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Abstract. According to the uncertainty, dynamics and dependency of maize diseases, this paper puts forward a kind of maize disease diagnosis model combined ontology with multi-Agent. The knowledge representation of ontology provides a clear formal specification for the onset periods and symptom characteristics during maize disease occurs. Using the Agent's intelligence and the division collaboration of Agent modules, we have solved the bottleneck problem of the acquisition and representation of maize disease knowledge and improved the learning ability of the ontology. Experiments show that the model can diagnose maize diseases accurately and efficiently and has a good application prospect.

Keywords：multi-Agent technology; ontology; maize disease; intelligent diagnosis

1 Introduction

Maize is the crop holding characters of food, feed and economy concurrently. The maize industry has been one of traditional industries in JiLin Province and its per capita, commodity volume, transfer volume and export volume have been for many years in the first place in the whole country. But in recent years, factors such as maize disease monitoring and evaluation, forecast and warning and timely and accurate diagnosis and treatment to corn have brought some influence to the high, steady and efficient yields. The current maize disease diagnosis and treatment is still basing on experience and more extensive and has the phenomenon such as lack of agricultural experts, untimely and inaccurate diagnosis and unreasonable pesticides. Not only does it waste resources and pollute the environment, but also lead to the maize production can't be high and stable. It is the important link to ensure the high and stable maize

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yields that researching maize disease diagnosis and treatment and reducing the losing of maize disease.

At present, the expert system applied in crop protection bases on the database expert system mainly, which provides services about the plant disease and caterpillar diagnosis, forecast, the comprehensive management, plant quarantine and pesticide management. Even if the expert system based on the model has the bottleneck problem of knowledge acquisition and representation, too. [1] The knowledge model of which is fixed and doesn't have the learning function and can't update real-time according to knowledge changes in the related areas.

This paper takes the maize disease in JiLin Province as the research object, extracts and classifies the knowledge experience in the field and takes knowledge representation, intelligent reasoning and knowledge study by using ontology technology. It adopts multi-Agent to realize ontology learning, task decomposition scheduling, information processing and intelligent diagnosis function respectively [3].

2 Research data and related technology

2.1 Research data sources

The research data derives from:

Consulting the domain experts, such as related experts of Jilin Agricultural University and the Institute of Plant Protection, JiLin Academy of Agricultural Sciences.

Relevant knowledge obtained by consulting and concluding from science and technology literature materials, such as the published books, teaching materials, articles published on science and technology journals, proceedings and degree thesis of the expert on the issue.

On the basis of test data accumulated from scientific research project (national 863 project). According to the experiment of the relationship between the yield of corn and harm, we collected maize growth traits index data 29250, such as, maize seedling, huge bellbottom period and mature; the maize disease occurring degree data and the field data 4320 and photos 189 copies; the maize insect damage field data 5760 and photos 306 copies; the maize grass damage field data 4320 and photos 286 copies. We absorbed scientific research and data also.

Collect knowledge and practice experience of all the farmers and agricultural technicians in the agricultural demonstration zone and add source of knowledge.

The source of the picture data is the staff room of plant protection of Jilin Agricultural University.

This paper organizes 13 maize disease common in the JiLin Province, such as, maize dwarf mosaic, maize rough shrink disease, maize leaf blight, corn top rot disease, maize stalk rot, maize stalk rut, maize head smut, maize curvularia leaf spot, corn sheath blight, Bipolaris maydis and northern leaf spot. Corn cercospora sogina, maize stem rot disease, corn.bacterial wilt, corn silk HeiSuiBing, corn curved spore

fungus leaf, WenKuBing corn, corn small spot disease and corn circle spot disease. The structures of maize disease organized are shown below:

Table 1. maize disease organization structure

serial number	disease name	happen period	symptom	prevention method	disease picture

2.2 Ontology

The concept of the ontology comes from the realm of philosophy. In the 1960 s, the field of computer began to use ontology, but until 1993 Gruber gave the ontology standard definition: ontology is the clear specification of the conceptual model[4]. At present, the definition of ontology is the clear formal specification of the sharing the conceptual model. It can be took as four levels, such as the conceptual model, clearity, formalization and share. Specific description as follows:

The concept model, obtained by abstracting out some of the objective world phenomenon related concepts. The meaning showed by concept model is independent of specific environmental state;

Clarity, means that the concept used and constraints used by concepts are clearly defined;

Formalization, with the body language code, ontology can make the computer be read and processed.

Share, ontology embodies knowledge recognized commonly and reflects the concept set recognized publicly in the relevant fields, that is, ontology aimed at groups rather than individuals consensus.

In general, the goal of onto1ogy is to obtain, describe and express knowledge in related fields, and provide the common understanding of the domain knowledge and make the vocabulary knowledge clearly recognized commonly in the field, and give the definition between these words and relationship between these words clearly. General speaking, the onto1ogy is a file which officially define a group of words and the relationship between them. It is the integration of the knowledge representation and the relationship rules for intelligent system. It defines some relevant classes and objects to express the knowledge. The relationship rules express the relationship between knowledge and provide a kind of intelligent reasoning mechanism.

