Community based Context-aware Information for the Intelligent Personalized Information Service

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Abstract

With the advent of ubiquitous computing environments, it has become increasingly various context-aware technology implemented. It is researched; however, rather than providing a simple situations, is not possible following the large scope of context-aware data. Nevertheless, it is possible to effectively manage and categorize information by using the characteristic of professional contextual information, which is inherently limited in scope as it is a professional language. This paper presents the system architecture of community based context-aware management service with the properties, operations, and tasks for context-aware services. We apply the proposed a method to community context information by converting various application terminologies used to provide information services. The implemented content recommendation service, a mobile service agent, and advertisement recommendation for suit one's taste.

Keyword*: Context-aware, Information Server, Advertisement recommendation.*

1. Introduction

Context-aware technology is becoming a key factor in developing competitive systems, and it presents adequate responses to the rapid development of sensor technology as well as a strategic vision. Context-aware technology is not just limited to a number of services but can be applied to industrial control systems, information-based electronic appliances, or mobile services as well as personal services[1,2]. In particular, the value of context-aware technology is enormous in the ubiquitous area such as advertisement, traffic control, and distribution.

In general, unlike online services based on web traffic, ubiquitous systems make possible instant interactions with a user, location-based service, and collection of context information. However, this service can be offered only upon user's agreement. If a user is given unwanted information, such service could be ill-considered. In addition, the majority of people view ubiquitous service as mere a means of transferring the existing services (e.g. music, text messages, graphics, moving pictures, and so on) to a mobile device, which limits the ubiquitous business.

Mutual trust between service providers and users is very important to ubiquitous services. And this is the reason why monitoring technology, which inclusively controls the previous service environment and sensor technology, is drawing increased attention. This study focuses on analysis methods for community-based context-aware information in order to predict personal preferences and provide more efficient ubiquitous services.

Chapter 2 of this study introduces related researches and problems to be reviewed while Chapter 3 explains titles for the solution to the problems presented in the previous chapter.

Examples of integrated services applying the solution are described in Chapter 4. Lastly, Chapter 5 shows the results of this study.

2. Related Researches

2.1 Trends in Context-Aware Research and Technology

The demand for quality ubiquitous service is increasing and, so is the need for methods of extracting user data on a sophisticated level, understanding the preferences of a user, as well as of making possible high correlation among such data.

The characteristics of ubiquitous services call for clear understanding of user preferences. That is, a system that may serve as a broker is necessary, keeping and managing data of user preferences so as to offer an efficient schedule. This broker-like system shall apply data with the standards of collecting context-aware information.

Table 1. shows a typical example of application of context-aware information.

Project	Research Subjects	Context-Aware Information	Features
Call Forwarding	Olivetti Research Ltd.	Location of a user	Sensing the location of a user through an active badge system and forwarding an incoming call to a phone nearest to the user.
Active Map	Xerox PARC	Location of a user	Sensing the location of a user indoor through a PARC tab system and showing the location on a map PARC Tab.
Shopping Assistant	AT&T Bell Lab.	Location of a shopper	Providing services of a shopping guide, details of products information, location of a product, discount information, etc.
Cyberguide	Georgia Institute of Technology	Location of a traveler and time	Navigation, background information on location, automatic recording of a log, and so on.
Adaptive GSM phone and PDA	TEA at Starlab	Behaviors of a user, illumination, pressure, adjacent people	A PDA adjusting the size of fonts according to the speed of a user or surrounding illumination, a GSM that sensing the location of a user's hands (e.g. on a table, in/out of a bag)
Office Assistant	MIT Media Lab.	Behaviors and schedule of an office owner	Sensing and identifying a visitor using a sensor mat on the door, operation according to the behaviors and schedule of an office owner.
ComMotion	MIT Media Lab.	Location and time of a user	Automatically reading a memo using a voice device when a message is left on a specific place and the receiver approaches the location.

2.2 Context-aware Service Framework

Context-aware service framework have been focused on status information sensing technology and individual prototype service for specific platforms. However, context-aware service related to specific platform requires massive amount of effort for expansion, and re-usage is difficult due to a lack of module for common function [3, 4]. In order to solve such problem and create simple context-aware service, studies related to infrastructure of various Context-Aware Service Frameworks have been conducted. Factors, which must be supported by context-aware service framework studied in the past, have been classified according to their functional requirements and non-functional requirements, which are presented in the table below [5, 6].

Table 2. functional requirements and non-functional requirements for Context-Aware Framework

Functional Requirements	Non Functional Requirements
- Collect context information - Save and regulate context information - Read and deliver context information - Separate and unite context information	- Expansion, module, security, portability - Compatibility of Cross-platform, defect capacity, interface adequacy - Possibility of improving service quality

3. Community based Context-aware Information for the Intelligent Personalized Information Service

This study introduces the following steps of technologies to offer context-aware services and apply adequate research methods

- Analysis of context-aware information: Explores and classifies existing services so as to analyze specific patterns of information, thus efficiently integrating the services with sensor data
- Evaluation of context-aware information: Collects, analyzes, and evaluates various context-aware information through a number of phases that integrate them with web-based services to offer the optimum services
- Production of context-aware information: Produces and controls various context-aware information necessary for providing services

3.1 Analysis of Context-Aware Information

This study has utilized online services to explore existing services. Automatic key words were searched through Internet portals, and the links or data that appear first were collected. 10 most popular portal sites and 1,000 most-frequently-searched words were used for data collection. For 10 days change in the data was monitored.

