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ENHANCING TOURIST EXPERIENCE: A HYBRID RECOMMENDATION SYSTEM FOR PERSONALIZED TOURISM INFORMATION

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Abstract: Tourism plays a major role in a country's economy. But there is still a lack of a platform that provides personalized information regarding tourist attractions. If there exists a system that can provide personalized accurate information to tourists about local attractions, food, and shopping it will be a huge benefit for tourists. In this project, we are proposing a hybrid approach of recommended systems to recommend tourist attractions for users. This recommendation process involves a combination of both content and collaborative filtering approach. This Hybrid approach avoids the disadvantages in both the methods and provides users with accurate information. To calculate the similarity between items the cosine similarity method is adopted. We have applied a model-based collaborative filtering approach called SVD for better results. The weighted hybridization approach is used to combine the results of both methods. The data of tourist attractions and users have been collected for implementation. This approach has given better results compared to CB and CF filtering methods separately.

Index Terms **-Algorithms, Artificial Intelligence, Machine Learning, Personalized Travel, Recommendations, Travel.**

I. INTRODUCTION

Recommender systems are encountered every day in different forms to serve various purposes. The effectives of recommender systems are seen in the amount of revenue generated through it. Recommender systems finds relationships between users and things they need is just based on the actions, there is no human curation involved at all, and it uses many patterns.

Recommendations systems are not only to buy items online, but there are recommender systems which recommend content. This is quite popular like a newspaper in United States it looks at the articles that are read by any reader in past to recommend other articles the reader might enjoy reading. By just looking at the patterns in the articles people read, instead of patterns in the things people buy, there is a slight difference between search engines and Recommender systems, search results are personalized. It is not only doing information retrieval also it is looking at past behaviors as in individual to find out what search results are most suitable for the person searching.

Recommender systems just filter the content which based on past actions. Recommender systems are everywhere and they play the important role in building modern economy. There are different types of Recommender Systems which uses any of the below mentioned filtering techniques: Collaborative filtering, Content-based filtering, Context filtering, Hybrid filtering, Demographic filtering, Knowledge, Social filtering, Utility Recommender System, Market Basket Analysis, Community-based filtering, Trust based recommender systems.

Recommender Systems where implemented in many domains like Social websites like Facebook, Entertainment like Netflix, YouTube, Ecommerce like Amazon, Flipkart, In Travel Domain like TripAdvisor, Trivago.

In this section it says about the organization of the paper which as follows, Section I contains Introduction of Recommender System, Section II contains overview of Travel Recommender System, Section III contains related work of Recommender System with respect to Travel and Tourism, Section IV concludes with future scope.

II.TRAVEL RECOMMENDER SYSTEM OVERVIEW

It is often essential for travelers to consult different people while making an itinerary for a holiday and as such, exchanging such information over the internet and social networks have become immensely popular. There is a vast amount of information available online but at times it becomes a little difficult to obtain the right type of information as per a user's choice. This is the place where travel recommendation systems come into the picture and they have become quite popular in the last few years. Travel recommendation systems can be based on various features like location type, the best time to visit the location, experiences of past visits different users etc. Recommendation systems are basically of two types: content-based and collaborative filtering. To get a better understanding here we will discuss the types of recommendation along with their advantages and disadvantages. Content-based recommender systems try to recommend items similar to those a given user has liked in the past. ("Recommender Systems - Brigham Young University") The basic idea of the content-based systems is matching up the attributes of a user profile in which preferences and interests are stored with the attributes of a content object (item), to recommend new interesting items to the user.

1) CONTENT-BASED FILTERING :-

Content-based filtering is a recommendation technique that operates on the principle of analyzing the intrinsic characteristics of items to make recommendations. In the context of content-based filtering, items refer to pieces of content such as articles, movies, or products. The system evaluates the features of these items, such as textual content, metadata, or descriptive attributes, to understand their inherent characteristics and match them with the preferences of the user. By building a profile of the user's preferences based on their interactions with previous items, the system can suggest new items that are similar in content to those the user has shown interest in before. Unlike collaborative filtering methods that rely on the opinions or behaviors of other users, content-based filtering offers personalized recommendations based on the specific attributes of the items themselves. This approach is particularly useful in domains where explicit item attributes are available and where users' preferences can be inferred from the content of the items they interact with.

