

Design and Implementation of Terminal for Emotion-media Broadcasting Service

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Abstract— With the emerging 4D media service era, it has seen that various personalized emotion-effect devices such as motion chairs, scent display devices, tactile devices and so on. So, we try to show emotion-media broadcasting service to provide user with scents matched and synchronized with high-quality AV on broadcasting environment.

Keywords—Emotion-media terminal, Scent display, Metadata engine, MPEG-V

I. INTRODUCTION

The purpose of this study is to design and implement emotion-media broadcasting terminal interworking with scent display device that can augment the immersion and reality in a broadcasting environment.

MPEG-V (ISO/IEC 23005) defined metadata for the scent display on virtual reality, but it only standardized the scent intensity and duration time as scent parameter. If we only control scent intensity in broadcast contents, we just might not get a desired realistic effects, because of its fast and sensitive plot line in broadcast contents.

For video reality improvement, there has been much advancement in the methods of providing visual, auditory, and tactile information. On the other hand, there is little research on olfaction for video reality because it is difficult to define correlation between sight and olfaction. As a first step for video reality improvement using olfactory information, we referred an investigated users' acceptability of smell when they watch videos of various kinds and then classified the video clips based on their acceptability of different criteria[1].

In this paper, we explain about scent features and standardization for emotion-media service. And then, we explain about structure and main functions of the implemented emotion-media broadcasting terminal interworking with scent display device. Finally, we will show test result of emotion-media broadcasting service.

II. EMOTIONAL-MEDIA SERVICE

A. Improvement of Sensory Effects based on Scent

It is common sense that providing specific scent can augments the video reality when video scene has an object reminding specific scent. However, people still do not know how to increase video reality and emotional immersion when

there is no information on specific scent in the scene. Recently, it has been explored about study about how we improve video reality and immersion when the scene has no concrete scent information from some objects. According to various study about immersive media, it is most important that providing matching scent with object in video is very effective to increase content reality[1].

We think there are important things to improve of sensory effect based on scent as follows.

- Matching method between scene's object and scent that most of people can sympathize.
- Classification of scents by similarity and definition of alternative scents smelled in daily life.
- Recognition of scent according to change scent intensity, scent persistence, scent emission distance and so on.
- Delivery and emission of scent to synchronized with AV.

B. Standardization of Scent information

ISO/IEC 23005 (MPEG-V) provides an architecture and specifies associated information representations to enable interoperability between virtual worlds, e.g. digital content provider of a virtual world, (serious) gaming, simulation, DVD, and with the real world, e.g. sensors, actuators, vision and rendering, robotics (e.g. for revalidation), (support for) independent living, social and welfare systems, banking, insurance, travel, real estate, rights management and many others[2-4].

TABLE 1. EFFECT TYPES OF MPEG-V STANDARD

ID	EffectType	ID	EffectType
0	Reserved	8	FogType
1	LightType	9	ColorCorrectionType
2	FlashType	10	RigidBodyMotionType
3	TemperatureType	11	PassiveKinestheticMotionType
4	WindType	12	PassiveKinestheticForceType
5	VibrationType	13	ActiveKinestheticType
6	SprayingType	14	TactileType
7	ScentType	15	Reserved

The implemented emotion-media terminal supports emotion-media service by using 'ScentType' shown in Table 1.

This part of ISO/IEC 23005 contains the sensory information which can stimulate other senses than vision or

audition, e.g. olfaction, mechanoreception, equilibrioception, or thermoception. That is, in addition to the audio-visual content of, e.g., a movie, also other sense shall be stimulated giving her/him the sensation of being part of the particular media which shall result in a worthwhile, informative user experience[5].

In this paper, we designed and implemented terminal to improve sensory effect by using scent only.

III. EMOTION-MEDIA TERMINAL

In this section, we explain about structure and main functions of emotion broadcasting terminal interworking with scent display device.

In Figure 1, emotion-media broadcasting terminal consists of player module, browser module, environment sensing module and device control module. Player module is basic function module of the legacy DTV receiver implemented by DTV specification and provides emotion engine module with scent information and AV synchronization information. Environment sensing module measures real-time changes of temperature and humidity to control intensity-value of scent display. Emotion engine module parses scent metadata and control emission of scent display depending on scent metadata. Finally, device control module is interface module to make control message for various types of emotion effect devices.

Scent display consists of control module, scent storage module and pump module. Scent display device is connected with emotion-media terminal via zig-bee or wi-fi and the small-sized pump controls the intensity of scent discharged through a pulse width modulation (PWM) control.

