Image Database System based on Readers' *Kansei* Character

Yamanaka, Toshimasa / Institute of Art and Design, University of Tsukuba
Uchiyama, Toshiaki / Institute of Art and Design, University of Tsukuba
Honjo, Emi / Ibaraki Institute of Engineering Technology
Hiramatsu, Shigeo / Ibaraki Institute of Engineering Technology

Keywords: *kansei*, database, analysis

Abstract

This research is to proof the efficiency of *Kansei* characteristics to present a variety of image data as a portal to the contents. There is typical approach for spreading the image data in map style used calculated score with multi variable analysis that represents majority of panels. However, viewer might feel easier or familiar with the map that consists with the axis related to their proffered *Kansei* image scale.

In this research, we selected the target of image and products to tomb. There are many elements to determine the shape, style, material, decoration and size. Firstly, we studied the impression (= *Kansei* evaluation) to tomb. Then a number of typical characteristics were found which describe them in words. Then we studied the relationship with *Kansei* evaluation and customer_s profile. With an analysis of canonical correlation, there found nine relation sets between the balances of both characteristics. Then we could create 72 different maps. However, we are still unconscious that which is easier for the customer to see the well categorized map, that is preferred tombs are gathered at one area, or well spread. With the checking survey, we could make a well arranged portal to the image database according to the customer_s *Kansei* preference.

1. Introduction

Mapping is a generally accepted visualizing method for displaying data according to expected meaning. Then we can distribute a special meaning from the layout of data, categorical view, dimensions or direction and more graphical characteristics. For this purpose, some special analytical method are said to be useful. For example, result through Factor analysis or Principal Component analysis can be used to create a scatter plot with principal factors. Then the map will show relationship among data based on major factors.

In the way, those methods use a common part of people's perception as a generally accepted map. However, from a view of *kansei* information, there should be individuality for accepting the meaning through the map. Then map can take different form to show a set of information by individual.

In this study, we considered a mapping data mapping method with visual database with a sample database system of tombstone design. This research is based on the preceding study presented by Honjo, et al [1].

Research consists with four parts. 1) Determine an appropriate words and form factor for the expression of tombstone design. 2) Determine some relationships between *kansei* evaluation and form factor in tomb. 3) Analysis the relationships and profile of user of this database, 4) Compose a database system with those information.

2. Experiment 1: *Kansei* expression keywords for tombstones

Firstly, we made a research for collecting as many words as possible through free answer enquete showing nine visual image of typical tombstone. (figure. 1)

Figure 1: Sample tombstones for collecting expressions

2.1 Clustering the keywords

The research had made to 75 panels (male: 41, female:34, age 19-67) showing 180 typical keywords extracted from Color Image Scale edited by Japan Color Design Research Laboratory [2]. As a result, 250 words containing very small differences as well as unique expressions. We contracted the words into 72 using typical Japanese dictionary [3, 4]. Then we applied the Principal Component Analysis for the 72 expression words from 75 panels x 9 tombstones design to contract to the principal keywords [5].

2.2 Primary result of first Experiment 1

Result of analysis is shown in figure 2 as a scattered map of Principal Component vector and Sample Score of factor 1 and 2. The first principal component can be understood as ‘novelty’ with avant-garde image on positive and traditional image on negative direction. The second component can be interpreted as formality or familiarity with majestic in positive and tender in negative. The third component is artistic scale with artistic in positive and status in negative. The third component is visualized by color overlapping effect.

