously rated those entities. The idea is that similar types of users are likely to have similar ratings for a set of entities.

Recommender systems have wide variety of applications. Many of the big technology companies use a recommender system in some form to recommend products to customers. They are used by Amazon for product recommendations, YouTube for video recommendations, Netflix and IMDB for movie recommendations and Facebook for friend recommendations. The ability to recommend relevant products or services to users can be very profitable for a company. Hence, it is so common to find this application by many companies.

## III. LITERATURE REVIEW

There are many studies dedicated to the developing recommender system in tourist in various aspects, like suggesting different movies based on their choice and point of interest, restaurants, travelling places etc.

The field of tourism has seen significant advancements in the development of recommender systems aimed at providing personalized recommendations to travellers. These systems leverage various AI techniques to improve the reliability and relevance of recommendations. Here are some key approaches and techniques used in the domain of tourism recommender systems:

1. **Hybrid Recommendation Approach**: Hybrid recommendation systems combine multiple recommendation techniques to provide more accurate and diverse recommendations. These systems may integrate collaborative filtering, content-based filtering, and other approaches to account for different aspects of user preferences and item characteristics.[12]
2. **Collaborative Filtering and Text Analysis**: Collaborative filtering techniques analyze user interactions and preferences to recommend items that similar users have liked. Text analysis can further enhance these recommendations by extracting insights from textual reviews, descriptions, or user-generated content associated with tourist destinations or activities.[13]
3. **Agent-Based Personalized Approach**: Agent-based recommender systems utilize intelligent agents to interact with users and gather information about their preferences, constraints, and context. These agents then employ personalized recommendation strategies to suggest suitable tourist activities, destinations, accommodations, or experiences.[14]
4. **Reputation-Based Collaborative Filtering**: Reputation-based collaborative filtering algorithms augment traditional collaborative filtering methods by considering the reputation for reliability of users and items in the recommendation process. These algorithms aim to improve the quality of recommendations by incorporating trust and credibility metrics into the recommendation model.[15,16]
5. **Other AI Techniques**: In addition to the approaches mentioned above, various other AI techniques such as machine learning, natural language processing, and knowledge graphs are employed to enhance tourist recommendation systems. These techniques enable deeper understanding of user preferences, semantic analysis of tourist-related information, and more sophisticated recommendation strategies.

Overall, the development of recommender systems in the tourism domain involves a diverse range of approaches and techniques aimed at improving the reliability, relevance, and personalization of recommendations for travellers. Researchers continue to explore innovative methods to address the unique challenges and requirements of tourism recommendation systems, ultimately enhancing the travel experience for users.

