Modeling of Flu Fuzzy Diagnosis System Based on Linguistic Variable Ontology and SWRL on the Semantic Web

Yiduo Liang [1,1], Jun Zhai [2,1]

[1] Traffic Transportation and Management College, Dalian Maritime University, China
liangyiduo_dlmu@yahoo.cn
[2] Traffic Transportation and Management College, Dalian Maritime University, China
zhaijun_dlmu@yahoo.com.cn

Abstract. Ontology has a powerful expressive ability on knowledge. In order to share and deal with the fuzzy knowledge on the semantic web, the linguistic variable ontology is proposed as the basis of the Flu Fuzzy Diagnosis System. After that, Protégé is introduced to build the fuzzy rule base. The paper concludes that linguistic variable ontology-based fuzzy diagnosis system can achieve the function of flu diagnosis correctly.

Keywords: fuzzy linguistic ontology, SWRL, Flu Fuzzy Diagnosis System

1 Introduction

The Semantic Web is turning into a new generation web. The goal of ontology-based management is to improve the manage-ability of network resources through the application of formal ontologies [1]. Concepts are rather vague than precise in the context of semantic Web and multimedia applications. So it is important to cope with the inexact concepts on the Semantic Web.

The fuzzy ontology is capable of dealing with fuzzy knowledge [2]. And fuzzy ontology is efficient in text and multimedia object representation and retrieval [3]. Jun Z. et al.[4] utilize fuzzy ontology and RDF to represent formally the fuzzy linguistic variables, which facilitates to incorporate fuzzy systems into the Semantic Web. Qi W. et al.[5] build the knowledge base of catalogue concepts and rules on SWRL, which realizes the sharing of knowledge of audio-video material catalogue and the integration with relative information. Christopher J. M.[6] use SWRL to represent the complex knowledge needed to identify what is happening in an evolving situation awareness applications. Jun, Z. et al. [7] construct the fuzzy ontology for product knowledge and establish the semantic query expansion, facilitating the semantic

[1]Yiduo Liang is a doctor candidate in Dalian Maritime University. His research interests include ontology-based knowledge management. Jun Zhai is a professor and Ph.D. supervisor in Dalian Maritime University. His research interests include knowledge management and the semantic web.

© SERSC 2013

retrieval for the fuzzy product information on the semantic web. Jun, Z. et al.[8] introduce data type of fuzzy linguistic variable into RDF data model. After constructing the semantic query expansion in SPARQL, they implement the semantic information retrieval for Electronic business on the semantic web.

In this paper, firstly, definition of linguistic variable ontology is given. On the basis of that, Flu Fuzzy Diagnosis System is built and a tool of protégé is used to construct the fuzzy rule base. Finally, the conclusion is given.

2 Definitions of Linguistic Variable Ontology

To achieve the fuzzy knowledge representation and inference on the Semantic Web, it is essential to combine the linguistic variables with ontology. Definition of linguistic variable ontology is as following [9].

Definition. Basic fuzzy ontology. A basic fuzzy ontology is a 5-tuple $°_F = (c_a, C_F, R, F, U)$, where:

(1) c_a is a concept on the abstract level, e.g. 'price', 'speed' etc.

(2) C_F is the set of fuzzy concepts which describe all values of c_a. And C_F has certain structure or relations R.

(3) $R = \{r \mid r \subseteq C_F \times C_F\}$ is a set of binary relations between concepts in C_F.

(4) F is the set of membership functions at U, which is isomorphic to C_F.

(5) U is the universe of discourse.

3 Modeling of Flu Fuzzy Diagnosis System

Through the investigation and analysis on the features of flu patients, we summarize the following fuzzy rules that constitute the basis of the Flu Fuzzy Diagnosis System.

Table 1. Descriptions of Fuzzy Rules

Rules	Part of IF	Part of THEN
Rule-1	temperature is high and cough is frequent	comfort is terrible
Rule-2	temperature is low and cough is slight	comfort is bad
Rule-3	temperature is normal and cough is little	comfort is good

Abstracting linguistic variables and its values in the rules, we build the linguistic variable ontology model for the fuzzy rule base.

$°_{F1}$ (temperature) =

(c_a = temperature, C_F = {low, normal, high}, R = {low normal high}, F = {$F_{low}(x)$, $F_{normal}(x)$, $F_{high}(x)$}, U = [0, 50])

O_{F2} (cough) =

(c_a = cough, C_F = {little, slight, frequent}, R = {little slight frequent}, F = {$F_{little}(x)$, $F_{slight}(x)$, $F_{frequent}(x)$}, U = [0, 100])

O_{F3} (comfort) =

(c_a = comfort, C_F = {terrible, bad, good}, R = {terrible≤ bad ≤ good}, F = {$F_{terrible}(x)$, $F_{bad}(x)$, $F_{good}(x)$}, U = [0, 100])

Using protégé to represent the model above, there are three enumeration classes, Each enumeration class consists of several individuals. Linguistic variables are mapped into object properties whose ranges are individuals belonging to enumeration classes. Fig.1 shows structure of these enumeration classes and its individuals. Fig.2 shows the structure of object properties and its ranges.

