The Access-Enhanced Search Interface Design for Korean Paintings*

다양한 접근점 기반의 한국화 검색 인터페이스에 관한 연구

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ABSTRACT

The purpose of this study is to suggest retrieval interfaces for Korean paintings which support users to retrieve specific digitalized images of them through various access points and to widely browse based on unique features Korean paintings. The study, first, develops a set of descriptive elements suitable for Korean paintings. Twenty-six core elements and one hundred seventy-two attributes are selected as descriptive items for Korean paintings based on the opinion of 8 experts. Then, to gain realistic evidence of what descriptive elements of image serve users as access points, it is investigated which elements are used as retrieval access points among 26 core elements by 300 peered users who are consisted with two groups such as common users and domain specialists. The study, in final, designs two(general and advanced) types of search interfaces and display interfaces based on the most popular top 15 descriptive elements. This access-enhanced platform which enables user-oriented searches will satisfy users in image retrieving.

초 록

본 연구는 디지털 콘텐츠로 변환된 한국화 이미지를 이용자가 원하는 접근점을 이용하여 특정적으로 검색할 수 있으며 동시에 한국화만이 지니는 형태적 또는 소재적 특징을 이용하여 폭넓게 브라우징 할 수 있도록 하는 한국화 검색 인터페이스를 설계하였다. 이를 위해서는 먼저 한국화를 설명하기 적합한 상세한 한국화 기술요소 세트(26개의 핵심요소와 172개의 하위 속성요소)를 2차에 걸친 실무자 및 전문가의 검토를 걸쳐 구축하였다. 다음으로, 이용자가 선호하는 한국화 검색 접근점을 파악하기 위하여 전공자와 일반이용자로 구성된 300명에게 26개의 기술요소의 검색접근점 선호도에 대한 설문조사하였다. 설문조사결과를 바탕으로 전공자와 일반이용자가 접근점으로 가장 선호하는 각각의 15개 기술요소를 선정하였다. 마지막으로, 이를 기반으로 전문가와 일반인을 위한 한국화 검색 인터페이스와 디스플레이 인터페이스를 제안하였다. 이와 같은 이용자 중심의 검색이 가능한 플랫폼을 제공함으로서 이용자의 이미지 검색 만족도를 높일 수 있을 것으로 본다.

Keywords: access-enhanced retrieval interface, interface design, image retrieval, descriptive elements of image, retrieval access points, search interface, display interface, Korean paintings
한국화 검색 인터페이스, 인터페이스 설계, 이미지 검색, 이미지 기술요소, 검색 접근점, 한국화 검색

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1. Introduction

In knowledge based society of the 21st Century, the cultural industry as well as knowledge industry is considered as the core elements of the social property. Cultural industry is known as the industry which produces various kinds of contents and services for people's emotional satisfaction including pursuit of happiness. Therefore, the art galleries and museums as the main body of cultural industry have built cultural contents and have tried to provide cultural services. These institutions, especially, put a lot of efforts to digitalize Korean paintings and to develop an image retrieval system which enables various users to access and utilize them in virtual environment. However, the accessibility and retrievability for digitalized Korean paintings is far from satisfactory even though these institutions have provided image retrieval service on the web as well as other traditional one.

Korean paintings are unique because they represent not only Korean spirit, history and culture but also Korean life style through our own unique expressions and techniques(Hong 2007a). Thus, users who want to search and browse specific Korean paintings request for more access points besides titles of the art works and names of the artists. In other words, users want to search Korean paintings by using their own unique characteristics such as an object matter or a mounting shape etc, and also to browse them by using styles of painting or/and brush stroke. However, the present search interface does not satisfy this kind of users' demand.

