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Restaurant Recommendation System Using Machine Learning Algorithms

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Abstract-The Recommendation system is the unavoidable thing for whatever we buy or go to the new place. Restaurants also need recommendation systems in terms of attracting more customers in the management side and tasting favorite, famous food in the restaurant in customers side. In reality finding the favorite food and famous food especially in new area is a challenging task. In this paper, we present the recommendation system for restaurants based on food rating distribution, service rating distribution by calculating the matrix density. With addition to that we build the popularity based recommender model for recommending restaurants to the customers. Ranking scheme can be employed based on scores. The output of the model may be recommending most popular restaurants and most popular food items served by the appropriate restaurant. For betterment of the model we accompany collaborative filtering with singular value decomposition. Evaluation of the model can be completed with RMSE. This experiment is executed on the Kaggle data set and we build a web based application is built using python's Flask web frame work.

Keywords:- Recommender system; Machine Learning; Collaborative filtering;; user inputs and behaviors; user feature, Ranking.

I. INTRODUCTION

Recommendation systems have recently become most popular because of its use in various domains. A recommendation system is a set of algorithms that learns from the input and after processing it can recommend the needed to the customers.

In general it is tool that would recommend products to customers based on various factors like search history, similarities of users, similar patterns, based on ratings. Real time popular examples are e YouTube, amazon, Facebook, etc. Their working mechanisms are mainly based on historical data. Based on the data available items are ranked and most relevant are given to the customers. Recommend systems are mainly classified into two categories.

- Content Based
- Collaborative Filtering (CF)

1. Collaborative Filtering:
Purely based on past interplay between customers and products. Hence the primary input of collaborative filtering was historical data that involves all the transactions between user interplays with the targeted products. Matrix is used for storing the data where rows are the customers and columns are the products.

This technique fully depends on only historical data and no more than that like present trending and culture. At deepest level CF can be classified into memory based and model based methods. Memory based method is the simplest method that follows only historical data with simple distance measurement. Model based approach used model for fitting the possible outcome.

2. Content Based Filtering:
It will employ additional information about customers and products. For better predictions they require additional information like data of birth, region, sex, etc. It tries to predict the features and behaviors of the customers with respective to the product based on positive reaction or negative reaction.

Food is the only thing which attracts from young child to old aged peoples. Food also represent the appropriate values, tradition and culture. Though there are high number of restaurants ranges from small to large and cheap to costliest but there are inevitability to choose the restaurant for satisfying taste, quality and famous food in the appropriate region. This is the reason for some restaurants earning more profits than others. Same reason may applied to low profit restaurants.

One side restaurants offer quality food and other side customers searching the quality and tasty food. To satisfy both customers and owners we need interface which recommends the features of the restaurant to the customers systematically.

It reduces the problems like unawareness of famous and tasty foods and restaurant nearby of the customers. If the customer is visiting abroad then they are in big trouble for finding the restaurants which offers tradition foods and the famous quality food in that region. In such cases we can employ machine algorithm in the recommender system based on the reviews.

This paper experiments with real time data set with web-based restaurant recommendation system. The primary aim of the application is to suggest users the best food to eat on the given location based on their food preferences.

II. LITERATURE SURVEY

Various methods are present for the development of restaurant recommendation system. Many of the existing systems and functioning are as follows.

In this recommender system, they developed recommendation based on preferences of user. It was motivated by the observation that a user's preference against an item is affected by different aspects discussed in reviews. They first explored the topic modelling to discover the hidden aspects from review text.

Finally, they utilized regression models to detect the user-restaurant relationship.

They described the restaurant recommendation system was very popular service whose accuracy and sophistication keeps increasing every day. They presented a personalized location-based restaurant recommendation system integrated in mobile technology. It was ubiquitously studied the user's behavioral pattern of recommendation systems and proposed methods to rectify it.

In this Research, they described the restaurant recommendation system with machine learning algorithms. In order to find a good machine-learning model, they have tried several collaborating filtering methods to predict ratings between restaurants and users. The methods they have implemented are Slope One, k-Nearest Neighbors algorithm, and multiclass SVM classification. Our evaluation shows that the multiclass SVM classification method outperforms the other methods.

For rating prediction, they compare user-based and item-based collaborative filtering algorithms. Finally, architecture is given to support the building of a real-time recommendation service.

In this Proposed system, they had used SVM to predict the restaurant based on the user location. By developing a recommendation system which could help a user to decide which restaurant one should visit, the person can save a lot of his time, efforts and money and thus have a great experience and satisfaction.

There are various factors based on which a user decides of visiting a restaurant like the type of cuisine of the restaurant, the location of the restaurant, the ambiance, price range, popularity, ratings, etc. Such information is collected and made available on sites such as Yelp and Zomato.

Using well rounded, open source dataset provided by Yelp which provides data not only of the restaurant reviews, but also user-level information on their preferred restaurants the aim is to build an efficient recommendation system for the Yelp users in the form of a software application and thus help

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them predict whether they will like visiting a restaurant or not by applying machine learning techniques and algorithms.