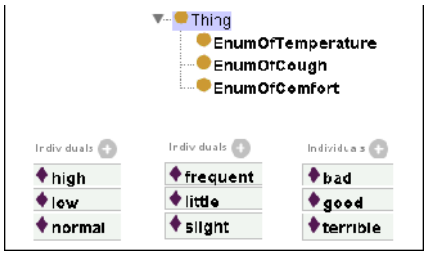

Fig.1 Enumeration Classes and Its Individuals

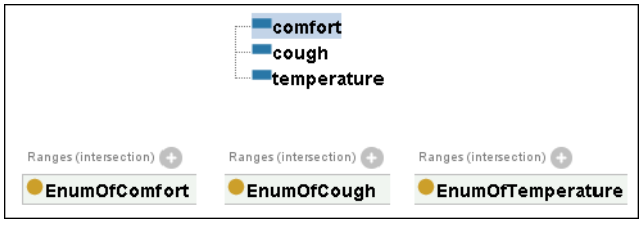

Fig.2 Object Properties and Its Ranges

Using SWRL to describe rules of flu fuzzy diagnosis system, we obtain the following fuzzy rule expressions.

Rule-1: temperature (?x, high)∧cough(?x, frequent)—comfort(?x, terrible).

Rule-2: temperature (?x, low)∧cough(?x, slight)—comfort(?x, bad).

Rule-3: temperature (?x, normal)∧cough(?x, little)—comfort(?x, good).

where x is either variables or OWL individuals. Fig.3 shows the expressions of fuzzy rules in SWRLTab of protégé.

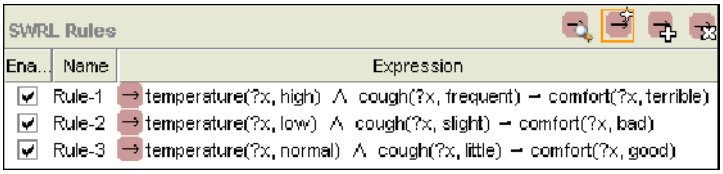

Fig.3 Expressions of fuzzy rules in SWRLTab

4 Conclusion

In the paper, the ontology is combined with the linguistic variable which is called linguistic variable ontology. Protégé is employed as a tool for the pictorial representation of our formal model. An instance of fuzzy flu diagnosis is showed that fuzzy information can be expressed well with the proposed model.

Our further researches lay on the exchange and integration of fuzzy knowledge among heterogeneous systems, and also the inference based on the model of linguistic variable ontology.

References

1. Antonio, G., Víctor, A. V., Jorge, E. L. d. V., Alfonso, S., Julio, B.: Ontology-Based Policy Refinement Using SWRL Rules for Management Information Definitions in OWL. In: Large Scale Management of Distributed Systems, pp. 227--232. Springer, Heidelberg (2006)
2. Dwi, H. W., John, Y.: A Fuzzy Ontology-based Abstract Search Engine and Its User Studies. In: the 10th IEEE International Conference on Fuzzy Systems, vol. 3, pp. 1291--1294. IEEE Press, New York (2001)
3. David, P.: A fuzzy ontology for medical document retrieval. In: Australasian Workshop on Data Mining and Web Intelligence, vol. 32, pp. 121--126 (2004)
4. Jun, Z., Weixin, L., Yiduo, L., Jiatao, J.: Using Ontology to Represent Fuzzy Knowledge for Fuzzy Systems. In: the 5th Fuzzy Systems and Knowledge Discovery, vol. 3, pp. 673--677 (2008)
5. Qi, W., Aina, S., Yongbin, W.: Knowledge Representation and Reasoning of Cataloging Based on Domain Ontology and Rule. In: International Conference on Management and Service Science, pp. 1--4 (2009)
6. Christopher, J. M., Kenneth, B., Mieczyslaw, M. K., Jerzy, J. L.: Using SWRL and OWL to Capture Domain Knowledge for a Situation Awareness Application Applied to a Supply Logistics Scenario. In: Rules and Rule Markup Languages for the Semantic Web, pp 130--144. Springer, Heidelberg (2005)
7. Jun, Z., Changfeng, Y., Jianfeng, L.: Modeling and Semantic Retrieval of Product Data Based on Fuzzy Ontology and SPARQL. In: Advanced Science Letters, vol. 4, no. 4, pp. 1855--1859 (2011)
8. Jun, Z., JianFeng, L., Yan, L.: Semantic Retrieval Based on SPARQL and Fuzzy Ontology for Electronic Commerce. In: JOURNAL OF COMPUTERS, vol.6, no.10, pp. 2127--2134 (2011)
9. Jun, Z., Yiduo, L., Yi, Y., Jiatao, J.: Semantic Information Retrieval Based on Fuzzy Ontology for Electronic Commerce. In: JOURNAL OF SOFTWARE, vol. 3, no. 9, pp. 20--27 (2008)