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Research Article

Research on Model of Ontology_based Management of Vegetable Quality Security

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Abstract: To resolve the problem of Vegetable Quality Security data description, in the guidance of ontology based knowledge management theory, we put forward a Knowledge description method on Vegetable Quality Security and build the management of Vegetable Quality Security ontology model. In order to help computer comprehend the ontology model and the semantic reasoning of domain concept acquisition, these ontology models are formalized Voronoi diagram.

Keywords: Knowledge of vegetable quality security, ontology theory, Voronoi diagram

INTRODUCTION

Vegetable is an indispensable healthy based food in people's lives; it can meet people's nutritional balance. Countries in the world have been concerned about quality of vegetables, as the world's largest vegetable producer, consumer and exporter, our country solves the problem of vegetable quality and safety has strategic significance. The quality of Vegetable products not only depends on the management of vegetable production, but also relies on relevant knowledge management. Kinds of internal and external knowledge of vegetable production enterprises largely determines the level of quality management during the vegetables product life cycle, it's to determine the fate of the vegetable products in the market competition. Vegetable quality safety involves many different areas, building vegetable quality safety domain ontology can form a common understanding of the organizational structure on vegetable quality and safety information for relevant personnel in various fields and it can lay the foundation for the protecting vegetable quality and preventing safety risks.

Establishing the knowledge management system of vegetable quality safety and eliminating information asymmetry in the process of vegetable production and circulation, is the necessary conditions for cultivating and expanding the safe vegetable market. Strengthening the vegetable quality safety supervision and risk prevention is main measures to fundamentally solve the quality safety problems of our vegetable. Ontology is explanation or description of an objective system, it concerned with the abstract nature of objective reality (Lee *et al*., 2012). As the abstract specification and description of domain knowledge, as expression, sharing, knowledge reuse method, Ontology is an appropriate abstract description (Chambers and Jurafsky, 2011). Taking knowledge management theory based on ontology as a guide, this paper achieve a method of vegetable quality and safety knowledge management and knowledge acquisition systems from a technical point of view. This provides technical means for the government, researchers and participants of vegetable quality and safety management to obtain knowledge of vegetables quality and safety, further to provide theory and related methods for supporting decision-making, improve information level on the of quality and safety of vegetable knowledge management, enhance the quality and safety level of vegetables and vegetable industry's competitiveness. This lay the foundation for the realization of the sharing and emphasizing-use for the knowledge of vegetable quality safety and risk prevention.

MATERIALS AND METHODS

Vegetable quality and safety knowledge system: Our country and abroad have a lot of research on "knowledge", but there are different views on the concept of "knowledge". Peter Ferdinand Drucker's argument is more comprehensive, he noted that "knowledge is information which can change some people or some things that not only make information as based approach for action, but also include through the use of information an individual (or organization) have the ability to change or to conduct more effective way. "Under this definition, we can roughly think that quality and safety knowledge is a kind of information

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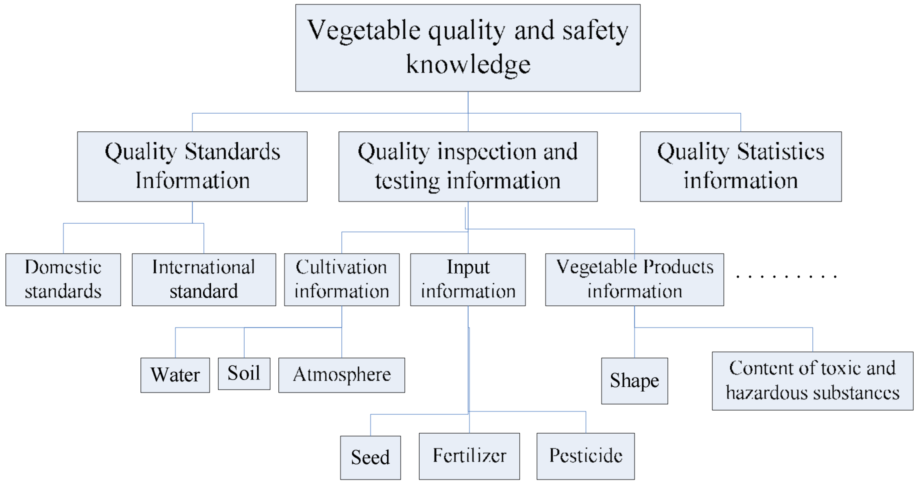

Fig. 1: Vegetable quality and safety knowledge map (local)

which can change people or things related to safety and quality activities, that not only make quality information as the basis of methods for the quality activities, but also make quality staff to control and improve quality in the product life cycle through using the information of quality.

