Leonard Bolc Zbigniew Michalewicz
Toyoaki Nishida (Eds.)

Intelligent Media Technology for Communicative Intelligence

LNAI 3490

Second International Workshop, IMTCI 2004
Warsaw, Poland, September 2004
Revised Selected Papers

Springer

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Preface

The 2nd Workshop on Intelligent Media Technology for Communicative Intelligence commemorating the 10th anniversary of the Polish-Japanese Institute of Information Technology in Warsaw aimed to explore the current research topics in the field of intelligent media technologies for communicative intelligence.

Communicative intelligence represents a new challenge towards building a super-intelligence on the ubiquitous global network by accumulating a huge amount of human and knowledge resources. The term "communicative intelligence" reflects the view that communication is at the very core of intelligence and its creation. Communication permits novel ideas to emerge from intimate interactions by multiple agents, ranging from collaboration to competition. The recent advance of information and communication technologies has established an information infrastructure that allows humans and artifacts to communicate with each other beyond space and time. It enables us to advance a step further to realize a communicative intelligence with many fruitful applications.

Intelligent media technologies attempt to capture and augment people's communicative activities by embedding computers into the environment to enhance interactions in an unobtrusive manner. The introduction of embodied conversational agents that might mediate conversations among people in a social context is the next step in the process. The scope of intelligent media technologies includes design and development of intelligent supports for content production, distribution, and utilization, since rich content is crucial for communication in many applications. The promising applications of intelligence media technologies include e-learning, knowledge management systems, e-democracy, and other communication-intensive subject domains.

The first workshop was held in Tokyo, Japan in August 2002, as PRICAI 2002 (7th Pacific Rim International Conference on Artificial Intelligence) WS-5: International Workshop on Intelligent Media Technology for Communicative Reality. As indicated by the title, the role of reality was emphasized at that time. We considered that communication plays the central role not only in interpreting existing objects but also in attributing information to physical objects. The physical substances in the real world make sense to us only if they are associated with a meaning in the conceptual world. Typical examples are historical objects displayed in a museum. They make sense only if their historical facts and stories are well presented to the visitor. The sense of reality comes from the way in which physical and information features of those objects interact with each other.

The first workshop consisted of three invited talks and nine presentations. The invited talks covered key dimensions of the communicative reality, including computer-mediated interaction in the real world, situated conversations, and conversational agents. The presentations addressed additional topics such as video-based interactive media, a personalized navigation system, immersive distance learning, shared understanding by ontology building, analysis of facial expression for estimating the conversation mood, embodied communication of information and atmosphere by a team of robots, conversational contents for knowledgeable conversational agents, meaning acquisition from communications, and cognitive linguistic modelling of understanding irony.

The scope of this workshop covered much wider areas than the previous one. The topics involved media technologies from areas of artificial intelligence, Web intelligence, human-computer interaction, and other intelligent and cognitive technologies that may lead to the development of individual or collective intelligence.

This volume consists of two keynote papers, six plenary papers, and 38 regular papers. The topics include the following:

1. Perceptual technologies for capturing semantic information
2. Smart environments that support communicative activities
3. Embodied conversational agents that create and mediate knowledge in a social context
4. Sociable agents that cohabit with people in the real world
5. Intelligent content production and management for communicating intellectual assets
6. Automatic media annotation generation
7. Intelligent grids built as overlays on grid technologies
8. Measurement and evaluation of communicative intelligence
9. E-learning and multimedia technologies in education
10. Applications of communicative intelligence

We hope this workshop contributed to further advancing the state of the art in intelligent media technologies.

Finally, we would like to thank the members of the Program and Organizing Committees for their hard work in making this workshop happen.

March 2005

Leonard Bolc
Zbigniew Michalewicz
Toyoaki Nishida

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Table of Contents

Design Intelligent Web Applications Using Web Modelling Language (WebML)

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Abstract. This article will describe the Web Modelling Language (WebML), a notation for visually designing intelligent Web application at the conceptual level. All the concepts of WebML are specified both graphically and in the XML standard. WebML defines four orthogonal dimensions: structural model, hypertext model (splits on composition model and navigational model), presentation model and personalisation model. All models enable a high-level intelligent approach to designing and maintaining Web site.

1 Introduction

Designing and development of Web applications could be seen as an easy job. This is a good approach for small (home written) Web sites, which are based on simply static language like HTML. Nowadays there are a lot of technologies like JSP, PHP or ASP for a dynamic Web site development. Each of these technologies makes a designing process more complex. This also causes problems with later maintenance of the applications. The best solution for this complexity is to put into practice appropriate designing methodology. From early nineties, many Web designing methodologies were formed. Most of them are not adequate to nowadays. WebML is the most recent methodology, that considers all aspects of a designing process and allows a designer to involve all available technologies in an intelligent way.

