

Implementation of Generic Context Middleware for Context-Aware Applications

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Abstract

Context-awareness enables generation of context by analyzing situation of users and environments so that applications can autonomously react to contexts without user's explicit commands. There is growing interest in the use of context-awareness as a technique for developing pervasive computing applications that are flexible, adaptable, and capable of acting autonomously on behalf of users. In this paper we are presenting the implementation of Generic Context Middleware for developing context-aware applications in pervasive computing environment. The implemented context-aware applications shown are Smart Home applications. The Generic context Middleware developed is adaptable for any types of context-aware applications like Smart banking, smart office, and Smart classroom and so on. This Context Middleware works based on the user Input and is capable of providing the best service to the user request based on the context.

Keywords: Context, Context-aware, Context Middleware, autonomous, adaptable.

I. Introduction

Context awareness has attracted a lot of attention in recent years, especially in the realms of mobile and ubiquitous computing. Systems that utilize information about the situation of its users, the environment, or the state of the system itself to adapt their behavior are called context-aware systems [1, 2]. Typically, such systems are also self-adaptive in the sense that they can dynamically adapt as a response to changes in the execution context. Context management in ubiquitous computing environments must reflect the specific characteristics of these environments, e.g. distribution, mobility, dynamic discovery of context sources, and heterogeneity of context information. In order to ease the development of context-aware self-adaptive applications, that utilize the full potential of such environments, the developer should be able to transparently access context information without bothering with the underlying context accessing techniques and the distribution aspects. A context-aware application reacts to the situation and adjusts their actions and presents related services by making the interactions

between humans and computers easier depending on the context.

Context-awareness (or context sensitivity) is an application software system's ability to sense and analyze context from various sources; it lets application software take different actions adaptively in different contexts [3]. By using middleware for context-awareness, there will be huge benefits include reduced development times of context-aware applications and great ease in specifying complex behaviors of these applications. Context-aware middleware provides an easy way for developers to specify the way in which an environment should automatically respond to different contexts. Developers do not have to worry about the details of getting contextual information from different sources or the mechanics of triggering different actions in different situations. Middleware for context-awareness would allow autonomous, heterogeneous agents to seamlessly interact with one another.

1.1. What is context?

Context is any information that can be used to characterize the situation of an entity. 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 [2]. The three aspects of context like (1) where you are; (2) who you are with; and (3) what resources are nearby by configuring sensors, devices, user and associating set of rules among them [4].

Context plays an important role in developing intelligent applications in ubiquitous computing environments. Not satisfied by a general definition, many researchers have attempted to define context which has the meaning related to computer environment [5], [6], [7], [8].

Schilit and Theimer (1994) refer to context as location, identities of nearby people and objects and changes to those objects [9]. In a similar way, Brown, Bovey, and Chen (1997) define context as location, identities of the people around the user, the time of day, season, temperature, etc [10]. Ryan, Pascoe, and Morse (1997) define context as the user's location, environment, identity, and time [11].

1.2. Context-Awareness in Ubicomp Environments

In ubiComp environments, context-awareness plays an important role in smart services autonomously reacting to context. This context is generated by sensing the change or situation of users and environments and by extracting the needs of users.

In general, context-awareness refers to the idea that applications can understand their context and adapt their behavior based on information gathered from the environment without an explicit user intervention. Thus, it aims to increase usability and effectiveness of applications. Most importantly, this dynamic adaptation aspect can provide context-aware applications with a degree of autonomy.

1.3. Context-Aware Computing

In ubiComp domain many definitions for context-awareness have been conceived. Schilit and Theimer (1994) firstly referred context-aware computing to be software that adapts to its location of use, the collection of nearby people and objects, as well as changes to those objects over time [12]. Then, definitions of context-aware computing falls into two categories: using context and adapting to context. This requires a context-aware system to detect, interpret and respond to the context. There are no generic context middleware suits for all types of application [13].

