OOPS: User Modeling Method for Task Oriented Mobile Internet Services

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Abstract

Growth in the mobile services industry has remarkably increased in the number of mobile services provided, and present methods of service provision have proven insufficient to guide users efficiently to the services they need. To solve this problem, a Task-oriented menu, which enables users to search for services by "what they want to do" instead of by "name of category", has been proposed. Construction of such a Task-oriented menu is based on a task ontology modeling method which supports the description of user activity such as task execution and the solving of obstacles encountered during the task. This paper discusses a task ontology-based modeling method which supports the description of users' activity and related knowledge such as how to solve problems that occurs on the users and prevention method for accidents. Models described by our method contribute to checking, designing and improving mobile internet services

1. Introduction

So many mobile service providers take part in Japanese mobile internet services today, and it causes various problems in the management and organization of the services. It is difficult for customers to search for and access services they need, for example. According to an annual report by NTT DoCoMo [1], Japan's premier mobile communications company which manages mobile internet services and occupies about 58% of the market, we have more than 96,000 service sites today. Services are varied, providing everything from entertainment (Games, ring-tone downloading, etc.) and information (Train schedules, weather reports, etc.) to transactional services (Online banking, reservations, etc.). Current menu systems for the services are organized from the viewpoint of domain, which we call domain-oriented menu. In such a menu system, each category of the menu is named for the domain such as "Traffic report", "Shopping" and "Hobby", does not meet users' needs. When a user faces "problem", such as "I have to get on a bus bound for an airport", she/he has to consider which category has the proper internet service to solve the problem first. In this case, she/he has to find that information about bus is served in the domain of the "Traffic", and then she/he has to trace the menu hierarchy like "Traffic > Public transportation > Bus > XYZ Bus line". The user is forced to consider by two steps before she/he reaches the mobile service. This example may be seen as an easy one, but as I mentioned above, today we have too many services with many domains in Japan. Each layer of the menu hierarchy has several candidates to be selected. At the top level, for example, "Traffic", "Local info." and "Latest info." are contained and all of them may have bus information. Because of such difficulty, only such services that have clear correspondence between the name of the domain and the content of the service are frequently accessed by the mobile users today.

To solve the problem, the authors proposed another type of menu system for mobile services which we call "task-oriented menu" that works on mobile handsets [3]. By task, we mean users' problem solving activity in the real world. In the task oriented menu, the users seek for mobile internet services by the name of the directory which represents a task they are involved in rather than the name of category which might be unfamiliar to them. Users select a menu that is most resemble to what they want to do; "Move to station X", "draw cash to buy a ticket", "get on the next bus", for example. Value of information depends on how well the information fits to the needs of the users. Experiments on the prototype of the task-oriented menu [3] showed that even novice users can reach his/her necessary services faster than the current domain-oriented menu system or keyword search.

The prototype, however, is an ad hoc one because they designed it based on an ad hoc model of users based on analysis of some situations which do not cover many part of the users' activities. Thus we need to analyze wider area of activities to list up the situations and task models of users as many as possible. Referring to the models, providers of mobile services are able to look for chances to support users and design mobile services.

For better design, vocabulary for the model should be carefully defined and systematized. Ontology for the users' activity, designed upon the list of the task models should satisfy the requirement. Thus, we need to generalize and organize the task model to develop the ontology. Furthermore, since mobile services are useful when users face troubles, the ontology should contain such situations. At the same time, an effective modeling method to support description of the situations is needed.

With backgrounds discussed above, this article introduces a task-oriented mobile service navigation system with task ontology based modeling framework. The authors have already proposed a user modeling method and evaluated within a limited domain, mobile users' activity in a theme park. Based on the modeling method, this paper proposes OOPS (Ontology-based Obstacle, Prevention, and Solution) modeling method which supports description of the necessary situations. We have applied the OOPS modeling method to model "Tourism" domain which covers a broader activities.

The research project is conducted by experts of ontology design in cooperation with experts of mobile services. This paper mainly focuses on how to analyze users' activities, how to build models of them to build necessary ontologies. For building and providing ontologies, we use "Hozo" [6-7], an ontology editor with GUI, which can export developed ontologies in OWL, RDF, XML, and so on. On the basis of the theory of task ontology [2] and experiences in the field of engineering domain [5][8,9][12], we modeled user activities and necessary ontologies. The approach based on task ontology enables us to describe task models in terms of generic task vocabulary which are detached from domain model. A model of the task "move", for example, can be applied to model movement in several domains like travel, commute, and so on. Based on the task ontology, our modeling method contributes to designing and describing users' activity models that are referred when designing mobile services by service providers. Furthermore, specification of the modeling process based on categorization of users' activity provides the knowledge authors with guidelines.

