User Event Analyzer for Bidirectional DMB Data Service

양방향 DMB 서비스를 위한 사용자 이벤트 분석 모듈

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Abstract Digital Multimedia Broadcasting (DMB) is a digital radio transmission system for sending multimedia such as radio, TV, and data casting to mobile devices. Nowadays, DMB specifications are the major standard for digital broadcasting and have been establishing for bidirectional service using MPEG-4 system. But there has been only some simple demonstrated system for this bidirectional services. In this paper, we introduce bidirectional DMB data service system that provides the interaction between the user and DMB server without any additional equipment such as web server. The proposed bidirectional DMB system can capture and send user interaction information and response through the existing DMB transmission channel, finally update the original contents. The action event from the user is the most important thing in developing the bidirectional DMB system. Therefor, capturing the event data from the user is the first step we need to do for the bidirectional DMB service. In this paper, we propose an interaction manager module for the user events. This system will extract the user events and make a plan to update the original scene with the server's reaction information.

Keyword: HDMB, Bidirectional Interaction, MPEG-4

1. Introduction

Digital Multimedia Broadcasting (DMB)[1], which has already launched in Korea, provides high quality multimedia contents service for many kinds of handheld device anytime and anywhere. It is typical example of the convergence between broadcasting and communication which provides various data services such as program information, product information, and traffic information as well as audio and video services on a mobile environment.

In this paper, we discuss the bidirectional data service in DMB system, while the earliest research was only focused in how to broadcast the multimedia contents to the mobile device, without considering the interaction between the user and the server[2-3]. It is important because it can allow the user to give his/her own opinion or take part in generating new information with the received contents and transmit to the server. Then, finally the contents server and the broadcasting server can provide better and user adaptive service by referring the user event information through the bidirectional DMB system[4-7]. In this paper, we suggest a system architecture of the bidirectional DMB data service and describe how the user communicates with the DMB server and how the DMB server can response to the user's requirements or interaction. We set the focus on how to analyze and extract the bidirectional user interaction information from the user event.

The rest of this paper is organized as follows. We introduce and compare the three possible cases to

construct the bidirectional data service for DMB system in section II and describe our proposed bidirectional DMB system and its detail sub-modules in section III. The user event analyzer for picking up the bidirectional user interaction information is presented in section IV. Conclusion and future work are given in section V.

2. Bidirectional DMB Data Services

There are some classifications for the bidirectional data service. In bidirectional DMB system, a user can interact with the server via third part web site, or SMS service, or the return channel.

In case of the bidirectional data service via web browser, it needs an additional web server to support and manage the web site, contents and user information. The web site is the interface between the user and contents provider. A user can be linked to the specific web site from the contents received by the server. It is possible to be implemented by anchor node supported in MPEG-4 BIFS. The bidirectional DMB system with the web server, the content provider can support lots of complicated services for the users such as, commercial information, file download, online vote, etc. But it needs high cost fee, such as site management fee of the server and web surfing data fee of the user. Furthermore, because it uses third part web server, bidirectional user's interaction information may not be reflected to the server immediately and server' s reaction information also may not be sent to user terminal in real-time.

In case of the bidirectional data service via SMS service, the system is light weight, simple and easy to be implemented. The drawback is it can only support text format information and a few of simple data service.

In case of the return channel, the user can interact with the contents and transmit the user event information to the server directly, and the server also can react with the user event information in real-time. To support the bidirectional event, it needs a specific protocol between the server (contents authoring tool and streaming server) and the player in user terminal for the real-time bidirectional interaction. In addition, it also needs a middleware to extract the user event information from the terminal and send it to the server. For the bidirectional DMB service via a return channel, we designed and added an interaction manager to the DMB system.

