Query Language Interface for Ubiquitous Objects

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Abstract

The vision of ubiquitous computing (UC) has been described in terms of the disappearing computers. To achieve this invisibility, the interactions between various objects of daily life should be as free as possible from explicit human administration. UC will enable the new breed of applications and systems resulting in to a smart world (SW) in which computational intelligence is distributed throughout the physical environment to provide services to people. To embed such autonomic behavior in every day objects around us, it is necessary to build knowledge repository, which helps objects in smart world to monitor, plan, analyze and execute autonomously like human being. In this paper author proposes query language interface for such knowledge representation of ubiquitous objects, which enables object aware capability and hence the object intelligence.

1. Introduction

Recent advances in technology offer multifold promise in bringing the benefits of rich computational capabilities to dynamic, diverse situations in everyday life. However much of this promise remains unfulfilled. The reasons being the major challenges like [1, 2, 3, 4, 5]:

The Networking Challenges:

1. Integrating the entire infrastructure that is available in order to create a new ubiquitous infrastructure
2. Millions of devices all communicating with one another will exhibit many unintended behavior. A major research priority is to develop abstractions that predict the behavior of large number of interacting devices.
3. Discovery protocols power aware computing and communication, data dissemination and aggregation, replication and reliability, high-level compassable (services), security and authentication.

Context Awareness:

If devices become truly ubiquitous, then they will be used constantly in a wide range of continually changing situations. For the devices to be truly helpful, they must be aware of the environment as well as the tasks that the user is performing or will be performing in the near future.

Device Challenges:

For devices, the emphasis has been on improving the functionality in addition to reducing size, cost and power requirements. The functionalities can be classified into: Support for mobility and support for context awareness.

Object Categorization and Identity:

Advancements in ubiquitous computing have initiated the need for a systematic method of classifying objects [6]. There is an increasing demand for accessing information, anywhere,

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anyplace, and anytime. This requires coding objects according to a standardized classification convention for ubiquitous computing across ubicomp compatible product manufacturing companies as it eases the process unambiguous object identification and simplifies the communication mechanism between the ubicomp compatible products.

Legal Issues:

It is guessed that various Legal issues that have been not thought so far will occur in future ubiquitous information society. Therefore it seems that many kinds of legislation that addresses the Personal Information Protection Act, Law for surveillance camera, and Unauthorized Computer Access Act etc.

2. Structure of Ubiquitous Objects

The structure of an autonomic element [8] is as shown in figure-1. Each autonomic element is responsible for managing its own internal state and behavior and managing its interaction with an environment. Ubicomp applications should have the characteristics like [7]: Ubiquitous access, Context awareness, Intelligence, Natural Interaction. The need for universal coding scheme arises because of the requirement of flexible communication across inter vendor products.

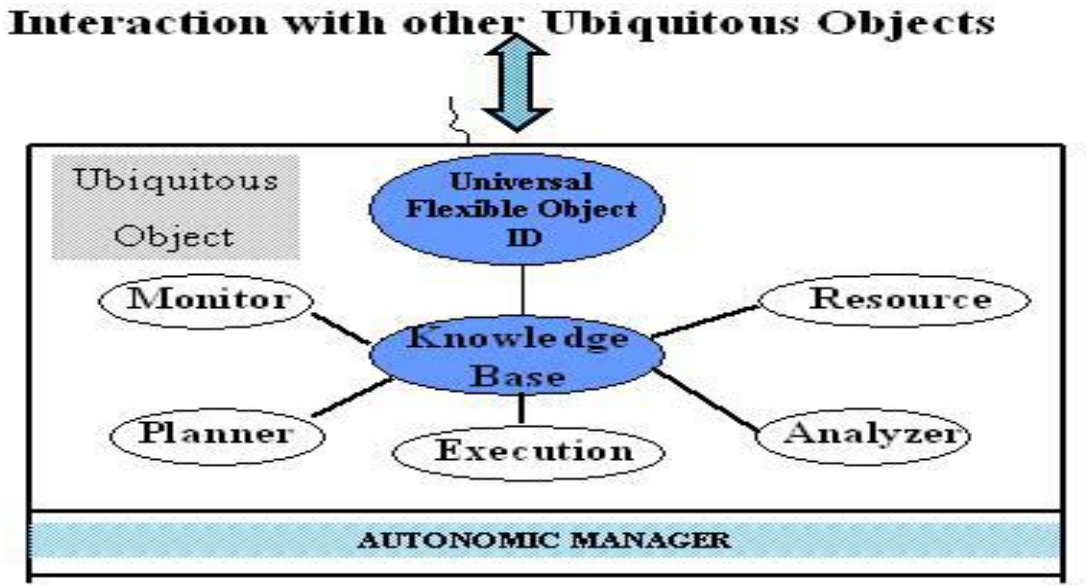

Figure 1. Autonomic Element

A useful object classification scheme is necessary so that, the individual objects represent unique instances of larger classes and generic classes. The classification should also allow an active object to focus on the level of specificity that best suits its purpose. Most of the current research work does not address this as an important issue facilitating the search analysis and object awareness.