1.4. Context-Aware Smart Home Applications Example

Recently, context-aware applications have actively been developed in ubiComp. In this paper, we introduce the Five Generic contexts as Location, Time, User, Device and Environment and the implemented context-aware applications is smart home. For example the smart home environment context focus on controlling home appliances or adjusting residential conditions such as lighting, temperature, and humidity by using context.

Scenarios make it easy for people saving the list of action for further use, in addition to

design multiple actions to be done in a single scenario application [14].

2. Categories of Context

1. Location context
2. Time context
3. Device context
4. User context
5. Environment context

2.1. Context Categories for Smart Home

The Context Categories are Location, Time, Device, User and Environment. The location context class includes location name, present location and changed location as attributes and to find location as method. The Time context class includes Am and Pm as attributes and to set and reset the time as methods. The Device context class includes lights, tv and alarm as attributes and to get the device as methods. The User context class includes the activity of the user such as cooking and sleeping as attributes and to find the user activity as methods. The Environment context class includes temperature and light as attributes and to find the environment as methods as shown in fig 1.

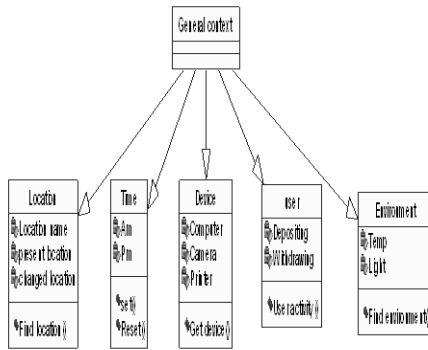


Fig 1: Context Categories for Smart Home

2.2. Five Context Categories with Their Specified Context for Smart Home

The class diagram for the Smart Home application consists of five general contexts as Location, Time, Device, User and Environment context and the attributes and methods are to be specified in the general context. For a smart home application the

location context class includes living room, kitchen, reading room and bathroom. The time context class includes early morning and noon. The device context class includes lights, alarm and tv. The user context class includes the activity of the user as cooking and sleeping. Then finally the environment context class includes temperature and light as shown in fig 2.

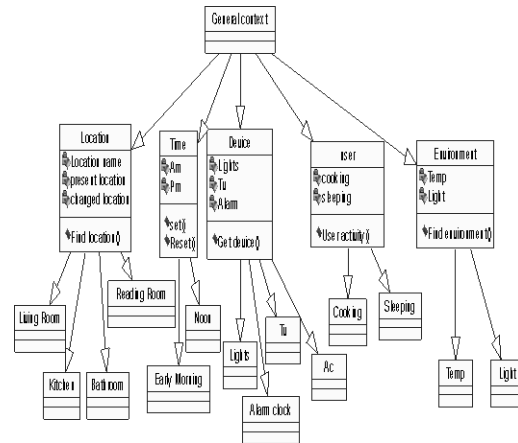


Fig 2: Five Context Categories with Their Specified Context for Smart Home

3. Working Model of Generic Context Middleware for Smart Home Application

Steps for implementing Smart home Application,

Step 1: Enter the Input scenario for smart Home Application, Scenario: if \user/ relaxing in living room turn light on. This scenario is the input given to the Generic context Middleware. Similarly all the possible scenarios are given as input to the Context Middleware as shown in fig 3.



Fig 3: Entering the input scenario

In this step from the given input scenario the Generic Context Middleware splits the context and generates the XML Representation for the given scenario as shown in the fig 4.



Fig 4: Generating the xml representation

Step 3: Save the XML Representation in the database for future use.

In this step the generated XML Representation is stored in the database and it is used for future use. If the same smart home scenario is given as the input and the XML Representation is again stored in the database the Generic Context Middleware shows that the data already exist in the database so to save the working time, first check the database that the data already exists or not if exists the same data is to be reused as shown in the fig 5.

