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Design and Implementation of Agricultural Knowledge Cloud Service

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Abstract: Currently, China's agricultural decision support information systems and expert systems are isolated each other. Repetitive construction of agricultural information resources and systems is a serious problem. Proposed cloud services model of agricultural knowledge based on cloud computing platform.Then based on Knowledge Model base, using Web Service and XML technology, designed and realized generic expert knowledge cloud Web Services. Application results showed that it is a convenient tool for building personalized knowledge application systems of zero Configuration client. The work is an effective attempt to achieve the "knowledge as a service".

Key words: Coud service, knowledge, agriculture, reasoning, weighted fuzzy

INTRODUCTION

Existing cloud computing platform has matured, like Google App Engine, Amazon Elastic Compute Cloud and so on. Cloud-based applications can be deployed on the Cloud Platform and share its computing resources. Google Bigtable and Amazon simple Storage service and the others have provided support to achieve massive data distributed storage and access. Commercialization development of computing platform lay a good foundation for building agricultural knowledge cloud services of the underlying architecture (Chen and Zheng, 2009; Sun and Jia, 2010).

Web services is usually an application running on the Internet. Which running on a host server and requested by the remote side user. This type of web api allows users to take advantage of the Internet sharing function, rather than providing their complete application. The result of this approach is a customized, web-based applications, the majority of the program is provided by a third party, thus reducing the demand of development and bandwidth. The users of Google Maps API created "integrated application" is a good example of the Web services. What they need to do is to connect to Google's Web api with no coding and no providing map application.

As an extension and sublimation of agricultural information service, agricultural knowledge service has the advantages such as relevance, creativity, effectiveness and so on. Undoubtedly which will be the development direction and trends of agricultural science and technology service system (Zhang *et al*., 2008).

Based on the model library of knowledge, design and development of fuzzy inference engine, against the expert knowledge model required by the production management of a variety of crops. Packaging and publishing knowledge services, constructing agricultural knowledge model web api. Enabling users to take advantage of the internet shared knowledge services api, build their own knowledge services system, regardless of the knowledge representation, organization, storage and also they do not consider the reasoning of the decision-making model of knowledge and the deployment of these services, so as to provides a fast and effective tool for users building their knowledge service system.

SYSTEM ARCHITECTURE

In Fig. 1, the agriculture ontology be utilized during the process of knowledge model constructing can be integrated from the thesaurus, agricultural soil ontology, plants ontology, crop ontology, agricultural pests ontology and be updated through data mining system and experts arrangement.

In terms of the knowledge representation and reasoning, adopting the representation of "fuzzy production rules combined with model". Inference engine was based on fuzzy knowledge base and the model library, supporting model calculations. The fuzzy matching algorithm was controlled by meta-knowledge, goal-driven, with heuristic search and conflict resolution.

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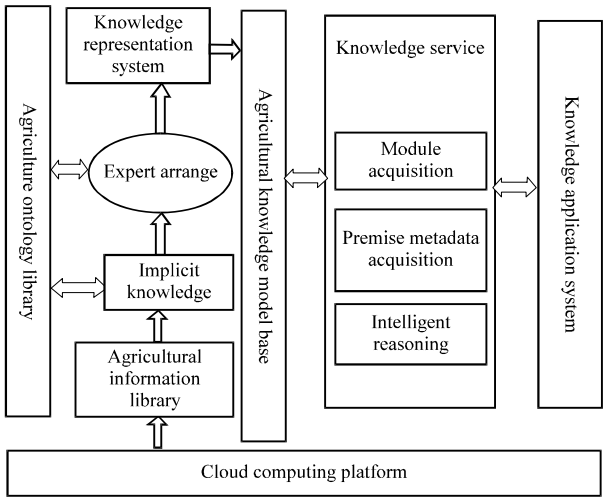

Fig. 1: System architecture

Through web service, packaging knowledge extraction module, decision prerequisite metadata capture, intelligent reasoning three core business functions. Allowed customers to build personalized knowledge applications flexibly and efficiently by introducing the service, rather than install the server applications at local.

SYSTEM IMPLEMENTATION

Knowledge acquisition and representation: The general form of the fuzzy production rules in this system is:

- P→Q, CF, ⊤, the left portion generally represents a set of assumptions or conditions and the right portion represents the conclusion or action. Premise P and conclusion Q may be blurred. CF (0 <CF≤1) is called the confidence of the rule, ⊤ is a threshold of the rule. The above means that if the premise P is satisfied in some degree we can draw the conclusions Q (or action Q) with a certain degree of confidence which is the CF "
- Knowledge with the BNF described as:

<Knowledge base>: : = <Production rules> {, <Production rules>}
<Production rules>: : = <Premise> ¬<Conclusion>, <Credibility CF>, <threshold⊤>
<Premise>: : = null | <Fuzzy logic weighted formula> <Fuzzy logic weighted formula>: : = <Weighting factorù>*<Prerequisites data item> {?<Weighting factorù>*<Prerequisites data item> }