In making digitalized images retrieval systems, there should be appropriate access points so that users can perform searches on their own words and browses on their view. In terms of access points, it seems clear that there are differences between image and text retrieval. Because most textual materials provide title, author, abstract, or subject categories which we need to located textual materials, we can easily come up with access points such as title, author, subject etc. Whereas, visual materials have broader and less well defined access points such as an object, background, method, content, themes, and even emotion. These descriptive keys which are like author, title, date, genre and physical description are used for standard physical description of visual materials as a means of access. But subject matter or background of images is very difficult to be described because the words used to describe images vary and cannot represent an image entirely(Choi & Rasmussen 2003). It is also recognized that manual assignment is time consuming and costly and that the descriptions of images are often subjective because different people have different interpretations of an image(Yang 2004).

Recently in order to enhance users' access to images, the retrieval functions have been extended on visual contents such as color, texture, spatial layout and shape. Such an approach is called as content-based image retrieval, which is to extract automatically image features or visual contents and to measure the similarity between a pair of

images based on their feature vectors. This technique might be useful when image cannot be accurately described in terms. However, many users still rely on verbal forms to describe and retrieve image because users have difficulties in representing their information needs in image queries. Using a verbal representation for an image is sometimes much more convenient than drawing images, or even images representing a broad subject category(Choi & Rasmussen 2003). In consequence, access to image collections through the manual assignment of text descriptors and classification codes, which enables to use widely approved text information retrieval techniques for searching visual resources, is a popular method used by image retrieval systems of many institutions(Goodrum et al. 2001).

The purpose of this study is to suggest retrieval interfaces for Korean paintings which support users to retrieve specific digitalized images of them through various access points and to widely browse based on unique features Korean paintings. Because it is obvious true that the textual annotation of images is still useful for image retrieval and rich annotation could lead to the provision of appropriate access points to visual materials for retrieval.

The study, first, develops a set of descriptive elements suitable for Korean paintings. Then, to gain realistic evidence of what descriptive elements of image serve users as access points, it is investigated which elements are used as retrieval access points based on the opinion of two groups such as common users and domain specialists. The study, in final, designs two types of search interface and result display interface for a simple search and an advanced search based on the most popular descriptive elements. These interfaces supporting browsing, query formulation, and display of search results. This access-enhanced platform which enables user-oriented searches will satisfy users in image retrieving.

2. Literature Review

Efficient and effective retrieval techniques of images such like paintings or photos are researched because of the explosive growth of digital images. Especially, image retrieval techniques by text queries matched against associated text and attributes of significance in describing images has been long researched.

Statford(1994) describes the four attributes of images upon which access can be based: "biographical attributes, subject attributes, exemplified attributes, and relationship attributes." Biographical attributes are related to creators, artists, the time and place of a picture's creation, and any name or title given to it by its creator. Subject attributes have to do with the meanings of images, for example, time, space, activities, events, and objects. Exemplified attributes are concerned with the physical format of the images, such as etching, photographs, and posters. Relationship attributes refer to associations with other images or textual work. Three of the categories of the attributes of an

image are concerned with a more objective factual description within the image, and the subject attributes is concerned with themes or concepts expressed in images(Choi & Rasmussen 2003). Also Krause (1988), more earlier, classifies the meaning of pictorial information for indexing purpose into hard and soft indexing. Hard indexing is concerned with the relatively objective description of what ban be observed in a picture; soft indexing related to the subjective meaning and the personal response which it evokes, by extending the indexing to reveal the message behind the image. Therefore, the descriptive elements of visual images must be covered in different levels of subjectivity and allow widely varying expressions.

On other hands, there are studies related with image retrieval. Dunlop and van Rijsbergen(1993) examined the user of hyperlinked networks for image retrieval, using links to calculate representations for non-textual nodes. The ideas in this work were later extended to a study of image retrieval from art gallery Web sites by Harmandas, Sanderson and Dunlop(1997). Chen(2001) presented a method of multimodal caption retrieval involving both content-based and textual-based modalities, enabling images in Web collections to be browsed. Images are clustered from the URL, from the image ALT tag, and the image link, together with a simple color histogram content-based approach. Elworthy et al.(2001) suggested to analyze the grammatical relations of both query and caption for retrieving photographic data. That is, the grammatical relations of both query and caption are compared and a similarity score are assigned based on ton matching dependency structures.

