Realization of u-Contents: u-Realism, u-Mobility and u-Intelligence

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***Abstract*—Recently the developments of Ubiquitous Computing and Augmented Reality technologies have made many changes on the existing applications. However, the contents used in the applications have been not revised conceptually. Thus, an expansive representation of the contents is required to adapt resources to new computing environments, and to reflect new emerging features such as realism, mobility and intelligence. In this paper, we address a noble concept: Ubiquitous Computing enabled Contents (u-Contents). Firstly, three key features, u-Realism, u-Mobility and u-Intelligence, are reviewed. Secondly, the realization issues are explained based on the properties of three key features. Lastly, u-Contents are discussed from the viewpoint of possible applications.**

***Index Terms*—Ubiquitous Computing, Augmented Reality, Ubiquitous Virtual Reality, Contents, and Mobility.**

I. Introduction

In Ubiquitous Computing Environment, computing resources are distributed around users. The new environment enables users to carry out impossible tasks as they can do in Virtual Reality (VR) space. Most attractive users' ability in VR is that the contents in the space can be transformed according to users' intentions and emotions. Recently, various researches of Augmented Reality (AR) have shown possibility to realize this ability of VR in real environment [1]. However, the contents used in the applications have been not revised conceptually. Thus, an expansive representation of the contents is required to adapt resources in new computing environments, and to reflect new emerging features such as realism, mobility and intelligence.

In this paper, we address a noble concept: Ubiquitous Computing enabled Contents (u-Contents). Unlike [2], the realization issues are focused. Firstly, three key features, u-Realism, u-Mobility and u-Intelligence are reviewed and revised. Secondly, the realization issues are explained based on the properties of three key features with examples. Lastly, u-Contents is discussed from the viewpoint of possible applications.

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II. u-Contents

u-Contents is a novel concept that describes realistic and intelligent contents seamlessly shared in Ubiquitous Smart Space (or Ubiquitous Computing enabled Space). It has three properties: u-Realism, u-Mobility, and u-Intelligence. Here, 'u' stands for 'Ubiquitous Computing enabled'. If each property is represented as a set (Venn diagram), u-Contents is the intersection of them as shown in Figure 1.

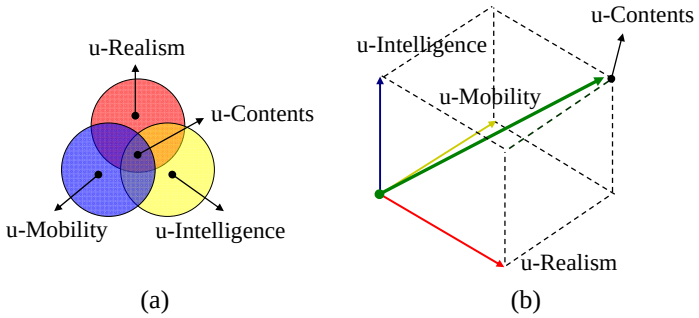


Figure 1. Representation of u-Contents and its three properties: u-Realism, u-Mobility and u-Intelligence (a) Venn diagram (b) 3D Space

- *u-Realism* is the property that contents are seamlessly registered into physical space by reflecting contexts. Contents with u-Realism provide realism suitable for users' contexts through multi-modal feedback based on users' five senses.
- *u-Mobility* is the property that contents are selectively shared among heterogeneous or homogeneous devices. Contents with u-Mobility are able to freely move themselves among devices such as large displays, PDA, and laptops.
- *u-Intelligence* is the property that contents respond intelligently by themselves or user's intention, attention, and emotion. Contents with u-Intelligence act as alive agents so that they provide more adaptive services to users.

III. Realization Issues

In this chapter, the details of three key features in u-Contents are discussed with concrete examples. Since contents used in AR applications are most likely to be accepted as future u-Contents, we deal the examples with AR contents.

The main differences between conventional contents and u-Contents are caused from the contexts obtained from physical space. Most AR applications already have used the camera context, but their utilizations are limited in camera pose

estimation. Various fusions can be generated to accelerate existing algorithms by helps of context-awareness technologies.