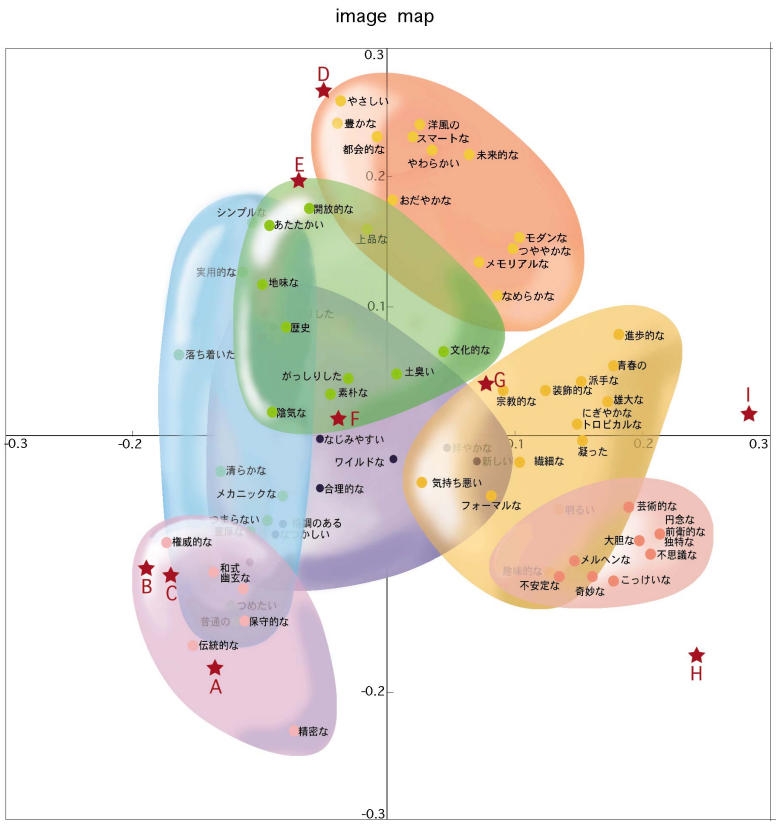


Figure 2: Scattered map of Principal Components 1 and 2

With those three components, the explanatory ratio was 55.8 %.

Next, aimed to determine the categorized group for those 72 expression words from the contracted principal components. Cluster analysis was applied for this reason. We used the liner scale for the calculation of distance and word method for the clustering. The result of cluster analysis, we could determine seven clusters. From the clustered keywords, we named those clusters as [Traditional, Plain expression, Simple style, Fun and artistic, Decorative, Steady and Rational, Modern and urbanized]. In the figure 2, colored area shows the seven clusters. In this map, the sample score of tombstone image was plotted to the related image position. (shown in A to I)

2.3 Important words for expression

The result of Principal Component Analysis shows the group of similar words in the sense. However, there is a problem that strong expression, Traditional, hides the detailed difference in image expression among the ‘traditional but slightly different’ tombstones. This happened especially among the A, B and C tombstones. Then we examined another PCA eliminating the keyword: Traditional. The result shows tombstone A and B are still in same group but B was removed and made new cluster with D and E. We choose words for these new clusters as “Old” and “Simple” and regarded these words as important expression words. In next process, we removed the word Stylish and did same process. Then tombstone B was separated with D and E. This process is shown as ta-

Table 1: Transitional changes of clusters according to data construction

	Clusters			
72 words	ABC	DEFG	H	I
Exclude "Traditional"	AC	BDE	FGHI	
Exclude "Simple, Traditional"	AC	BFI	DEG	H
Exclude "Conservative, Traditional"	AF	BDE	C	GHI

This process can be named as exploratory factor search. It is effective for analyze the dataset with chaotic meaning level.

Table 2: *Kansei* expression keywords for tombstone

represent words	related or opposite words	
traditional	conservative	
modern	westernized	
simple		
decorative	exquisite	
new	oldish	
ponderous	hard	
unsophisticated	refined	
practical	gorgeous	
artistic		
faultless	worthless	fun

As a result, we found seven important keywords according to the sensitivity of clustering. Also, we defined 12 keywords that are frequently used as “easy to express” for additional keywords. As a result, we determined 19 essential keywords for express the *kansei* image of tombstone. (table 2)

3. Experiment 2

For the preparation to the expanding the database, we have to determine the characteristics of tombstone to determine the form factor.

3.1 Sample

In the experiment 1, we used nine tombstones as typical design. However, database must cover more variation. Then we extended the number of tombstone to 30. Panels for this process was skilled tombstone designers aged 45 to 65, four males and two females.

3.2 Characteristics

We applied Dichotomiy Imaging Method with dividing those 30 tombstones while watching the image and name the characteristics of division. This process was applied repeatedly to 30 samples and found 57 form parameters. However, there were many words for detailed difference in small parts. Then clustering these detailed parameters, we could determine 19 characteristics for determining the form characteristics of tombstones. The result is arranged in table 3

Table 3: form parameters for tombstone

orientation (tall / wide)
number of steps
top line (straight / round or wave)
upper unit (quadrilateral / round / other)
color (light / dark)
surin (with / without)
flower vase (with / without)
incense stick holder (with / without)
surface finish (mat / gloss)
front angle of upper stone (vertical / slanted)
balance of upper/lower stones (upper heavy / lower heavy)
color (multi-tone / monotone)
material (multi-material / mono-material)
wall type (yes / no)
engraving (with / without)
edge decoration (with / without)
upper unit edge (sharp / rounded)
upper unit cutout (with / without)
arabesque like decoration (with / without)

