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Agent-based Model for Intelligent Shopping Assistant and its Application

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Abstract

With the rapid expansion of the Internet, the implementation of agent technology in electronic commerce (e-commerce) becomes very popular, which provides a promising field for the approach of agent and Artificial Intelligence technology. In this paper, we describe a multi-agent intelligent shopping assistant implemented in our EasyMall system, and present the agent-based model for intelligent shopping assistant. The user interacts with the agent by means of a text dialog, and the input texts are translated into agent communication language through XML. Thus it solves the problem of understanding natural language for agent in the virtual environments.

Key Words: Agent, Intelligent shopping assistant, e-commerce, XML

1. Introduction

With the rapid expansion of the Internet, the implementation of agent technology in electronic commerce(e-commerce) becomes very popular, which provides a promising field for the approach of agent and Artificial Intelligence technology. The technique of personal assistant, which is usually used in applications, such as news filtering, book recommendation and meeting scheduling, further enhances AI technology [1].

Some existing e-commerce systems use the personal assistant. These systems are not open for the third-party systems in most of the cases, but only focus on the improvement of the algorithms and the dialogue. Commercially available systems are commonly not agent-based and in many cases use database integration into third-party systems. Such as WebSell[2] and Alifc-WebGuide system[3].

2. Shopping Assistant Model Based Agent

The goal of the agent system is to expand the range of the online business module. This agent system differs from common ones. Since the current e-commerce systems often have strict requirements on the price, the number of buyers and the number of transactions, they are lack of real time interactivity between the users and the system. Our research, which presents the agent-based model for intelligent shopping assistant, solves the problem. There are three different contents: multi-agent model system, system semantic protocol and natural language process base text.

2.1 Multi-Agent Model System

The EasyMall system is a multi-agent system. There are four different agent models which are responsible for processing natural language base text between users and the system (see Figure 1): user interface agent, language process interactive agent, intelligent search agent and database agent. The user asks for some products in text-based natural language, and then user interface agent sends requests to event analyzer which queries database and returns the information.

The multi-agent model system allows each of agent models to use re-usable modules in order to improve the system efficiency. A user interface agent is the most complex subsystem which acts as the interactive interface between outer database and the multi-agent model system. It not only interacts with the virtual world to find out what the event changes in the scene (such as customer speaking and moving), and but also generates actions (such as facial and body animations output for the avatar). A user interface agent includes the natural language analyzer which analyses the user action and converts action language into XML format (a language based on the defined-text style). The natural language

parser inside language process interactive agent parses the input XML to decide the next action. Intelligent search agent and database agent contain the same function module as a user interface agent---event analyzer and action trigger, but these modules do not interact with user actions. The result queried by database agent is transmitted to user interface agent in the style of natural language semantic so that the intelligent shopping assistant may perform the actions such as product demonstration and body animation.

