A Context-Aware Model Based on Mobile Agent

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Abstract. With the development of Internet120, the information on the Web is more and more abundance. In this paper, combining Mobile Agent theory and Context-aware, a kind of Context-ware model based on Mobile Agent has been brought forward. The function of analyzing actual requirement of users which combines their context information, utilizing Mobile Agent to aware, process and manage context information, and providing precise knowledge to users are implemented. At last a Context-aware prototype system based on Mobile Agent which is on the Aglet software platform is realized, it can aware of user profile context and the experiment preferably educes the characteristic of Context-aware.

Keywords: Context-aware, Mobile Agent, Aglet.

1 Introduction

With the sustainable development of Internet, the knowledge on the Web is growing rapidly. At present, people usually search knowledge by using the method of inputting key words. If the key word is too general, we may get necessary knowledge from a lot of results. Even the keyword is specific enough; it is also difficult for us to obtain actual required knowledge. The key problem is that the system, which provides knowledge searching service didn't aware of users' context information, such as location, profile, time, and so on. Therefore, providing appropriate knowledge searching service through Context-aware for users is an important task, it has profound academic significance and applied value.

In this paper, a Context-aware model has been established. By using the model required precise knowledge which combining with the user's context information is provided. We use mobile Agent to aware, process, control and manage the context information.

2 Context-Aware

The concept of context has been used in many ways in different areas of computer science, such as "context-sensitive help", "contextual search", "multitasking context

switch", "psychological contextual perception", and so on. We only focus on the context used by applications in mobile computing[1]. The context can be defined as "any information that can be used to characterize the situation of an entity. And an entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves" [1]. The typical context such as profile, location, identity, and time can be used in many applications.

When providing mobile services to service object, context information is a kind of important service basis. The accuracy and credibility of this basis is called quality of the context. The quality of Mobile service is determined by it to a large extent. And it can be examined from four aspects including automation, availability, dynamicness and correctness [2].

The Context-Aware computing is a kind of application which can adapts to discovered context automatically, by changing the application's behavior. Context-Aware computing has received comprehensive attention from many overseas research institutions since the 1990s, and many related applications had been developed, such as Shopping Assistant [3] from AT&T Bell Laboratories, Office Assistant [4] from MIT Media Laboratory, and Conference Assistant [5] from Future Computing Environments (FCE) at the Georgia Institute of Technology.

3   Mobile Agent Technology

In the early 1990s, the General Magic Company puts forward the concept of Mobile Agent in the Telescript commercial system. In brief, Mobile Agent is a type of software agent, with the feature of autonomy, social ability, learning, and most importantly, mobility. More specifically, a Mobile Agent is a process that can transport its state from one host to another in heterogeneous network, with its data intact, and be capable of performing appropriately in the new environment.

Mobile Agents provide many advantages. First, they reduce network overloading allowing the code to be executed at data location, instead of fetching remote data from code's emplacement. Also, network latency is decreased. Agents can be used to execute locally where the control is required, reducing latency time in real-time applications. Mobile Agents provide an asynchronous and autonomous execution which is ideal to work with in environments with expensive or fragile network links. Heterogeneity is a natural feature inherent in mobile agents. They are hardware and transport layer independent and hence they provide optimal conditions for uniform system integration. Robustness and fault tolerance are two more advantages easily provided by Mobile Agents. Mobile Agent system consists of mobile Agents and Mobile Agent infrastructure [6]. Mobile Agent infrastructure implements transportation of Agents between hosts based on Agent Transfer Protocol ATP, and offer execution environment and service interface for Agents. Agents are executed in infrastructure. They communicate with each other based on Agent Communication Language ACL and get services from infrastructure.

4   Context-Aware Model Based on Mobile Agent

The appearance of Context-aware theory and Mobile Agent technology provides a new method to traditional knowledge search system. The use of Context-aware and Mobile Agent change the traditional service mode and search method. It can help users acquiring the knowledge related to their real intentions, while reducing the network bandwidth dependent degree of traditional system. Therefore the service capability can be improved greatly.

Context-aware model can analyze the user's actual demand combined with his context information, and provide precise knowledge for users by utilizing Mobile Agent to aware, process, control and manage with the context information. This kind of design greatly facilitates the design and implementation of Context-aware mobile service. How the Mobile Agent used in Context-aware model can be categorized as follows:

- Extract context information from heterogeneous execution environment;
- Comprehensive process the obtained context information to determine the context of mobile client;
- Provide adaptive service to the specific context.

The structure of the Context-aware model based on Mobile Agent is shown in fig.1, as can be seen from the figure, the Context-aware model is divided into three layers: context extraction layer, Context-aware process layer and context submission layer.

The function of context extraction layer is the extraction of different context. It mainly consists of some context extraction Mobile Agents. Various context extraction Mobile Agents are used for extracting different types of context. The mobile schedule is established for Agents to accomplishing context extraction.