Lewis and Martine(2004) proposed a new approach to image retrieval which is combined with more conventional content and metadata retrieval approach, and implemented within a distributed architecture to provide cross-collection searching and navigation in a seamless way, in the domain of museum and gallery image collections. External systems can access the different collections using interoperability protocols and open standards, which were extended to accommodate content-based as well as text-based retrieval paradigms.

Cheng and Chien(2004) presented a novel probabilistic model for images annotation beside on content-based image retrieval techniques and statistical analysis. One key difficulty in applying statistical methods to the annotation of images is that the number of manually labeled images used to train the methods is normally insufficient. Numerous keywords cannot be correctly assigned to appropriate images due to lacking or missing information in the labeled image databases. To deal with this challenging problem, they proposed an enhanced model in which the annotated keywords of a new image were defined in terms of their similarity at different semantic levels, including the image level, keyword level, and concept level. To avoid missing some relevant keywords, the model labeled the keywords with the same concepts as the new image.

Yu and Moon(2004) used aesthetic impression

(unconscious, instantaneous parts of visual perception and emotion) for a high-level feature of image retrieval. They defined the four kinds of aesthetic impressions such as strong impression, soft impression, courteous impression, and refined impression. In CBIR, 2 subjects performed image retrievals using example evaluations. They were asked to retrieve images by using the aesthetic impression or the keywords. In evaluation, subjects showed that they were satisfied with the aesthetic impression-based image retrieval system on the average. Kim(2004) examined the concepts and features of content-based Image and Video retrieval systems. It then analyzed the retrieval performance of on five content-based retrieval systems in the terms of usability and retrieval features. The results showed that the combination of content-based retrieval techniques and metadata based retrieval will be able to improve the retrieval effectiveness.

Matusiak(2006) suggested social tagging which was perceived as a tool for enhancing description of digital objects and providing a venue for user input and greater user engagement. This article seeks to examine the pros and cons of user-generated metadata in the context of digital image collections and compares it to professionally created metadata schema and controlled vocabulary tools. It is found that user-generated metadata vary in the level of description, accuracy, and consistency and do not provide a solution the challenges of image indexing. Enser and Sandom(2006) suggest semantic images retrieval to provide a better-informed view of the extent of the semantic gap in image retrieval. For the project, they survey a broad spectrum of operational image retrieval activity. It is found that evidence from the real-world practice of image retrieval highlights the existence of a generic-specific continuum of object identification, and the incidence of temporal, spatial, significance and abstract concept facets, manifest in textual indexing.

Jansen(2008), lately, examined the way in which end user searching on the web has become the primary method of locating digital images for many people. He investigated the structure and formation of image queries on the web by mapping a sample of web queries to three known query classification schemes for image searching(design/ methodology/ approach). The results indicated that the features and attributes of web image queries differed relative to image queries utilized on other information retrieval systems and by other user populations. This research pointed to the need for five additional attributes(such as collections, pornography, presentation, URL, and cost) in order to classify web image queries, which were not present in any of the three prior classification schemes.

3. Selecting Descriptive Elements

3.1 Selection Method

In order to select appropriate descriptive ele-

ments of Korean paintings, the study analyzed on whole set of the elements suggested by metadata formats for art works(CDWA Core, VRA core4.0, CIMI), metadata used in National Museum of Korea and the British Museum, metadata proposed by several researches conducted in Korea(Kim & Kim 2002, Hwang 2002, Kim 2003, Kim 2004, Cho 2004), and representative texts concerning features, types and techniques of Korean paintings(Hong 2007a, 2007b). On the basis of this analysis, 31 elements and 182 attributes describing the intellectual content and features of the Korean paintings were selected. Four specialists with more than 5 year experiences on managing art works(a curator in antique museum, a Korean painting artist, a database manager from the Foundation for the Preservation of Cultural Properties, and a university librarian), on a primary level, examined the set of descriptive elements. The primary scrutiny had continued for 7 days, from July 20 to 27, 2007 and the examined elements were articulated below: ① relevancy of selected descriptive elements and the system itself; ② accuracy in naming the elements and their concept; ③ existence of unnecessary elements; ④ existence of the omitted elements; and ⑤ other descriptive elements which should be added.