2 What Is WebML

Web Modelling Language (WebML) is a conceptual language for high-level designing, which divides the whole designing process into few orthogonal dimensions. Each dimension describes a specific aspect of Web application designing by WebML concepts and semantics. WebML is an integrated set of models, that covers all aspects of a designing process. WebML is also a language for data-intensive Web sites, closely connected with database systems, which become much more popular nowadays. WebML is easy to learn and use in designing and also later in the maintaining phase in the whole software life cycle. Due to XML, WebML is a methodology independent on publishing language and database system, which makes this methodology more flexible and intelligent.

L. Bolc et al. (Eds.): IMTCI 2004, LNAI 3490, pp. 1–11, 2005.

3 XML in WebML

All information in WebML can be stored in an XML format. Each model in WebML has an XML representation and each step of the designing process ends with a proper XML document. This approach simplifies the whole designing process. The designer can start or finish his work on any step, for example: it is possible to create a proper XML document from an existing database structure and use it as input for WebML.

Due to an XML document, Web pages can by generated using XML transformation. This can by done automatically, in the end of the designing process. Also publishing language can be easily changed. Even at the end of the designing process, the designer can still choose the database system and implementation language.

4 WebML Models

The conceptual model of Web application, specified by WebML, forms five orthogonal perspectives, that cover all aspects of Web applications: structure model, composition model, navigation model, presentation model and personalisation model. Each of these perspectives considers a different aspect of a Web application, but concerns the same application domain. The structure model expresses the data content of the Web site. The composition model specifies which elements compose hypertext and make up pages. The navigation model specifies links between composition elements. The presentation model specifies the layout and graphic appearance of pages, independently of the publishing language. The personalisation model considers user or group of users requirements. Because of close connection of composition and navigation model, both of them form a hypertext model of a Web application.

4.1 Structural Model

The structural model includes the data content of the Web site. Data is modelled in terms of entities and relationships like in a database design process. It is possible to set generalisation hierarchies between entities. WebML does not specify yet any other notation to represent data model. It is up to a designer which notation (E/R model, ODMG object-oriented model, UML class diagram) will be used.

4.1.1 Entities

Entities represent an object in the real word. An individual object is an instance of entity. All the instances of an entity form the population of the entity. Entities have named properties – called attributes – with type associated. An attribute is a property common to the instances of an entity. It can be also called scalar attribute or mono-valued attribute. Some objects may have not a meaningful value for an attribute (e.g., total sale). An attribute, which has a set of values, is called multi-valued attribute and can be represented by means of an entity plus a relationship. An attribute, which has an internal structure (e.g., an address may consist of several fields), is called structured attribute and is represented by means of an entity plus relationship.

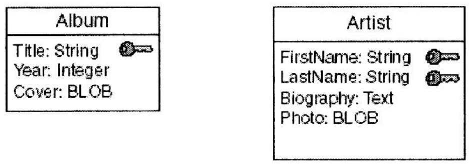

Fig. 1. Example of WebML entities

```
<ENTITY id="Album">
    <ATTRIBUTE id="Title" type="String"/>
    <ATTRIBUTE id="Year" type="Integer"/>
    <ATTRIBUTE id="Cover" type="BLOB"/>
</ENTITY>

<ENTITY id="Artist">
    <ATTRIBUTE id="FirstName" type="String"/>
    <ATTRIBUTE id="LastName" type="String"/>
    <ATTRIBUTE id="Biografy" type="Text"/>
    <ATTRIBUTE id="Photo" type="BLOB"/>
</ENTITY>
```

Code 1. Example of XML representation of a WebML entities

4.1.2 Relationships

Relationship represents semantic connections between entities. Relationship between two entities can be also called binary relationship. There are also N-ary relationships, which involve more than two entities. N-ary relationships are represented by an entity plus N binary relationships. Relationships may be given role names and cardinality constraints. The relationship role is a one of two directions under which relationship can be regarded (e.g., Figure 2 – relationship Publication may have two roles: Published_By and Publishes). For each direction of the relationship the maximum and minimum cardinality constraints can be specified (e.g., Figure 2 – for role Publishes, an Artist may produce zero or more Albums and for role Published_By, an Album has with one and only one Artist). Relationship can also has attributes that refer to pairs of entities. These attributes are represented by entity and two relationships.