3. Proposed Concept

Here authors propose suitability of hierarchical Tree based knowledge base, concept used in United Nations Standard Products and Services Code [09], as an appropriate structure for ubiquitous objects classification. In this method there are five levels in the hierarchies for object classification and are:

1. **Logical Aggregate** : The logical aggregation of generic classes for analytical purpose.
2. **Category** : A collection of generic classes.
3. **Generic Class** : A commonly recognized group of interrelated classes.
4. **Class** : A group of objects sharing a common use.
5. **Object** : A group of common functionalities.

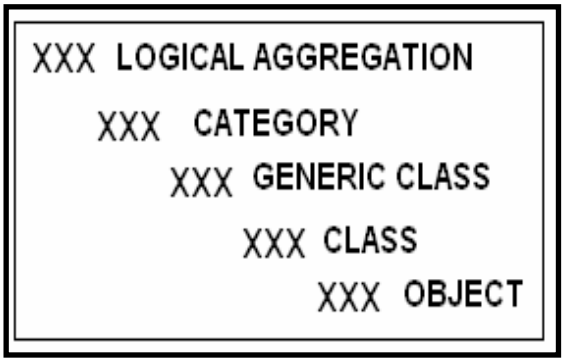

Figure 2. Hierarchical Object Classification.

This scheme makes the active objects more intelligent. It provides the active objects with a capability to reason, analyze apparent relationships between objects in the hierarchy and hence facilitates the active objects in the decision making process. Consider a situation where a user of an ubicomp compatible mobile enquires the ubicomp compatible refrigerator about the availability of a cold drink. If the cold drink is not available the active object will be able to inform the user that the cold drink is not available and will be able to provide an acceptable alternative, like available juice or milk.

The system is designed with the following features:

1. Defining the 5 Level tree structure suitable for ubiquitous object environment to store their associated objects in a context environment.
2. Making the structure that ease the search based on intelligence required with supporting interfaces like:
   - addObject ()
   - deleteObject ()
   - searchObject(Obj ID)
   - searchNearObject(up Level)
3. Defining a query language similar to SQL, that facilitate the following features:
   - Support Drill Down and Roll Up Features: i.e. allow searchers to drill down /roll up among the vast group of objects to precisely find the required object.
   - Object aware search.
   - Statistical count requirements on knowledge tree.

Example:

Consider a situation where a user of an ubicomp compatible mobile(Y) enquires the ubicomp compatible refrigerator (Z) about the availability of a cold drink coke by sending the following query.

Select Name, Level, Count
From Object Name = Coke
Where *Source = Y, Destination = Z*
Alternate Level = 1 up.

If coke is present its details with count is returned else if the coke is not available then active object (Z) will be able to inform the user(Y) that the coke is not available and will be able to provide an acceptable alternative, like available juice or milk at up level 1 in the tree as stated in the query. Such kind of search can be submitted to local i.e. self-knowledge tree or to the knowledge tree of an associated object at remote.

Consider another general query as below:

Select <property>
From <object>
Where Source = Y, Destination = Z
<Property>:= mai | obt |sen .
<Object> := valid object name.

This will retrieve the object properties like: Manufacture Identity (mai), Object Type (obt), Serial Number (sen) etc. The protocol used here for object Identity is based on protocol shown in figure-4, of the earlier work [06].

4. Make the structure scalable i.e. it must accommodate new infinite objects of future.
5. Be responsible to the ubicomp product manufacturers and code assignments should be impartial.
6. Be consistent, i.e. Single item must be identified at only one place. It should allow aggregation/segregation to appropriate levels without sacrificing accuracy.
7. Be complete, i.e. a good scheme identifies all the objects that are ubicomp compatible.
8. Be responsive i.e. it should accommodate new emerging products and discontinue with obsolete products.

