An Approach to Interactive Media System for Mobile Devices

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ABSTRACT
The interactive system which interacts human with computer has been recognized as one direction of computer development for a long time. For example, in cinema, a person gets information he wants or plays the media data while moving by using a mobile device. As the development of this system, we designed and implemented the system interacts with users in a small terminal. Our study has three categories. The first category is the development of new interactive media markup language (IML) for the writing interactive media data. The second category is the *IML translator* which translates IML into the best form to be played on mobile device. And the third category is the *IM player*, which plays the transferred media data and interacts with user. IML was designed for controlling vector graphics and general media objects in detail and supporting synchronization. Also, it was designed to be operated in small mobile device as well as desktop PC or set-top box which has high CPU performance. The player, implemented finally, is operated on PDA (HP iPAQ) and plays the multimedia data consist of vector graphics (OpenGL), H.264 and AAC etc. according to the choice of user. This system can be used in the ways of interactive cinema and interactive game, and can substitute new interactive web services for existing web services.

Categories and Subject Descriptions: D.2.2 [SOFTWARE ENGINEERING]: Design Tools and Techniques - Modules and interfaces; H.1.2 [MODELS AND PRINCIPLES]: User/Machine Systems; H.5.1 [INFORMATION INTERFACES AND PRESENTATION]: Multimedia Information Systems

General Terms: Design, Human Factors

Keywords
Interactive Media, IML, Mobile Device.

1. INTRODUCTION
Interactive media which is served by user interaction has recently become a hot topic in the areas of human-computer interaction (HCI). Though information service on mobile device has became commonplace, most research of interactive media targeted desktop PC and TV set-top box platform on wired network [1]. So, it is becoming very attractive to offer interactive media system on mobile platform. For these reason, we designed whole interactive media system and implemented it. First, we designed a new markup language in detail for supporting interactive media service which is most suitable for mobile device. IML (Interactive Multimedia Language), which is designed for user interaction, has sync-information to synchronize various media objects and descript information of those objects. And it can control each media object directly by supporting raster graphic module and core OpenGL, which is based on vector graphic, on language level. For example, it can represent video content on a face of 3-dimensional rotate cube composed of vector graphic. Second, we designed and implemented *IML Translator* which takes a charge of midway process for playing IML contents on mobile device which has low resources. Through this process, we could eliminate XML parser in mobile device and save memory and CPU resource. Third, we also designed and implemented player for viewing these intermediate contents on PDA. To support this, we ported codecs of OpenGL, H.264 (MPEG-4 Part 10), AAC (Advanced Audio Codec) to PDA. After these all, we made some interactive media contents (e.g. Interactive Cinema, Interactive Game, and Psychological Test) for demonstrating at ubiquitous area workshop.

In this paper, we will discuss a method for supporting interactivity to media on mobile device and describing internal system architecture in detail.

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2. SYSTEM ARCHITECTURE

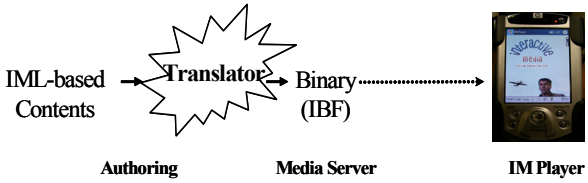

Figure 1. Interactive Media System

As shown figure 1, our proposed interactive media system is composed of server part and client part. And server part translates XML-based content to intermediate binary format. After all, this IBF (Intermediate Binary Format) file is played on player of client part. Each part is discussed in below.

2.1 Interactive Media Language (IML)
The characteristics of IML are as bellows.

- Serviced as byte-aligned binary format.
- Easy to handle for it's similarity with SMIL.
- Embed vector graphic (OpenGL) functionality.
- Can control media object directly.

The proposed IML is represented in a byte-aligned binary format. The binary format reduces the size of interactive multimedia contents, and the byte-aligned format reduces the processing cost in terminals. Another feature of the IML is vector graphics, which assists that terminals obtain user interaction easily and gives more flexibility to the contents. Vector graphics, which has strength in zooming, can be attractive to various screen sizes. For example, small buttons (e.g. labeled 'previous', 'next' and 'stop') made in vector graphics are useful to take interaction from users, because they can be maintained in clear shapes according to sizes. Another merit of IML is that it can control each media object directly, because it has video control module and OpenGL control module.

