Ontology-Based Decision Support System for Crop Selection on Android (ODESSA)

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Abstract

Besides the many practical reasons to grow trees, there are also traditions resting upon beliefs and traditions that call for planting very specific crops at auspicious locations and times. Related information on such procedures is difficult to gather on the Web. Therefore, we provide the Ontology-Based Decision Support System for Crop Planting on Android (ODESSA), which helps users make decisions for planting and growing crops effectively following Feng Shui rules. The knowledge is represented by an OWL Ontology. ODESSA represents the essential information of plants to users, such as the planting process, adequate care, and regular information regarding a tree. The system consists of two main parts: 1) the recommendation component for planting auspicious crops, in which ODESSA applies 39 rules, created in SWRL, to find the proper crops that enhance prosperity for users; and 2) the planting of crops for particular proposes. Users provide specific requirements to the system, so that the SPARQL component in ODESSA can generate the appropriate results. In addition, the system can query useful websites for taking adequate care for trees or flowers and display maps and routes for the nearest garden supply shop based on the current location of the user as a location-aware service.

Key Words: Android OS, Ontology, Semantic Web Rule Language, Recommender System, Mobile Application, Information System, Feng Shui

1. Introduction

Planting is an activity to expand green spaces and shaded areas to reduce environmental stress. It protects the inside of the house from sunlight, so that the indoor space remains at lower temperatures. Most Thai people have believed in good fortune when growing plants since ancient times [1]. Auspicious trees, for example, which match with the house owner’s birthday can add to house members’ wealth, make them raise to a more important rank in their jobs, or lead to good living. However, collecting relevant information from Websites or documents is time consuming.
In addition, many house owners believe in Feng Shui and need to put plants in places that suit the Feng Shui directions or are proper for house owners. According to In-thongkham [2], who studied the behavior of buying flower trees in Pathumthani, most respondents paid special attention to the principles of Feng Shui. These principles can also be applied to the environment of the house, for which Chiu, Chuang and Lin created an assistive decision model using Feng Shui principles [3]. The results showed that house buyers could meet the principles of Feng Shui using the decision model. Similar to the believing in luck from ancient Thai, planting auspicious crops which correspond to house owners’ birthdays increase prosperity and lead to good fortune.

To address the problem of finding appropriate plants to grow in accordance with Thai beliefs and Feng Shui principles, we have created an ontology for representing knowledge on auspicious plants and have defined rules in SWRL language to assist users. Moreover, garden supply shops that are close to the current location of users are provided with routes and, additionally, useful websites for taking adequate care for trees. In the following, we lay out the method of this research including the system architecture, report on the testing and results, and we finally draw conclusions and future work.

2. Methodology
2.1 Plant Ontology

In agriculture, there are different classifications of plants but the most basic uses the term crop for useful plants and the term weed for all others. Agronomic crops are grown in large areas (on farms), and horticultural crops are grown in garden-like surroundings (e.g., orchards). Many more subdivisions exist: forage crops, oil crops, seeds, cereals, vegetables, fruits and herbs to name a few [4]. Nevertheless, there is no generally accepted classification, so researchers in different regions of the world may use their own classifications according to their needs; see, for example, the studies of Somsri [5] and Srichetta, Shuuttha and Pholsi [6], who base their results on different crop classifications.

In this research, we introduce a plant ontology (Fig. 1) which is divided into three classes: 1) class of flowers consists of flowering herbs, shrubs, climbers, trees, leaf plants, floating plants, palms, and bamboo trees, 2) class of fruit comprises edible fruits and non-edible fruits, and 3) class of herbs includes detoxifying, aromatic, and medicinal herbs (here called treat). The plant ontology was set up with Protégé 3.5 and designed as an OWL ontology called tree.owl with all the rules that come with the principles of gardening by Feng Shui [7] to guide the decision making for planting. Certain criteria are applied, such as birthday, zodiac year, and zodiac sign. Rules for selecting appropriate plants were made using SWRL.
2.2 SWRL Rules

SWRL [8] is an expressive OWL-based rule language that can be used to increase the amount of knowledge encoded in OWL ontologies. While semantically a SWRL rule can be considered as an additional type of OWL axiom, the authoring and management of SWRL rule bases requires specialized tools that are not typically present in standard OWL development environments.

ODESSA allows the user to enter their birthday, then take into consideration with SWRL rules to help select suitable plants according to user. There are 39 rules used in the system and each rule was tested with the Jess Inference Engine. Some examples of the rules can be shown in Table 1.
Table 1. Example SWRL Rules for tree selection.