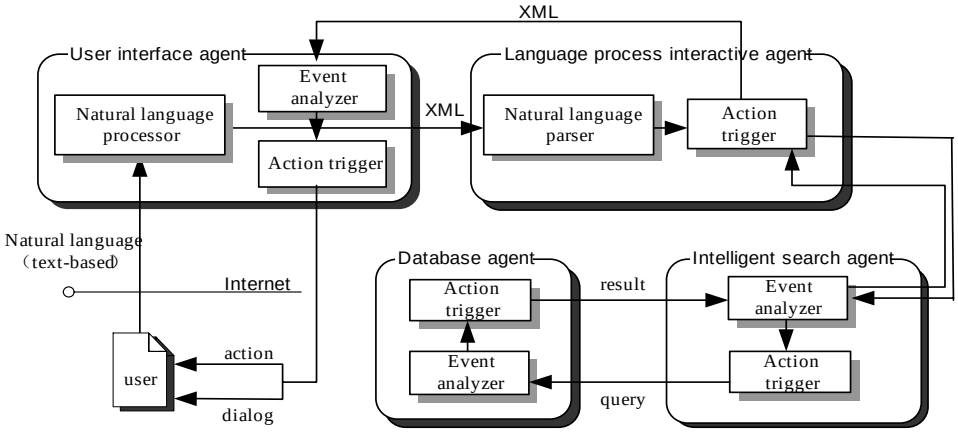

Figure 1: the structure of a multi-agent model system

2.2 System Semantic Protocol

The communication between the user interface agent and users or among the multi-agents is managed over the system semantic protocol. This is a mixed protocol composed of XML [4] and KQML (The Knowledge Query and Manipulation Language)[5]. The 3D intelligent shopping assistant interacts with users over this protocol.

XML is an open technology standard developed by the World Wide Web Consortium (W3C). The XML provides the mechanism to restrict the saving format and logical structure. The software module named XML processor reads and saves the content and structure of the XML file. In the EasyMall system we translate the KQML information code into XML. The Figure 2 is an example for a dialog description in XML.

```
<xml>
<form id=”T-shirt_order ”>
<field name=”T-shirt”>
<prompt>
Hello, I’m lead shopping agent. Can I help you?
        </prompt>
        <grammar>
        ([I want a] | [I need a] | [Give me a] | [I’d like to have a])
            T-shirt
            ([white] {color} | [no sleeve] {sleeve})
            </grammar>
        </field>
        ...
    </form>
    …
</xml>
```

Figure 2: the example for a dialog description in XML

KQML is a high-level language supporting interoperability among agents in distributed system applications. It is both a message format and a message-handing protocol to support runtime knowledge sharing among agents. KQML is an interlingua, a language that allows an application program to interact with an intelligent system. It can also be used for sharing knowledge among the multiple agents [6]. The Figure 3 shows the procedure of translation from natural language speech to KQML language between the user and the user interface agent.

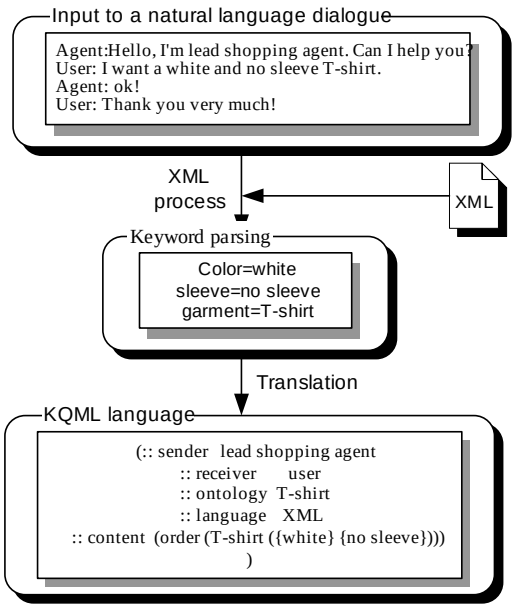

Figure 3: the procedure of translation from natural language dialogue to KQML language