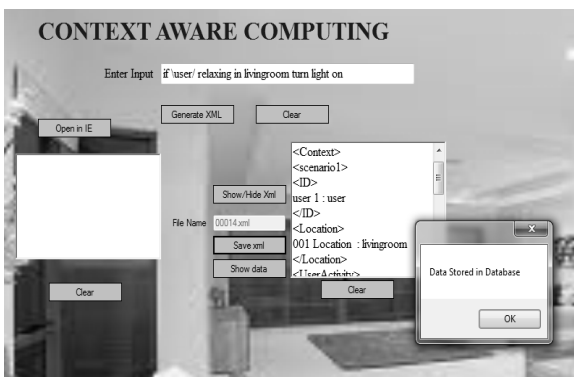


Fig 5: Storing the Xml Representation to the and show the data.

In this step the saved XML file is retrieved from the database to show the fast retrieval of context data as shown in the fig 6.

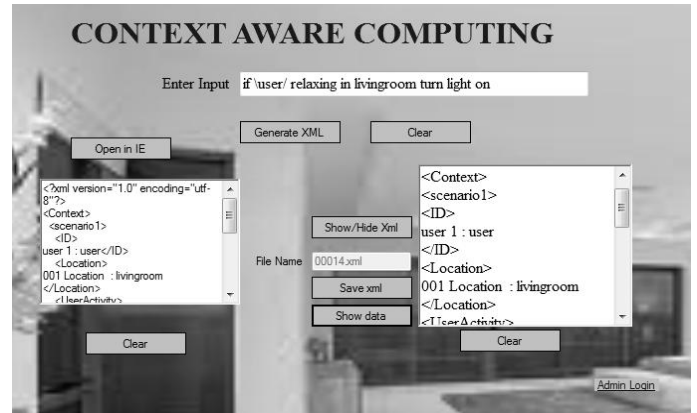


Fig 6: Retrieve the XML file

Step 5: open the Xml file in Internet Explorer to view the files.

In this step we can also view the database file not only from the database but also in Internet Explorer also as shown in the fig 7.

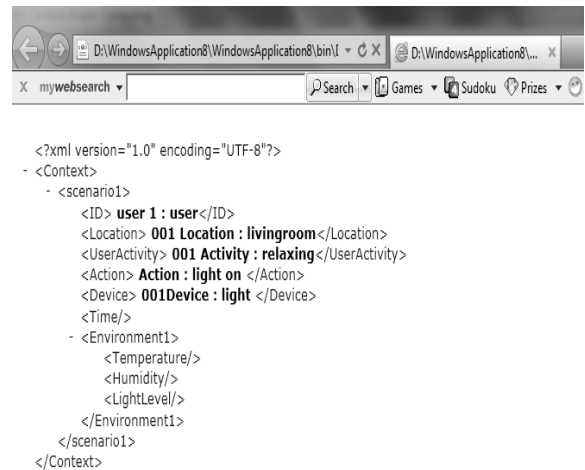


Fig 7: viewing the XML file in Internet Explorer

Step 6: Store new device context in the Generic Context Middleware

In this step we can add more number of context such as location context, Time context, device context, User context and Environment context in our Generic Context Middleware.





Fig 10: provide authentication

Step 9: To view data in the database.

In this step we can view the data in the database and to view all stored XML files as shown in the fig 11.

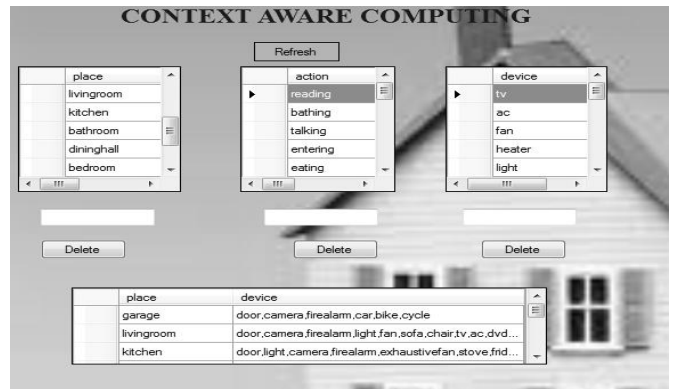


Fig 11: To view data in the database

Step10: To delete any context in the database.

