

Development of User Modelling using Ontologies

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Abstract:

Ontology plays a vital role for knowledge representation particularly in semantic web and modelling techniques. This paper aims to design User Modeling Ontologies for Ubiquitous Teaching Learning Environment (UTLE) using Ontology development tool. The ontology will be constructed through mapping relations between users' and related services like Help-On-Demand Services (HODs), On-Demand Services (ODs) & Ambient Intelligence Services (AmIs). This paper discusses the various ontological representations. The major advantage of this work is that it makes the cognitive support easier to the user.

Keywords: User Modelling, Ontology, Services, Ubiquitous Environment.

1. Introduction:

Ontology specifies concepts. It defines easier view to understand. Ontology comprises concepts, entities and objects in the information domain and their relationship specifications. Conceptualization gives an abstract view of the world. *Ubiquitous Learning Environment* helps learners to access the learning resources in an easier and convenient manner. Its main characteristics include *context sensitivity* and *ubiquitous*. This environment normally integrates different *workshops, societies* and *educational institutions*. It is based on three ubiquitous aspects such as *learning interface, learning behavior* and *learning support services*.

User modelling is an interdisciplinary research area that focuses on human agent interaction, personalization, and information filtering and dialogue design. Its main areas of applications are e-commerce, knowledge management system, ubiquitous learning etc. The main objective of the personalization lies in improving the interaction process by reducing the complexities in interaction. User modelling process has been designed for personalization of web information system, user interface (UI) development etc. There exists a demand for the development of effective methods to model human and to represent the same through advanced visualization

techniques like ontologies. This paper aims to design User Modeling Ontologies for Ubiquitous Teaching Learning Environment (UTLE) using Ontology development tool.

2. Related Works:

Modelling of users in ubiquitous environment has been a hot research area for the past few years. The application of ontologies for the same becomes a quite popular technique. Several such applications have been reported in the literature: COBRA-ONT, Onto bum, IMHOTEP. They mainly attempted on the design of user modelling using ontologies in ubiquitous environment to show effective interaction and knowledge representation.

3. Ubiquitous Learning Environment:

The present HCI (Human Computer Interaction) research mainly focuses on contributing user-friendly and user-acceptable solutions (low cost) in a high level network secured environment. It means to create standards for enabling interaction between computers and people who are at any physical locations. Ambient Intelligence (AmI) and ubiquitous computing are the emerging research disciplines to support the development of solutions to these problems. This foreseen environment is unobtrusive, interconnected, adaptable, dynamic, embedded, and intelligent.

Ubiquitous computing: Devices with microprocessor that are integrated with day-to-day objects. Objects may be like, desk, table, chair, utensils and so on.

Ubiquitous communication: Different devices with processor should be able to communicate

Intelligent user interface: Interface to interact with the environment or to the ubiquitous devices.

The objective of ubiquitous computing lies in offering human-computer interaction in remote manner. Ambient intelligence in near future will make computer input and output media to disappear. It will integrate sensors and processors in day-to-day objects. Thus, screens, keyboards and mouse usage will be soon replaced by clothes, household devices and furniture. They ensure the communication among them. The AmI environment aims to be sensitive to the user's requirements and responding according to their behaviour. This, environment should be conscious of the users requirements and preferences. This should always access the people in an easier manner. An AmI environment should have the abilities, such as expression, recognition and response to emotions.

Devices based on ubiquitous computing technologies such as, Pen-based, Portable devices, Interactive screens, Wireless network, and Voice or Vision sensors such as, could build dynamic models of different environments. It means they could record and recall past

environments in order to act at any new environments. Ubiquitous computing uses wireless technology to enable flexible communication among portable and mobile devices. Wireless LAN, Bluetooth technology, high rate W-PAN (IEEE 802.15TG3), low power W-PANS (IEEE 802.15TG4), wireless Body Area Network (BAN) and Radio Frequencies Identification (RFID) are the currently available wireless technologies to support ubiquitous communication. User adaptive interfaces use intuitive, efficient and secure mechanisms to offer effective interaction. They help the computers to infer more about a remote person's environment. Hence, they are also known as intelligent social user interfaces. They are broadly classified into five groups—the first one is visual recognition to recognize face, 3D gesture and location, the next one, sound recognition to recognize speech and melody and the remaining groups such as, scent recognition, tactile recognition and other sensor technologies.

Ambient intelligence can be applied to any social environment to ensure convenience, cost savings, time savings security, safety and entertainment. Thus, ambient intelligence becomes a necessary current need to the society because of the spread of computing environment, mobile users, availability of increased information appliances and easier communication between individuals and things. Hence, ambient intelligence can also be referred to as a marriage between the technologies of ubiquitous computing and social user interfaces.

Any ubiquitous environment should have *server module, communication module, mobile devices and sensors*. The ULE should be mainly concentrating in providing *enormous teaching resources to the teachers, multiple Modalities of learning, collaborative learning environment and user friendly interface between user environments*. Thus *ubiquitous learning environment* is characterized by *Permanency, Accessibility, Immediacy and interactivity*. Following are the notable problems identified in the development of *Ubiquitous Learning Framework: Construction of Resources, Resource Discovery & Interaction, Standards of Ubiquitous Learning, Security and Implementation Cost*.

4. Methodology :

Protégé-2000 is a popular tool for modelling knowledge in an effective manner. It is a product developed at Stanford University. It can be used to edit Ontologies and knowledge-bases interactively. Through a graphical user interface and Java API, this tool can be accessed. New functionalities and services can be added to this tool through pluggable components. A number of plug-ins has been so far designed to offer following additional features:

- Extra ontology management tools
- Multimedia support
- Querying and reasoning engines
- Problem solving methods, etc.