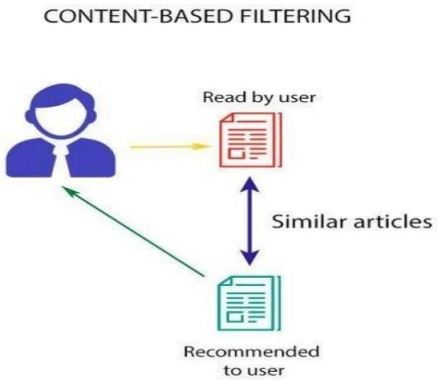

Figure 1.1: Content-based recommender systems.

Advantages

- User dependence
- Transparency
- New item

Disadvantages

- Limited content analysis
- New user
- Overspecialization

2) COLLABORATIVE BASED FILTERING :-

Collaborative based models use the collaborative power of the ratings provided by multiple users to make recommendations. (“New contextual collaborative filtering system with ...”) The basic idea of collaborative filtering methods is that the unspecified ratings can be inputted because the observed ratings are often highly correlated across various users and items.
Collaborative filtering is a recommendation technique that relies on analyzing the behavior or preferences of multiple users to generate personalized recommendations. Unlike content-based filtering, which focuses on the characteristics of items, collaborative filtering considers the interactions between users and items. The fundamental idea behind collaborative filtering is that users who have similar tastes or preferences in the past are likely to have similar preferences in the future.
In collaborative filtering, user-item interaction data, such as ratings, reviews, or purchase history, is collected and used to build a model of user preferences. This model captures the relationships between users and items and is then used to predict the preferences of a particular user for items they have not yet interacted with. There are two main types of collaborative filtering approaches: user-based and item-based.
User-based collaborative filtering identifies users who have similar preferences to the target user and recommends items that those similar users have liked or interacted with. Item-based collaborative filtering, on the other hand, identifies items that are similar to the ones the target user has liked in the past and recommends those similar items.
Collaborative filtering is widely used in recommendation systems for various applications such as movie recommendations, e-commerce product recommendations, and music recommendations. It is particularly effective in scenarios where explicit item attributes are not available or when users' preferences are better captured through their interactions with items rather than their explicit characteristics.

Figure 1.2: Collaborative filtering-based recommender systems.

Advantages

- Good serendipity
- No domain knowledge required

Disadvantages

- Generates a sparse matrix
- Recommendation based on neighboring users

3) HYBRID FILTERING :-

Every filtering method will utilize diverse source of information, and they have distinctive qualities and shortcomings, and appear to be somewhat prohibitive in isolation, particularly when various source of information are accessible.

Hybrid recommendation frameworks have been intended to investigate these potential outcomes in which one might want to make utilization of all the knowledge accessible in various information sources and furthermore utilize the algorithmic intensity of different recommender frameworks to make hearty inferences.

Hybrid filtering combines the strengths of both content-based and collaborative filtering approaches to overcome their individual limitations and provide more accurate and effective recommendations. In a hybrid filtering system, recommendations are generated by integrating information from multiple sources, such as item attributes, user preferences, and past interactions.

By leveraging the complementary nature of content-based and collaborative filtering, hybrid filtering can produce more diverse and personalized recommendations. For example, content-based filtering can help address the cold-start problem by making recommendations based on item features, even for new or less popular items with limited user interactions. On the other hand, collaborative filtering can capture subtle user preferences and relationships between users and items, leading to more accurate recommendations in situations where explicit item attributes may not fully capture user preferences.

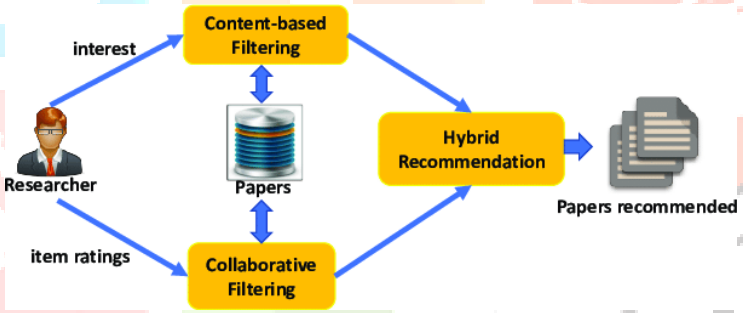

Figure 1.3: Hybrid filtering-based recommender systems.