<Conclusion>: : = <Decision-making value>[<Rules interpretation>]
<Decision-making data entry value>: : = <Decision-making data entry = value>
<Prerequisites data items>: : = <First-order fuzzy logic formula>
<First-order fuzzy logic formula>: : = <Fuzzy predicates>

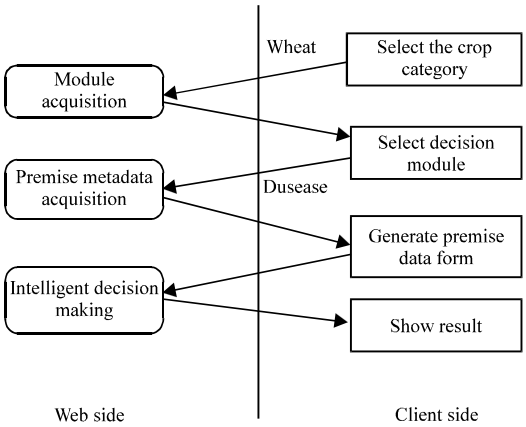

Fig. 2: Process of knowledge service application

Experts summarize their knowledge according to the knowledge template that we have designed, then computer manager entered the formally rules into the computer (Yang *et al*., 2002; Xi *et al*., 2006; Sun *et al*., 2012).

Knowledge services: The process that application at client-side worked with knowledge service at server-side shows as follow:

- In Figure 2, first, constructed interactive page to choose crop at application side, then select the crop. After that got all the knowledge modules corresponding to the crop in the knowledge model library by calling the "module acquisition" web service at server side and then generated modules

Table 1: Edit mode

input	Input box
Select	Drop-down box (1) a, display value is the value to be saved, split it with symbol ",". Such as: plains, mountains, sandy wasteland; b, display value is not the value to be saved, after defined the value to be saved then added symbol "::" and the last is the display value. such as: 0::High, 1::Low (2) query data from the database, grammar: the SQL statement is enclosed by "{"and "}", replace "'" with "^", if value displayedis not the value to be saved, You need to select the second field as a value field and use "[]" to wrap, such as:{select wjdy, [wjm] from d_c_table }, Where field "wjdy" display the value to users and "wjm" store the value to the database
Associated select	Execute the SQL statement defined in the metadata of the field and got a result as the current value Instead of user input. The SQL statement is enclosed by "{"and "}", replace "'" with "^", the data item to be refered is enclosed by "_at" and "at_". For example: Township name can be found from table "T_ Geographic Information" according to the county value. We defined the metadata of Township as "{select distinct xz from gis where qx = ^_at qx at_^}", edit mode is "associated select"

slection page. Chose one knowledge module and then called "premise metadata acquisition" web service. Constructed interactive page with the metadata to accept the input of the users.Packaged the data that users have input as a parameter and called the "Intelligent decision making" web service to seek the Conclusion.Finally, showed the result to the users (Zhou *et al*., 2007; Li and Feng, 2009; Wu *et al*., 2006)

Module acquisition: public string GetModules (string dbname)

*According crop name, get all the knowledge module in the cloud knowledge base
*Parameter: dbname, name of knowledge base
*Return value: xml format string, as follows
"<?xml version = "1.0" encoding = "utf-8"?>
<root>
<module><id>hggl</id><text> Flowers and fruit management </text></module>
<module><id>trgl</id><text> Soil Management </text></module>
<module><id>bhzd</id><text> Disease diagnosis </text></module>
<module><id>yyzd</id><text> Malnutrition diagnosis </text></module>
<code>200</code> 200 Indicates successful, 400 Indicates failure
</root>"

Premise metadata acquisition: Prerequisite expression of knowledge rules in knowledge base is composed of many logical subexpressions, each subexpression contains a premise and shows that the value of the premise must meets certain condition. We determined the boolean value of the subexpression by replaced the premise in the subexpression with the value user input. In order to match the data user input and the condition data in the subexpression, we must confirm these are of the same range, so we gave a clear data range definition of the premise.Metadata is the data to describe data range and edit mode.

The Edit modes are in the following Table 1.

The task of premise metadata acquisition web service is to get such metadata

public string GetItems (string dbname, string moduleid)
*Parameter: dbname, name of knowledge base; moduleid, decision module name
*Return value: xml format string, As follows:
"<?xml version = "1.0" encoding = "utf-8"?>
<root> <items>
<item><zdm>bw</zdm> <zddy> Diseased Position </zddy> <szlx> C</szlx> <bjbs>8</bjbs> <jldw></jldw><zd_ysz> </zd_ysz><csz>bw|| </csz><yhts></yhts></item>
<item><zdm>zz1</zdm>…</item>
<item> <zdm>zz2</zdm> <zddy> Symptom 2</zddy> <szlx>C</szlx> <bjbs>8</bjbs> <jldw></jldw> <zd_ysz></zd_ysz> <csz>zz2|| (bzzz1:zz1), (bzbw:bw) </csz> <yhts></yhts> </item> </items>
<bzitems> // Standard reference data <bzitem> <bw> Leaf </bw><zz1> There are obvious lesions </zz1><zz2> Lesion color is brown </zz2><zz3> Small brown spots appear on the leaves, purple edges. On the condition of High temperature and humidity, many lesions joins to form an irregular large spots, lesions grow black mold layer on the back.
</zz3><zz4>null</zz4>
</bzitem>
<bzitem>…</bzitem> </bzitems> <code>200</code> </root> "