In this paper, they studied that the consumers use online reviews for a variety of reason. For many products/ services, there are a large number of reviews which makes it difficult for consumers to decide which reviews to pay attention to. Hence, previous research has suggested that online reviews websites can provide a customized review sorting system for each individual consumer.

Consequently, drawing upon five consumer segments as well as 10 restaurant characteristics found in the literature, we propose a content-filtering recommender system that evaluates individual online reviews and assigns a numeric score to each review for each of the five consumer segments. The numeric scores can later be used to sort online reviews for individual consumers according to their taste for restaurants.

III. METHODOLOGY

The proposed Recommendation system has used the statistical methods and exploratory data analysis for answering the following questions. To find out number of unique users and restaurants. Find out ratings including food,service and quality.

For betterment of model we found how many times user rated, totally how may times the restaurant been rated and find out the rating distribution of food, service and quality separately.

```
Unique users:  138
Unique restaurant:  130
Total no.of ratings given:  1161
Total no.of food ratings given:  1161
Total no.of service ratings given:  1161
```

Fig 1. Find out unique values of the entity.

```
U1061     18
U1106     18
U1134     16
U1024     15
U1022     14
```

Fig 2. Find Number of times user rated.

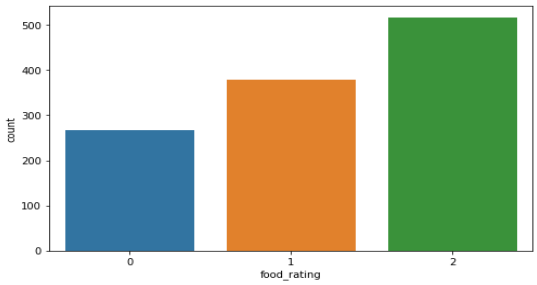

Fig 3. Food Rating.

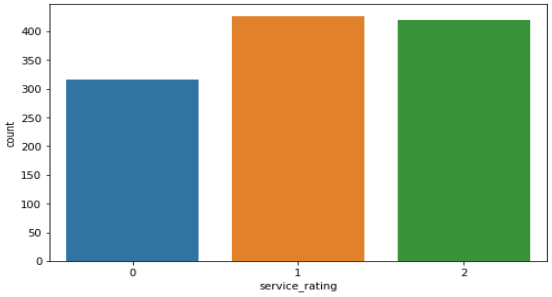

Fig 4. Service Rating.

	userID	placeID	rating	food_rating	service_rating
0	U1077	135085	2	2	2
1	U1077	135038	2	2	1
2	U1077	132825	2	2	2
3	U1077	135060	1	2	2
4	U1068	135104	1	1	2

Fig 5. Retrieving Users with food/Service Rating.

```
given_num_of_ratings:  884
possible_num_of_ratings:  16640
density: 5.31%
```

Fig 6. Density Matrix for the data set.

1. Dataset:

In this recommendation system, the main resources are the kaggle dataset that we are going to use in this application for recommend the restaurant.

Totally it contains 9 csv files including ratings,cuisine,user payment etc. In that we analyze mainly rating file which contains 1161 instances and mainly 5 attributes. This dataset is integrated with our application so that the machine learning

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algorithm deploys the suitable results for the customer.

2. Popularity Based Recommendation:

This is the common baseline approach. This model not focused on personalized approach but it simply recommends to the user the most popular thing in that region or on that occasion or the best thing in the appropriate restaurants. Hence the consumer may use the product or may not use the same on previously. It recommends the current trending or popular across the region.

This type of recommendation is very useful when we do not have any past historical data about the particular user. It works based on principle of popularity and in the current trend. Benefits of this technique are it does not affect the problem of cold start and there is no need of customer's historical data. Demerits of this system may its not personalized and the system may recommend same sort of products based on popularity to every customers.

	placeID	score
123	135085	36
31	132825	32
80	135032	28
98	135052	25
33	132834	25

Fig 7. Assign score to the most popular places.

	placeID	score	Rank
123	135085	36	1.0
31	132825	32	2.0
80	135032	28	3.0
98	135052	25	4.0
33	132834	25	5.0

Fig 8. Rank based on the scores.

	placeID	score	Rank
123	135085	36	1.0
31	132825	32	2.0
80	135032	28	3.0
98	135052	25	4.0
33	132834	25	5.0

Fig 9. Prediction for most popular restaurants in popularity based recommendation.

3. Collaborative Filtering:

Collaborative filtering is a most recently using algorithm for recommendation system. This method uses inputs from the multiple users with similar taste. It has user-based CF and item-based CF.