**Iv. LITERATURE SURVEY TABLE**

| Sr. No | Author Name | Paper Title | Conclusion | Future works |
|---|---|---|---|---|
| 1 | Baoting Han, Xiaoyao Zheng , Manping Guan,Liping Sun, and Yue Zhang | Personalized Route Recommendation with Hybrid Tabu Search Algorithm Based on Crowdsensing. | The hybrid tabu search algorithm is exploited to optimize multi-objective personalized travel route.[1] | 1. The data on tourists' preferences can be collected from more sources and more heterogeneous individuals.<br><br>2. The running time of the hybrid tabu search algorithm can be optimized.<br><br>3. Experiments need to be conducted on the attractions of other cities to validate the effectiveness of the hybrid tabu search algorithm Information security. Naïve User |
| 2 | Leyla Gamidullaeva , Alexey Finogeev , Mikhail Kataev and Larisa Bulysheva | A Design Concept for a Tourism Recommender System for Regional Development | Creating a digital tourist avatar with actual information being collected and accumulated Throughout the implementation of the entire tourist route.[4] | security issues of personal Information |
| 3 | Remigijus Paulavičius, Linas Stripinis, Simona Sutavičiūtė, Dmitrij Kočegarov, Ernestas Filatovas | A novel greedy genetic algorithm-based personalized travel recommendation system | A unique personalization approach was created to consider tourist preferences and build highly personalized POI scores (ratings). [3] | More accuracy for more than 50 POIs. |
| 4 | Sarkar, J.L., Majumder, A., Panigrahi, C.R. et al. | Tourism recommendation system: a survey and future research directions | The primary focus is the tourism domain, where RS serves as a valuable tool for the tourist to plan his trip. Traditional RS systems only cater to the needs of the tourist by examining few factors. However, there are a large range of factors such as environment factors , actual geo-coordinates, trip destination, preferences of the user etc. that need to be taken into account in order to make a foolproof recommendation to the tourists[6]. | Future research direction has been suggested which would improvise the Quality of Service (QoS) of the RS in tourism industry. |
| 5 | Alves, Patrícia, et al. (2023): 1-70. | Group recommender systems for tourism: how does personality predict preferences for attractions, travel motivations, preferences and concerns? | The approach was created to consider tourist preferences and build highly personalized. [10] | The "Personality vs Traveling Motivations" model needs to be improved, so all personality dimensions can be considered. |
| 6 | Sun, Xiaoyu, et al. 12.6 (2019): 661-678. | Building a model-based personalised recommendation approach for tourist attractions from geotagged social media data | Proposed a model-based recommendation system, which has a two-stage architecture for matching and ranking. | The offline experiment could not comprehensively evaluate the recommendation performance; so that an online A/B test will be used in future work. |

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| 7 | Ms. Soumya Bailkeri, Mr. Shreyas Karadiguddi, Ms. Spoorti Koshavar, Mr. Vivek Tigadi, Mr. Siddharth Bhatkande | Tourism Recommendation System Using Machine Learning | It leverages data analysis to provide valuable insights and fosters trust and loyalty among travellers, ensuring a positive and fulfilling travel experience. | It will use advanced recommendation algorithmsfor more accurate suggestions. AI techniques for intelligent decision-making, real-time data sources for up-to-date information, personalized travel planning features, integration with social platforms for user-generated content and collaboration, development of a mobile application for convenience |
| 8 | S. Choachaicharoenkul, D. Coit and N. Wattanapongsakorn, in IEEE Access, vol. 10, pp. 10688-10705, 2022, doi: 10.1109/ACCESS.2022.3144855. | "Multi-Objective Trip Planning With Solution Ranking Based on User Preference and Restaurant Selection," | Introduced the new real-world tourist trip design problem called the multi-objective orienteering problem with restaurant selection and compulsory POIs. | The preference of restaurant selection such as type of food, budget, and food limitations will also be considered. Limitation : The branch-and-cut algorithm can easily search for the optimal Pareto fronts for 13 and 15 POIs, but for 20 POIs, it took 15-23 hours runtime. Hence, it failed to find the solutions when the number of POIs is more than 20, which was half of all test cases. |
| 9 | Wang, Meng. PLoS One 15.12 (2020): e0240656 | Applying Internet information technology combined with deep learning to tourism collaborative recommendation system | Generating personalized recommendation lists for users using deep learning and collaborating techniques provide good result and accuracy. | cold star problem not solved by using this algorithms |
| 10 | Aggarwal, Karan, et al. Iraqi Journal for Computer Science and Mathematics 3.1 (2022): 115-123. | Has the Future Started? The Current Growth of Artificial Intelligence, Machine Learning, and Deep Learning | In machine learning and deep learning, unbalanced and/or missing data cause an algorithm to leave the test data due to incomplete knowledge of the mode | A set of studies that employ artificial intelligence techniques to analyze data of people infected with any disease will be addressed. |
| 11 | Ko, Hyeyoung, et al Electronics 11.1 (2022): 141. | A Survey of Recommendation Systems: Recommendation Models, Techniques, and Application Fields | it is necessary to develop a variety of recommendation systems that can help users to efficiently receive item informa-tion and make decisions amid the rapidly increased amount of item information due to the expansion of these services. | plan to expand our research to the research and development of recommendation systems suitable for the characteristics of business by application service field |