2.3 Natural Language Process Base Text

The interaction between the user and system is implemented by the natural language. The natural language processor transforms the text natural language to XML language, and the natural parser transforms the XML language to KQML, so the agents communicate with each other, such as querying and searching the database agent. The data related with system have a rigid classify in database. The semantic and lexical rules affect the information flow in the natural language processor. The semantic rule proves the veracity both in the output sentences and in the context of the input text, then the product and agent service decide the possibility of action that the intelligent shopping assistant performs. The more accurate the natural language processor parses, the more accurate the information user gets. The EasyMall system uses the keyword matching to solve the input text natural language. This method can analysis the text fast and accurately, but it might ignore the context, which may lead to mistakes for users. Even so at the present this method is the best way for application and programming. The analyzing process of sentences and semantics is shown in Figure 4. The analyzation of sentences in the Figure 4 uses LFG(Lexical Function Grammar) ,which is brought forward by Ron Kaplan and Joan Bresnan [7]. In LFG, there are two parallel levels of syntactic representation: constituent structure (C-Structure) and functional structure (F-Structure). C-Structure has the form of context-free phrase structure trees, while F-structure is sets of pairs of attributes and values; attributes may be features, such as tense and gender, or functions, such as subject and object. The name of the theory emphasizes on an essential difference between LFG and the Chomskyan tradition from which it developed: many phenomena are thought to be more naturally analyzed in terms of grammatical functions as represented in the lexicon or in F-Structure, rather than on the level of phrase structure. An example is the alternation between active and passive, which rather than being treated as a transformation, is handled in the lexicon. Grammatical functions are not derived from phrase structure configurations, but are represented at the parallel level of functional structure. The natural language sentence parse in the Figure 4 is a C-Structure analyzation, and the last experiment gets four group explains, so it proves that the sentence can be recognized by the natural language parser.

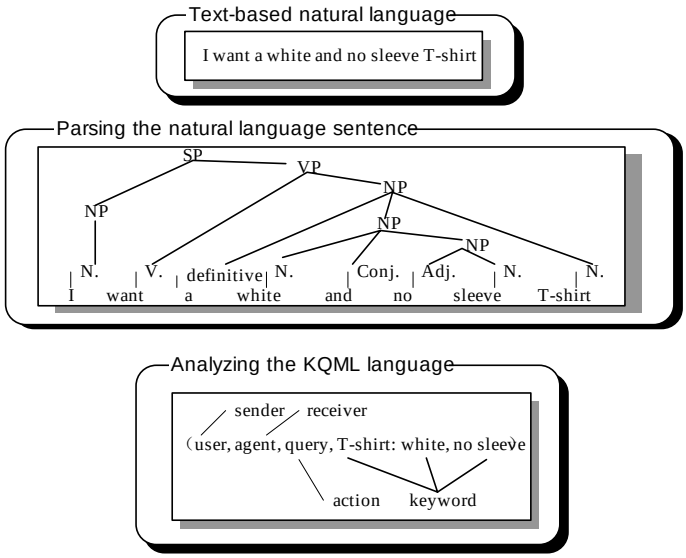

Figure 4: the procedure of analyzing the KQML language

3. Intelligent Lead Shopping

The application of intelligent shopping assistant strengthens the interactive of EasyMall system. The variety and complexity of users lead to the personality and complexity of user data in database agent. In particular, when was the last time the user visited the market, what product did the user visited the market, was it recently or did some time elapse. The information stored in the database will provide the history data for the intelligent shopping assistant. Such as: “Hello xu, How do you like the T-shirt you bought last week?”. The user’s answer becomes the product feedback for the intelligent shopping assistant. The database agent stores three types of user data: the user’s profile information (e.g. name, gender, age, etc.), the time and date of the user’s previous sessions and the products that the user bought in the past. An example of the information is presented as the following:

(user-info (user-id 1001) (name xu) (gender male) (age 26))

(shopping-info (arrival-time “2003-07-10 17:20:19”) (departure-time “2003-07-10 17:53:10”))

(product-info (product-type “garment”) (color “white”) (model “no sleeve”) (price “75”))

Keeping track of the regularity of a user’s visit data ensures that the intelligent shopping assistant can provide the veracity and satisfaction of service for users. The more accurate the user’s data is, the more accurate the intelligent assistant is. The database agent updates the information when the user quits the system.

The intelligent shopping assistant leads the users via the user interface agent. The user interface agent listens to the event occurring in the 3D EasyMall scene. Events are communicated between the agent and 3D scene via EAI (External Authoring Interface). The user interface agent has four sensors in the EasyMall system. The sensors bring all the actions of users to relative events. These sensors are:

1). Touch Sensor: when the user clicks on the object in the scene, alerts to the intelligent shopping assistant.

2). Visibility Sensor: when the object is in the user’s field of view, alerts to the intelligent shopping assistant.