In consideration of the fact that opinions of four specialists in charge and experts could collide and be complementary, 34 descriptive elements and 172 attributes were selected. Next, these revised elements and attributes were investigated again by a group of experts included a Korean painting artist and professor, a professor in Department of Library and Information Science, an executive of exhibition in National Palace Museum of Korea, and a chief in Arko Library and Information Center. They assessed descriptive elements based on relevancy, systemicity and coverage. Examinations were practiced in the format of an in-depth interview and those were conducted twice for 7 days from September 3 to 10, 2007. Based on collections of opinions, 10 descriptive elements and 22 sub-elements with 172 attributes were selected.

3.2 Descriptive Elements of Korean Paintings

Descriptive elements of Korean paintings were developed to support users to search and browse image of Korean paintings with various and appropriate access points. Descriptive elements selected are divided into 10 parts: information on creators, title, descriptions, keywords, production date, object matters, techniques, physical matters, shapes, and materials. Moreover, under the dumb down principle, sub-elements and specific attributes are clarified for more complex and specific searching and browsing. All elements and attributes are arranged based on approach frequency, but in some cases which do not have special features the arrangement is done in Korean alphabetical order.

Descriptive elements of Korean paintings suggested in this study are identical with <Table 1>. Most of descriptive elements except title, description, and keywords possess sub-elements. Produc-

〈Table 1〉 Descriptive Elements for Korean Paintings

Category	Descriptive elements	Sub-elements	Attributes
CONTENT DESCRIPTION	Creator	Name	
		Gender	
		Nickname	
		Social status	
		Birth-death year	
		Birthplace	
		Deathplace	
	Title		
	Description of works		
	Subject keyword		
	Production date	Period	goguryeo/ baekje/ sinla/ tongil sinla/ goryeo/ balhae/ josun chogi/ josun joonggi/ josun malgi/ daehanjeguk/ iljegangjumgi/ gwangbokeehoo/ hyundea/ sidaemisang
		Year	
	Object matters		sansu/ inmul/ youngmo/ hwajo/ hwahuwe/ erhae/ chochung/ poonsok/ sagunja/ gimyungjulji/ min/ bul/ girok/ hyuckpil
	Techniques	Style of painting	gwakheepa/ gerbipa/ dongerpa/ mahapa/ egwak/ gangheean/ kimjunghee/ danwon/ angyeon/ jungsun/ choichnsook/ bukjong/ namjong/ namsongwonche/ ilpum/ myungdaejerl/ opa/ won seoche/ won sadaega/ others
		Style of line drawing	galpil/ yoonpil/ balmook/ sunyeom/ sunmook/ jukmook/ chomook/ pamook/ baekmyo/ honhab/ others
		Style of brush stroke	goorek/ molgol/ baekmyo/ nansi/ nanja/ dansunjum/ mijum/ maah/ boobyeok/ soeachal/ woomo/ woojum wondu/ juldae/ jikchal/ pima/ hayeop/ haejo/ others
		Style of composition	gowon/ pyeongwon/ simwon/ dosun/ byeongak/ daeching/ samgakhyung/ samdan/ soojik/ wonhyung/ edan/ jogamdo/ others
	Shapes	Shape type	gyungjulchub/ gwun/ byungpoong/ sunmyeon/ aekja/ ohjulchub/ jokja/ chaek/ pyeonhwa/ others
		Mounting technique	Korean/ Japanese/ Chinese/ others
		Mounting shape	gamahyung/ gwanaekja/ ohdanghyung/ ejungaekja/ hapsungsuji aekja/ pannel/ others
	Types	Size	
		Size(ho)	
		Format type	
	Materials	Color materials	muk/ meajae/ dongmulsung/ sikmulsung/ gwangmulsung/ hwahakjaeryo
		Blush materials	semopil/ jidoo/ mopil/ hyopil/ jukpil/ chulpil/ sukpil
		Ground materials	hanji/ yangji/ myeon / hoebyeok