American Verna Allee believes that knowledge management is to help people reflect on own knowledge to help develop support for the people of knowledge sharing technology and internal structure and helping people access to knowledge sources, to promote exchange of knowledge between them. Combing the characteristics of the quality of activities, the author think vegetable quality and safety knowledge management should be a conscious strategy adopted by organizations, that guarantees to transfer the most need of quality knowledge to the most in need people in the most needed time, that helps people to share quality information and then put into the quality practice in different ways and ultimately achieve the purpose of improving product quality and enterprise competitiveness. Based on this purpose, we build vegetable quality and safety knowledge as shown in Fig. 1.

Quality standards information contains all kinds of domestic and international standards for vegetable products, these standard details the terms of certain vegetables, definitions, requirements, test methods, inspection rules and identity; Quality inspection and testing information contains a variety of inspection and testing data, the data recorded various kinds of information which affect the quality of vegetables in the whole process of vegetables' production and distribution, from the cultivation of environmental testing (including water, soil, air), seed selection, to using fertilizers and pesticides testing in the growth stage, Until the final test data of the vegetable products; Quality Statistics information contains knowledge derived from analysis a large number of long-term test data by using statistical methods, such as the most likely cause or production processes causing some quality problems, using a fertilizer or pesticides may have adverse consequences. This knowledge is extremely important to ensure and enhance the quality and safety of vegetables.

This architecture reflects the hierarchy relations between categories, it can achieve a classification method based on the information/knowledge organization system, when retrieving the information, it can accord to category relationship between the upper and lower positioning navigation. However, in this architecture, the intrinsic relationship between data sources does not be completely reflected. Such as vegetables, which eventually failed products, may only do not meet the requirements of a particular standard, may be planted to the environment caused by pollution, may also be inputs' Improper use or operation of non-standard in a link of the vegetable production. The association between information and knowledge is not described in this structure, the ontology can explicitly, formally express various relationships in the field.

Knowledge representation based on ontology: Ontology is a philosophical concept originally, from the scope of philosophy, Ontology is explanation or description of an objective system, it concerned with the abstract nature of objective reality (Lee *et al*., 2012). Later, with the development of artificial intelligence, the concept has been given a new definition in artificial intelligence community. As the abstract specification and description of domain knowledge, as expression, sharing, knowledge reuse method, Ontology is an appropriate abstract description (Chambers and Jurafsky, 2011).

Perez and Benjamins (1999) think that domain knowledge can be represented as five types of elements by using ontology: class, relations, Function, axioms and instance. Class represents all knowledge and rules set in the field, usually class is also known as conception; Relations is interaction existing between knowledge entities or knowledge atomic in the field; Function is a mapping of knowledge atoms on the operating rules; Axiom is a true assertion Wing; Instance is the specific representation of class knowledge. In addition to ontology construction tools and ontology representation language, domain ontology construction must have the participation of experts in the field and have been repeatedly demonstrated. The constructed knowledge of vegetable quality and safety system previously, we can build vegetable quality and safety of the domain ontology on this basis. In general, Ontology contains two subsets: category subset of the noun concept, category subset of the predicate concept. The concept of predicate subset has movement behavior, it can also be seen as noun and this is called with the ambiguity. They all have a common object property, but have not been clearly defined.

Because of the limited study length, the following is only part of quality and safety of vegetables domain ontology constructed.

Subset of the noun concept:

- Standard
  Example: The standard pollution-free vegetables
- Cultivation environment:
  - Water
  - Soil
  - Air
- Inputs:
  - Seed
  - Pesticide
  - Fertilize

Subset of the predicate concept:

- Planting
- Field management:
  - Watering
  - Fertilization
  - Pest Controlling
  - Weed controlling
- Harvesting/processing

Ontology is organized by a concept tree, hierarchical relationship between the concepts of all Ontology strings together. Between these concepts also contains many non-hierarchical relationship, view from this relationship, these concepts is a kind of network structure. Thus, when retrieving the Ontology, not only through the concept of relations between the upper and lower Navigation to Locate, but also in accordance with the retrieval of the Ontology to be associated with some other Ontology to locate; And, once found a Ontology, the concept of upper and lower (Upper and lower levels be expressed by the hierarchy) and between the attributes of the concept, occurrence associated with other Ontology readily seen.