In this step we can delete any number of context in the database e.g. delete corridor it is deleted successfully as shown in the fig 12.

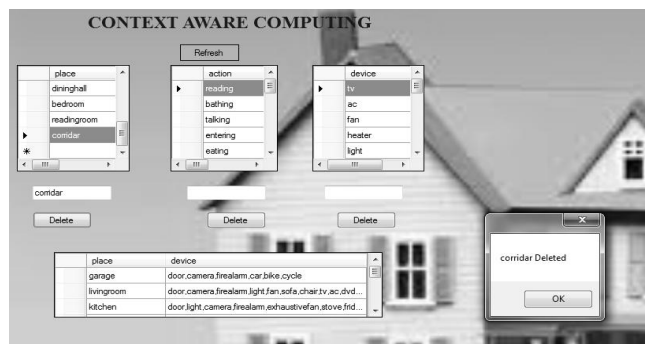


Fig 12: Deleting any context in the database

Fig 8: Store new device context.

Step7: The new device context data is updated.

In this step the new device context data is updated in the database as shown in the fig 9.



Fig 9: New device context data is updated

Step 8: To provide authentication.

In this step by providing the authentication of user name and password we can view the data in the Generic Context Middleware as shown in the fig 10.

Step 11: To view the XML files for Smart Home Application.

In this step we can view all stored XML files as shown in the fig 13.

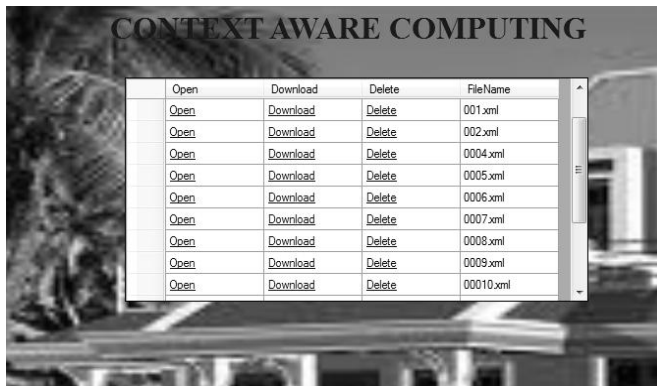


Fig 13: View all XML files

Step 12: open the xml file of 003.xml

In this step from the stored XML files we can open the file named 003.xml and it is opened in the Internet Explorer as shown in the fig 14.

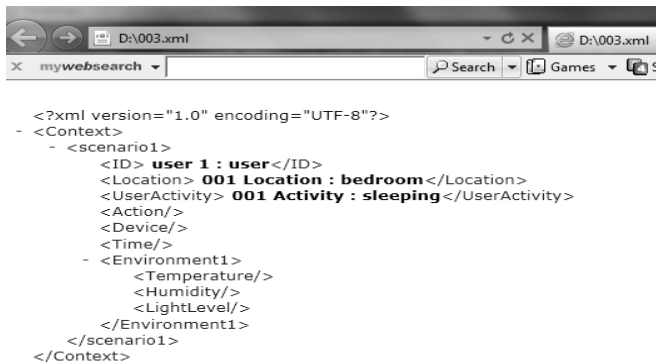


Fig 14: open the xml file

4. Conclusion

This paper worked on implementing the sample Context-aware application smart Home with the following Working Model steps implemented in the Generic Context Middleware. Similarly the Generic Context Middleware implemented is adaptable for different Context-aware applications such as Smart banking, smart office, and Smart classroom and so on.

5. References

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