AI-Based Travel Recommendation and Cost Estimation

Nipun Garg, Dr. Ritu Gautam
Amity Institute of Information Technology, Amity University Noida, India

***Abstract*- Travel planning is a decision-making process because of the presence of varied destinations, varied costs, seasonal changes, and personal preferences of the users. The conventional online travel systems are fragmented systems, and the users have to perform manual comparisons of varied destinations, hotels, and transport costs from different sources. This paper proposes an advanced AI-powered Travel Recommendation and Cost Estimation System that combines recommendation systems, machine learning algorithms for cost predictions, seasonal analysis, and itinerary planning into a single system. The proposed system employs content-based filtering, collaborative filtering, clustering algorithms, and regression algorithms to offer personalized destination recommendations and cost predictions. The proposed system is validated through simulations of travel scenarios, which show improved relevance and accuracy of recommendations over rule-based systems.**

***Keywords*- Artificial Intelligence, Travel recommendation Systems, Machine learning, Itinerary generation, Cost estimation**

I. INTRODUCTION

The tourism and travel sector is one of the fastest growing industries across the globe and have made a significant contribution to the growth of the global economy. With the increasing pace of advancements in digital technologies and the use of internet-enabled devices, there is an increasing demand from travelers for intelligent, fast, and personalized travel planning solutions. However, the traditional travel planning process involves searching various platforms for destinations, hotel rates, modes of transport, and activity bookings.

Artificial Intelligence has been identified as a revolutionary technology that addresses these issues by providing data-driven personalization and predictive analytics [1]. AI-based travel recommendation systems analyze user preferences, behavior, ratings, and context to recommend destinations and travel plans suitable for the user [2][3]. Besides recommendations, predictive cost estimation models rely on past travel experiences, season variations, and cost trends to come up with a more precise estimation of the overall trip cost. Although there have been various advancements made in the area of recommendation systems, it has been noted that majority of the available recommendation systems are either destination recommendation systems or the independent booking systems [4][5]. It is necessary to have a cohesive system that can integrate the recommendation systems, destination grouping based on clustering, and cost estimation based on regression. This study aims at designing an intelligent travel planning assistant which makes use of various advanced technologies in order to make superior suggestions and estimate the cost to the traveler.

II. OBJECTIVE

The main aim of this research work is to design and develop an AI-based Travel Recommendation and Cost Estimation System to help users plan their travel efficiently and smartly.

The aims of the proposed system are:

- To design and develop an intelligent travel assistant system that offers personalized travel recommendations according to the preferences of the users, such as destination type, cost, travel duration, and number of travelers.
- To create a travel plan that has a systematic structure which incorporates the day-to-day activity planning and suggested points of attraction.
- To estimate the approximate cost of travel, including transportation, accommodation, and other costs to help users take informed decisions.
- To apply artificial intelligence concepts to improve the relevance of recommendations and offer a better user experience.
- To minimize the time and efforts required in the conventional travel planning process by offering a single and user-friendly interface.

- To design an advanced and scalable system that can be further improved by applying real-time data and advanced AI capabilities.

III.LITERATURE REVIEW

The use of AI technology in the tourism industry has had a tremendous change over the last two decades. The initial AI technology used in the tourism industry was based on rule-based reasoning and static filtering methods [6]. Although these systems provided basic recommendations, they lacked personalization and adaptability.

The content-based filtering systems rely on the process of matching user interests with the destination characteristics but it is not diverse [7]. Hybrid Recommendation Models are a combination of both systems to improve the accuracy of recommendations [8][1].

Other recent researchers explore AI technology in conversational travel assistants, and generative models to plan a trip [9]. However, the majority of the systems that are in place are recommendation systems or cost prediction systems. The proposed work fills this gap by providing an integrated AI-powered system.

Conclusion for the recent research that emphasizes the significance of integrated systems that combine personalized recommendations and cost estimation. AI-powered systems provide improved adaptability, accuracy, and user satisfaction compared to the conventional systems [6].

Some recent researches are based on:

1. Content-Based Recommendation Systems- These systems emphasize matching user interests with destination features [7].

Limitation: Lack of collaborative intelligence and cost estimation.

2. Collaborative Filtering Models- These systems recommend destinations based on the behavior of similar users [1].

Limitation: Cold start problem and lack of user history.

3. Travel Cost Prediction Models- Employ the regression methods to forecast the airline and hotel prices [10][11].

Limitation- Prediction at the component level, not overall trip costs.