To achieve the computer understanding of the ontology model, we need to formalize the ontology model. There are two kinds of formalization: one kind is to provide the possibility for qualitative reasoning; other kind is to provide the possibility for quantitative reasoning. This paper use an improved Voronoi diagram formal representation based on qualitative reasoning provide the possibility for quantitative reasoning.

RESULTS AND DISCUSSION

Voronoi figure for mal description of ontology: Voronoi diagram is basic data structure which closes to nature of natural phenomena; it is applied more in all areas related to geometric information, such as GIS. Voronoi diagram's generating method has no fixed pattern; the traditional generating method is through the establishment of connection between two points (or arc) to achieve an approximate segmentation (Chen, 2002).

In the Voronoi diagram generation process, combining the characteristics of vegetable quality and safety ontology model, this generation method give up the traditional way and use the method of discrete structure. This approach takes the node of vegetable quality and safety ontology model as a generator, identify the nearest node of their relationship as the next generator, relationship between the nodes is represented through the relationship between Voronoi polygon edges. This realization has nothing to do with the shape of Generator, does not require complex calculations and consider the error control and has more practical.

Voronoi diagram divide the two-dimensional space into a number of Voronoi polygons, Voronoi polygon edge is called the Voronoi edge. Nodes in Voronoi diagram are the classes and subclasses of vegetable quality and safety ontology. As indicated earlier, there are 19 nodes in the diagram, every node represent one node of vegetable quality and safety ontology. The relationships between nodes in voronoi diagram have two groups: related and unrelated. The related include directly related, including relevant and transfer-related.

In the diagram, directly related is described as two Voronoi polygons having adjacent Voronoi edge; including relevant means first-level sub-class and its second-level sub-class having related relationship through including; transfer-related refers two Voronoi polygons having no directly adjacent Voronoi edge, but one of the Voronoi polygon related with the other Voronoi polygon through passing more than one directly related or inclusion relation, thus the two Voronoi polygons have a relationship of transfer-related.

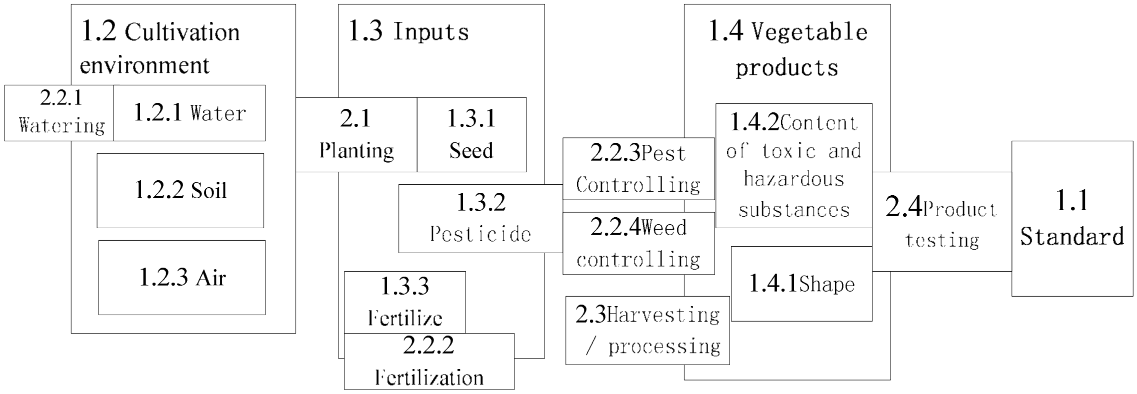

Fig. 2: The node distance of vegetable quality and safety described by improved Voronoi diagram

Unrelated means two Voronoi polygons having neither public side nor including relations and not related by transferring directly related or inclusion relation.

When establishing vegetable quality and safety ontology, we set rule that first-level sub-classes of the same kind class are not related if without transferring.

Voronoi diagram is a better model to describe adjacency relations, it is also applied to distinguish between adjacent, separated and multi-stage adjacent and so on. In general application analysis model, more only involve the adjacent space entity. The separation of adjacency relations for constructing adjacent operations can greatly reduce the search space, improve query efficiency and reduce computational. Take information retrieval for example, traditional query directly depends on the search term itself, but vocabulary (terminology) in the natural language text has characteristics of polysemy and a multi-word meaning. Thus, the traditional word-based search queries cannot meet the user semantics and knowledge needs. The ontology model can overcome the deficiencies of traditional search and realize semantic knowledge retrieval.