2.3 Multi-Agent technology

Agent technology is a kind of intelligent technology which develops on the basis of the distributed and artificial intelligence research needs [5]. Agent is a kind of a smart entity with initiative, reactive, sociality and autonomy Characteristics etc. It Can be understood as intelligent computer hardware or software system with three kinds of function of the knowledge, ability and target. The knowledge obtains by users, some Agents or their own learning. The ability is the method and means of Agent to solve some problems. The problem to be solved and the task are the goal of Agent [6]. Due to the system resources quantity and their own capability limits, the

tasks which can be accomplished by one single are very limited. Multi-Agent technology takes single Agent as the foundation and takes use of the cooperation and interaction between self-government Agents to solve some kink of problems and complete the complex task together.

3 Construction of maize disease diagnosis model based on multi-Agent and ontology

3.1 knowledge representation and knowledge model based on ontology

Aiming at the effects brought by complex factors, such as the symptoms of maize disease, pathogenesis regularity complex, vulnerable to climate condition, soil factors and the difference among areas, it is difficult to use a single knowledge representation to obtain accurate expression. Taking use of ontology, some bottleneck problems in the agricultural expert system, including the knowledge representation, knowledge organization and knowledge sharing, can be well solved. The goal of ontology is to obtain, describe and express the knowledge of the related field, provide the common understanding of the domain knowledge, determine the common admissive vocabularies in the field and give a clear definition of the relationship between these vocabulary words and terms from different levels of formal model. Based on above aims, this subject set up the database of maize disease ontology.

We adopt Protege4.0 to construct the maize disease ontology database, use seven footwork in the constructing process, take formalism description on target ontology and generated the owl file [7]. Specific steps as follows:

List the important terms of ontology:

There are many concerned terms in describing maize disease. In order to extract the corresponding information, we choose some necessary terms, such as disease name, onset period, onset place, disease characteristics, disease spot shape, disease spot color and prevention-control method, etc.

Definite classes and the class level system: make the definition and classification of the class on maize disease ontology.

Definite attributes of classes: aiming at maize disease name, onset period, onset place, disease spot shape, disease spot color and prevention-control method, we establish data attributes to store the specific content of the description.

Define constraint attributes: one attribute may be with multiple constraints. The types of the attribute value include any, integer, string, float, etc.

Create example: make sure the nearest class to the individual and add the individual in the class as an instance and evaluate attributes of this instance. The maize disease instance include 13 common disease name, onset period, onset place, disease spot shape, disease spot color etc. The knowledge base relationship of ontology is shown in fig. 1.

Fig.1. the knowledge base relationship chart based on ontology

Ontology constructed as shown in figure 2 below.

Fig.2. concept structure of ontology maize disease

Maize disease ontology constructed can remove large junk information to improve the accuracy of the information retrieval during retrieving and reasoning. It can retrieve contents closely related to retrieval condition and improve the comprehensive information retrieval.

3.2 the realization of multi-Agent in the maize disease diagnosis model

The system can be divided into four layers from function and role. The first level is the user application layer. The second is intelligent processing layer, which is composed of information exploration Agent, intelligent diagnosis Agent, task decomposition and scheduling Agent, ontology evaluation Agent and ontology information processing Agent [8]. The third level, data storage layer, is composed of ontology knowledge base, disease database and ontology learning knowledge database, in which ontology studying completes by ontology studying Agent, respectively. The fourth level is the original data infomation layer.

The process of disease diagnosis can be described as: the user submits remotely diagnosis data through client. after receiving the diagnosis data, the diagnosis system use the diagnosis model in advance of data storage to make preliminary diagnosis analysis. If it can't find the matching model, the diagnosis system studies the corresponding diagnosis model by using ontology studying agent. In data processing layer, the agent of task decomposition and scheduling will breakdown the diagnosis task and use the specific algorithm of this diagnosis module by taking use of intelligent diagnosis agent, and then ontology evaluate agent evaluates the algorithm or ontology information processing agent processes the corresponding diagnosis and finally makes the conclusion and output to the user.

In intelligent diagnosis, we adopt the framework of the reasoning approach, that is, concluding the regular knowledge of agriculture (such as maize disease diagnosis and treatment technology) and depositing at the framework and using different guidance processing according to different situations [9]. The characteristics of this framework reasoning method: divide maize disease into a number of subproblems depending on each other by using frame method and form the knowledge hierarchical structure. Another sub problems focus in one frame to describe and then realize the modular and compact of the knowledge [10]. Basing on improving database, the knowledge base and material database, aiming at the specific disease characteristics needed to be diagnosed, we find out one framework similarest to the disease and match them by "top-down".

We adopt the semantic retrieval in this model. This retrieval can not only diagnose conditions consistent results in grammar form but also diagnose the results which meet the conditions on the semantics. When direct search is without results, the intelligent agent can make semantic expansion and strive to obtain highly relevant results.

3. Summary

This paper proposes a multi-Agent maize disease diagnosis model based on ontology.

In order to verify the validity of the model, we train it by taking use of survey data of the project team. We brought five kinds of common maize disease in JiLin Province to train in the experimental process and then compared with real situation.

The inspection results of multi-Agent maize disease diagnosis model based on ontology. It can be seen that the average accuracy of the model is 82.98%.

This paper introduces ontology and multi-Agent technology into maize disease diagnosis for their research, combines it with the implementation of the national "863" maize precise operation system research and application project, verifies the feasibility of the model and has a certain practical value. According to special requirements of the content of maize disease diagnosis, the diagnosis program and the diagnosis result, we select protege4.0, JADE and Eclipse as the based software and construct the processing platform by taking model diagnosis, model learning and diagnosis result output as one system through integrating above three softwares and provide a smooth technical supporting system for the database building of maize disease diagnosis, the learning, diagnosis, inquiry, retrieval and update of the model.

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