tion period, object matters, style of paintings, style of line drawing, styles of brush strokes, style of composition, shape type, mounting technique, mounting shape, color materials, blush materials, and ground materials possess also plenty of attributes to describe each characteristics and information in detail, so that these attributes support users to navigate images diversely in the browsing process.

4. Selecting Access Points

4.1 Preference of the Retrieval Access Points

With the access points such as title or title keywords, name of creator, subject keywords which are widely found in the general retrieval interface, users cannot retrieve information of the images satisfactorily. To design the retrieval interface which provides the users with wished-for access points, this study investigated descriptive elements used when users retrieve for art works. The questionnaire instrument and 300 respondents was employed in this study. The respondents consisted of two groups: 150 subject domain users who were combined with 50 junior and senior students each from the department of Oriental Painting, Library and Information Science(LIS), Visual Design and 150 general users who have visiting experience on art galleries and museums. 228 of 300 responses had collected so that the survey returning rate reached 76%. 38 copies were returned by students majoring in Oriental paintings(76%), 40 copies were returned by students majoring in LIS(80%), 40 copies were returned by students majoring in Visual Design, and 110 copies were returned by common users(73%). The survey was conducted from October 1 to 15, 2007.

The questionnaire was divided into two major sections such as 'About searching behavior for images' and 'About access points for images'. That is, the first section was asked for users' experience, frequency, and purpose of image retrieval and satisfaction level in image retrieving. The other section led survey respondents to select wished-for retrieval access points from 26 descriptive elements proposed in the chapter 3.2. <Table 2> is a provided list of 26 descriptive elements inquired to users.

4.2 Analysis on Searching Behaviors of Art Works

The study focused not only on investigating preferences of retrieval access points but also on the image retrieval patterns of the respondents. Over 90% of students majoring in Visual Design or in Oriental Paintings had experienced in retrieving images, 75% of students majoring in LIS had experienced in retrieving images, and only 61% of common users had experienced in retrieving images. Furthermore, 71% students majoring in Oriental Paintings(21 students) and 63% students majoring in Visual Design(23 students) had a tendency of

〈Table 2〉 A List of Descriptive Elements Inquired to Users

	Contents categories	Items
1	Creators	Name / Gender / Nickname / Social status /
		Birth-Death year / Birthplace / Deathplace
2	Works	Title / Production year / Production period /
		Subject keyword / Description of works
3	Techniques	Object matter / Style of painting / Style of line drawing /
		Style of brush stroke / Style of composition /
4	Physical Material	Shape type / Mounting technique / Mounting shape /
		Size / Size(ho) / Format type
5	Material Matters	Color material / Blush material / Ground material

retrieving images on a basis of 1-2 times per week, whereas 39% of common users retrieved images. Moreover, 50% of students majoring in LIS retrieved images once or twice per semester. 54% of students majoring in Visual Design and 35% of students majoring in Oriental paintings retrieved images mostly for academic reasons such as for homework or researches, whereas 34% of common users or 27% of students majoring in LIS retrieved images for utilizing information(See <Table 3>).

There seems to be a strong connection between the purpose of image retrieval and usage pattern of access points. That is, more than half of total users prefer to use the name, title, subject keywords as access points of image retrieval because their main purpose of image retrieval is to get some information from the search results. Another point to be made is that the group of students majoring in either Oriental Painting or Visual Design shows to put importance to descriptive elements related with the object matters and techniques(See <Table 4>).