4. Experiment 3

4.1 Data collection

After previous steps, we could determine 19 *kansei* expression words, 19 expression words, 30 sample tombstones and 6 customer's profile parameter and 6 self -determined customer's preference parameters. We made a public research with these parameters for 175 panels (male: 106, female: 69). Profile data consists with Sex, Age, Occupation, Religion, Family, Target price range, Preference in image (New or traditional, decorative or simple, Artistic or not), Preference of Stone, Place of cemetery and purchase for myself or not. These data will be helpful for determine the panels' basic preference to the tombstone. For 10 expression words, panels are requested to answer in 5 degrees scale based on their impression to the sample tombstones. This experiment was done at the public exhibition for the tombstone.

4.2 Analysis 1: Effective parameters

Firstly, we had to examine the effect of explanation by the profile parameters in *kansei* expression of the tombstones. ANOVA had applied to the totally 360 combinations of tombstones and 6 profile parameters and 6 self -determined preference parameters. The result is summarized in table 4 as the significant combination shows in cells with * (significance level > 0.1).

Table 4: Significance ob the parameters by tombstones

Tomb-stone	sex	age	job	religion	family	price range	novelty	decora-tion	artistic	material	ceme-tery	purchase
1												
2											*	*
3											*	
4	*	*	*		*						*	
5	*										*	
6	*						*		*			
7	*						*					
8	*											
9	*											
10	*	*					*		*		*	
11		*		*				*				*
12	*						*	*	*			
13	*	*				*	*		*			
14					*			*	*		*	
15									*			
16							*		*			
17							*	*	*			
18	*	*	*				*		*			
19			*						*			
20	*	*	*				*		*			
21	*				*	*	*		*		*	
22			*				*					
23			*				*					
24							*		*			
25			*								*	
26											*	
27		*	*	*							*	
28	*	*	*	*			*	*	*			
29		*			*					*	*	*
30						*						

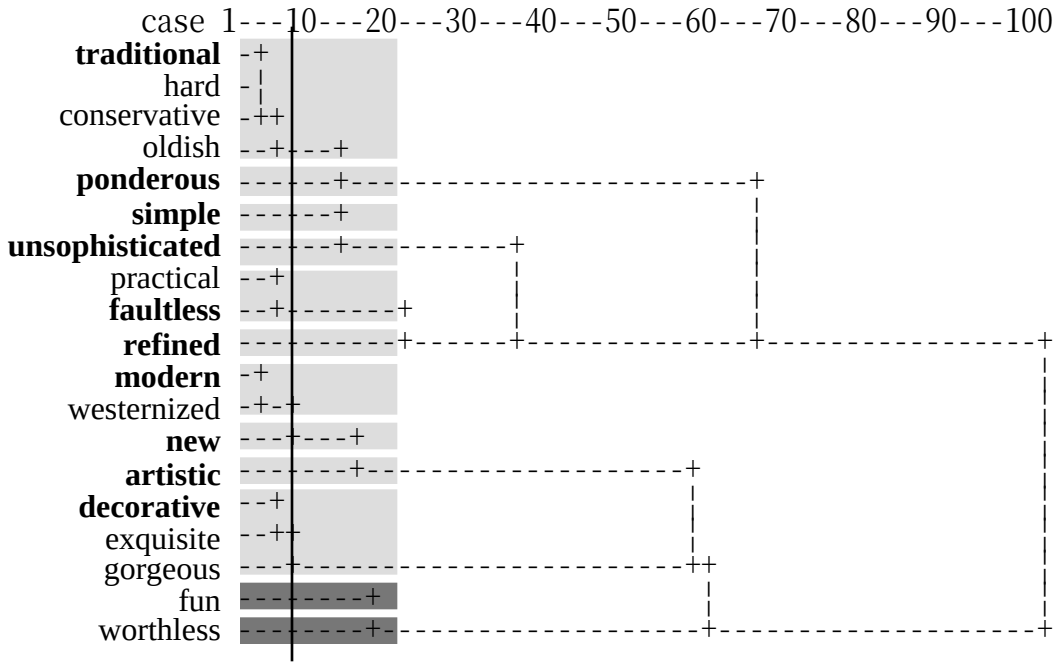
From this table we can say religion status, family status, expected price range, preference to the material, purchase timing are less significant for a image evaluation parameters.