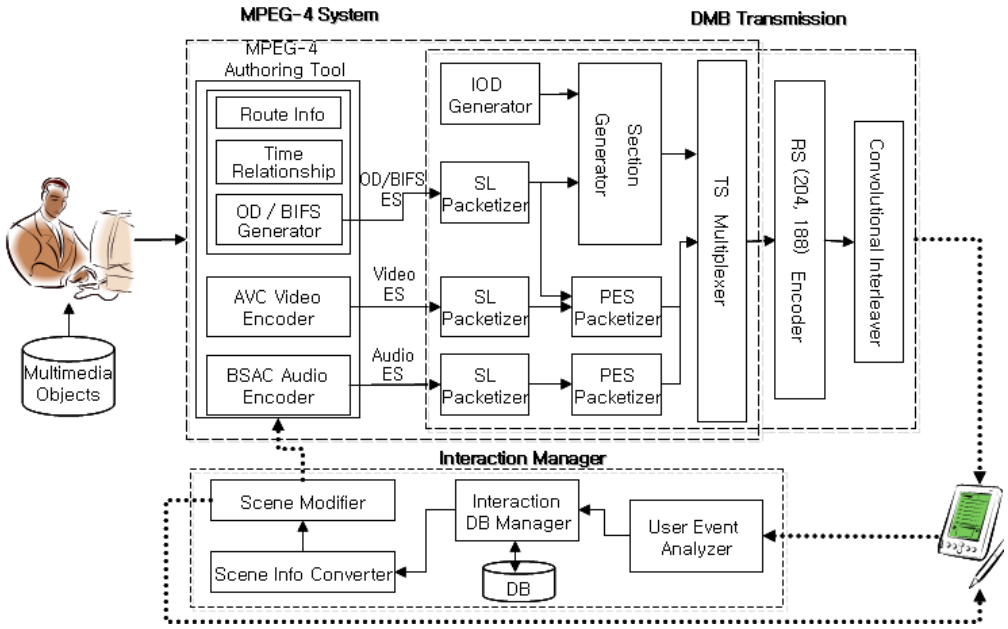

Figure 1. Bidirectional User Interactive DMB System

3. Interaction Manager

Figure 1 shows the overall structure of our proposed system. The various multimedia objects composing the contents can be encoded by correspondent encoder separately. Then, each elementary stream will go through the synch layer(SL) packetizer, pakectized elementary stream(PES) packetizer, transport stream(TS) multiplexer and it will be multiplexed as one stream. After adding forward error correction code(FEC: RS encoder and convolutional interleaver), the contents stream finally can be transmitted to the user's terminal[8-11]. We designed and added the interaction manager for the bidirectional user interaction. The user can transmit the event information to the multimedia server via interaction manager, and the server will do the reaction and transmit it to the user's terminal through the existing streaming channel to update the original contents with the server's reaction information.

The interaction manager is the major process for developing the user interactive bidirectional DMB system. It consists of four sub-modules, user event analyzer, interaction DB manager, scene information converter, scene modifier. When the user interacts with the contents, the user event analyzer extracts bidirectional user event information and transmit to the interaction database manager. Then, the interaction DB manager stores the user event information to the database and makes the decision for it. The scene information converter makes the plan to reflect the decision by updating the original contents with a set of BIFS commands. The scene modifier will arrange these commands to make a schedule by giving various priority to each command. The scheduled commands may be sent to the server if they are applicable to all the users or sent to the particular user directly after being encoded in a binary format.

3.1 User Event Analyzer

The main function of the user event analyzer is to extract the user' s event information for directional DMB service. There are five main steps in this module. Figure 2 shows the procedures of the user event analyzer.

First of all, we need to define the meaning of the user interaction. The interaction can be divided into two types. One is the interaction between the user and the contents (inner action), and the other is between the user and the server (outer action or bidirectional interaction). The bidirectional interaction may be occurred when the user does online vote, online quiz program, commercial shopping or file download. The bidirectional interaction notifier in figure 2 distinguishes these two types of user interaction. If the user interaction is inner action then it just ignores, otherwise the interaction information extractor will extract the useful information from the outer action.