Domain concepts acquisition deducing method based on ontology formalization: Resent, we usually take "word" as a feature item in information retrieval. But these words do not necessarily express the contents, type and theme of the text. This problem is especially serious when dealing with domain text, it has hindered the development of text processing tasks. Domain concept is a word at first; it can be an entity concept, property concept or relations concept. Domain concept can more accurately express the content of the text.

For domain concepts acquisition, it is essential to completely express acquisition of physical concept, property concept and relations concept. This study's domain concepts acquisition starts from the acquisition of vegetable quality and safety ontology concepts, links different and interrelated entities together by property concepts, instance concepts and entity concepts. Relations between concepts' acquisition is realized by reasoning between concepts, the reasoning contains two kinds: Qualitative reasoning and quantitative reasoning.

In voronoi diagram of vegetable quality and safety ontology model as shown in Fig. 2, nodes' direct correlations have four kinds: class inheritance; instance of a class is property of another class; instance of a class is sub-class of another class; classes with common attributes. If knowledge search keywords submitted are nodes of vegetable quality and safety ontology model, we can use four kinds' direct correlations between nodes to do qualitative reasoning in concepts of vegetable quality and safety ontology and to realize the first layer semantic expanding of retrieval item.

After the first step in the extended semantics, we have get extending concepts of key words, semantics of these concepts are related to key words, but had not measure the degree of correlation. In order to objectively describe the related degree between key words and concepts, this study adopts domain concepts' similarity arithmetic based on advanced Voronoi diagram formalization.

We calculate the semantic similarity of nodes through calculating the path distance nodes. Supposing the path distance between two nodes in the Voronoi diagram is d, we can obtain the semantic similarity between the two nodes as:

$$\mathrm{Sim}(n_1, n_2) = \frac{\alpha}{d + \alpha}$$

where, n_1, n_2, express two nodes of Voronoi diagram, d is the path distance between n_1, n_2, α is an adjustable parameter.

When two nodes have a relationship of transfer-related, this transfer relation includes the following three conditions: directly related (instance of a class is property of another class; instance of a class is sub-class of another class; classes with common attributes), including relevant (inheritance of second subclass from its parent-level subclass) and transfer-related through transferring directly related or inclusion relation. The impact on the similarity calculations of these three situations is different, to distinguish the influence of three different relations, we use the following formula to calculate the semantic similarity of two nodes:

$$\mathrm{Sim}(n_1, n_2) = \sum_{i=1}^{3} \beta_i \prod_{j=1}^{i} \mathrm{Sim}(n_1, n_2)$$

where, n_1, n_2, express two nodes of Voronoi diagram, β_1, β_2, β_3, respectively express Weight percentage of Sim 1 (n_1, n_2), Sim 2 (n_1, n_2) and Sim 3 (n_1, n_2) in calculating of Semantic Similarity.

We can obtain the quantitative characterization of qualitative concepts acquisition by calculating of semantic similarity, further describe the degree of relationship between the search terms and obtained domain concepts and then achieve quantitative reasoning.

CONCLUSION

The use of ontology can help us clearly understand related elements, relationships and concepts of the specific areas of vegetable quality and safety make more accurate and convenient for knowledge representation and help people make better business decisions. We build the domain ontology based on Vegetable quality and safety knowledge system, adopt improved Voronoi diagram to describe relationship and distance between the nodes of Vegetable quality and safety for realizing the computer understanding of the ontology model and quantify the degree of correlation between the concepts by calculating of semantic similarity and then achieve quantitative reasoning based on qualitative reasoning.

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REFERENCES

Chambers, N. and D. Jurafsky, 2011. Template-based information extraction without the templates [C]. Proceeding of the 49th Annual Meeting of the Association for Computational Linguistics: Human Language Technologies (HLT'11). Association for Computational Linguistics, Stroudsburg, 1: 976-986.

Chen, J., 2002. Voronoi Dynamic Spatial Data Model. Surveying and Mapping Press, 2002: 54-78 (In Chinese).

Lee, C.M., C.K. Huang and K.M. Tang and K.H. Chen, 2012. Iterative machine-learning chinese term extraction [C]. Proceeding of the 14th International Conference on Asia-Pacific Digital Libraries, 2012: 309-312.

Perez, A.G. and V.R. Benjamins, 1999. Overview of knowledge sharing and reuse components: Ontologies and problem-solving methods. In: Stockholm, V.R., B. Benjamins and A. Chandrasekaran (Eds.), Proceeding of the IJCAI-99 Workshop on Ontologies and Problem-Solving Methods (KRRS), pp: 1-15.