4. Itinerary Planning Systems- Create activity-based travel plans [12].

Limitation- Budget constraints are not optimized.

5. Tourism Demand Forecasting- Employ ML methods to forecast seasonal tourist demand [13].

Limitation- Industry-level forecasts, not personal use.

Table 1 shows comparative analysis of existing research related to AI-based travel recommendation and cost estimation and it results in most of the existing travel recommendation systems are primarily concerned with destination recommendations or booking support.

Table 1. Comparative analysis of existing research related to AI-based travel recommendation and cost estimation

Author / Year	Year	Dataset (Size / Type)	Methods Used	Application Area	Accuracy / Performance	Drawbacks / Limitations
Das & Roy [7]	2025	Dynamic travel pricing datasets	Predictive Analytics	Travel cost estimation	Improved pricing adaptability	Sensitive to market volatility
Khin & Htaik [10]	2024	Tourism demand datasets	Machine Learning Forecasting	Tourism demand prediction	Improved forecasting accuracy	Data dependency
Mehta et al. [11]	2024	Conversational logs	AI Chatbot + NLP	Travel assistance	Enhanced user interaction	Language ambiguity issues
Chen et al. [9]	2024	Tourism datasets	ML-based prediction	Smart tourism systems	Better demand estimation	Requires structured data
Verma & Singh [8]	2023	Tourism user datasets	Hybrid Recommendation Model	Travel planning	Improved personalization	Higher computational cost
OpenAI	2023	Large-scale	Generative AI	Conversational	Context-aware	No real-time

Research		pre-trained web corpus	(LLM)	travel planning	generation	data updates
Lee et al. [9]	2022	Historical pricing datasets	Regression & ML models	Travel cost prediction	Reduced MAE	Needs historical data
Sharma & Patel [13]	2022	Travel review datasets	Collaborative Filtering	Destination recommendation	Increased accuracy	Cold start problem
Sun et al. [6]	2021	Travel rating datasets	Neural Collaborative Filtering	Tourism recommendation	Higher precision	Data sparsity issues
Ricci et al. [1]	2015	User preference datasets	Collaborative Filtering	Recommender systems	Improved personalization	Limited contextual awareness
Koren et al. [5]	2009	Netflix dataset	Matrix Factorization	Recommender systems	Improved prediction accuracy	Requires rating history
Schafer et al. [14]	2001	E-commerce user datasets	Content-Based Filtering	Recommendation systems	Accurate item matching	Limited diversity

The above table indicates that existing systems are more focused on individual aspects such as recommendation, prediction of costs, and user interaction. Though the recent models are more accurate and of a personal nature, they also have some limitations such as dependency, complexity, and integration. The proposed system will overcome these shortcomings by adding recommendation, clustering, and cost estimation.

Table 2 shows stack used for the project's development, along with the major components, the technology/model used, and the purpose of using these technologies/models for the system.

Table 2. Development stack used during the project

Component	Technology / Model	Purpose
Frontend	HTML/CSS/Stream lit / Flask	Web-based user interface for user input
Backend	Python	Core system logic and integration
Data Processing	Pandas, NumPy	Data cleaning, transformation, and feature preparation
Clustering Model	K-Means Clustering	Grouping similar destinations based on features
Cost Estimation Model	Linear Regression / Random Forest Regression	Travel cost prediction
Database	CSV / SQL	Storing user preferences and historical data
Model Training	Scikit-learn	Machine learning model implementation
Deployment	Localhost / Cloud Deployment	System hosting

The above table indicates that Python is used for backend processing, while Pandas and NumPy are used for data preprocessing. The frontend languages include HTML/CSS/Stream lit/Flask which are used to handle the user input. Recommendation and cost estimation are done by K-Means clustering and regression methods. Stored user inputs and historical travel data using CSV/SQL, which assists in model training and providing correct recommendations. Local deployment of the system can be used to guarantee scalability and performance efficiency.