4.3 Reviewing the *Kansei* expression keywords

In the process of Experiment, there are still very similar words were found. This is because the research had done to the common customer who does not have many experience of this kind of questioner. Then similar words became more closely.

To define the similarity, we applied Principal Component Analysis to the expression to the 30 tombstones by the 175 panels. To determine the similarity, Cluster Analysis was applied to the Principal Component matrix.. From the result, we could define at most 12 words representing essential *kansei* evaluation.

Figure 3: Dendrogram of Cluster Analysis



Additionally, those words “fun” and “worthless” seemed to be very difficult while answering, we decide to eliminate these words for next analysis.

4.4 Relationship between *kansei* evaluation and form factors

This data consist with three factors, *kansei* expression, form factors, and samples. We applied a Canonical Correlation Analysis to define the reasonable relationship between *kansei* expression and form factors [6]. The result showed there were nine canonical correlation factors that have good correlation coefficient between *kansei* expressions and form factors. Table 5 shows the all of the canonical correlation factors.

Considering the result, it can say that first factor represents the *kansei* expression of “traditional” and is highly related to the form factor of the shape of upper unit. The second factor represents the simplicity that is related with orientation, number of steps, top line and front angle of upper stone. The third factor also represents the artistic aspect but with a traditional point of view. The effective form factors are flower base, engraving and arabesque like decoration. This factor suggests that a kind of artistic feeling came from the arrangement of decorative patterns. The fourth factor represents the traditional again. The related form element is incense holder. This means the part represents the traditional feeling strongly. The fifth factor represents refined artistic. For this feeling, wall type affect strongly. The sixth factor is for modern image. The modern image came from the presence of incense stick holder combination with wall type. The seventh factor related to unsophisticated and faultless. This image is a kind of negative emotion. For this feeling, traditional orientation and engraving support strongly. The eighth factor represents a new image. It come from the wall style especially upper stone’s design. The ninth factor represents traditional and new image. Engraving is a key factor to this evaluation.