Advantages

- Provide more detailed and individualized recommendations.
- Mix many models to overcome drawbacks of particular model individually

Disadvantages

- High computational complexity
- Require a large dataset of ratings

III. PROJECT WORKFLOW AND METHODOLOGY

A. Implemented model Overview

As shown above, our proposed system begins by scraping the data from the trip advisor website. After scraping the data, we performed an Exploratory Data Analysis to get a better understanding of the data. We have designed our recommendation system using both content based and collaborative filtering model.

In the content-based model, the recommendations have been generated using cosine similarity and Clustering algorithms. For clustering, we have used K Means, while for collaborative filtering we have implemented classification algorithms using both surprise and sci-kit learn libraries. The algorithms implemented for both libraries are Support Vector Machines (SVM), K-Nearest Neighbors, and Decision Tree. Finally, the results from all the

models are analyzed and the best model has been integrated with dialog flow to create a chatbot that makes our system user-friendly and easy to use.

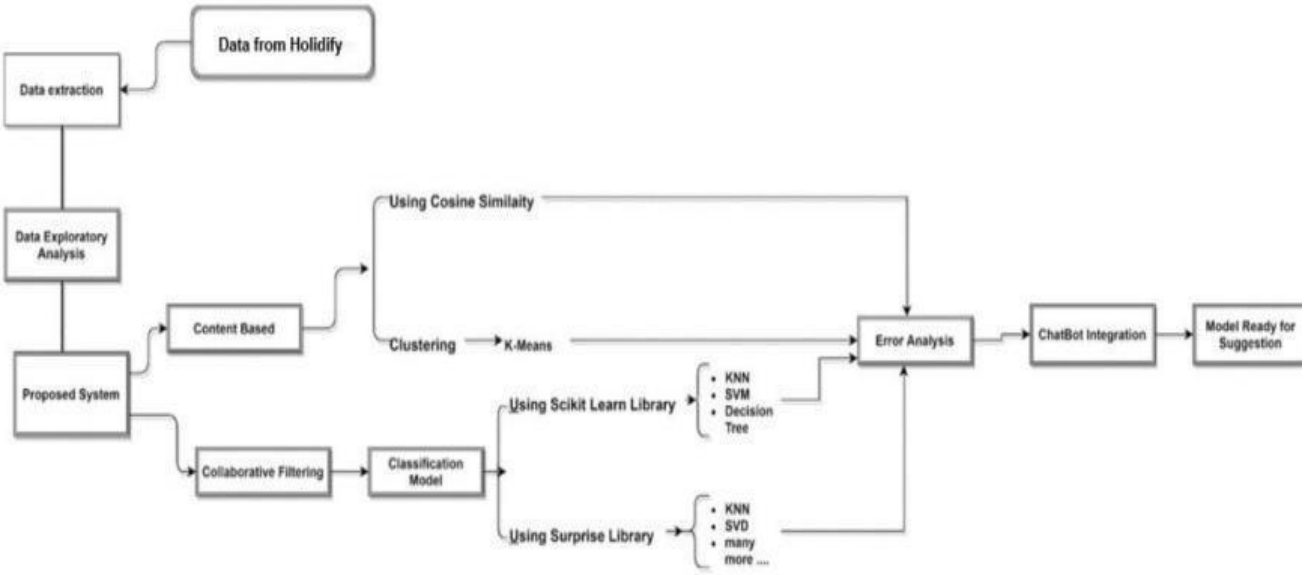

Figure 1.4: Implementation of proposed recommender systems

B. Libraries Used

1. For data extraction and integration
   Beautiful Soup, URL Open, Requests, Pandas, Regular Expression

2. Data Exploratory analysis
   Plotly, pandas, NumPy, Jupyter, Dash

3. Content-based recommender system
   Sklearn, NumPy, Pandas, Seaborn, matplot

4. Classification-based recommender system
   Pandas, Scikit learn, surprise, NumPy collection datetime

5. Clustering-based recommendation system
   Scikit-learn, NumPy, Pandas, Pickle Matplotlib

6. React App with Chat bot integration (dialog flow, flask and ngrok)

C. Data integration and data preparation