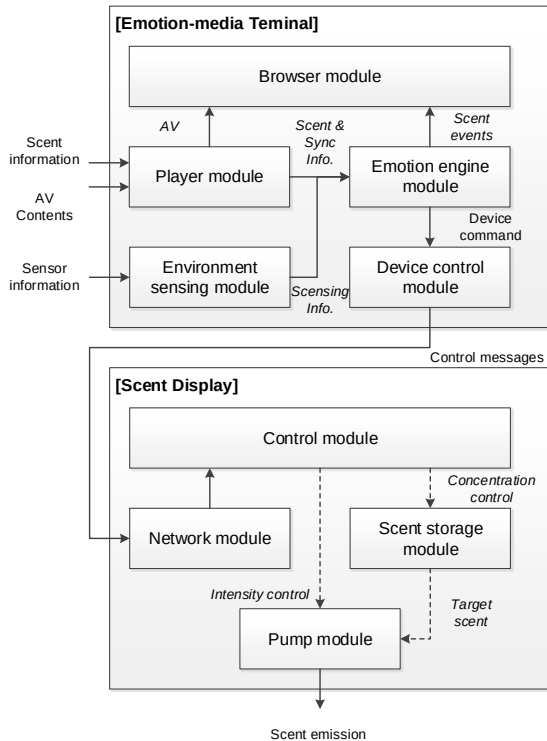


Figure 1. Emotion-media terminal and scent display

A. Sensory Effect Metadata for Scent

This Subclause specifies syntax and semantics of a scent effect defined by MPEG-V.

In figure 2, this example shows the description of a scent effect with the semantics of Table 2. Scents are orange, coffee, butter, flower and perfume according to the classification scheme, the intensity is 1 ml/h (within a range of [0.0,10.0] ml/h) with a duration of 10 seconds and the effect starts at si:pts="6169" of content.

TABLE 2. SEMANTICS OF THE SCENTTYPE

Name	Definition
ScentType	Tool for describing a scent effect.
intensityValueFlag	This field, which is only present in the binary representation, indicates the presence of the intensityValue attribute. If it is 1 then the intensity-value attribute is present, otherwise the intensity-value attribute is not present.
intensityRangeFlag	This field, which is only present in the binary representation, indicates the presence of the intensityRange attribute. If it is 1 then the intensity-range attribute is present, otherwise the intensity-range attribute is not present.
scent	Describes the scent to use. A CS that may be used for this purpose is the ScentCS defined in Annex A of ISO/IEC 23005-6.
intensity-value	Describes the intensity of the scent effect in ml/h
intensity-range	Describes the range of the intensity value. EXAMPLE [0.0, 10.0] ml/h.

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<?xml version="1.0" ?>
- <SEM xmlns:si="urn:mpeg:mpeg21:2003:01-DIA-XSI-NS"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:sev="urn:mpeg:mpeg-v:2010:01-SEV-NS"
  xmlns:mpeg7="urn:mpeg:mpeg7:schema:2004"
  xsi:schemaLocation="urn:mpeg:mpeg21:2003:01-DIA-XSI-NS
    http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-
    21_schema_files/dia-2nd/XSI-2nd.xsd urn:mpeg:mpeg-
    v:2010:01-SEV-NS MPEG-V-SEV.xsd
    urn:mpeg:mpeg7:schema:2004
    http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-
    7_schema_files/mpeg7-v2.xsd" xmlns="urn:mpeg:mpeg-
    v:2010:01-SEDL-NS">
  <Effect xsi:type="sev:ScentType" duration="10" si:pts="6169"
    scent="Orange" intensity-value="1" />
  <Effect xsi:type="sev:ScentType" duration="10" si:pts="51209"
    scent="Coffee" intensity-value="1" />
  <Effect xsi:type="sev:ScentType" duration="10" si:pts="96099"
    scent="Butter" intensity-value="1" />
  <Effect xsi:type="sev:ScentType" duration="10" si:pts="141349"
    scent="Flower" intensity-value="1" />
  <Effect xsi:type="sev:ScentType" duration="10" si:pts="194489"
    scent="Perfume" intensity-value="1" />
</SEM>

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Figure 2. Example of sensory effect metadata

B. Emotion Engine

Emotion engine module of terminal makes scent effect information and control message for scent emission synchronized with AV after getting scent metadata and environment sensing information such as temperature and humidity.

After playing contents, emotion engine search sensory effect metadata(SEM) of the content and make device command by using device capability, user preference and

sensed information. After that, emotion engine send device command to device control module.

Main functions are as follows.

- Generates sensory device command(SDCmd) by using sensory device capability, user preference and sensory effect metadata made by emotion information authoring tool.
- Parses sensory effect metadata, user's sensory preferences(USP) metadata and sensory device capability(SDCap) metadata defined by MPEG-V.
- Transfers sensory effect metadata to emotion effect information for devices by using sensory effect metadata and user's sensory preference metadata.
- supports 14 numbers of sensory effect metadata such as light, flash, scent, fog and so on.

C. Environment sensing

Environment sensor measures temperature, humidity and illumination intensity to limit unnecessary and excessive operation of sensory device.

For example, environment sensing information is used to control scent intensity and emission speed of scent display, because most of scents are sensitive to temperature and humidity change.



Figure 3. Environment sensor

D. Device control

In Table3 and Figure 3, control message structure consists of STX(Start of Text), ETX(End of Text), device ID, command type, scent ID, operation time, scent intensity and blower speed value.