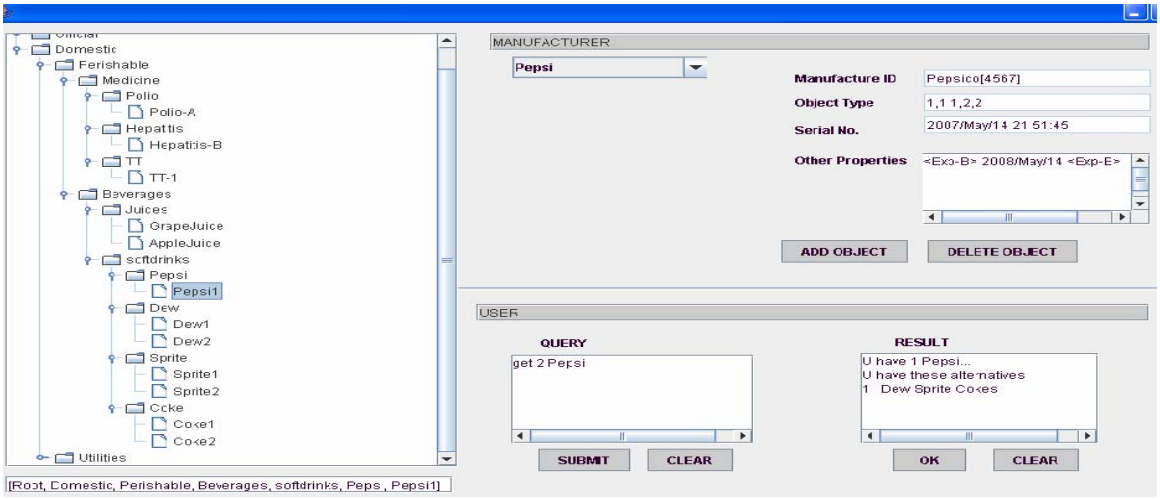

Figure 3. GUI of the implemented system.

Figure 4. Protocol for Ubiquitous Object Identity & Categorization.

RFID Field	Description
MaI	Variable length -Unique ID for manufacturer. This is to be given by Designated Competent Authority
ObT	Variable length -Unique ID for Objects Type, Ex- Food, Data Storage Device, Computational Device etc.... This is to be given by Designated Competent Authority
SeN	Unique serial number of that particular Object. Format: YYYY: MM: DD: hh:mm:ss. Representing manufacturing Date/time.
OtP	Object's other related programmable Information. Ex: Expiry date for the Medicine.

Table 1: **ID** Field details

The GUI of the implemented system is as shown in the figure-3.

4. Conclusion

Based on above work and concepts developed, we infer that; the hierarchical classification has numerous advantages. Along with identification codes, it facilitates object awareness and object relationship. Apart from these it makes the system more intelligent and scalable. The implementation query language [QL] using this knowledge repository [9] demonstrates the necessity of such standard interaction among the ubiquitous objects. The QL implemented requires further refinements towards establishing standard.

5. Acknowledgement

Authors sincerely acknowledge the authorities of the white paper [09], as we are adopting their methods for ubiquitous environment and developing the concepts over and above that.

6. References

[01] Gaetano Borriello, "The Challenges to invisible Computing", University of Washington, Seattle, Nov 2000.

[02] Arthur H.Van Bunningen, Ling Feng, Peter M.G.Apers,"Context for Ubiquitous Data Management", Centre for Telematics and Information Technology, University of Twente, The Netherlands, Proceeding of the 2005 International workshop on ubiquitous Data Manangement (UDM 05), 2005 IEEE.

[03] Michael.J.Franklin,"Challenges in Ubiquitous Data Management", University Of California, Berkley.

[04] Ryusuke Masuoka,"Quest for Mobile and Pervasive Data Management", Fujitsu Laboratories of America, Inc, MaryLand, Jan24, 2002.

[05] Yasujiro Murakami,"Legal Issues for Realizing Ubiquitous Information Society", School Of Media.

[06] U.P.Kulkarni, J.V.Vadavi, S.M.Joshi, K.Chandra Sekaran, A.R.Yardi, "Ubiquitous Object Categorization and Identity", 14th International Conference on Advanced Computing and Communication, 20-23 Dec 2006, NITK, Suratkal, pp585, 1-4244-0715-X/@2006 IEEE.

[07] Alois Ferscha, "Co-ordination in Pervasive Computing environments", university OfLinz, Alnberger strobe IEEE workshops on enabling Technologies, 2003 IEEE.

[08] Jeffrey O, Kephart, David M. Chess, "The vision of Autonomic Computing", IBM Thomas J. Watson Research Center, pp41, Jan 2003 IEEE.

[09] White paper on "Why Coding and Classifying Products is Critical to Success in Electronic Commerce", United Nations Standard Products and Services Code, September 1998, updated October 2001.