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Retrieval method for augmented reality objects based on color impression

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Abstract: In this paper, we propose a retrieval method for Augmented Reality (AR) objects based on color impression. In this method, AR objects can be retrieved by *Kansei* words and superposed on a live video at the positions specified dynamically by users in use of special markers. The retrieval method employs color information such as RGB value and ratio of the color in the texture. We are implementing a virtual clothes fitting software as a smart-phone application.

Keywords: augmented reality, *Kansei* retrieval method, color impression

1 INTRODUCTION

Nowadays, Augmented Reality (AR) has become a popular technology with many applications on PCs, tablets and smart phones. Also, there have been many studies conducted on AR technologies to augment live videos with artificial objects [1-3]. However, these studies are to treat objects registered in advance only and therefore they are not dynamically replaceable to user's order.

On the other hand, several methods have been proposed to intuitively retrieve images from the viewpoint of *Kansei* engineering [4-7]. Most of them are so-called *Kansei* retrieval methods where images are retrieved by affective words representing characteristics of objects such as shape and color.

Considering these facts, we have developed a *Kansei* retrieval method based on color impression. In this paper, such human intuitive and subjective emotion is statistically quantized via affective adjective phrases such as elegant and pretty [8]. The remaining sections are as follows. Firstly, Section 2 digests our extension of AR technology and Section 3 details the proposed method for dynamic AR object retrieval based color impression. In Section4, the *Kansei* retrieval method is designed for computer implementation. The development environment and the applications are presented in Section 5. Lastly, Section 6 discusses and concludes this paper.

2 The Expansion of AR Technology

In the traditional AR technologies, neither content providers nor users could exchange any desired object after release of AR contents. The AR can be categorized as 4 types as shown in Table 1.

(1) **Static AR (SAR)** is the traditional AR only supporting one object at one mark.

(2) **Provider Oriented AR (POAR)** allows only providers to exchange objects. Users can only specify the places of AR objects.

(3) **User Oriented AR (UOAR)** allows users to exchange objects at markers. Providers cannot any operation.

(4) **Dynamic AR (DAR)** allows both users and providers to exchange objects using retrieval function at markers.

3 AR Object Retrieval Method based on Color Impression

In this method, an AR content is composed of a retrieved object and a live video on AR space. The user puts a marker on a certain real object to specify the display position and selects one of *Kansei* words concerning color only here as shown in Fig.1. The system retrieves its corresponding objects from the database, consisting of the following modules. Figure 2 shows their organization.

(M1) ***Kansei*** **Retrieval Engine** retrieves several objects with textures matching with the *Kansei* word.

(M2) Database stores markers, objects and relations between *Kansei* word and color information in RGB.

(M3) AR Space Compositor synthesizes the retrieved objects and the live video according to the pairs of marker and *Kansei* word.

Table 1. Expansion of AR technologies

	Non-exchangable by Provider	Exchangable by Provider
Non-exchangable by User	Static Augmented Reality (Traditional Technology)	Provider Oriented Augmented Reality
Exchangable by User	User Oriented Augmented Reality	Dynamic Augmented Reality

4 *Kansei* Retrieval Method

Conventionally, it is difficult for users to obtain desired objects or data from databases by using keywords or indices because these are prepared by the system designers and influenced by their subjectivities. Considering this fact, we have employed the *Kansei* retrieval method based on color impression. This method evaluates an object *O* by a *Kansei* word *Key* formalized as Equation (1).

$$F_{uo}(Key, O)=U(Key) \circ F_o(Key, O) \quad (1)$$

where

$F_{uo}(Key, O)$: Calculated value for the pair of *Kansei* word *Key* and object *O*,

$U(Key)$: Calculated value of subjectivity for *Kansei* word *Key*,

$F_o(Key, O)$: Statistic value for the pair of *Kansei* word *Key* and object *O*.

The color impression is quantized in terms of adjective phrases associated with a certain statistics [8]. In this study, for *Key*, 16 adjective phrases were employed considering their independency in color impression as shown in Fig.1. On the other hand, *O* is an element belonging to the set of objects same in shape and different in texture color as shown in Fig.3. Each *O* is translated into a vector representing area ratios of all the colors involved in advance to compute the correlation value with the *Key* as shown in Fig.4.

The value $U(Key)$ is calculated based on statistics of users' *Knasei* evaluation of retrieved objects. The value $F_o(Key, O)$ is given by (2).

$$F_o(Key, O)=F_{ilt}(F_c(Key),F_s(O),k_o) \quad (2)$$

where

$F_c(Key)$: Set of objects retrieved by *Key*,

$F_s(O)$: Set of objects retrieved by *O*.

$F_{ilt}(F_c(Key),F_s(O),k_o)$: Set of objects with area ratios over k_0 included in both $F_c(Key)$ and $F_s(O)$.