To begin our recommender system, a data set that contained all the required information about various tourist attractions was our main concern. For our recommendation model, we decided to focus on the tourist attractions within India and have thus collected various information of several locations. A list of the relevant information used in the system can be shown below.

- Location
- Location Type
- Best time to visit
- User Rating
- Address

D. Proposed system

Our proposed system is based on both content-based and collaborative filtering models. In the content- based model, we have implemented the recommender system using two different methods, we have also designed the recommender system based on cosine similarity distance parameters along with that we have used k-means as the clustering algorithm. So for both the algorithms used in the content-based model, varioustypes of features were used to predict/recommend new locations to the user. The features that we use for the cosine similarity-based model are state, best season, cost, and location type. Also, for the clustering model, we combined the features like attraction name, state and location type into a single column and then passed it to the k-means clustering algorithm to group them into clusters. The entire procedure and analytical results for both models are discussed in the next sections. Along with the content-based model, we have implemented the collaborative model using various classificationalgorithms from surprise and scikit learn library. From the scikit learn library we used KNN, SVM, and Decision Tree, while from the surprise library several algorithms were used like KNN, SVD, SlopeOne,NMF, CoClustering, etc. The accuracy scores for the multiple algorithms were calculated and after a thorough comparison and analysis, the best model for the classification model was selected. The model creation and accuracy will be discussed in detail in the next section.

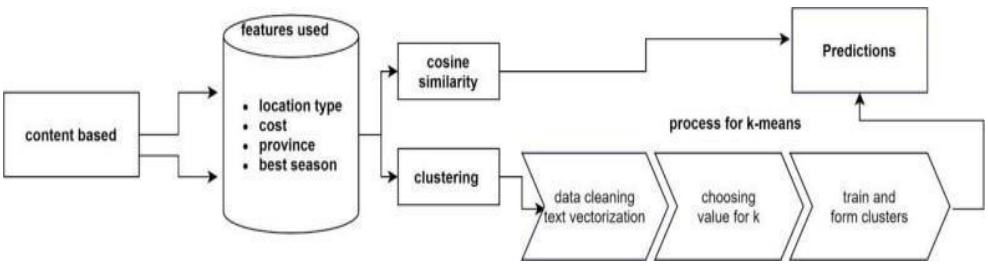

Figure 1.5: The proposed content based recommender system.