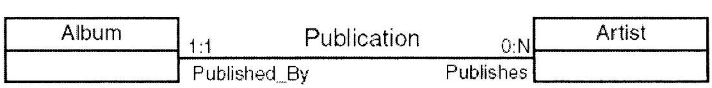

Fig. 2. Example of a WebML relationship between entities

```
<ENTITY id="Album">
    <ATTRIBUTE id="Title" type="String"/>
    <ATTRIBUTE id="Year" type="Integer"/>
    <ATTRIBUTE id="Cover" type="BLOB"/>
    <RELATIONSHIP id="Published_By" to="Artist"
inverse="Publishes"
  minCard="1" maxCard="1"/>
</ENTITY>

<ENTITY id="Artist">
    <ATTRIBUTE id="FirstName" type="String"/>
    <ATTRIBUTE id="LastName" type="String"/>
    <ATTRIBUTE id="Biografy" type="Text"/>
    <ATTRIBUTE id="Photo" type="BLOB"/>
    <RELATIONSHIP id="Publishes" to="Album"
inverse="Published_By"
  minCard="0" maxCard="N"/>
</ENTITY>
```

Code 2. Example of XML representation of WebML relationship between entities

4.1.3 IS-A Hierarchy

An IS-A hierarchy represents a special connection between two entities. One of entities (sub-entity) is a special case of the other one (super-entity). The sub-entity inherits the properties of the super-entity. The IS-A hierarchies may have several levels.

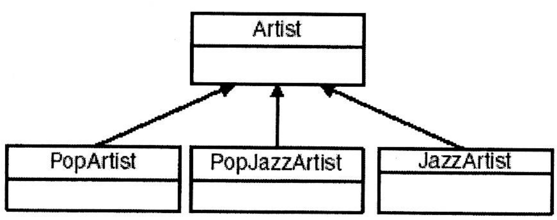

Fig. 3. Example of WebML IS-A hierarchy

```
<ENTITY id="PopArtist">
    <ISA-HIERARCHY id="isa-popartist" to="Artist"/>
</ENTITY>
```

Code 3. Example of XML representation of a WebML IS-A hierarchy

4.2 Composition Model

Composition model specifies which nodes compose the hypertext contained in the Web site. Elements can be specified as content units, i.e., the atomic information elements that can appear in the Web site, or pages, i.e., containers of content units that can be delivered to the end user. In a concrete HTML implementation of these elements, content units can form HTML files whereas pages can form HTML frames that organised such files on the screen.

4.2.1 Content Units

Content units are atomic content elements that publish information designed in the data model. Simple content unit can treat to whole population of a given entity. Population can be decreased by selection condition called selector, i.e., the specification of a set of restrictions that determine the actual population of entity to be used as the content of the unit at runtime, this is similar to "WHERE" clause in SQL language. The selector is associated with specific input and output parameters. Input parameters are used by a selector to compute a population of the current unit and output parameters compute other unit or units depending on the current unit.

In WebML there are five specified primary types of content units: data units, multi-data units, index units, scroller units and entry units.

4.2.1.1 Data Units

Data units represent a single object of a given entity.

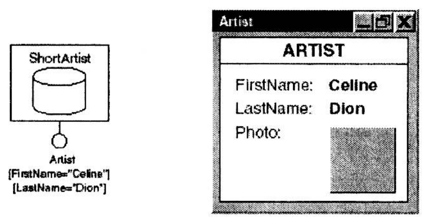

Fig. 4. Example of a WebML data unit, and rendition in HTML

```
<DATAUNIT id=''SchortArtist'' entity=''Artist''>
    <INCLUDE attribute=''FirstName'' />
    <INCLUDE attribute=''LastName'' />
    <INCLUDE attribute=''Photo'' />
</DATAUNIT>
```

Code 4. Example of XML representation of WebML data unit

4.2.1.2 Multi-data Units

A multi-data unit represents several objects of an entity together, by repeating the presentation of several data units.

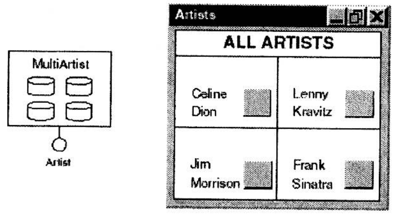

Fig. 5. Example of a WebML multi-data unit, and rendition in HTM

```
<MULTIDATAUNIT id=''MultiArtist'' entity=''Artist''>
    <DATAUNIT id=''SchortArtist'' entity=''Artist''>
            <INCLUDEALL />
    </DATAUNIT>
</MULTIDATAUNIT>
```

Code 5. Example of XML representation of WebML multi-data unit

4.2.1.3 Index Units

An index unit represents multiple objects of an entity as a list.

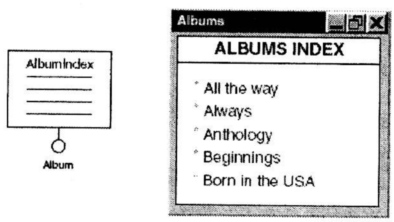

Fig. 6. Example of a WebML index unit, and rendition in HTML

```
    <INDEXUNIT id=''AlbumIndex'' entity=''Album'' >
        <DESCRIPTION Key=''Title''>
    </INDEXUNIT>
\vspace{3mm}
```

Code 6. Example of XML representation of WebML index unit

4.2.1.4 Scroller Units

A scroller unit provides commands to scroll through the objects in a set.

4.2.1.5 Entry Units

An entry unit supports form-based data entry.