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|---|---|---|---|---|
| 12 | Amzad, Homaira, and K. Vijayalakshmi. International Journal of Engineering Research & Technology (IJERT) Vol 10. | Tourism Recommendation System: A Systematic Review | It leverages data analysis to provide valuable insights and fosters trust and loyalty among travelers, ensuring a positive and fulfillingtravel experience. | It will use advanced recommendation algorithmsfor more accurate suggestions. AI techniques for intelligent decision-making, real-time data sources for up-to-date information, personalized travel planning features, integration with social platforms for user-generated content and collaboration, development of a mobile application for convenience |
| 13 | Zhang, Yanmei, et al IEEE Access 8 (2020): 39536-39547. | A tourism route-planning approach based on comprehensive attractiveness | multidimensional tourist preferences to improve the travel routes | Combine the personal preferences of different tourists and then plan routes that meet those interests |
| 14 | Guo, Lei, Haoran Jiang, and Xinhua Wang. Information 9.4 (2018): 85. | "Location regularization-based poi recommendation in location-based social networks." | The development of the location-based social network makes the POI recommendation as an important application of locations. | The feature factor of users will incorporate both the features from collaborative filtering and other influential contexts. Fused regularization terms will be added to the objective function. Second, the method that can reduce the computational complexity of the training process will be studied. We will develop more efficient sampling strategies and parallel methods to speed up the optimization process |

## V. RESEARCH GAP

From the literature survey, destination path may different based on user preferences, but in some circumstances recommendations are not appropriate according to user existing priorities, due to this reason recommender system fails to give suggestion on optimal path for the tourist and data retrieval are also not too fast.

Cold start problem is very common problem in recommender system where we do not know how to recommend that new item or what to recommend to that new user added to the system.

Using the current location and historical travel sequence of the querying tourist to generate a real-time route recommendation when the tourist requests route recommendations at a random location within a POI for improving the flexibility of system [2].

## VI. RESEARCH OBJECTIVE

The purposes of these studies are as given below:

a. To recommended the best, short and safe places according to user's choice and past reviews or interest, while travelling. So, it is important to have a system which will provide facility.
b. For novel user, gives recommendation or best suggestion by asking question on their interested areas. This is based on the distinctive three dimensional relationships among users, tags and items, a new user profiling and similarity measure method is being proposed. One of the best solutions for this is Multi-armed bandit algorithm.
c. To develop a model for providing user best route according to their preferences and suggestion.
d. To Use hybrid recommendation approaches to overcome some of the common problems in recommender systems such as cold start.

This problem brings two observations of cold star problem:

- How to recommend a new place, food, etc for users?
- What place, food, etc to recommend to new users?

## VII. RESEARCH METHODOLOGY

The Research Life cycle of the proposed the recommender system for routes based on content filtering and collaborative tagging. Additionally, recommender system delivers the simple and easy GUI to handle all types of user queries. The methodology to recommend routes follows steps are mentioned and explain as follow.

1. New user: For the new user, the system requests to register him/her for an account to gather his preferences.

2. Map database: Collect the information for recommendations in map such as routes, shortest path, parameters like hospitals, restaurants, doctor, café, interested area from past visits etc.

3. Information collected: This is based on the distinctive three dimensional relationships among users, tags and items. Analyze the collected information by filtering component that whether it is likely to be of interest to the active user by comparing features in the item representations to those items stored in the user profile from third party data collection.