2.2 IML Translator

IML Translator removes a redundant XML parsing work on mobile device by translating a content file from XML-based text type into binary type in advance. The advantage of *IML Translator* is it does not need XML parser, saves CPU power and reduces a content size (about 70% of XML-based content). And it uses byte-aligned format for reducing bit operations, because mobile devices have not enough calculating power [2].

2.3 Interactive Media Player

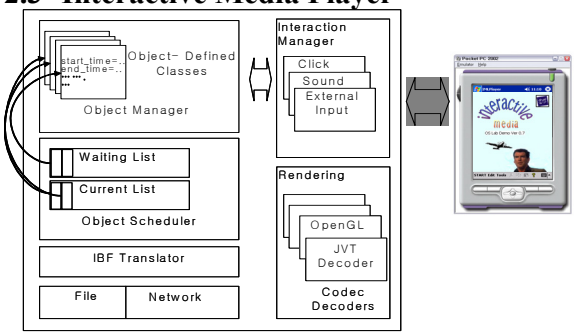

Figure 2. Internal architecture of our interactive media player

In detail, after a content is transferred to the *IBF Translator* by network or file system, it is translated and analyzed. Then, timestamp information that objects have to be started and be ended and event information which is related to a user interaction are registered to internal list. Each *Waiting List* and *Current List* contains pointer value which indicates objects to be played and object playing now. To manage these internal lists (*Waiting List* and *Current List*), *Object Scheduler* was designed and implemented [3].

3. IM SYSTEM DEMO

The result of this research was published and exhibited at 'International Ubiquitous Computing Symposium (Dec. 2003)' and 'HCI2004 Ubiquitous Workshop (Feb. 2004)'. During those exhibitions, many people enjoyed and satisfied with our interactive media system. As mentioned above, this system supports 'JVT (H.264, MPEG-4 Part 10) Simple Profile' for video codec. For H.264 codec has high compression power (about twice MPEG-4 Part 2), it appropriates to PDA which has low resources (e.g. low memory, low bandwidth wireless network). Though it needs high CPU power to decode content, it could decode over 15 frames per second in our implemented system. Because this system was designed to use very low resource and H.264 codec in it was newly optimized by us.

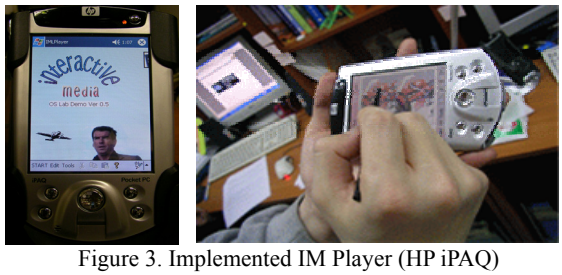

Figure 3. Implemented IM Player (HP iPAQ)

Above figure shows demonstrate scenes of our implemented interactive media player. The left side figure is intro scene of interactive cinema written in IML, and it shows moving airplane by controlling vector and raster graphic object. After these intro scenes, cinema is going on various stories as user interaction. And the right side two figures are scenes of playing the IML game content whose name is 'Find differences'. This interactive game is going on next stage when user finds all of differences between two pictures.

4. CONCLUSION

In this paper, we have presented an interactive media system on mobile environment. It is an interactive, lightweight, and resource-efficient system. The first contribution of this research is that it is not a one-way system but an interactive system, and the second one is that it is designed for mobile device like a PDA in the first beginning time unlike the other systems are designed for high powered desktop PC or home server. Therefore, a user can be enjoyed for interactive media service as his opinion while he is moving. To put it more concretely, since a content written in IML is converted to binary format, it has a lower data size. Moreover, it also needs a lower network bandwidth and need not XML parser which is a burden for memory and CPU resources. Another merit of IML is that it can control each media object directly, because it has video control module and OpenGL control module in its internal library. Consequently, objects written in internal vector graphic interface can be reused and reduce network connection cost.

In a point of wide view, we defined a novel interactive markup language IML, implemented IML translator and IML player in this research. Examples of practical application of our developed system are interactive cinema and interactive game player on mobile device. Moreover, it can be applied to many media fields without complicated programming if sensor or voice is used for an input event, and can substitute new interactive web services for existing web services.

5. REFERENCES

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