Avant-garde	**Fresh**
Clear	**Romantic**
Sexy	**Ethnic**
Noble	**Chic**
Casual	**Wild**
Elegant	**Dandy**
Pretty	**Gorgeous**
Formal	**Sporty**

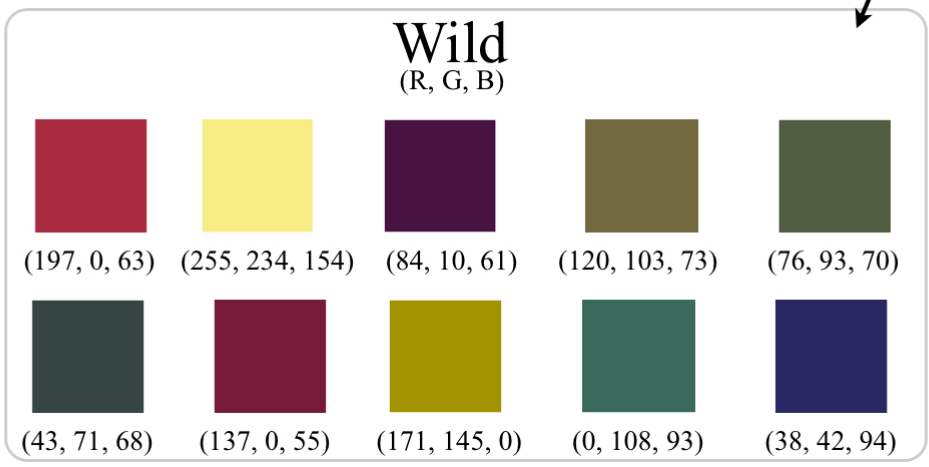

Fig. 1. Conversion of *Kansei* words based on color impression

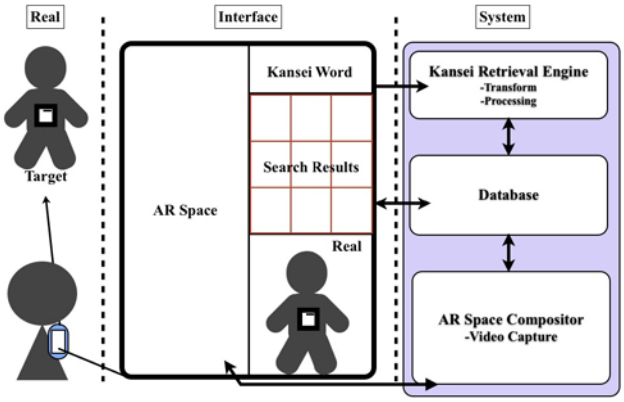

Fig. 2. AR Object Retrieval Method based on Color Impression

Fig. 3. Objects in the Database

Fc

Wild

R	G	B
197	0	63
255	234	154
84	10	61
0	108	93
...		
38	42	94

Fs

CG•Texture

R	G	B	Pixel count	color-ratio
0	0	0	200	
...				
197	0	63	100	
...				
84	10	61	50	
...				
255	255	255	0	

Fig. 4. Comparison in RGB between *Kansei* words and objects

5 Implementation

Our method has been implemented as a virtual clothes fitting system running on smart phones as shown in Fig.5. This system enables a user to try clothes on virtually by putting a marker on him/her and to select one among those retrieved by his/her *Kansei* word.

The software supports video capturing, AR space composition and *Kansei* retrieval configured by such modules as shown in Fig.6. The video capturing function and AR space composition are available on smart phone clients while *Kansei* retrieval works on the PC server.

The system was developed in C++ using STL, open frameworks and Magic++ as shown in Fig.7.

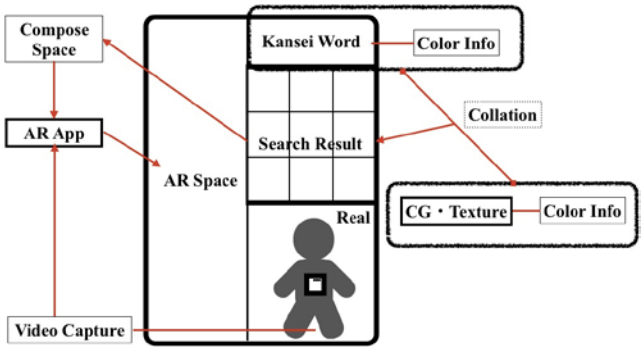

Fig. 5. The user interface of the software

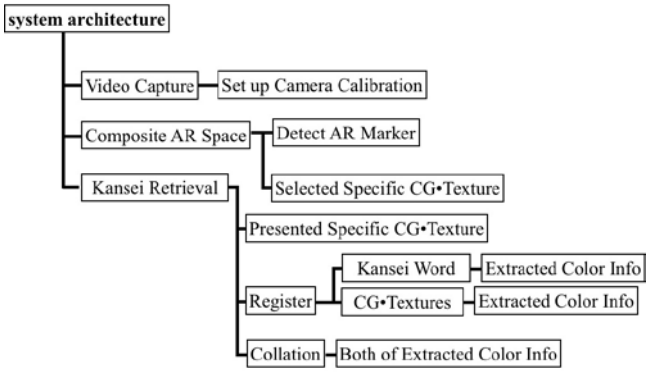

Fig. 6. Module configuration

Xcode			Database Management System
C++	Standard Template Liblary (STL)	Open frame works	Magic++
MacOS X			

Fig. 7. Software development environment

6 CONCLUSION

In this paper, we proposed a *Kansei* retrieval method for AR technology expanding from the static AR to the dynamic AR and its application. Currently, we are implementing a virtual clothes fitting software in order to adapt our method appropriate to the statistic color impression and to much more objects both in quantity and kind. In future, we will evaluate and improve our *Kansei* retrieval method enforced with user models.

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