A Tourism Recommendation System for Thailand using Semantic Web Rule Language and K-NN Algorithm

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Abstract

This paper reports on the development of a Tourism Recommendation System for Thailand using the Semantic Web Rule Language (SWRL) and a KNN algorithm to find and display appropriate tourist information. The system has been built with Java Server Page (JSP) and harnesses two different ontologies: a Tourism Ontology for touristic attractions in Thailand and a Temporal Ontology that shows important festivals derived from the Thai Lunar Calendar. The system allows the user to select from a menu of personal interests (accommodation, food places, attractions types, etc.), uses the data to find an appropriate destination and further places nearby that can be recommended according to the user’s selections. The tests show that most users were satisfied with the interface and the results presented by the system.

Key Words: Ontology, Semantic Web Rule Language, Recommender System, Web Application, Information System, Management Information Systems

1. Introduction

Current tourism information on the Internet is increasing and presented in various formats. Travel information, such as accommodations, restaurants, and attractions, sometimes is difficult to use for planning travel, since the information from many sites is uncertain and unreliable. In addition, to request the information, users may have to register before they have access and they must wait for responses for a long time [1], [2]. Also users find difficulty and confusing with large results of searching which are mixed and contain some unrelated information they need. The tourists will have to search in order to plan ahead or choose specific points of interest only to save time during travelling [3]. Recent research on tourism searching and planning recommendations is summarized in Table 1.
Table 1. Summary and comparison of related research.

<table>
<thead>
<tr>
<th>Source</th>
<th>Remarks</th>
<th>Methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garcia-Crespo et al. [4]</td>
<td>Hotel recommended by detailing requirements, including service, location, seasons and events and taken the ratings from user reviews for analysis.</td>
<td>expert systems / Semantic Web / ontologies / fuzzy logic</td>
</tr>
<tr>
<td>Palaniammal et al. [5]</td>
<td>Travel guide that provides detailed information about accommodation, attractions, shopping, restaurant and transportation. Users can choose the attractions according to ages and jobs for creating appropriate activities.</td>
<td>ontology for travel information /SPARQL</td>
</tr>
<tr>
<td>Chaves et al. [6]</td>
<td>Accommodation details amenities/facilities recommendation such as a bathroom, outside the room, disabled, drivers, airport shuttle, car seat rental, bike rental, payment, laundry, butler newspaper, for newlyweds and day tour.</td>
<td>ontology for accommodation</td>
</tr>
<tr>
<td>Hristoskova et al. [7]</td>
<td>Buildings travel advice such as museums, science centers, and banks.</td>
<td>ontology for travel information /SWRL</td>
</tr>
</tbody>
</table>

Thailand’s tourism industry aims to add value to the local economy. Currently, there are various systems to help providing tourist information to visitors, whether in the form of multimedia website press releases or print media. However, to visit interesting places, travelers need to know all information about the attraction, accommodation, nearby restaurants and other attractions. Most of the tourists look for information through search engines but the results mostly do not meet the requirements.

This paper presents the development of a tourism recommendation system for Thailand using Semantic Web Rule Language (SWRL) and K-Nearest Neighbor (K-NN) algorithm. Recommendation Rules have been developed for travel information with SWRL and K-NN algorithm for calculating and ordering appropriate information. The system can benefit travelers in planning or preparing for traveling to places.

2. Methodology

The Thai Tourism Recommender System is divided into four parts: (1) a novel tourism ontology focusing on Thailand, (2) SWRL (Semantic Web Rule Language), (3) KNN algorithm, and (4) the Tourism Recommender System. These parts will be briefly discussed in the following.

2.1 Tourism Ontology

In this research the Thai Tourism ontology [8] has been used, which consists of 10 classes: ThaiProvince, ThaiAmphoe, ThaiTambon, ThaiEvent, ThaiAttraction, ThaiAccommodation, ThaiTransportation, ThaiRestaurant, ThaiSouvenir, and ThaiOTOP (One Tambon [sub-district] One Product). The tourism ontology keeps details and background information on the 77 provinces in Thailand.
2.2 SWRL (Semantic Web Rule Language)

SWRL is a language for creating rules in the Semantic Web, which is a combination of the features of OWL (Web Ontology Language) and RML (Rule Markup Language). A rule in SWRL language can be described as in the following example: 
\[
\text{Tourist(?x) ^ hasAgeRank(?x,Age36-55) ^ isLocatedInProvince(?a, "Province") ^ Island(?a) -> sqwrl:select(?a)}.
\]
This rule means that a tourist between 36-55 years of age can visit the island located in that province.

In this research, SWRL is used to create rules with five variables: tourist, age, sex attractions and province for tourist information recommendation. SWRL implies a management mechanism in recommending tourist information by using the example of a travelling behavior, as the following example:

- Young people aged between 19-25 years; if they are married but have no "honeymoon" attractions or activities may often be interesting together with facilities well equipped, nice atmosphere, romantic surroundings, such as the sea and aboard ship.
- Elderly people aged 55 years and older; this is a group that has both time and money. Travel habits of this group focus on comfortable environment, excellent service and short travel times. Appropriate sites or group activities are visits of historic places, temples to make merit, going shopping, and so on.