3). Proximity Sensor: alerts the intelligent shopping assistant of the orientation and position of the user’s avatar in the 3D scene. This enables the agent face and approaches the user’s avatar. In addition, it alerts the agent when the user’s avatar enters or leaves the virtual mall.

4). Collision Sensor: alerts the agent when the user’s avatar collides with an object. This is especially useful for detecting whether the user’s avatar collides with the agent’s.

These sensors give the accurate information to the intelligent shopping assistant, which can reduce the errors when recommending products for customer.

4. Implementation

The EasyMall system uses VRML, Java3d, XML and computer network technology to implement a multi-user interactively virtual environment. In this environment, every customer has his/her own avatar. The customer can communicate with other avatars, products in mall and intelligent shopping agent. The system gets the natural-language-based text from Java3D intelligent shopping assistant by client/server model. And in the following we describe how the intelligent shopping assistant leads customer to shop. The proximity sensor of intelligent shopping assistant listens to the distance between itself and avatar when the customer avatar enters the hall. Once the avatar walks inside the area, the intelligent shopping assistant says “Hello” and “What can I do for you?” to avatar. The user interface agent plays the role as analyzing the natural language, and the intelligent search agent plays the role as searching database.

(find list_of: T-shirt: property: white : no sleeve)

(query list_of: T-shirt: property: white: no sleeve)

With the required information, it forwards the query to the database agent which stores the data of T-shirt. In the database agent, the query is inserted and a list of T-shirts is generated. Then it is passed back to the search agent, so the intelligent shopping agent leads the user into the matched virtual scene. Finally the user completes the whole shopping procedure. See Figure 5.

Figure 5: the implementation of the intelligent shopping assistant in EasyMall system

5. Related work

EMBASSI (Mehrdad Jalali-Soli et al., 2001)[8]is a multimodal intelligent shopping assistant system, which is a project involving more than twenty big German companies and sponsored by BMBF[9]. Its goal is not to focus on the unlimited possibilities of this technology, but rather on the individual prerequisites of the human in contact with it. The system takes into account psychological and ergonomic aspects and using innovative interaction techniques [10]. SeMoA(Mobile Agent Server)(Volker Roth et al., 2000) is a web-integrated personal commerce assistant model based on mobile agents. The assistant’s task is to do some high-level shopping on behalf of a user, such as organizing the catering for a birthday party [11]. In Multi-agent architecture for a virtual sale assistant, agents use high level abstractions for representing, reasoning and planning human-like dialogs, which include mental abstractions such as belief, desire and intension as well as social abstractions such as role relationships and commitments (Kaveh Kamyab et al., 2001). The fuzzy modeling is used to model a user’s preferences and subjective perception of product attributes [12]. E-PSA model explores a new paradigm for e-commerce human-interaction, presentation and personalization (Yasmine Arafa et al., 2000). It describes face-to-face conversational interaction with intelligent, visual, lifelike electronic sales assistant agents [13]. EasyMall system is a multi-server based on agents (ZhiGeng Pan et al., 2003), which uses blaxxun to implement the interaction between customers and the virtual environment. Its goal is to create an interactive virtual mall with integrated e-commerce, agent technology and virtual reality. We use VRML, Java3d, XML and computer network technology to implement a multi-user interactively virtual environment. In this

environment, every customer has his/her own avatar, and can communicate with other avatars, products in mall and agents [14][15].

6. Conclusion and Future Work

The work described in the paper is concerned on agent-based model for intelligent shopping assistant and its application, then we have presented an architecture of a multi-agent model in virtual environment and implementation the procedure of natural language based on text.

The next stage of work we plan to study is the voice-based natural language based on the text-based natural language; there is more work to do in this area. Now the reorganization of voice-based natural language is an essential part in the research field of AI. The implementation of voice control of agent-based intelligent shopping agent will expand the application of agent technology in e-commerce.

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