This paper is structured as follows: Chap.2 describes practical use of the developed knowledge and its application framework for mobile services. Chap.3 describes OOPS (Ontology-based Obstacle, Prevention and Solution) modeling framework. Chap.4 explains about OOPS models and Chap.5 discusses issues about related works. Chap.6 concludes with future topics.

2. Task Oriented Menu for Mobile Service Navigation

Fig.1 shows a sample process of service navigation by task-oriented menu on the prototype system [3]. First, the most abstract task candidates are shown on the mobile phone (Fig.1 left). A user selects one of them (e.g. "Go to a department store") to solve his/her current problem (e.g. "need to buy cloths"). Then services associated with each task are displayed on the right side of the task nodes (Fig.1 center). Finally, services associated with the task selected by the user are shown, and each of them leads to access to the actual service (Fig.1 right).

As shown in this example, task-oriented menu is easy to use for novice users of mobile internet services. Just selecting "what the user want to do in the real world" from the menu, he/she will be lead to the service for solving current problem. Knowledge about the hierarchy of the menu is not necessary.

Such hierarchical selection of the activities looks like hierarchical planning technology ("Refinement Planning [14]", for example). In this research, however, we do not deal with planning. Our service navigation system just leads users to the mobile service site which provides information to solve problems on the spot.

3. Modeling Framework

Fig.2 depicts the framework of our research. "Designer of mobile service" designs users' activity

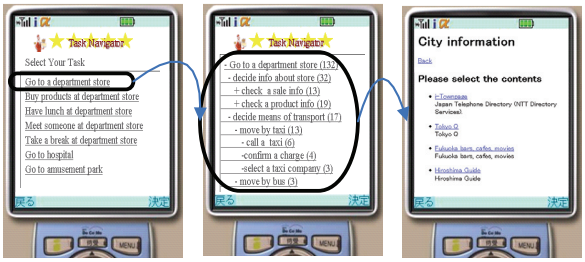

Fig.1 Task oriented menu system (prototype)

models and mobile internet services, which is used by the "User of the mobile services".

Although service providers usually have implicit business models about their own mobile services; they do not have generic task models for representing users' activities. Generic models and task/domain ontologies which are designed by "Designer of Ontology" are referred to by the service providers to obtain concrete models by instantiating them.

"Designer of Ontology", an important role of the authors, designs and maintains ontologies. Although there are huge numbers of "tasks" in the real world, those have to be solved by mobile handset users are not very large, since they are limited to daily-life tasks done out side home. Furthermore, to organize task concepts is easier than that of domain concepts, because it is independent of domain, is able to be decomposed into subtasks and has a generality in the abstract space. For example, a task concept "buy a ticket for a movie" consists of two task concepts, "buy something" and "receive service (Including model of queuing)". Both concepts can be applied to modeling similar tasks in various domains. Task concept thus has a generality in its nature and hence we can organize its structure at a high level of abstraction.

3.1 Description of OOPS Basic Models

Fig.3 represents a process of building an OOPS model. A dotted rectangle with number (1) corresponds to the basic model of users' activity. It is described by instantiating generic models and/or ontology. Description starts from the task at the level of large granularity. Next, ways to achieve the task are linked, and each of the ways is decomposed into a sequence of sub-tasks. Our "way" is similar to "method" of CommonKADS [4] and "how to bundle" of the Business Process Handbook [10].

Following this process, task of the large granularity is decomposed into sub-tasks via way. The area with number (1) in Fig.3 represents that a task "Move to the theme park" is achieved by three ways.

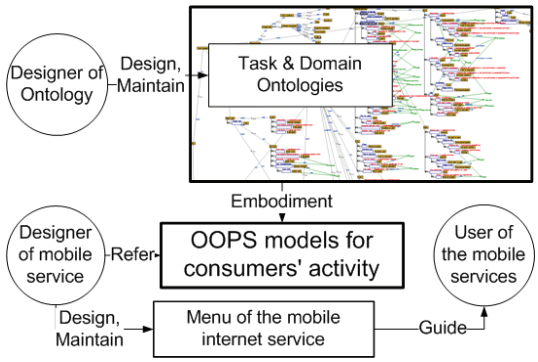

Fig.2 Framework for modeling

Among them, the way "Move by driving my own car" is decomposed into three sub-tasks such as "Go to the parking lot", "Drive from one's home" and "Park the car at the parking lot".