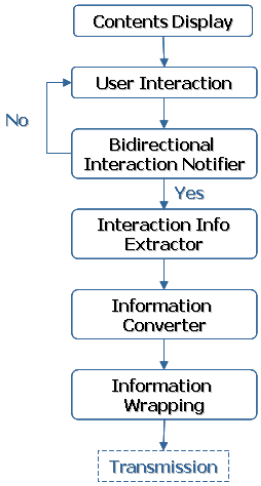

Figure 2. Processing Steps of the User Event Analyzer

The information converter converts the extracted data to an intermediate format to store it in the interaction database. from the interaction info converter. Before storing the interaction information to the database, we need to add some additional information to distinguish with others. The table 1 shows the example of output data of the event analyzer module for online quiz. The output data may include the additional wrapping data as user ID, contents ID, action type and the question ID. The detail description for the user event analyzer will be described at section IV.

Table 1. Output Data Format from User Event Analyzer

User ID	Contents ID	Action Type	Question ID	Candidate ID

3.2 Interaction DB Manager

The interaction database manager is the second sub-module of the interaction manager in the bidirectional DMB system. Its main function is to make the decision processes for the user's event information and store it to the database. Figure 3 shows the detailed process of the interaction DB manager.

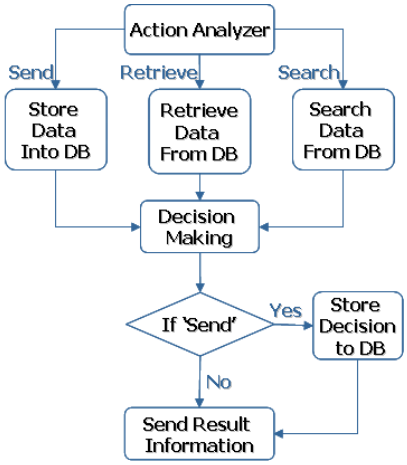

Figure 3. Processing Steps of the Interaction DB Manager

The information from the action analyzer can be divided into three action type, 'send', 'retrieve' and 'search'. 'Send' is the normal case for the user to request to the server. After making decision for the user's requirement, the server reaction information will be stored in the database and sent it to the information converter. 'Retrieve' will be occurred when the user wants to retrieve all the information correspondent to the current streaming contents from the database. 'Search' searches information from the database by the given keyword and return the result to the user.

3.3 Scene Information Converter

The main purpose of the this module is to make a plan for the server reaction information. From the previous module we can get the decision for the user's event. The server's reaction information can be sent to the user as image, text, geometry or some composite object. The scene information converter can make the update plan by selecting one of these styles. Then, according to this plan, the BIFS update command generator will generate a serial of BIFS commands to implement the plan. Figure 4 shows the detail state for the scene information converter.

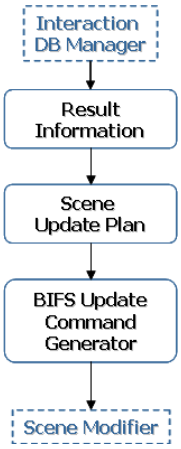

Figure 4. Processing Steps for Scene Information Converter

3.4 Scene Modifier

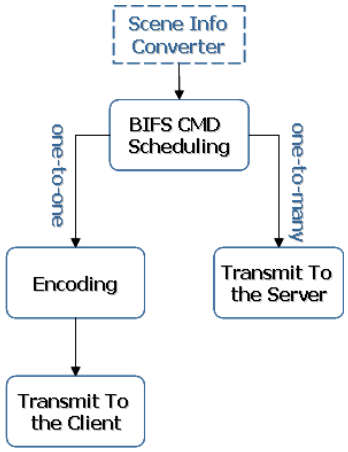

Figure 5. Processing steps of Scene Modifier

The scene modifier has only one main process – BIFS command scheduling. It arranges BIFS update commands such as the sequence of the commands that will be sent and executed. The scene modifier assigns various priority value to each BIFS command. Commands which is in high priority can be sent to the server or the user terminal earlier than lower one. Furthermore, it also checks the server reaction type. If the scene update plan is applicable to particular

user, it will encode these commands and transmit directly to the user terminal. If the plan is for every user, the serial of commands will be sent to the server first and then the server will be encode them to sent to the user's terminal through the existing DMB system. The following figure shows the diagram of the scene modifier module.

