Advanced Science and Technology Letters
Vol.29 (SIP 2013), pp.92-95
http://dx.doi.org/10.14257/astl.2013.29.19

Context-Aware Augmented Reality Services

Byoung-Dai Lee

Department of Computer Science, Kyonggi University, Suwon, Korea
blee@kgu.ac.kr

Abstract. Augmented Reality (AR) has become increasingly popular these days and applications in various domains such as entertainment, game, and education adopt the technology to provide enhanced user experience. Recently, a personalized context-aware presentation of AR information has emerged as an important feature of AR services for attracting mobile users In this paper, we present methods for providing such a functionality by extending the existing MPEG-4 BIFS technology.

Keywords: Augmented Reality, BIFS, Context-Awareness, Sensory Effects.

1 Introduction

Augmented Reality (AR) refers to a simple combination of real and virtual worlds and it has been widely used in various domains including education, broadcasting, health, and entertainment. Recently, due to widespread of mobile devices and the availability of high-speed wireless networks, the popularity of mobile AR services is increasing. In particular, personalized context-aware presentation of AR information has become an important requirement for attracting mobile users. Context-awareness is an important feature of future AR services. In particular, as the amount of AR information increases, presenting all information simultaneously can decrease the readability and usefulness of the information. Therefore, it is strongly recommended that AR information be presented selectively on the basis of user circumstances.

Binary Format for Scenes (BIFS) [4] is one of the representative standards for representing and delivering rich media services and it is the core technology used in the AR standardization of the Moving Picture Experts Group (MPEG). In this paper, we extended the BIFS to associate context information with a group of virtual objects and allow for the presentation of a subset of AR information that corresponds to given context information.

The remainder of this paper is organized as follows: An introduction to a BIFS scene description is presented in Section 2. Section 3 describes the proposed methods for supporting context-awareness in detail. Finally, Section 4 offers some concluding remarks regarding the proposed methods.

ISSN: 2287-1233 ASTL

2 Introduction to MPEG-4 BIFS Scene Description

BIFS is an MPEG scene description standard used to represent temporal and spatial relationships among multimedia objects, such as audio, video, image, graphics, and text, as well as user interactions. A BIFS scene is composed of a collection of nodes arranged in a hierarchical tree. Each node represents, groups, or transforms an object (e.g., audio, video, or graphical objects) in the scene and consists of a set of fields that define and control the node properties, such as the size, color, and location in a 3D space.

The data types of the node fields can be either single or multiple values, as indicated by single-value field (SF) and multiple-value field (MF) immediately before the actual data type. Fields listed as SF data types, such as SFFloat, can contain only one value, whereas MF data types, such as MFFloat, can accept an array of values. The node fields can be classified into one of four possible types: field, *exposedField*, *eventIn*, and *eventOut*. The field type is used for values that are set only when instantiating a node. The *eventIn* field is used to receive events, and *eventOut* can be considered the conduit through which the events generated by a node are sent. The *exposedField* allows both sending and receiving events. All fields of the *exposedField* type have an *eventIn* and *eventOut* implicitly associated with them. The routes are the means to connect the *eventOut* field of a node to an *eventIn* field of a different node and can be considered the wiring used to connect event generators to event receivers. Sensor nodes sense changes in the user and environment for authoring an interactive scene. They generate events based on user interaction or a change in the scene.

3 Extension of MPEG-4 BIFS for Context-Awareness

To support context-awareness in BIFS, we propose a *ContextGroup* node that associates context information with a group of BIFS nodes that represent AR information, and a *ContextSwitch* node that allows for the presentation of a subset of AR information corresponding to the given context information.

Table 1 shows the detailed syntax and semantics of the *ContextGroup* node. The children field specifies a group of nodes for AR information that share the same context. The AR information contained in the children field can be dynamically added or removed by the *addChildren* or *removeChildren* field. The *context* field specifies the context information associated with the AR information represented by the children field. As several techniques are available to represent context information (e.g., a key-attribute approach, an XML schema approach, and an Ontology approach) and because there is no standard for this, the *contextRepType* field indicates a specific technique used for a context representation. Therefore, information contained in the context field must be interpreted according to the method indicated by the *contextRepType* field. The *priority* field specifies the priority of the AR information. This field is used to determine what AR information should be presented when there are multiple matches to the given context and it is impossible to display all of the matched AR information. The *relatedURL* field specifies the location where

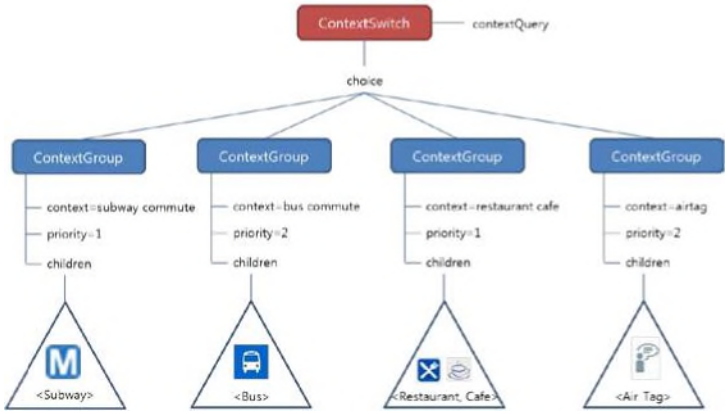

Fig. 1. Logical structure of scene description for context-awareness.

additional information about the context such as the context representation method can be acquired.

Table 1. Detailed syntax for the ContextGroup node.

Node	Syntax

ContextGroup	ContextGroup {
	eventIn MFNode addChildren
	eventIn MFNode removeChildren
	exposedField MFNode children []
	exposedField MFString context [“”]
	exposedField SFString contextRepType “”
	exposedField SFFloat priority 1.0
	exposedField MFString relatedURL [“”]
	}

Table 2 shows the detailed syntax and semantics of the *ContextSwitch* node. The *choice* field specifies AR information against which the *contextQuery* will be executed. The *enabled* field specifies whether context-awareness must be initiated. The *contextQuery* field specifies a query that represents the context of interest. The *contextQueryRepType* field specifies the method for a context query representation.

Table 2. Detailed syntax for the ContextSwitch node.

Node	Syntax
ContextSwitch	ContextSwitch { exposedField MFNode choice [] exposedField SFBool enabled FALSE exposedField SFString contextQuery “” exposedField SFString contextQueryRepType “” }

Figure 4 illustrates the logical structure of the BIFS scene description supporting context-awareness. Each *ContextGroup* node contains nodes representing AR information in its children field and sets the *context* field accordingly. Note that in this example, simple string matching is used for a context representation and context comparison. The four *ContextGroup* nodes are listed in the choice field of the *ContextSwitch* node. If it is detected that a user is going to work, then the *contextQuery* field is set to "commute," which results in the presentation of AR information associated with "commute." In addition, if the display size of the user's mobile device is not large enough to accommodate both subway stations and bus schedules, only AR information on the subway stations will be displayed according to the *priory* field.

4 Conclusions

Owing to the widespread use of mobile smart devices equipped with various sensors such as a global positioning system and camera, as well as the availability of diverse high-speed wireless connectivity options, AR services have become increasingly popular in recent years. In particular, a personalized context-aware presentation of AR information and the provisioning of an enhanced user experience in a more realistic manner are important requirements for attracting mobile users. In this paper, we presented methods for providing such functionalities by extending the existing MPEG-4 BIFS technology.

Acknowledgments. This work was supported by Kyonggi University Research Grant 2013.

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