3.2 Description of obstacles, prevention/ solution tasks and ways

Models of obstacles and how to prevent/solve them are described in three steps. Firstly, the designer describes plausible obstacles for each partial task. For example, the task "Drive from one's home" has four kinds of obstacles: "Trouble of the car", "Missing route", "Traffic jam" and "Fatigue of driving".

Then prevention/solution tasks are described and linked to the obstacles. In the example in Fig.3 (3), one of the tasks "Drive from one's home" may be obstructed by "Trouble of the car". We can prevent occurrence of the obstacle by the task "Inspect the car beforehand", for example. As described in Fig.3 (3), model of an obstacle and its preventive tasks are linked by "Prevention" links.

On the other hand, we can solve the same obstacle "Trouble of the car" by the task "Repair" on the spot where the trouble occurred. In Fig.3 (3), those solution tasks are linked to the obstacles with a "solution" link. One of the most useful mobile services is a one that provides solutions for troubles that occur outside of the home. To deal with models that users come across troubles and solve them, our method supports modeling of solution tasks as well as preventive tasks.

After modeling the prevention/solution tasks, our method supports description of ways to achieve the tasks. Examples are shown in Fig.3 (4). The prevention task, "Check beforehand", can be achieved by two ways, "Have a car serviced" and "Check the car by oneself" way. The goal of mobile internet services is to provide ways to prevent/solve problems for the users thus this step supports the point.

As mentioned in section 3.1, basic model of the users' activity is described by decomposition of the task. To foresee obstacles about the task with small granularity is easier than that with large granularity. With our example in Fig.3, to enumerate plausible obstacles about the task "Drive from one's home" is easier than about the task "Go to the theme park". Since we have more experience of driving than going to the theme park, we can enumerate more obstacles which might occur while driving.

This characteristic meets our requirement that the framework should support generation of new ideas about obstacles, prevention, and solution tasks. Results of our preliminary experiments within limited domain

[15] support this point. The number of idea about mobile users' activity by the subjects with models of obstacles has become more than twice compared to the subjects without support.

4. OOPS user activity model

For building OOPS models of mobile service users, ontologies that are referred to for describing the model should be scalable and general. It makes OOPS modeling framework scalable and general, too. We have built ontologies concerning about mobile users' activities within limited situations [15]. Applying analysis result based on tourism domain, we expanded the ontologies. There are several reasons for choosing tourism domain. Firstly, mobile users are in a place unfamiliar to them, where problems are more likely to occur and thus the necessity of mobile services is expected to rise. Furthermore, the tourism setting covers a broad spectrum of actions from traveling around and having meals to staying at a hotel. Thus its analysis would cover most of the activities users of mobile services might engage in and give a reliable overview of what obstacles users might encounter in daily life. We exploited an abstraction hierarchy in task ontology of previous work and and reorganized ontologies obtained in the previous work in [15].

On the process of expansion, we took a bottom-up approach. First, we generalized the identified concepts. At the same time, vocabularies collected by domain experts are added to the previous ontologies. As a result, we developed new one that consists of about 700 concepts assuming mobile users' activities. Our ontologies consist of (1) Generic task (move, receive services, buy, etc.), (2) Meta task (kill time, enjoy, etc.), (3) Obstacles (short of cash, lack of items, etc.),.

4.1. Coverage of the OOPS model

Based on the expanded ontology, we developed a OOPS model for the "Tourism" setting this analysis, 391 Task concepts, 346 Way concepts and 112 Obstacles have been identified and modeled based on the classes defined in our ontology.

We have evaluated the coverage of the OOPS model by verifying situations assumed and represented in the OOPS model developed on tourism setting and those situations assumed to be supported by current mobile services. In 2004, NTT DoCoMo provided the i-mode service consists of about 5,000 officially authorized service sites. Excluding entertainment services (Games, ring-tone downloading, etc), 2,732 sites that consist of 9,162 specific services inside. We analyzed a situation for each of the 9,162 services. For example, we analyzed that one of the i-mode services "Search hotels around" and found it is provided for a user's situation "Not knowing where lodging facilities are" in Fig.5 (an obstacle near the central part). Like this, we counted the number of services whose intended situations are covered by our OOPS model. At the same time, we ignored differences of the situations which come from the difference of domain knowledge. There are many services which provide latest information about famous people, for example. We counted all of them assume one situation in which mobile users get information to talk to others about it.