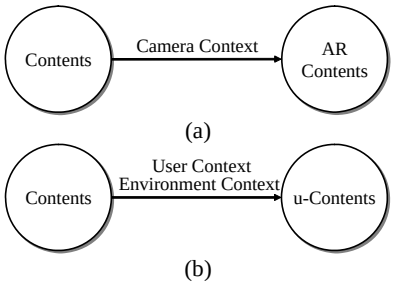
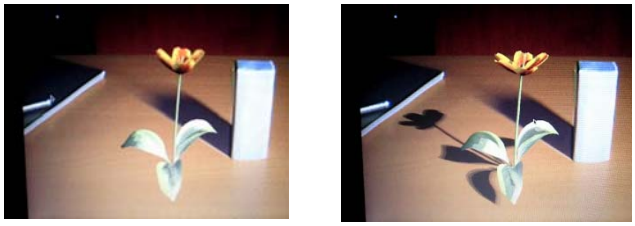


Figure 2. u-Contents realization (a) 3D contents and images are converted to AR contents by applying camera contexts (b) u-Contents are obtained by using adequate user's and environmental contexts

A. u-Realism

The realism of contents is enhanced when all environmental contexts are mapped to parameters in a mixed space. For example, virtual shadows of the virtual objects as shown in Figure 3 can be seen as realistic when the real light sources are extracted from the environment correctly. In the existing AR applications using only camera sensors, the generation of these mapping is a challenging and has limitations due to a lack of information.



(a) (b)

Figure 3. Realism enhanced by a virtual shadow: (a) flower augmentation without a shadow (b) the augmented shadow based on the light source

In u-Contents, from the viewpoint of the implementation, the meaningful contexts are collected from a hundred of sensors distributed in the real space. Then, the contexts are transformed to the existing parameters in AR space. Table 1 shows the context examples and how the contexts assist in realizing u-Realism in the applications. Note that the five senses should be considered in the ideal cases.

Table 1. Examples of contexts for u-Realism

Context Source	Information	Example
Camera	Physical specifications	The seam can be reduced by adding image noise to contents.
User	Global location	Realistic 3D sounds can be generated.
Environment	Air flows Light source	Augmented virtual flags can flap in the wind.

B. u-Mobility

The mobility of the multi-media contents has been implemented with MPEG-I, II and transcoding technologies. These technologies enable contents to move freely among heterogeneous devices via network with predefined manners. In addition, contents with u-Mobility can transform themselves or move to other devices according to user's contexts. This property also includes the transfers among different spaces such as VR to AR. Thus, u-Mobility adaptively yields a path to the contents. Table 2 shows the examples where the user's contexts are required.

Table 2. Examples of contexts for u-Mobility

Context Source	Information	Example
User	User's device specification	Levels of contents are converted automatically.
Environment	Environmental resources	Network resources are selected automatically to share contents.

C. u-Intelligence

The research on the intelligent contents was started with the questions, 'Which actions are regarded as proper conducts?' and 'How the living subject can be imitated?'. The main approach in u-Intelligence is to put 'Personality', 'Emotion' and 'Sociality' into contents with helps of context-awareness. Figure 4 shows the low-level intelligence implemented with a virtual robot character.

(a) (b) (c)

Figure 4. Example of a low-level intelligence: 3D running robot crashes with real blocks, this shows the simple reaction against the 'crash' event

In u-Contents, u-Intelligence has an important role in generating reactions. Contents act by themselves with self-motivations. However, the abundant sensor data is essential to let the contents decide their behaviors. To determine (or generate) responses, not only the user's context, but also the environmental context are combined and parameterized.

IV. Discussion

The proposed concept toward the realization of u-Contents is going to be applied various AR applications. Especially, u-Mobility is deeply related to the design and development of the mobile AR services. And u-Realism can drastically reduce the computational burdens, also enhance reality in all domains. In addition, u-Intelligence will bring the mechanism for seamless interactions in AR applications.

References

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[2] SJ.Oh, W.Lee, Y.Park, and W.Woo, " u-Contents : New kinds of realistic contents in ubiquitous smart space", International Symposium on Ubiquitous VR (ISUVR06), Vol. 191, pp. 13-16, 2006.