<table>
<thead>
<tr>
<th>Rules No.</th>
<th>Rules</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Person(?x) A hasForDay(?x, &quot;DayName&quot;) A CanEat(?a) A hasForDay(?a, &quot;DayName&quot;) → sqwrl:select(?a)</td>
</tr>
<tr>
<td>2</td>
<td>Person(?x) A hasForZodiac(?x, &quot;ZodiacName&quot;) A CanEat(?a) A hasForZodiac(?a, &quot;ZodiacName&quot;) → sqwrl:select(?a)</td>
</tr>
<tr>
<td>3</td>
<td>Person(?x) A hasForChineseZodiacYear(?x, &quot;ChineseZodiacName&quot;) A CanEat(?a) A hasForChineseZodiacYear(?a, &quot;ChineseZodiacName&quot;) → sqwrl:select(?a)</td>
</tr>
<tr>
<td>4</td>
<td>Person(?x) A hasForDay(?x, &quot;DayName&quot;) A CanNotEat(?a) A hasForDay(?a, &quot;DayName&quot;) → sqwrl:select(?a)</td>
</tr>
<tr>
<td>5</td>
<td>Person(?x) A hasForChineseZodiacYear(?x, &quot;ChineseZodiacName&quot;) A FloweringClimber(?a) A hasForChineseZodiacYear(?a, &quot;ChineseZodiacName&quot;) → sqwrl:select(?a)</td>
</tr>
</tbody>
</table>

3. The Architecture of ODESSA

We have designed the architecture of ODESSA using an ontology (Fig. 2), which is suitable for Android OS and has the following work flow:

Fig. 2. ODESSA system architecture.

We have designed the architecture of ODESSA using an ontology (Fig. 2), which is suitable for Android OS and has the following work flow:
1. Users either enter their date of birth or the type of plant they want to grow. ODESSA uses the date of birth to identify the day of the week, zodiac symbol, and zodiac year. The appropriate results come from the landscape architecture database and are qualified with some useful data, e.g., sunrise resistant, rain resistant, aromatic, shade, and auspicious plant.

2. The results from the first step, which are day of the week, zodiac symbol, and zodiac year, will be sent to Web server and compared to the recommendation rules for tree planting. The recommendation is stored in the form of language SWRL using Protégé API and the Jess Inference Engine. Otherwise, the specific characteristics of the plant the user wants to grow will be queried using SPARQL with Jena API.

3. The results are shown to help users make the best decision for planting, such as tree information (name, scientific name, other names, common characteristics of the plant) including: propagation, adequate care, and belief-in data. Moreover, ODESSA provides maps and routes for the nearest garden supply shop according to the current location of user.

4. Testing and Results

This section shows the results of the development of ODESSA based on the plant ontology for Android OS. Information on trees found in Thailand was collected and stored in tree.owl and has been used for testing, thereby applying the Feng Shui rules. The landscape architecture database has also been used to determine the direction and location of the trees according to the zodiac and year of the birth of the owner or resident.

After users input their birthday, e.g., March 25, 1998, ODESSA recommends plants that should be grown to enhance their luck. When the user clicks on the cornstalk plant (Fig. 3), ODESSA uses SPARQL to query information for this plant including: propagation, adequate care, and belief-in data.

Fig. 3. Result of plant selection based on birthday with plant information.
When users select the desired characteristics of trees, e.g. yellow flower, high sunlight resistance, flowering in March/April, shaded, and auspicious tree, ODESSA recommends plants (Fig 4 left), such as Yellow Pui, Yellow Tabebuia, Cassia Glaucua, and Tembusa. In addition, ODESSA can provide maps and routes for the nearest garden supply shop as a location-aware service (Fig. 4 right). When users click on the name of the tree and select Map, ODESSA displays the nearest garden supply shop with geographic location, e.g. Nakhon Sawan, Thailand. Users can click on the red pin on the map to get more details, and the Route button provides the path from the current location to the store.

<table>
<thead>
<tr>
<th>Result of Tree Selection</th>
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<tbody>
<tr>
<td>Criteria:</td>
</tr>
<tr>
<td>☑ Yellow flower</td>
</tr>
<tr>
<td>☑ Sunrise</td>
</tr>
<tr>
<td>☑ Shade</td>
</tr>
<tr>
<td>Result:</td>
</tr>
<tr>
<td>1. Yellow Pui</td>
</tr>
<tr>
<td>3. Cassia Glaucua</td>
</tr>
<tr>
<td>5. Golden Shower</td>
</tr>
</tbody>
</table>

Fig. 4. Result of selection with maps and routes of garden supply shop.

5. Conclusion and further work

This paper has presented the results of a project for a decision support system with a plant ontology for Android OS, which is intended to find information and give advice on planting appropriate crops for enhancing prosperity or other purposes without wasting time for searching several times using traditional search engines. Useful information will be displayed in its entirety, such as scientific plant names, information on adequate care, and propagation. The results can be linked to nearby shop locations with maps and routes according to current user location. We plan to expand the system features by developing an automatic control app on Android OS for a water supply system to ensure appropriate watering of the plants.
References


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