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그래픽스 컨텐츠 적응을 위한 사용자 환경 기술 체계

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Usage Environment Description Scheme for Adaptation of Graphics Contents

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Abstract

This paper presents a user preference description for graphics contents that is developed in the process of the MPEG-21 DIA (Digital Item Adaptation) standard. The description scheme in this paper is proposed by the authors and adopted in the current AM (Adaptation Model) document of the MPEG-21 DIA. The goal of MPEG-21 standard is providing a multimedia framework that provides augmented and transparent use of digital contents across various networks and terminals for the life cycle of digital contents. DI (Digital Item) is a standardized basic unit of digital contents for transaction in the scope of MPEG-21. A DI contains both media resources and metadata including rights information.

1. Introduction

Content adaptation has been widely and long practiced human activity. In medieval age, the text of the Bible is adapted to pictures on stained glass in a church by painters to convey a biblical story adapting to illiterate people. A created content is transmitted to and consumed by a user so that the target media and the target user group is critical factor for the content creation. When there are needs of that content in different media and/or for different users, the original content should be appropriately adapted. A movie film is adapted to home video tape media in terms of aspect ratio, running time, sexual and violent scenes.

The possible number of adaptations of a content *Na* is linearly dependent on the number of target media *Nm* and the number of target user groups *Nu*. When *Nm* and *Nu* are small in the old times, the adaptation process was not a big issue. However, in the complicated networked digital era of today, both *Nm* and *Nu* are very big and automated content adaptation technologies are required. Media can be further divided into transmission media such DVD, audio tapes, ADSL, internet, mobile network and presentation media such as TV, MP3 player. These transmission and presentation media have various attributes such as storage capacity, delay, jitter, the number of audio channels, sampling rate, CPU power that distinguishes the media further in detail.

Digital content adaptation technologies have been developed recent years. Scalable coding techniques encode an original high quality content bitstream into a base layer and more than one enhanced layer bitstreams. The base layer supports low quality content for low capacity transmission and presentation media. When more enhanced layers are added to the base layer, higher quality content requiring more resources of transmission and presentation media are supported. The scalable coding techniques exploit the redundancies between layers for coding efficiency. Scalable coding techniques do not consider actual media or user parameters. Efficient scalable coding techniques are standardized for video and audio in MPEG-4 standard [1].

More elaborated digital content adaptation techniques [2][3][4][5] are developed in the concept of UMA (Universal Machine Access) and reflected in MPEG-7 standard. UMA is

to adapt multimedia contents to be able to be consumed at different terminals connected to networks of different characteristics. UMA uses metadata of content, network and terminal characteristics and the user characteristics. MPEG-7 Transcoding Hint metadata contains content characteristics information suchas coding difficulty and motion vector range for reducing transcoding complexity and enhancing content quality [2]. MPEG-7 Variation metadata describes content characteristics of variations of original content in terms of resolution and modality for content adaptation [3][4]. WAP (Wireless Application Protocol) forum standardizes UAProf (User Agent Profile) that can describe network and terminal capabilities and the user preferences together with protocols of transporting the description [6].

The DIA (Digital Item Adaptation) part of the MPEG's ongoing latest standardization work item MPEG-21 deals with UMA technologies complementing MPEG-7 UMA expanding UMA metadata to cover the digital usage environment of networks, terminals, user characteristics and natural environment. The description scheme for graphics content adaptation in this paper is proposed by the authors and adopted in the current Adaptation Model of the MPEG-21 DIA [7]. The paper is structured as followings: Section 2 briefly describes the MPEG-21 DIA concept. The proposed graphics schemes and its applications are presented in section3. The paper concludes in section 4

2. Introduction to MPEG-21 DIA

The goal of MPEG-21 standard is providing a multimedia framework that provides augmented and transparent use of DI (Digital Item) across various networks and terminals, where Digital Item is a MPEG-21 defined package of digital contents comprising multimedia resources and metadata. MPEG-21 standards cover XML-based DI schema, URI-based DI identification, intellectual property protection and management technologies such as REL (Rights Expression Language) and RDD (Rights Data Dictionary) and DI processing systems. DIA is one part of MPEG-21 framework. MPEG-21DIA concept is shown in the Fig. 1. MPEG-21 DIA standardizes the usage environment description schema of the user characteristics, terminal and network characteristics and natural environments. DIA engine adapts the original DI to the usage environment description sent from the terminal and transmits the adapted DI to the terminal.

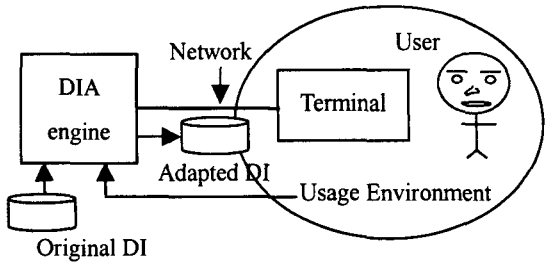

Fig. 1 Usage environment of MPEG-21 DIA

3. Proposed Graphics DIA

Figure 2 shows an XML schema diagram of the user preference description scheme for graphics contents presented in this paper.