Context-aware process layer realized the function of representing context from context extraction Mobile Agents normatively, scheduling context with user record reasonably, and submitting the result to knowledge search system interface. It composes of a control Agent, some context process Agents and a context dispatcher Agent.

The knowledge search system interface in context submission layer implements the acceptance of user context witch is submitted by context dispatcher Agent.

The aware of context get started with monitoring and acquiring original data by context extraction Mobile Agents. Different context extraction Mobile Agents are applied to different types of context. Their function is the management of Context Sensors which is used to extract data. In the model there are three kind of context should be aware: natural context, technical context and social context.

The function of Context process Agent is converting original context related to current application which is extracted from computing environment to context information with clear semantic and unified format. When context information is formed, Context Slot is used to representing it. Its structure is shown in fig.2.
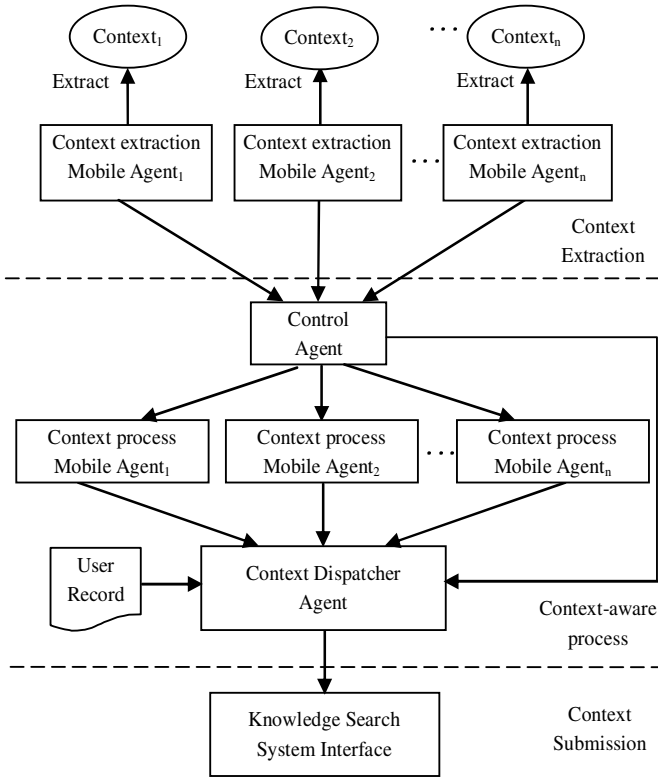
Fig. 1. Context-aware model based on Mobile Agent

PRI	TIME	WAIT	R	CONTENT

Fig. 2. Structure of Context Slot

The meaning of each field is listed as follows:

- PRI: priority of context;
- TIME: maximum duration of response;
- WAIT: maximum waiting time;
- R: a kind of tag;
    If the value of R is 1, it means this context can interrupt the executing of
        current context.
- CONTET: the content of context information.

A knowledge base is built to store context information according to the semantic
constitution of context information, meanwhile for facilitating dynamic modification

of context information. In order to provide precise search result to users, it is not sufficient for decision making only aware of one kind of context. The system sent out application communication request to higher level when context information is formed. Then reasonable dispatch will occur according to the priority of context.

Compared to traditional search technology, using Mobile Agent technology to Context -aware and WEB search has advantages of utilizing Internet bandwidth effectively, dispensing with persistent network connection and load balancing.

5   Prototype System

Context-aware based on Mobile Agent prototype system: CABMA is a Context-aware prototype system developed on Mobile Agent platform. The function of it is as follows: firstly, users' context are aware of by using Context-aware model when they login for searching knowledge, then necessary knowledge are searched with users' context, and finally search results are returned to users. A Mobile Agent platform Aglet is adopted in CABMA. It is a pure Java development mobile Agent platform of IBM Company.

The structure of CABMA system is shown in fig. 3. The system is made up of four parts: user interface, control subsystem, user Context-aware subsystem and knowledge search subsystem. User Profile context directly influences the habit and interest of users' knowledge search, and is the key part of the Context-aware system. Therefore in the implementation of system, a user Profile Context-aware experiment is conducted on the basis of our equipment conditions. When a user sends out a search request to system, a Context-aware Agent is generated in local. Then this Mobile Agent is sent to remote host to aware of user Profile context. As a result user Profile context can be extracted. Finally, appropriate knowledge according to user Profile context will be searched in local resources and search results can be returned. Fig. 4 shows the principle of experiment. In the experiment, two PCs installed Aglet platform are used, one is server host named "wq", the other is client host named "pmy" which is the destination host of Context-aware .Also a user Profile library is constructed to store user Profile.
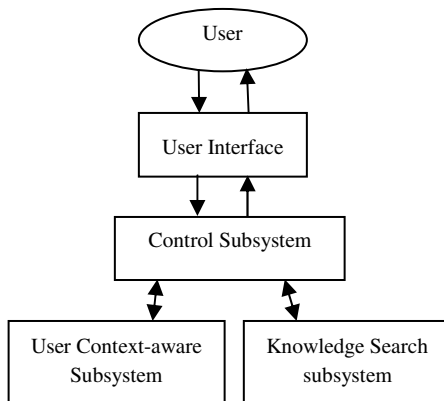