This methodology exploits the users underlying preferences through the analysis of latent features that define the input values. We used singular value decomposition collaborative filtering model.

placeID	132560	132561	132564	132572	132583	132584	132594	132608	132609
userID									
U1001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
U1002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
U1003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
U1004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
U1005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Fig 10. Pivot table.

```
Below are the recommended places for user(user_id = 12):

                    user_ratings  user_predictions
Recommended Places
135046                       0.0          0.780975
135026                       0.0          0.465279
135058                       0.0          0.458938
135055                       0.0          0.455777
135045                       0.0          0.440416
```

Fig 11. Recommend places based on ratings and user ID.

placeID	Avg_actual_ratings	Avg_predicted_ratings	place_index
132560	0.015625	-1.171132e-18	0
132561	0.023438	3.334107e-18	1
132564	0.023438	-1.491341e-18	2
132572	0.117188	9.900262e-02	3
132583	0.031250	3.323385e-02	4

Fig 12. Actual ratings and Predicted ratings.

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```
RMSE SVD Model = 0.01874
```

Fig 13. Evaluating the model with RMSE.

In this paper, we are using python for machine learning algorithm. Because python has many machine learning supporting packages. It used for representing the results in different ways by chart view, graph view and table view. For front end we are using python framework "FLASK" with html, CSS and JavaScript. Flask is easy for working with python.

The rendering is very fast and so responsive while working. For database we are using SQLite, for creating tables for each customers to maintain the customers logs, ratings, feedback, reviews and browse history.

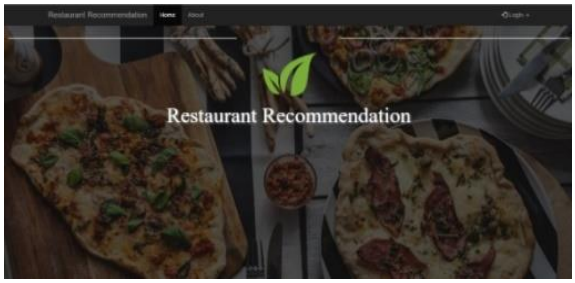

Fig 14. Home Page.

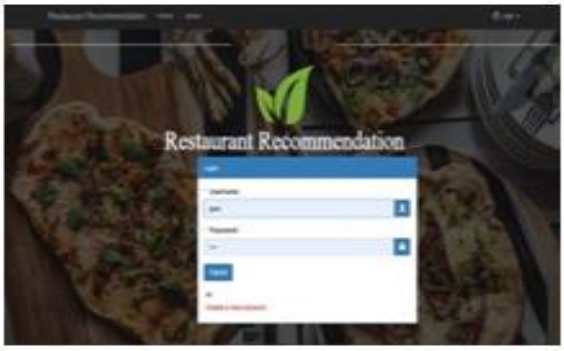

Fig 15. Login Page

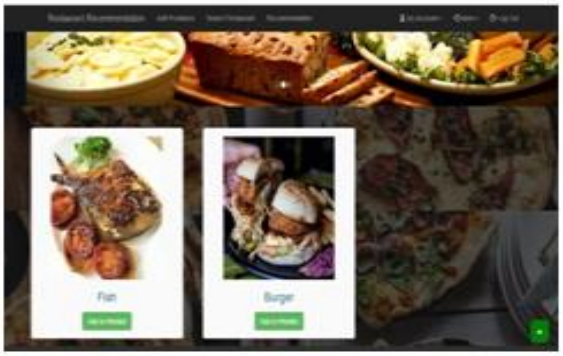

Fig 16. Menu Page.

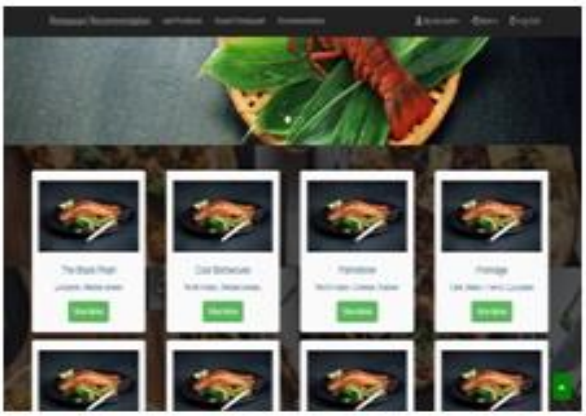

Fig 17. Options availability.

VI. CONCLUSION

The main objective of the study is to develop the restaurant recommendation system using machine learning with the web interface that can act as a application for the customers.

This application is used for the users to predict the suitable restaurant and find out which dish is famous in region wise and in person. This application ensures the availability of ratings to the customers.

The popularity based and collaborative based filtering makes the recommendation more efficient so that each user can use this application for their easy prediction of restaurant.

Most the case user need the restaurant with their nearby location. We also solving that issue by adding the restaurant location in our dataset. So that our machine learning algorithm easily predicts the restaurant for the customer with their present location.

This restaurant recommendation system web application will provide user a better experience in searching of restaurant with short amount of time and nearby location. This will decrease the user's effort and makes the time more precious.

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