Each tag "<item> </ item>" in tag "<items>" defined a premise metadata item, tag "<zdm>" represents the identifiers of the premise, tag "<zddy>" represents the description, tag "<szlx>" represents the value type, tag "<bjbs>" represents the edit mode (input, select, or select according to other value), tag "<jldw>" represents unit, tag "<zd_ysz>" represents constraint values (Upper and lower), tag "<csz>" set the value sources, tag "<yhts>" set the message to prompt user.

Among the Xml data returned, the identifiers of the third premise is zz2, the description is "Symptom 2", value type is string, edit mode is select according to other value, data source is the static data defined in the tag "<bzitems>". String "<csz> zz2 || (bzzz1:zz1), (bzbw:bw) </csz>" shows the user's optional data is from static data tags with "<zz2>". But it need to meet two conditions defined after the symbol "||". That is the value of premise "bw" and "zz1" user input must match the static data marked with tag "bzbw" and "bzzz1". The actual meaning is the optional data of symptom 2 determined by the value of diseased position and symptom 1 user input.

Intelligent decision making: To obtain conclusions according to the Knowledge Base, decision-making module and the fact that user input:

- Interface public string GetResult (string dbname, string moduleid, string data)

Parameter: dbname, Knowledge Base; moduleid, decision-making module;data, xml format string, As follows:

```
"<?xml version = "1.0" encoding = "utf-8"?>
<root><trhsl>23</trhsl> <dggmj>100</dggmj><sl> preliminary fruition tree </sl> <trlx> Loam </trlx><jymc> pinching soil somewhat damp </jymc><sqlx> gray entropy </sqlx></root>"
```

Return value:

```
"<?xml version = "1.0" encoding = "utf-8"?>
<root> <result> <jcsjxdy> Apple's disease diagnosis </jcsjxdy>
```

<jcjl> Heart mildew. Prevention and cure: remove bacteria source: clear stiff fruit on trees, branches, sweeping leaves, fallen fruit and incinerate. fruit storage temperature should be maintained at 0.5~1°C, relative humidity of about 90%.</jcjl>

<jlkxd>1</jlkxd> </result> </root>"

- **Intelligent reasoning algorithm:** In practical problems, importance or the amount of information of each premise item may be different in a premise expression of a rule. So defined a weight (w) for each premise item. In order to express such knowledge, we adopt weighted fuzzy logic formula which is very appropriate. The rule has the following form:

$$w_1 * P_1, w_2 * P_2, \ldots, w_n * P_n \rightarrow Q, CF, \tau$$

where, Q and Pj (j = 1, 2,..., n) as fuzzy logic predicates, take value between [0, 1]. wj: j = 0 (j = 1, 2, …, n) as weight of premise item Pj. CF:0 <CF = 1 as confidence of rules, τ:0 <τ = 1 as threshold that the rule can be applied.

The truth degree of the premise is t = ∑ wj*T (Pj), Where T (Pj) is the truth degree of Pj. T (Q) = t^CF, Where ^ is some kind of "cross-type operation". For example, take the small and multiplication, etc., when T (Q) greater than or equal τ, the rule can be applied (Hou *et al*., 2005; Xu *et al*., 2008; Huang, 2007).

Implementation technology: Rely on. Net Web Service technology to achieve Knowledge service. NET platform contains support for Web service. Different from other development platforms, you do not need other tools or SDK to complete the development of a web service.. NET Framework itself fully supports server-side request processor and support for the client to send and receive SOAP messages (Hou *et al*., 2005) several issues worth noting are as follow:

- In order to call Web Service method in java environment. Each method of.NET Web Service should be declared as Rpc method

```
Example:[WebMethod]
[SoapRpcMethod (Use = SoapBindingUse.Literal, Action = "http://nercita.paid/GetModules", RequestNamespace = "http://nercita.paid/", ResponseNamespace = "http://nercita.paid/") ]
```

- **Deal with return value, parameter:** Always try to keep the value type of return value and parameters as string. Do not use complex object types, it is easy to transmit on the network, avoiding the complex conversion of object type. While make sure string form is xml format but also guaranteed to return a string encoded as "utf-8", for example, use the following manner:return Encoding.UTF8.GetString (output.ToArray ())

CONCLUSION

Cloud computing platform provide a more favorable space for building agricultural knowledge base, processing knowledge arithmetic. Design and implementation of Agricultural Knowledge cloud service has opened up a new way for utilizing and sharing agricultural knowledge. Though the scale of agricultural knowledge base still can not meet the requirements, constitute a rich knowledge cloud and the design of interface and application is not as simple as Google Maps api. But the Agricultural Knowledge cloud service may be the most appropriate dissemination style of agricultural knowledge. The work is an effective attempt to achieve the "knowledge as a service".

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