TABLE 3. SEMANTICS OF CONTROL MESSAGE

Field	Bytes	Definition
STX/ETX	1	Describes start and end of messages and has always fixed values.
Device ID	1	Describes to identify and control various scent displays. (e.g. IP address, MAC address, unique numbers and so on)
Command Type	1	Describes types of message. (e.g. Cleaning, Emission, Waiting)
Scent ID	1	Describes the scent on scent display
Operation Time	1	Describes 5 steps scent emission time. (e.g. 10s, 15s, 20s, 25s, 30s)
Scent Intensity	1	Describes 3 steps of scent intensity. (e.g. Minimum, Middle, Maximum)
Blower Speed	1	This field is value to control synchronization with AV, considering distance between user and scent display.

STX (0x02)	Device ID	Command Type	Scent ID	Operation Time	Scent Intensity	Blower Speed	ETX (0x03)
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Figure 4. Control message structure

E. Scent Display

Scent display device is designed and implemented with 14 scent cartridges and Zigbee/Wi-Fi interfaces for receiving control messages from emotion-media terminal. And scent display has two pumps to control scent intensity and persistency tendency. It is possible to control scent intensity and persistency tendency by air flow control with PWM of each pump. In addition, scent persistency tendency is controlled by change operation time of solenoid valves on scent storage module[5, 6].

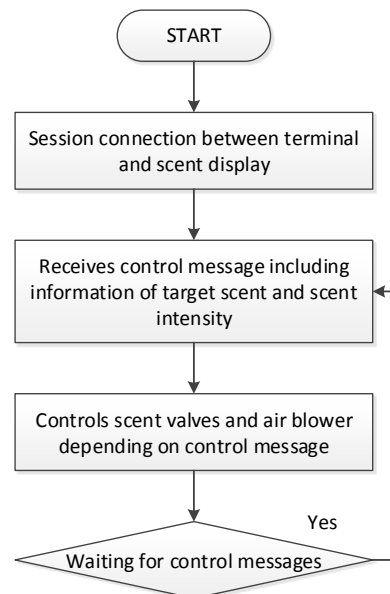


Figure 5. Control flow of scent display

In figure 5, control flows of scent display is shown. Emotion-media broadcasting sends control messages to scent display device according to events of received sensory effect metadata. And then, scent display device controls scent value and air blower according to control messages and waits for control message until next control message is received.



Figure 6. Scent Display

Scent display device is shown in figure 6. Scent display device has metal case stored 14 scents, air blower to control intensity of scent and serial port to upgrade firmware and so on[6].



Figure 7. Operation view of Emotion-media terminal

In Figure 7, we show example of emotion-media service for augment the immersion and reality in a broadcasting environment. The scent icon in lower end of left on screen means that scent is emitting synchronized with AV from scent display device.

IV. CONCLUSIONS

In conclusion, we designed and developed emotion-media broadcasting terminal interworking with a scent display device to augment emotion at broadcasting services.

Emotion-media broadcasting terminal have main 4 modules. First, the legacy DTV module receives MPEG-2 stream and extract emotion effect information through broadcasting and internet. Then, Metadata engine parses and storages emotion-effect information defined by MPEG-V standard, and manages to be synchronized emotion-effect with AV. Finally, emotion-effect control module controls type of scent, emitting time/duration, scent intensity and blower speed of scent display device using with proposed control message. And emotion-effect control module monitors the current status of scent display device.

In future, an implementation of Sensory effect metadata authoring tool is needed, which allows emotion-media terminal to be properly synchronized with the existing video service by using both the proposed control message and the developed scent display device. And it will be necessary to discuss how to transfer emotion-effect information through

broadcasting channel and how to design and control standard interface of various-typed emotion-effect device. Moreover, emotion-media bi-directional technologies will be needed for convergence of broadcasting and communication.

Finally, we will try to study about human factors related with scents and method to remove scent on closed space.

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REFERENCES

- [1] Guk-Hee Lee, JiHoon Choi, ChungHyun Ahn, Hyung-Chul O. Li, ShinWoo Kim, "Video Classification Based on Viewer Acceptability of Olfactory Information and Suggestion for Reality Improvement," *Science of Emotion and Sensibility*, vol. 16, pp. 207-220, Jun. 2013.
- [2] ISO/IEC 23005-1: Architecture, 2011.
- [3] ISO/IEC 23005-3: Sensory information, 2011.
- [4] ISO/IEC 23005-6: Common types and tools, 2011.
- [5] Seung-Ju Lim, Sung-Dae Park, Hyung-Gi Byun, Sang-Goog Lee, Ji-Hoon Choi, Chung-Hyun Ahn, and Jeong-Do Kim, "Olfactory Data Structure for Converged Multimedia Services," *SENSOR LETTERS*, Vol. 12, pp. 1160-1164, 2014.
- [6] Jeong Do Kim, Ji Hoon Choi, Seung Ju Lim, Sung Dae Park, Jung Ju Kim, and Chung Hyun Ahn, "Development of Scent Display and Its Authoring Tool," *ETRI Journal*, Vol. 37, Num. 1, Feb. 2015.



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