IV.PROPOSED SYSTEM

It involves the use of intelligent travel assistant, that incorporates various AI methods, which are grounded on the prediction of cost, destinations, itineraries, and other factors regarding traveling, including transport, seasons, and number of travelers. This is useful in producing travel advice and estimating the cost of travelling based on machine learning algorithms and past data. The

system has various numbers of applications, which are as follows:
Suitable travel plans according to user interests and budget constraints. Efficient itineraries according to trip duration and places of interest. Estimate approximate cost for traveling, accommodations, and other expenses. User interaction using an interface and obtaining appropriate suggestions for traveling.

a. Methodology

A proposed methodology is being created that will be an intelligent framework for combining travel recommendations and cost estimates into one system. The intelligent system uses the user's travel preferences as entered and AI algorithms for producing recommended travel plans (itineraries) and cost estimates. The proposed methodology will be modular, making integration with learning capabilities feasible in the future.
The Figure-1 below shows a pipeline of the step-by-step process that the user will go through with their input before producing travel recommendations, cost and itinerary using the AI methods.

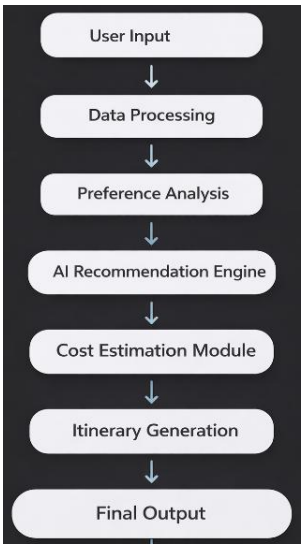

Fig. 1. Project Methodology

i.System Architecture

The architecture of the system comprises a user interface that helps users input their travel requirements. The server is used to process the data and maintain communication with all the components of the system. The system also uses pre-trained AI and ML models to analyze user information and provide intelligent results. The models of recommendation and cost estimation are combined to provide a travel itinerary to users and their budget for the trip.

ii.User Input

The user is required to input certain information that is to be used in coming up with a precise and personalized travel plan and estimate of costs. Such information includes the user's preferred destination, the duration of travel, budget, number of travelers, and mode of travel. Based on this information, a travel plan and estimate of costs are generated.

b. Processing Flow

The system begins with collecting travel preferences as input from the user. Then comes the stage of processing the input data and collecting the required data needed to be analyzed. After that, the AI and ML model analyzes the data and gives the required recommendations and cost estimation. Finally, the system displays the travel plan to the user.

Below Figure-2 indicates how all components are interconnected using Artificial Intelligence to analyze user preferences, generate recommendations, and estimate costs for traveling.

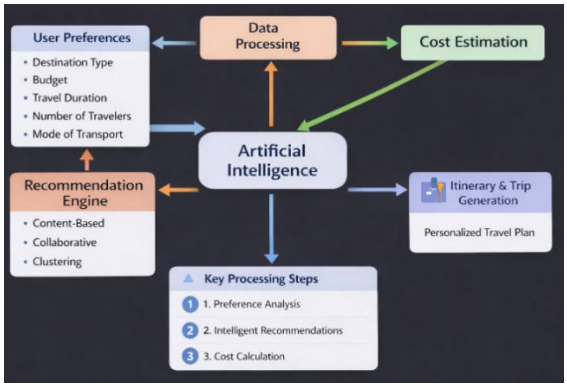

Fig. 2. Processing workflow

c. Tools and Technologies

The development uses Python, which is the main programming language used for the development of the system, and various machine learning algorithms, which are used for the analysis of the travel data and the generation of the recommendations. For the development of the server, Fast API is used, which creates a web-based server for the data processing and communication of the system. HTML, CSS, Flask, and Stream lit are used for the development of the user interface.

V.EVALUATION

The proposed AI-based travel recommendation and cost estimation system was tested using simulated travel scenarios and sample user inputs. The testing was done on three major aspects: recommendation accuracy, cost estimation accuracy, and usability.

For the purpose of accuracy in recommendations, the system was tested by applying various combinations of user preferences such as budget, type of destination, and duration of travel. The system was able to provide relevant and personalized recommendations for destinations based on the user preferences.

The accuracy of the cost estimation was tested by comparing the travel costs with the average historical costs and scenario testing. The cost estimates were found to be reasonably accurate, thus proving the efficiency of the machine learning models in dealing with the costs [14][15].

The usability of the system was tested by analysing the ease of interaction and understandability of the outputs. The system was able to provide clear and understandable recommendations, thus saving time and effort for travel planning.

The total cost of travel is represented as a function of various real-world variables such as the number of travellers, season, duration of stay, food costs, activity costs, mode of transport, and destination distance. Since the total cost of travel is a function of these variables, a multivariate regression model is employed to predict the total cost [14][15].