Among them, 199 services (2.17% of the 9, 162 official services) were not covered by the situations represented by our OOPS model. Although the OOPS model is described on the tourism setting, it covers most of the situations

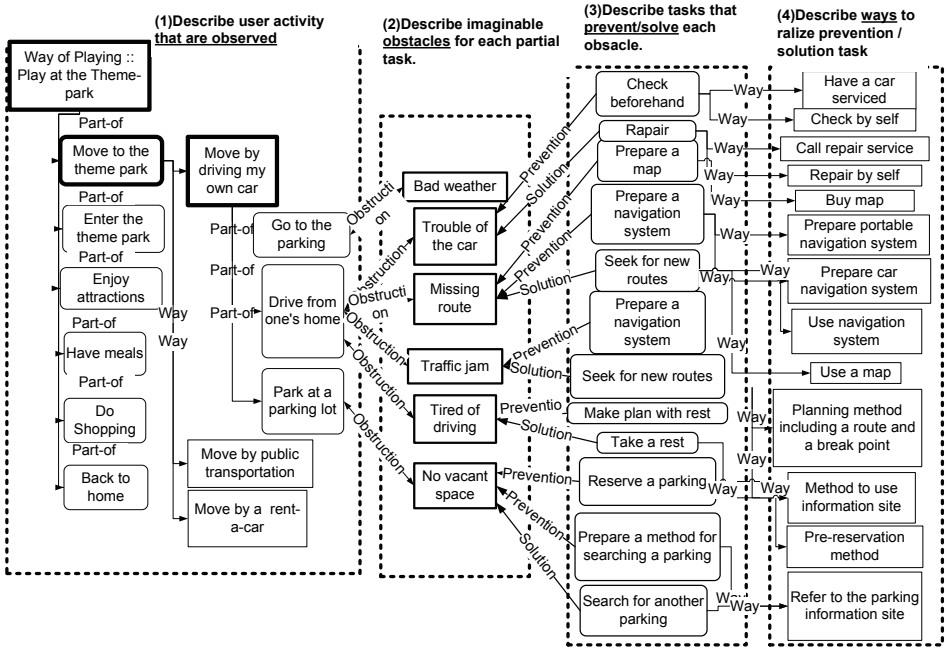

Fig.3 A process of building OOPS models

which current mobile services are intended to support. Those situations we did not describe in the OOPS model include funeral, donation for a political party, information about tax system, birth control, and so on.

Although possible activities and obstacles are too numerous to describe completely, the OOPS modeling methodology aids in the identification of obstacles, tasks and ways that users are most likely to encounter first. Reorganizing such contexts of mobile users, we aim at developing task oriented menu system.

5. Related work

Building models of possible obstacles is a unique feature compared to previous researches like [2][3][11]. Since the most valuable mobile service is to provide information to solve such obstacles, OOPS modeling method contributes to coping with them.

Masuoka proposed Task Computing framework and built a ubiquitous environment which provides more than 100 web services [11]. Web services are described by OWL-S, and the environment changes dynamically. The ubiquitous environment is unique because it deals with dynamic changes such as sudden appearance/ disappearance of clients/services.

Many researches today focus on "better composition of existing mobile services". Our modeling method which focuses on "better analysis of users' needs" is able to strengthen the researches explained in this chapter.

MIT's Process Handbook Project [10] deals with knowledge models about business. It focuses on modeling business activities and has taxonomy of basic business activity. However, the method for building the model is implicit and confusion of task concept with way concept occurs with some models. One of the models, "buy in a store", consists of a task concept "buy" and a way concept "in a store" for example. Such confusion lowers generality of the model, and does not meet our requirements.

6. Concluding remarks

This paper focused upon OOPS modeling method, by which we identified obstacles, tasks and ways that users of mobile internet service are most likely to encounter first. Reorganizing such contexts of mobile users, we aim at developing task oriented menu system in the next step. Long-term goals of the project would involve further expansion of the ontology created by analysis of users' task and activity under various contexts and finally creating an ontology which will act as a sound knowledge base for the construction of the task orientated menu for service navigation.

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