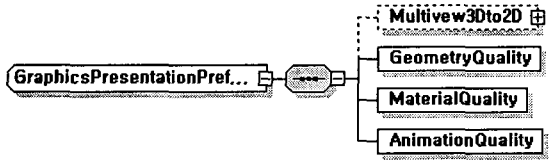

Figure 2. XML schema diagram for graphics user preference description scheme

Multiview3Dto2D description scheme contains information on parameters of multiple virtual cameras. This description is useful for the user with a device that does not have a 3D graphics processing capability that is typical case for most of current mobile devices. When a user request a 3D graphics content with this information to the adaptation engine, the adaptation engine captures 2D images from the requested 3D graphics contents with virtual cameras set by the received parameters. The captured 2D images are sent back to the terminal for the user. By setting this information with two virtual camera parameters with stereo camera configuration, the user can have better 3D experience with a HMD device. Other three elements of graphics user preference are the user's quality preference for each of the three components of graphics contents, which are geometry, material and animation. Figure 3 shows a simple graphics editing application user interface with the three quality preference elements. With this user interface, the user can adjust the graphics quality separately for geometry, material and animation using slide bars with ease. For instance, a 3D graphics for PC environment can be adapted to a 3D graphics for a more resource constrained mobile device with fine adjustment of geometry, material and animation.

GeometryQuality, *MaterialQuality* and *AnimationQuality* description elements are represented with one float number from *0* to *1* that represents the user's quality preference for each component of graphics contents. This normalized scale of quality representation is designed for dealing with many exiting and future graphics representation and adaptation algorithms. Many graphics technology developed for scalability, compression and simplification of geometry, material and animation can be used as an adaptation algorithm. When quality preference description elements are set by the user using the user interface in Figure 3 and sent to an adaptation engine, it maps this number to a specific quality metrics that is usedby a specific adaptation algorithm of the adaptation engine. For geometry quality, various metrics such as QEM (Quadratic Error Metrics) and the reduction ratio of polygon numbers may be used. For material quality, various metrics such as PSNR (Pixel Signal to Noise Ratio) and the ratioof image size reduction may be used. For animation quality, various metrics such as frame rates, the number of key values and also statistics of QEM such as average and variance of QEMs may be used.

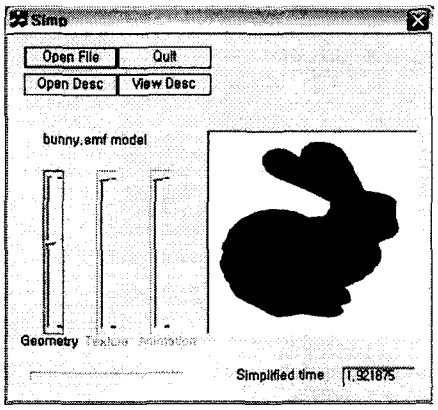

Figure 3. User interface for graphics quality editing application with quality preference of geometry, material and animation

For graphics adaptation, along with the user preference description scheme presented in this paper, terminal capability descriptions for vertex processing rate, memory bandwidth, fill rate and graphics format are standardized in MPEG-21. These terminal capabilities represent the animation processing capability of the terminal. When this information is sent to the adaptation engine, it constraints the adapted animation content can be processed in the terminal. Other usage environment description, such as user's color deficiency is related to graphics adaptation.

The following XML code shows an instance of graphics DIA for a user's graphics preference description.

```
<?xml version="1.0" encoding="UTF-8"?>
<DIA
xmlns="urn:mpeg:mpeg21:dia:schema:2003"
xmlns:bt =
"urn:mpeg:mpeg21:dia:schema:BasicTypes:20
03"
xmlns:mpeg7="urn:mpeg:mpeg7:schema:200
xmlns:xs="http://www.w3.org/2001/XMLSchem
a"
xmlns:xsi =
"http://www.w3.org/2001/XMLSchema-instanc
e"
<Description
xsi:type="GraphicsPresentationPreferenceT
ype">

<geometryEmphasis> 1.0

</ geometryEmphasis>

<animationEmphasis> 0.5
</animationEmphasis>

<textureEmphasis> 0.5

</textureEmphasis>

</Description>

</DIA>

</xml>
```

4. Conclusion

In this paper, we have presented graphics related user preference description scheme in the process of MPEG-21 standard and with its applications. We are currently developing a full graphics adaptation engine with other MPEG-21 graphics related description schemes.

References

[1] Fernando Pereira and Touraj Ebrahimi, "The MPEG-4 Book", IMSC Press, ISBN 0-13-061621-4, Ch. 10-Ch.11, 2002.

[2] Kuhn, P.; Suzuki, T., Vetro, A., "MPEG-7 Transcoding Hints for Reduced Complexity and Imrpoved Quality", *International Packet Video Workshop*, April 2001

[3] Rakesh Mohan, John R. Smith, Chung-Sheng Li, "Adapting Multimedia Internet Content for Universal Access", IEEE Trans on Multimedia, Vol. 1, No. 1, March 1999.

[4] L. Sampath L, A. Helal, J. Smith, "UMA-based Wireless and Mobile Video Delivery Architecture," Proceedings of the SPIE Voice, Video and Data Communications Symposium, November 2000

[5] Anthony Vetro and Huifang Sun, "Media Conversions to Support Mobile Users", Canadian Conference on Electrical and Computer Engineering 2001, Vol. 1, 2001.

[6] WAP Forum, "WAG UAProf Version 20.0", October, 2001.

[7] MPEG MDS Group: MPEG-21 Digital Item Adaptation AM (v.5.0). MPEG document No. N5613. Pattaya (2003).