2.3 K-Nearest Neighbor (K-NN) algorithm

This technique is used to classify or group data based on similar data sets, which are considered the closer of information values. The K-Nearest Neighbor algorithm compares data sets and input data and finds the minimum distance between them (K is represented by the distance between the desired information). In this research, the K-NN algorithm is used as Hamming Distance to calculate similarities of tourist information, since this calculation is fast, easy and appropriate to implement the tourist recommendation system [9]. For the K-NN algorithm is applied to rank and recommend the travel information in order to meet the needs of users. The user must select the type of tourist accommodation facilities, food and tourist attractions and activities; the following process is then:

- Initialize information: value 1 is given for selected information from users matching with tourist information types and 0 for no matched information.
- Compute and compare tourist information with selected information using Formula (2.1) with maximum distance values.
Display result of recommendation by displaying the tourist information, which has the maximum distance.

\[ D_H = \sum_{i=1}^{n} (x_i - y_i) \]  

(2.1)

where \( D_H \) is the sum of information \( x \) that is equal to selected information (by users) \( y \), \( x \) is a set of travel information, \( y \) is a set of selected information, and \( n \) is the total number of datasets used.

3. Thailand Tourism Recommender System Architecture

Fig. 1 shows the system architecture as described in the following.

The user enters the type of tourism, accommodation and food categories, gender, age, date of travel, number of days to travel, and the number of tourists; after that, the system follows these steps:

1. Take the user’s travel information and match it with the travelling rules stored in SWRL format.
2. Calculate travel information to meet the needs of the user applying K-NN algorithm.
3. Find and rank such items as attractions, accommodation, and restaurants with events (or festivals) that tourists should visit during the time of their stay.
4. Display the results of the recommendation process: 1) most recommended tourist items with details (e.g., map and necessary information within the selected province) and 2) where and when important traditional events are located near the destination.

In this work, the web application has been developed by using JSP (Java Server Page) for extracting tourism information from ontology and by applying inference rules for the recommender system.

4. Testing and Results

The selected tourist information by users (can be one or all of the group's members to travel) can have various options and is divided into the following choices.

1. Specific information: number of persons, gender, age, travel date, number of traveling day, and province to visit.

2. Tourism types: mountains, waterfalls, caves, museums, parks, shopping malls, dams, entertainment facilities, zoos, historic sites, islands, temples, and other cultural monuments, among others.

3. Favorite foods or type of restaurants: noodles, steak, barbecue, bakery, salad, pizza, fast & low, sukiyaki buffet, seafood, etc.

4. Type of accommodations with facilities: hotel, camp, apartment, bungalows, cabins, motel facilities, car park, swimming pool or spa, massage room, gym, steam room, sauna, Karaoke, breakfast, Internet access, cable TV, coffee shop etc.

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Fig. 2. Interface and results regarding user selection.
The result of the travel information recommendation in Thailand consists of two parts:
First, the recommended place is "Kramang Temple" because the activity meets the needs according to the user information. "Plerndow Hotel" is recommended because of parking needs and being a place nearby. A recommended restaurant is "Pa-Tawin Phatthai Wangthong", which is famous for typical stir fried noodles in Amphoe Wangthong, Phitsanulok. In addition, the system can also show a list of similar items to what users want and rank the tourist information in each category.
Second, the event recommendation uses the lunar calendar to find local and regional festivals (events) during the time of the year (bottom of the screen) that are based on this calendar and, therefore, change dates every year. Thus, users can check the right time for going to such events, since the system can give additional details for attractions, activities and festivals interested tourists should visit during the time of their stay. Fig 2 indicates that the user selected a trip on 5 November, 2014 for two days, and then the system suggested the tradition of Thailand as Loy Krathong and Buddhist Holy Day (15th day of the 12th waxing moon), which was 6 November 2014. Moreover, the system can provide instructions related to the various temples to make merit, allowing users to plan activities in tourism during their stay.

5. Conclusion and further work

This paper introduces the Tourism Recommendation System in Thailand Using the Semantic Web Rule Language (SWRL) and K-NN Algorithm. Testing found that the visibility of travel information meets the needs of most users. The system allows users to choose types of tourism, accommodations and foods by taking into account gender, age, and the number and duration of travel. Then, the system uses the data and compares them with the rules of the tourism ontology based on SWRL, which are also stored in the data model. Finally, the system calculates the travel recommendation to meet the needs of users with the help of the K-NN algorithm. The temporal ontology is applied to give additional details for attractions, events and festivals that tourists should visit during the time of their stay. Results generated by the system produce suggestions where and when important traditional events are located near the destination. However, the K-NN algorithm may take longer to process due to being examined individually, especially in the case of the user choosing a lot of selected data.
References


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