Restaurant Recommendation System Using Linked Open Data

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***Abstract*—The paper introduces a new restaurant recommendation system that, in addition to showing the ratings price range and other common filters related to a restaurant, will showcase the calories of the dishes at the restaurant. The system will also recommend restaurant options based on the emotion selected by the user. By utilising several restaurant-related datasets, linked data is created which can then be queried to retrieve restaurants based on user-selected filters.**

Keywords—restaurant, recommendation, rating, price, calories, emotions, semantic web, linked open data, ontology

I. INTRODUCTION

Food is one of the most important aspect of life for a human. And many people around the world spend hours in choosing a restaurant which is favourable to them in terms of ratings, prices, and cuisines. In addition to this, people, nowadays, are being conscious about their eating habits and are trying to maintain a healthy lifestyle. For this reason, they prefer to know the calories of a food item in the restaurant before opting for it. However, none of the existing systems today provide a note of the calories in a dish at their restaurants. Thus, the restaurant recommendation system will provide the number of calories, or the calorie range for a particular restaurant thus providing the user with more information regarding a restaurant. A recommender system helps find personalised results for a user based on filters in a complex, vast system [1].

In addition to presenting data about the calories of an item, the restaurant recommendation system will also help user choose a restaurant based on the emotion they are feeling. For any emotion presented to the system, it will provide a set of restaurants with suitable cuisines, along with any other filter selected by the user.

The data is accessed from several datasets which will help the system be more accurate by achieving thousands of restaurants. This data is then converted into the format of linked data which can then be retrieved with the help of semantic queries.

The ultimate goal of restaurant recommendation system is to create a user-interactive system where the consumer will be able to access thousands of restaurants and also filter them extensively based on their interest.

II. PROBLEM DEFINITION

There are lot of recommendation systems. We have all the typical constraints including price, ratings. But along with that we are planning to having calories and suggesting places to eat at based on emotion and location. The food industry is a multi-billion industry with millions of restaurants and fast food chains always innovating their menus to attract more customers. Using the Web Semantic Engineering, we can recommend the restaurants based on different cuisines to the customers. Tremendous amount of data such as different types of dishes, ratings, calories, etc. can help in luring new customers to try out different restaurants. We will be using an already available restaurant dataset in the Kaggle and we will be able to produce insights from it. The dataset is freely available and we will create triples from this dataset and further creating SPARQL Protocol and RDF Query Language (SPARQL) queries for the user to view the recommended restaurants.

Although, there are a lot of systems which recommend the restaurant based on the user preference. Our system has all the necessary features that a system existing alone doesn't have. So, this recommendation system helps people i.e., customer with the best way possible to choose the needed restaurant in the best way possible. To achieve this we are using the semantic web engineering which helps to fragment data according to the user interest and create the application with the all different features included as discussed. Semantic web defines the meaning of the data to the system and can add additional features to wherever possible based on the user requirement. The ontologies created are transferred using the Application Programming Interface (API) which retrieve the best restaurants based on user's preference. Our system also has a additional feature where we can select our comfort food based on the emotion. This system can be built in many ways

possible but the semantic web can help the system to be built according to the user emotion and requirement with the datasets which can help in building the system in easiest way possible. Hence, this would be a system which links different things together to make sure everything falls under user satisfaction as personalised product recommendation helps in serving the customers with the relevant products which are highly served.

Several datasets are being used to extract information related to restaurants. The data is then cleaned and processed to extract necessary information, which is then transformed into Linked Open Data (LOD) thus obtaining data that is only necessary [2].This data can then be retrieved using the API's based on the user interest. This system on the whole is combination of all the features that a user could ever want based on the need. Finding the right system with all the features is also tough. So, that can be eliminated with using this system where the user finds whatever he needs in a single restaurant recommendation system.

III. Related Work

A. Nutritional Semantic Recommender System For The Elderly

The nutritional semantic recommender system is a recommender system for elderly which provides the users an opportunity to build their own diet plans based on the recommendations and guidelines provided [3]. The system uses semantic similarity measure to provide recommendations about the information present. The system also ensures to use reasoner based on which items are closely aligned to the user's requirements. In addition to this, the system has a user-interface that is elderly-friendly. The database is represented in the form of Web Ontology Language(OWL) ontology which contains a nutritional, as well as, a user profile ontology.

B. Drug Encyclopaedia Linked Data Application

E-learning recommender system is another system that play a crucial role in assisting the students in finding useful and relevant learning materials that match their learning needs [4]. A fascinating area of research is the use of ontologies for knowledge representation in knowledge-based recommender systems for online learning. Ontology is used to convey knowledge about the student and educational materials in knowledge-based recommendations for e-learning resources. Additionally, it became clear that combining knowledge-based recommendations with other recommendation methods might improve their effectiveness of E-learning recommendation systems.

C. Movie Showtimes Recommender System

In this recommendation system, the location, crowd and time of the movie are considered and showtimes are suggested [5]. The user initially updates their profile after which time and location related filtering is carried out and then suitable showtimes are recommended. The information about these aspects is stored in an ontology by linking the data in the form of linked open data. The linking of the data facilities easy retrieval of information.

D. Publishing Historical Places and Old Maps

Geocoding applications for Linked data applications maintains historical data of geographical locations such as gazetteers and maps using SPARQL end points. The service is used for real time maintenance of maps and geo ontologies in real time [6]. This is made possible by using legacy catalog systems.The locations may be displayed on both historical and contemporary maps, as well as with extra contextual Linked Data connected, to help people better comprehend past locations. Also the service may be utilised and expanded in a federated manner by including additional distributed SPARQL endpoints or other web services with an appropriate API into the system.

E. Semantic Web Technologies at Pinterest

OWL has a wide range of application in the present applications and many applications are moving towards semantic web technologies to improve the application. One such example is Pinterest. In 2018 Pinterest opted to use semantic web for optimising the data and to create graph of users and content [7]. It uses a knowledge graph for representing vast amount of data in its database as well as information about its users in the application. This feature would help to discover the type of content to display for every Individual based on their interest as well as the suitable ads to display for marketing a product.

F. Uber Eats

Market-based recommendations are one resemblance. Uber Eats cater the selection and ranking of restaurants to our understanding of what eaters seek, from search results to the list of eateries and explicit suggestions on the app's home screen. By using multi-objective optimisation, we can ensure that restaurant partners get a fair amount of exposure in the app depending on user interest and assist diners in discovering a wide variety of eateries [8]. Eaters, restaurant partners, and delivery partners make up the three sides of the UberEats marketplace. Customers use the site to find and order food. The platform serves as a sales channel for restaurant partners to find clients. Additionally, delivery partners make money by procuring and delivering meals from restaurants to consumers

G. Content-Based Recommendation System

Another interesting system is the Content-based recommendation system. Similar products are recommended based on a specific item using content-based recommenders. This technology generates these recommendations using information like the description, genre, type of restaurant, etc. These kinds of recommendation algorithms work under the premise that if a person enjoys one item, they will also enjoy something similar to it [9]. For instance, if a customer orders a lot of spicy Indian food, they may start to realise that there are more Indian establishments serving spicy food in the app. At the same time, more Asian recommendations could appear.

The restaurant recommendation system uses a similar methodology of retrieving data and presenting it to the user. The data obtained from the datasets will be processed and converted into the format of linked open data in an ontology. This data will then be retrieved with the help of queries (based on the filters selected by the user). However, the restaurant recommendation system will also be different from the previous existing systems as this system will present more

filters to the user and also several new features(in the form of filters) which are not available to the consumer until now, such as the calories of a food item.

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