When recommending personalized travel routes for a new tourist, the system server can follow these steps using a route ranking method tailored to the tourist's personal profile, constraints, and similarity measures:

- Collect User Information: The system collects information from the new tourist, including preferences, interests, constraints (such as budget, time availability, dietary restrictions, mobility issues), and any other relevant details. This information can be gathered through a user questionnaire, user registration process, or implicit feedback from previous interactions.
- Profile Creation: Based on the collected information, the system creates a personalized user profile for the tourist. This profile encapsulates the tourist's preferences, constraints, and other relevant attributes that will influence the recommendation process.
- Route Generation: The system generates potential travel routes based on the tourist's profile and the available options. These routes can include various tourist attractions, landmarks, activities, accommodations, dining options, transportation modes, and other elements tailored to the tourist's preferences and constraints.
- Route Ranking: Each generated route is evaluated and ranked according to its suitability for the tourist. The route ranking method considers factors such as:
    - Relevance: How well the route aligns with the tourist's interests and preferences.
    - Feasibility: Whether the route adheres to the tourist's constraints, such as budget, time, dietary restrictions, and mobility considerations.
    - Diversity: The variety and balance of experiences included in the route to cater to different interests and preferences of the tourist.
    - Novelty: The inclusion of unique or lesser-known attractions or activities to enhance the tourist's experience.
    - Previous User Feedback: Incorporating feedback and ratings from previous tourists who have followed similar routes to assess their satisfaction and relevance.
- Similarity Measure Method: The system utilizes a similarity measure method to compare the tourist's profile with profiles of other users or predefined profiles representing different travel preferences. This comparison helps identify users with similar preferences and behaviours, allowing the system to recommend routes that have been successful or well-received by similar tourists in the past.
- Recommendation Generation: Based on the ranked routes and similarity measures, the system generates personalized travel route recommendations for the new tourist. These recommendations prioritize routes that closely match the tourist's preferences, constraints, and profile attributes, while also considering the experiences of similar users.
- Presentation and Feedback: The recommended travel routes are presented to the tourist through the system's interface, along with relevant details, descriptions, maps, and visuals. The tourist can review the recommendations, provide feedback, and make adjustments as needed before finalizing their travel plans.

  By employing a route ranking method and similarity measure approach tailored to the tourist's personal profile and constraints, the system can effectively recommend personalized travel routes that align with the tourist's preferences and enhance their overall travel experience.

4. Map route recommender: This phase recommends routes to the user using different recommendation methods like collaboration tagging and Hybrid Recommendation. Collaboration tagging enables users to add tags (labels) to information to help them and others. It is used to make information easier to find or link to. It also gives benefits to recommendations based on metadata using collaborative tagging. Collaborative tagging gives the process in which many users add small information in the term of keywords to share contents like (#) hash tag. Currently collaborating tagging is on the web popularity, on websites it allow users to tag bookmarks, different contents and photos etc.

Hybrid Recommendation – It used data of both collaborative data and content-based data (the data that we take from the user, either explicitly (rating) or implicitly (clicking on a link)).Combination of these above two approaches; it can resolve the big complications in more effective ways. An Ant Colony Optimization (ACO) algorithm is use for prediction of best and shortest path for the given destination location, based on hybrid recommender system for mapping route.

5. Cold start problem: Cold start problem is very common problem in recommender system where we do not know how to recommend that new item or what to recommend to that new user added to the system. This will solve by asking them some questions based on new user likes and dislikes. In collaborative filtering (CF) methods, the recommendation process is based on ratings of "similar" users (KNN), that is, users who have similar preferences. One commonly implemented solution to this problem is the Multi-armed bandit algorithm. The parameters for recommendation are the most important aspect of consideration in this area.

Solutions for cold star problem:

- Suggest or ask users to rate place, food etc.
- Default voting for place, food, etc.
- Use other techniques like content-based or demographic for the initial phase.

## CONCLUSION

To find out related content is very difficult task in current scenario where there is huge amount of data stored in the databases. Recommender systems are solution to this problem and attracting researchers to explore this area in past few years. In proposed study the concept of "smart routing"- a hybrid recommender system for map routing which recommend accurate route to the user according to their current location, preferences and Interest based on past visits. Wrong recommendations assigned to the user tend to decrease the efficiency of the system but this problem is reduced by using content & collaborative approach and optimal recommendations are provided to the user. This concept also has taken care of the cold start problem for new items where we do not know how to recommend new item or what to recommend to that new user for that can added to the system by using content, collaborative filtering and collaborative tagging approach.

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