Table 5: Significant relationship between *kansei* expression and form factors

Dimension		1	2	3	4	5	6	7	8	9
	Cannonical Correlation Coefficient	0.999	0.996	0.992	0.983	0.938	0.931	0.915	0.900	0.825
kansei expression	traditional	**1.25**	0.20	1.30	**8.17**	0.11	1.64	0.47	13.73	**5.22**
	modern	0.01	0.70	0.82	1.54	0.26	**2.13**	2.04	0.12	0.63
	simple	0.74	**5.16**	**2.09**	0.01	0.10	0.05	0.37	0.63	0.17
	decorative	0.12	0.62	0.26	1.24	0.40	0.48	0.10	0.80	1.15
	new	0.48	2.07	1.04	0.06	0.50	0.01	1.27	**27.04**	**6.25**
	ponderous	0.65	0.80	0.65	0.12	0.01	0.70	0.04	0.03	0.26
	unsophisticated	0.50	1.60	0.06	0.82	0.16	0.04	**4.97**	3.24	0.09
	refined	0.00	0.85	0.01	0.03	2.89	0.01	0.47	0.08	0.10
	artistic	0.00	0.51	**2.32**	1.12	**4.88**	0.09	0.09	1.86	1.79
	faultless	0.85	0.07	0.70	1.50	3.14	1.29	**5.12**	0.97	0.50
form factors	Orientation	0.02	**0.77**	0.10	0.05	0.10	0.01	**1.41**	0.48	0.14
	Number of steps	0.11	**1.09**	0.12	0.39	0.05	0.15	0.07	0.01	0.24
	top line	0.23	**0.91**	0.86	0.15	0.02	0.09	0.41	0.25	0.05
	upper unit	**0.80**	0.07	0.13	0.10	0.84	0.20	0.44	0.74	0.10
	color	0.04	0.07	0.01	0.31	0.59	0.02	0.33	0.73	0.02
	surin	0.01	0.01	0.06	0.00	0.06	0.11	0.02	0.18	0.05
	flowervase	0.29	0.26	**1.80**	0.01	0.00	0.09	0.17	0.13	0.01
	incense stick holder	0.23	0.00	0.02	**0.50**	0.22	0.89	0.05	0.06	0.11
	surface finish	0.04	0.08	0.02	0.02	0.23	0.01	0.13	0.02	0.00
	front angle of upper stone	0.01	**0.81**	0.02	0.14	0.01	0.12	0.85	0.41	0.00
	balance of upper/lower stones	0.10	0.05	0.17	0.19	0.16	0.07	0.47	0.05	0.02
	color	0.03	0.33	0.12	0.09	0.66	0.15	0.27	0.04	0.04
	material	0.02	0.11	0.24	0.03	0.16	0.02	0.18	0.12	0.15
	wall type	0.01	0.06	0.07	0.01	**1.32**	0.61	1.00	**0.90**	0.01
	engraving	0.11	0.01	**1.85**	0.01	0.05	0.28	**1.57**	0.21	**1.27**
	edgedecoration	0.04	0.08	0.29	0.03	0.07	0.25	0.07	0.44	0.19
	upper unit edge	0.02	0.00	0.02	0.05	0.58	0.01	0.05	0.01	0.00
	upper unit cutout	0.07	0.12	0.00	0.02	0.13	0.30	0.24	0.19	0.01
	arabesquelikedecoration	0.12	0.03	**1.99**	0.12	0.03	0.28	0.48	0.59	0.01
Object Scores	1	-0.15	-1.25	-0.36	-0.46	0.51	1.12	-1.22	-0.65	2.03
	2	-1.59	0.87	0.15	-0.42	-1.31	0.88	-0.88	-0.26	-0.49
	3	0.11	1.02	1.03	-0.08	-1.31	-0.99	0.01	0.52	-2.15
	4	0.99	1.60	1.42	-0.13	-0.07	-1.00	-0.09	0.98	0.46
	5	0.05	-2.16	-0.20	1.25	-1.16	0.98	0.54	-0.81	-0.30
	6	-0.60	0.22	-0.93	0.99	1.62	-2.13	-0.36	-0.49	0.48
	7	-0.67	1.48	2.26	0.04	0.11	0.14	1.27	-0.75	2.11
	8	1.06	0.51	0.19	1.33	0.42	-0.54	0.94	-0.98	-1.28
	9	0.26	0.63	-1.09	-0.75	1.78	1.75	0.95	-0.86	-0.68
	10	1.42	-1.48	-1.10	-1.40	-0.33	-0.43	0.47	2.53	-0.05
	11	1.72	-0.39	-0.89	1.18	-0.35	0.16	0.64	1.53	-0.59
	12	-0.24	0.50	0.36	1.07	1.20	0.41	0.85	2.40	0.38
	13	0.32	0.27	1.81	-1.25	-0.53	0.73	-1.21	0.27	-0.01
	14	-0.01	-1.61	2.09	-0.24	2.04	-0.57	-1.69	-0.16	-1.49
	15	-0.25	-0.31	-1.29	1.01	0.01	-0.78	-1.01	-0.73	1.13
	16	0.31	1.16	-0.77	2.07	-1.29	0.00	-2.03	-0.66	0.24
	17	-0.58	-1.14	0.50	1.19	-1.44	-0.84	0.63	0.21	0.02
	18	-1.74	-0.11	-0.51	-0.18	0.12	-0.16	0.64	-0.37	-0.74
	19	-0.84	-0.16	-0.50	-1.62	-0.71	-1.39	0.88	-1.22	-1.49
	20	-2.13	0.09	0.27	-0.11	-0.38	1.32	1.49	1.10	-0.10
	21	-0.38	0.66	-0.70	-0.54	1.55	0.30	-1.04	-0.13	-1.25
	22	-0.54	0.54	-1.60	-0.56	0.02	-1.15	0.91	-0.28	0.42
	23	-0.80	-0.52	-0.73	-1.91	-0.92	-0.77	-0.07	0.18	1.18
	24	0.22	1.53	-1.29	-0.62	0.31	1.11	-1.86	0.97	-0.42
	25	-0.18	-0.69	0.65	0.16	-0.54	-1.39	-1.16	0.76	0.97
	26	-0.47	-0.51	0.31	0.40	1.51	0.35	0.56	0.72	1.16
	27	-0.48	-0.96	0.43	1.49	-0.08	1.78	0.14	-0.40	-0.87
	28	1.75	-0.39	0.59	-0.53	0.97	-0.77	1.15	-1.64	0.29
	29	1.78	1.57	-0.48	-0.02	-0.84	0.82	0.89	-0.77	0.75
	30	1.65	-0.95	0.39	-1.36	-0.92	1.06	-0.33	-1.03	0.26

As this way, we could define the variety sets of *kansei* evaluation and form factors. It can support the design system of the tombstone by objective way.