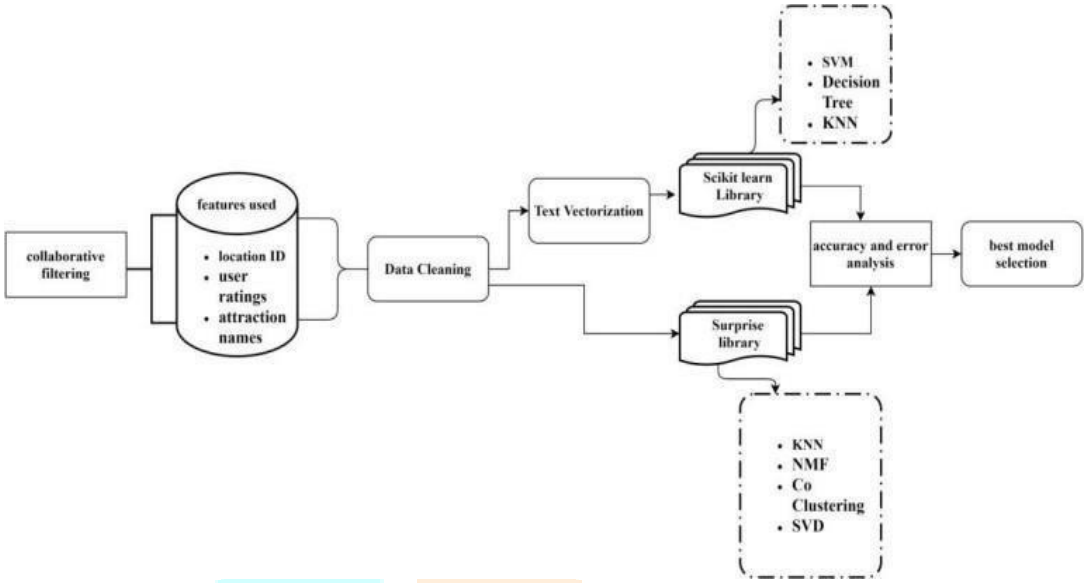

Figure 1.6: The proposed collaborative based recommender system

IV. RESULTS

a) Visualization for locations based on the state :-

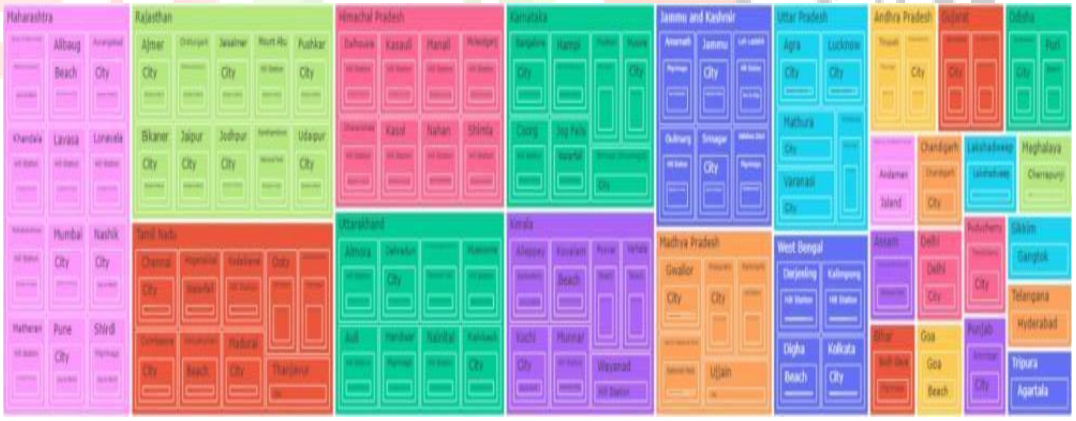

Figure 1.7: Visualization for locations based on the state (a zoomed image of the tree map)