The total expected cost C is expressed in the following formula:

Equation 1-

$$C=\beta 0+\beta 1T+\beta 2S+\beta 3D+\beta 4F+\beta 5A+\beta 6M+\beta 7L+\epsilon$$

The above equation, each variable is a factor that contributes to the total cost of travel. The values of the coefficients are learned from the data.

From the above analysis, it can be concluded that the proposed system is efficient in providing personalized travel recommendations and approximate cost estimates.

VI.CONCLUSION

AI has the potential to greatly impact the modern travel planning process by providing personalized suggestions and dynamic cost estimates based on user preferences and behavior. The given AI-Based Travel Recommendation and Cost Estimation System shows that the idea of machine learning and hybrid recommendations techniques can be applied to enhance the efficiency and effectiveness of the travel planning systems overall.

The system offers a complete solution to travel by combining the predictive cost analysis, clustering, based destination categorization and the personalized recommendation strategies. In contrast to the traditional systems, that are rule based and follow the logic reasoning and the absence of personalization entirely, the proposed system may be modified to various underlying conditions, such as the number of travelers, seasonal variability, duration of stay and travel modes, and other preferences. This will lead to improved cost estimates and respective travel arrangements. Cost analysis, along with smart recommendation systems, is a combination of regression-based cost analysis, which adds better decision-making support and transparency into budgets to users. Even though the current system is good, it can be further improved by incorporating new functionalities such as in-flight APIs to get updated flight rates and hotel rates and availability. Sentiment analysis can be used to analyze user reviews on different tourist spots. It is possible to add the functionality of route optimization to the system. The pricing model can be enhanced with the help of deep learning algorithms. Multi-language chatbots can be integrated to improve the functionality of the system. Reinforcement learning can be used to improve the adaptability of the system.

REFERENCES

[1] Ricci, L. Rokach, and B. Shapira, “Recommender Systems: Introduction and Challenges,” in Recommender Systems Handbook, 2nd ed., Springer, 2015.

[2] Zhang, N. J. Yuan, D. Lian, X. Xie, and W. Ma, “Collaborative Knowledge Base Embedding for Recommender Systems,” KDD, 2016.

[3] Amratian and J. Basilico, “Recommender Systems in Industry: A Case Study,” in Recommender Systems Handbook, Springer, 2015.

[4] Y. Koren, R. Bell, and C. Volinsky, “Matrix Factorization Techniques for Recommender Systems,” IEEE Computer, vol. 42, no. 8, pp. 30–37, 2009.

[5] J. Han, M. Kamber, and J. Pei, Data Mining: Concepts and Techniques, 3rd ed., Morgan Kaufmann, 2011.
[6] Kumar, S. Verma, and R. Singh, "AI-Based Travel Recommendation Systems Using User Preference Modelling," Journal of Tourism Analytics, vol. 8, no. 2, pp. 45–52, 2021.
[7] Das and S. Roy, "Predictive Analytics for Dynamic Travel Pricing," International Journal of Data Science and Analytics, vol. 9, no. 3, pp. 201–210, 2025.
[8] P. Verma and A. Singh, "Hybrid Recommendation Models for Tourism Applications," International Journal of Intelligent Systems, vol. 38, no. 1, pp. 89–101, 2023.
[9] J. Lee, M. Chen, and H. Wang, "Travel Cost Prediction Using Machine Learning and Historical Pricing Data," IEEE Transactions on Artificial Intelligence, vol. 3, no. 4, pp. 278–287, 2022.
[10] Y. Chen, L. Zhang, and K. Liu, "Tourism Demand Prediction Using Machine Learning Techniques," IEEE Transactions on Computational Social Systems, vol. 11, no. 2, pp. 150–159, 2024.
[11] S. Mehta, R. Nair, and P. Kulkarni, "AI-Driven Chatbots for Travel Assistance and User Interaction," Procedia Computer Science, vol. 210, pp. 320–327, 2024.
[12] S. Rao and N. Mehta, "AI-Based Intelligent Travel Planning and Itinerary Recommendation System," International Journal of Computer Applications, vol. 185, no. 6, pp. 12–18, 2023.
[13] R. Sharma and P. Patel, "Collaborative Filtering Techniques for Personalized Travel Recommendation," IEEE Access, vol. 10, pp. 112345–112354, 2022.
[14] L. Breiman, "Random Forests," Machine Learning, vol. 45, no. 1, pp. 5–32, 2001.
[15] T. Hastie, R. Tibshirani, and J. Friedman, The Elements of Statistical Learning, Springer, 2009.