4. User Event Analyzer

In this section we will set focus on the user event analyzer and describe it in detail. The contents can be created by normal BIFS node or specific scriptor node. In the first case, the event extractor can only pick up the node ID when the user event occurred. Therefore, the only way to notify if it is outer action is adding some fragments in node ID of the specific objects. In the second case, we can add some parameter in the function with the VRML scriptor when we create the contents. When the user does the outer interaction, the event information can be store into this parameter by the scriptor function. Using the VRML scriptor node, it is easy to extract the event information, but it is difficult to author the contents in server side. Therefore, in this section we will set the focus to the implementation with the naming technique for node ID.

To notify whether it is outer action or not, we add two fragment to the node ID. The table 2 shows the example structure of the node ID for online quiz.

Table 1. Example Structure of the Node ID for Online Quiz

Frag. 1 "bi"	Frag. 2 "0" or "1"	Question ID	Node ID	Candidate ID

The node ID in our system starts from the first fragment. It is the mark(ex: "bi") for the bidirectional interaction. After negotiating with the authoring tool and the player, we can determine this mark. When the user interaction occurs, the notifier check the node ID of the object first. If the first fragment of the node ID is equal to the predefined mark, then it will process the event as outer action.

The object which can occur the outer action can be divided into two categories. One is bidirectional information start point, and the other is bidirectional interaction invoker. In case of the online quiz, the start point may be the 'ok' button, and the invoker may be candidate answers of the question. The second fragment shows if it is start point or the invoker. In our system, '0' means invoker and '1' means start point.

The figure 6 shows the user event analyzer implemented with naming technique for node ID. When the user interaction breaks out, the user event analyzer gets its node ID from the scene tree first, and checks if the first fragment is equal to the predefined mark(ex: "bi"). If it is outer action, then it checks the second fragment to determine start point or interaction invoker. If it is interaction invoker, the user event analyzer then picks up the rest information from the node ID(ex: question ID, candidate ID) and waits for the start point to wrap the information. If it is start point, the user event analyzer checks whether the invoker is exist or not. If the user event analyzer already captured the information of the invoker and now it meets the start point, then it just picks up the event information and wraps with the additional data to send it to the interaction DB manager.

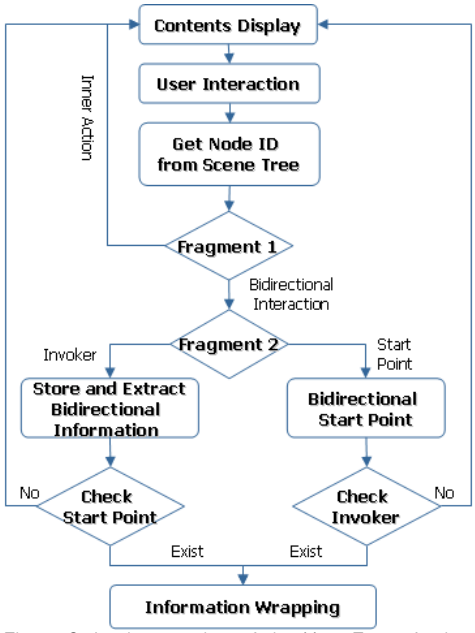

Figure 6. Implementation of the User Event Analyzer with Naming Technique for Node ID

5. Conclusion and Future Work

In this paper, we proposed a new module for real-time bidirectional user interactive DMB service, called Interaction Manager. We set focus on the user event analyzer to extract the user event information to send it to the server. We introduced two method to extract the user event information. Both two need a specific protocol between the authoring tool and the player. In the future, we will develop the remaining part of the bidirectional service, especially about the making a update plan for reaction information of the server and the command scheduling technique.

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