5. Application : Image database

As a visual result of this research, we tried to create image database system harmonizing with viewer's *kansei* preference.

5.1 Relationship between viewer's profile and *kansei* evaluation.

With the data used in Experiment 3, we can create the panels into several groups according to the combination of profile parameters. We checked if there is obvious relationship between some parameters of profile and *kansei* evaluations. We found three simple questions for the attitude of [novelty], [decoration] and [artistic] relate to the *kansei* evaluation. The questioner arranged in categorically, we could divide the panels into eight groups (table 6).

Table 6: grouping factors of panel's profile

	basic form		**detailed elements**		**Shape**	
groups	Originality	Traditonal	Gourgeous	Unsophisticated	Unique	Ordinaly
1	*		*		*	
2	*		*			*
3		*	*		*	
4		*	*			*
5	*			*	*	
6	*			*		*
7		*		*	*	
8		*		*		*

Then the averages of *Kansei* evaluation are calculated by those groups. Then the correlation coefficient can be calculated with the average and nine canonical correlation factors. (table 7)

Table 7: matching pattern of group of panels and canonical correlation factors

		canonical correlation factors								
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
group of panels	**1**	-0.877	***0.999***	-0.269	***-0.958***	-0.094	-0.900	-0.842	-0.481	-0.202
	2	-0.956	***0.988***	-0.071	-0.881	0.108	***-0.969***	-0.933	-0.296	-0.002
	3	-0.951	***0.991***	-0.087	-0.889	0.091	***-0.965***	-0.927	-0.312	-0.019
	4	***-0.985***	0.961	0.057	-0.814	0.233	***-0.993***	-0.971	-0.172	0.126
	5	-0.517	0.839	-0.717	***-0.972***	-0.581	-0.559	-0.457	***-0.857***	-0.667
	6	-0.968	***0.981***	-0.026	-0.859	0.152	***-0.979***	-0.948	-0.253	0.043
	7	-0.955	***0.989***	-0.073	-0.882	0.106	***-0.969***	-0.932	-0.298	-0.004
	8	***-1.000***	0.896	0.235	-0.696	0.404	***-0.998***	-0.998	0.007	0.301

With above matching pattern, we can create image map according to viewer's *kansei* preference. In other words, we can optimize the scattering pattern of images easier to choose with the reference of *kansei* preference of viewers.

In this image database, viewer will be asked name, sex, occupation as well as the *kansei* preference to the tombstone (figure 4). Then optimized scattering map will be shown (figure 5, 6). Viewer can check and choose the tombstone and examine the speculation of the tombstone (figure 7). With this record, viewer (= potentially a customer) can discus with the tomb designers for more detailed

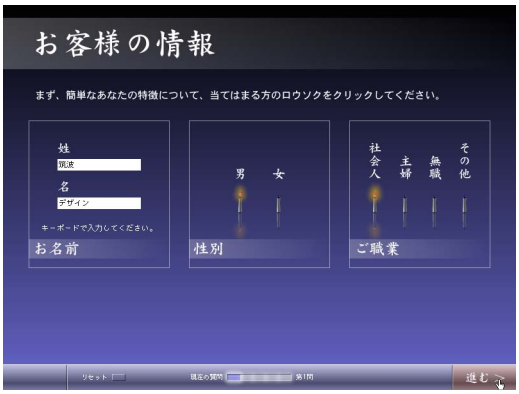


Figure 4: Enter a profile data

Figure 5: Image map for type 5 viewer

Figure 6: Image map for type 1 Viewer

Figure 7: Speculation of tombstones

6. Conclusion

Image map is a easy way for people to get certain image. However, the feeling or understanding by viewers are not always fits to them. This research can be the guide for creating a reactively optimized image map to produce the “good encounter” in the information exchange.

References

1. Emi Honjo et al.; Evaluation of Tomb’s Image and Analysis of Terms for the Evaluation; JSSD fall meeting; 1999
2. Kobayashi, J; Color Image Scale; Japan Color Design Research
3. Daijirin; Sanseido
4. Kojien (4th edition); Iwanami shoten
5. Sugiyama, K and Inoue, K; Research and analysis method with Excel; Kaibundo; 1995
6. Manual for the SPSS Professional; SPSS Japan; 1999