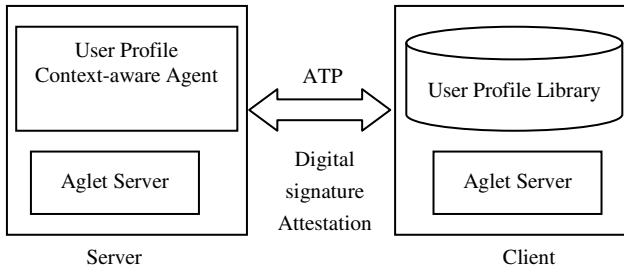**Fig. 3.** The structure of CABMA system

Fig. 4. The principle of CABMA experiment

After installing the Aglet platform and setting environment variables, then we can create our own Mobile Agent based on Aglet platform. The management interface of Aglet server is called Tahiti, and all the management of Aglet are carried through here. Needed Agent will chosen to execute and some operations ca be done here, such as: send to and recall from a remote host, destroy an Agent, etc. In the experiment, a Mobile Agent example called "ContextAglet" is created to aware of user's Profile context. The running interface of ContextAglet is shown in fig. 5. The destination host list of Context-aware is placed in Address Book. In our experiment, "pmy" is the destination host and Click "GO" button, a Mobile Agent called "ContextAglet" will be sent out. When it reaches to the host with address "Atp:// pmy: 4434" , user Profile can be extracted from Profile library by "ContextAglet" Mobile Agent, meanwhile search result will be returned. The running status of Mobile Agent is shown in fig. 6.

Thus we can read the basic information of user pmy. They are Name: pmy; Sex: Female; Age: 25; Job: teacher; Hobby: Computer. According to these user context, required knowledge can be provided to users.
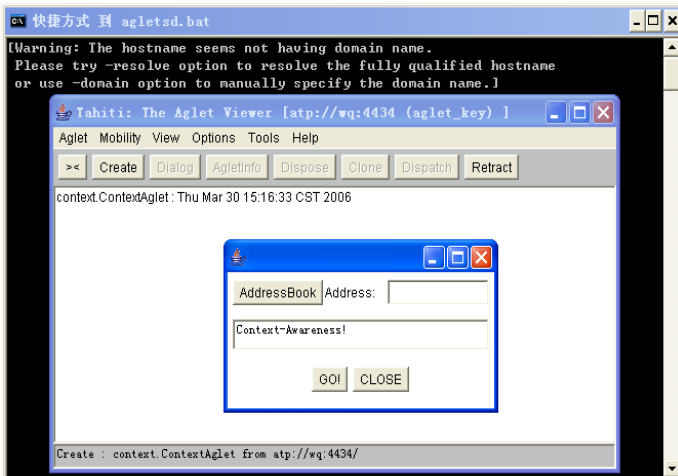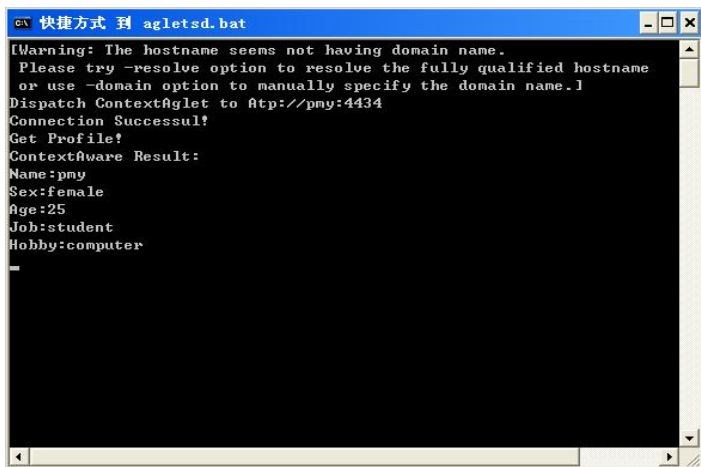

Fig. 5. ContextAglet running interface

Fig. 6. ContextAglet running status

6   Conclusion

Context-aware is a rising research field. Research in this field is just atarting at present. Development of Context-aware applications require two aspects of support: hardware and software. Compared to some research abroad, our research scope has limited because it is unable to obtain more kinds of sensors. In this paper, the design structure and realizing technology of Context-aware model based on Mobile Agent are systematically introduced. On the basis of it, the design and experiment of CABMA system is conducted. Basic functions of Context-aware syatem based on Mobile Agent are successfully realized. User Profile context are awared in experiment.

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