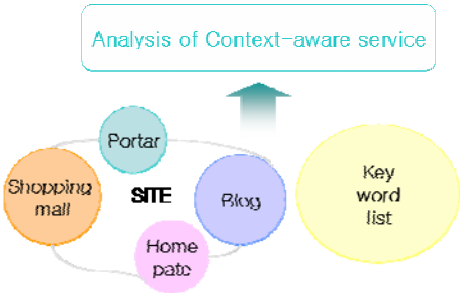

Figure 1. Context-aware search element

3.2 Evaluation of Context-Aware Information

This study has applied the concept of rules in order to collect, analyze, and evaluate the data produced in 3.1. This method is suitable to respond to change of logic in the classification process of context-aware information and to automatize data categorization. When environmental data or demands of a user become more complicated, finding a series of patterns is crucial to effective analysis of such data. And application of rules is very efficient in extracting the patterns.

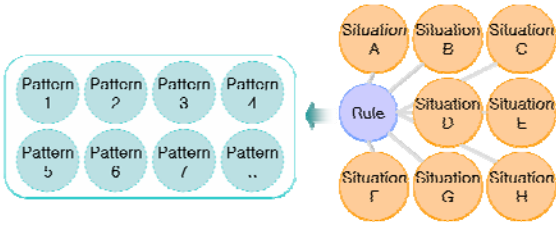

Figure 2. Analysis of rule pattern

3.3 Production of Context-Aware Information

In this step, context-aware information, which allows services to be offered based on analysis of user preferences or inquires, is produced. Priority data of the service analysis classified in 3.2 are extracted so as to produce information that highly matches specific data. Also, information is provided through a PDA so as to receive feedback on context-aware information for further data control.

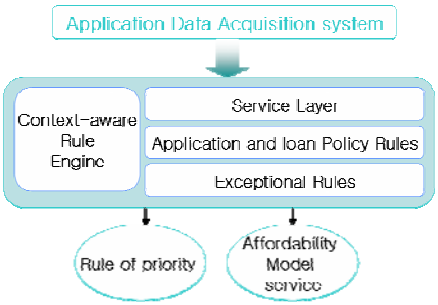

Figure 3. Architecture of Application data

4. Service Application

It is necessary to understand a scenario that may arise in ubiquitous computing environment so as to apply what is explained in Chapter 3.

[Example] Let's suppose that a user carrying a mobile device is looking for a book in a bookstore. And he wants information (advertisement) related with books. The following is the details of a scenario.

Scenario:

1. A user is looking for a new novel.
2. His mobile device automatically offers information highly matches his preferences and has fine evaluation.
3. The mobile device waits for his choice.
4. Detailed information of the book chosen by the user is offered and his choice is reflected in the preference data.

The mobile device requests evaluation of the chosen product for feedback.

For classification standards based on user preferences, books are put into categories such as living, education, health, children, humanity, people, magazines, and so on. Frequency of selection is saved as data and user evaluation expressed in a quantitative manner.

And the design of rules for this situation is as follows. Open-source drools were used for the rule engine.

```
<rule-set name="BESTBOOK-check"
        xmlns=http://drools.org/rules  xmlns:java="http://drools.org/semantics/java"
        xmlns:xs="http://www.w3.org/2001/XMLSchema-instance"
        xs:schemaLocation="http://drools.org/rules rules.xsd http://drools.org/semantics/java java.xsd">
    <import>java.lang.Object</import><import>java.lang.String</import>
    <import>javacan.drools.heater-check.heater-on</import>
    <rule name="Rule1">
      <parameter identifier="book-hit">
        <class>Bestbook</class>
      </parameter>
      <java:condition>Bestbook.hitNumber() <= 300</java:condition>
      <java:condition>Bestbook.state() == "hit"</java:condition>
      <java:consequence>
        MobileAD.state=ON;
```

```
            System.out.println(Bestbook.getName() + " hit");
        </java:consequence>
    </rule>
</rule-set>
```

Figure 4 depicts is a screen testing the scenario, which shows how data are received through a mobile emulator. A user can check the information of a selected book along with other various related data.

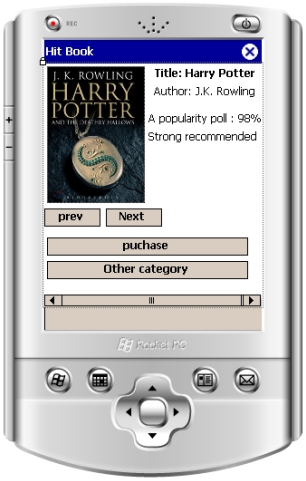

Figure 4. Book advertisement on the screen in mobile emulator

5. Conclusion

Although various ubiquitous services have increased as well as the contents, more improvements have yet to be made in order to satisfy user preferences. To that end, this study focuses on intelligent ubiquitous services that use a program more suitable for the needs of a user, employing contents (e.g. book advertisement in this study) highly matching user preferences.

In order to analyze, evaluate, and produce context-aware information, this research examines measures to collect existing services, integrate them with context-aware services, and control information through a feedback gathering process. For example, in case a user wants book information in a bookstore, data are offered based on his preferences, renewing the existing user data and reflecting the results in the system for future recommendation.

6. References

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