b) Visualization for all the tourist locations in Maharastra State :-

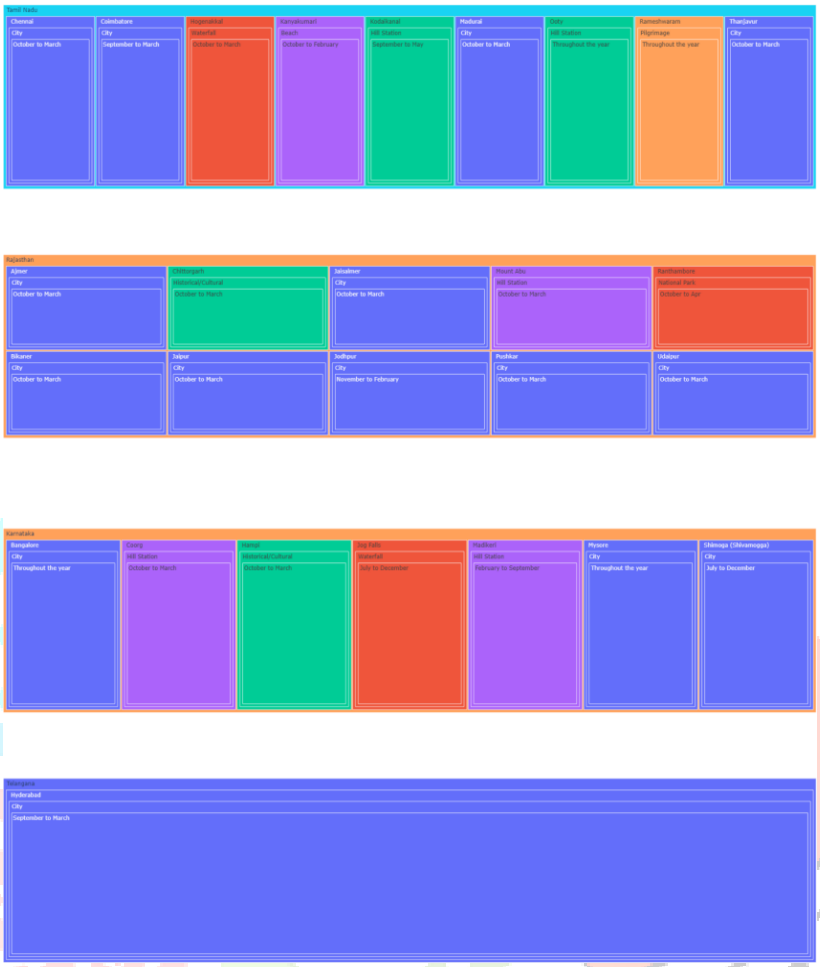

Figure 1.8: Shows how we have included locations distributed across different states and also included information about the type of location, the best time to visit that given location

c) React App with Chatbot Integration of the Recommender system:-

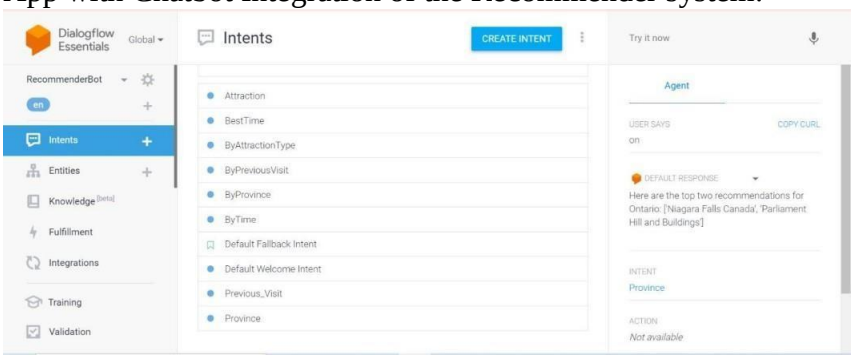

Figure 1.9: Intents for the chatbot

d) React app: -

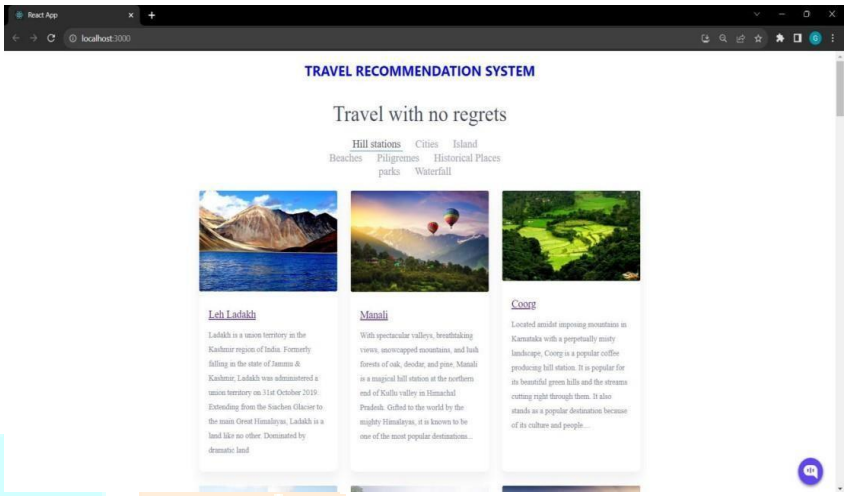

Figure 1.10: Intents for the chatbot

V. CONCLUSION

Recommendation systems are powerful technology tool that helps to produce/ generate useful information from user database. This information can used in many ways like to recommend new items/content to the user or keep track of user activities though this dataset information and based on that make the business model successful. Through this project we tried to enhance our knowledge on the internal functioning of recommender systems and

VI. ACKNOWLEDGMENT

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