An effective set of knowledge-modelling structures and operations for creation, visualization, and manipulation of various formats of ontologies has been implemented in protégé. Open Knowledge Base Connectivity (OKBC) protocol-based ontologies can be created by using Protégé. In 2003, an extension version was released to support OWL semantic web version. The protégé ontology can be exported using various forms, such as XML, OWL and RDF(s).

4.1. Ontology Development Process for User Modelling :

The ontology development process is shown in Figure 1. It describes the steps involved in the development process. Following is the list of steps with the respective actions:



Figure 1. Ontology development process.

Step 1: Determine scope

This step involves checking domain knowledge.

Step 2: Consider reuse

Once the ontology is created, it should be reused with following benefits:

- Save effort
- Ability to interact with other ontologies
- Can also be used for:
 - Domain specific ontologies
 - Ontology libraries
 - General ontologies
 - Upper ontologies

Step 3: Enumerate terms

This step enumerates the *terms* and *properties*. *Terms* denotes the object of ontology.

Properties give the relationships between instance and class and other instances.

Step 4: Define classes

This step of the ontology development process defines *class(s)*. It is a concept in a domain.

It is also a collection of elements with similar properties.

Subclass has a 'is-a' relationship.

Step 5: Define properties

Subclass inherits all properties from *super class*. There are six types of properties.

They are:

1. Intrinsic
2. Extrinsic
3. Relation with other objects
4. Parts
5. Simple-primitive values
6. Complex-relation with other objects

Step 6: Define constraints

Constraints describe or limit the set of values for the property.

Cardinality and *value type* [min, max and default] are commonly used constraints.

Domain-subject and *Range-object* also enable to constraint object. The subclass overrides all the constraints to narrow the values.

Step 7: Create instances/individuals

This process creates *instance/individual*. It is to give values to class.

Step 8: Checking integrity

This step involves checking if the *instance* of *subclass* is having the same instance of *super class*.

4.2. User Modelling with Onto-graph plug-in view:

This tool is designed for Protégé-OWL application. It enables interactive navigation of relationships of OWL ontologies. It uses layouts for automatic organization of the structure of the designed ontology. It is compatible with Protégé-OWL 4.1 and 4.2. The available versions are 1.0.1, 0.0.5, 0.0.4, 0.0.3, 0.0.2 and 0.0.1. This tool also provides advanced features, such as focus on home, grid alphabet, radial, spring, tree-vertical and horizontal directed, zoom-in, zoom-out, no-zoom, node-type, arc-type and search (contains, start with, end with, exact match, reg exp). Figure 2 is an example of *onto graph Plug-in* view.

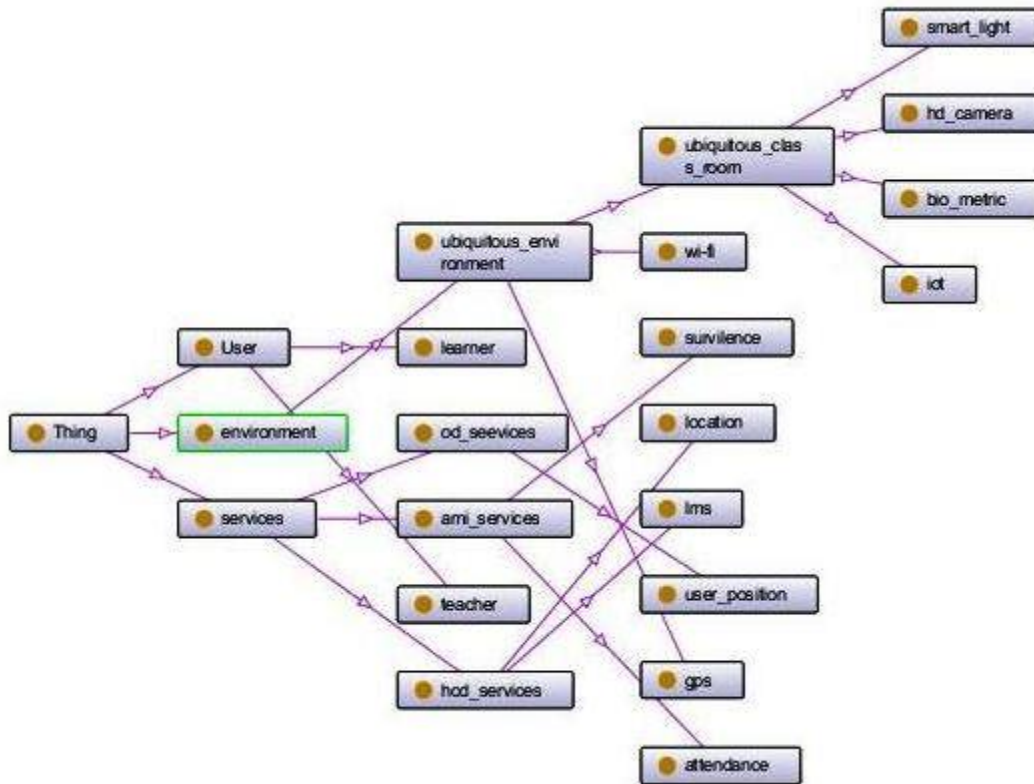


Figure 2. Onto graph plug in view.

5. Conclusion:

This paper designed User Modeling Ontologies for Ubiquitous Teaching Learning Environment (UTLE) using Ontology development protégé tool. The ontology was constructed through mapping relations between users’ and related services like Help-On-Demand Services (HODs), On-Demand Services (ODs) & Ambient Intelligence Services (AmIs). This paper addressed the onto-graph ontological representation. This work shows its ability to ensure effective cognitive support to the users.

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