〈Table 3〉 The Purpose of Image Retrieval

No.(%)

Ranking	Search Purpose	Orient paintings	LIS	Visual design	Common users	Total
1	For preparing reports or homeworks	12(35.3)	5(16.7)	20(54.1)	16(23.9)	53(31.5)
2	For utilizing on relevant visual information	9(26.5)	8(26.7)	11(29.7)	23(34.3)	51(30.4)
3	For appreciating works of art	9(26.5)	7(23.3)	3(8.1)	12(17.9)	31(18.5)
4	For online exploration of museum or art gallery	4(11.8)	6(20.0)	2(5.4)	7(10.4)	19(11.3)
5	Using for computer screen	0(0.0)	4(13.3)	0(0.0)	8(11.9)	12(7.1)
6	Others	0(0.0)	0(0.0)	1(2.7)	1(1.5)	2(1.2)
Total		34(100)	30(100)	37(100)	67(100)	168(100)

〈Table 4〉 Access Points for Image Retrieval

(#: frequency)

Ranking	Access Points	Orient painting	LIS	Visual design	Common users	Total
1	Creators	16	21	18	44	99
2	Subject	14	16	24	37	91
3	Title	6	24	12	40	82
4	Object matters	15	6	12	9	42
5	Techniques	12	2	10	9	33
6	Types	6	2	8	2	18
7	Production year/period	3	5	0	7	15
8	Materials	1	1	1	9	12
9	Others	0	0	1	1	2

Also, the majority(57%) of the users said that satisfactory level of the search results was 'normal'. The 80% of students majoring in Oriental Paintings said the results of images retrieval were 'dissatisfactory' or 'normal', showing a much lower satisfactory level than that of students majoring in LIS and the common users. One of the most common reason to this low level of satisfaction was because of 'the inability to the specific images(low precision of retrieval results)' as it was 41% of the answers. The next most common answer was 'lack of image collection' and while students majoring in Oriental Paintings said that there was 'lack of access points' and 'difficulty in selecting search keywords', 25% of common users said that they also experienced difficulty in selecting search keywords. Peculiarly, LIS students found there was lack of access points rather than lack of image collection(See <Table 5>).

4.3 Users' Preference of the Retrieval Access Points

In order to understand the users' needs for retrieving Korean paintings, 4 descriptive elements and 22 sub elements were given to 300 respondents

〈Table 5〉 Unsatisfactory Factors for Image Retrieval

No.(%)

Unsatisfactory Factors	Orient painting	LIS	Visual design	Cnmmon users	Total
Lack of access points	5(14.7)	10(33.3)	4(10.8)	6(9.0)	25(14.9)
Low precision of retrieval results	15(44.1)	10(33.3)	17(45.9)	27(40.3)	69(41.1)
Lack of image collection	12(35.3)	4(13.3)	11(29.7)	16(23.9)	43(25.6)
Not to know relevant keywords	2(5.9)	6(20.0)	3(8.1)	17(25.4)	28(16.7)
Others	0(0.0)	0(0.0)	2(5.4)	1(1.5)	3(1.8)
Total	34(100)	30(100)	37(100)	67(100)	168(100)

who chose the descriptive elements used or wished as access points in retrieving images. As a result, none were unselected by respondents but there were big differences in preference. Overall, the descriptive elements were chosen in order of importance as follows: name of artists were the most chosen(211), then title(177), object matters(149), and subject keywords(147). On the other hand, the descriptive elements that were given least importance were the artists' place of death(12), mounting shape(19), social status of the artist(22), gender of the artist(28), the artists' birthplace (37)(See <Table 6>).

Besides, there were differences between the preference of the group of domain expert users and the group of common users as well as differences in preference among groups of students with different majors. Though all the groups of respondents preferred to retrieve information through the artist's names, students majoring in Oriental Painting chose ground materials(25), description(24), object matters(24), styles of brush strokes (24) as the next important descriptive elements. The LIS and Visual Design students, however, chose the descriptive elements of object matters, subject keywords titles and description. One point in particular was that students not majoring in Oriental Paintings had much less interest in styles of brush strokes and ground materials. Likewise, common users preferred in order of artists' names(107), titles(93), subject keywords(69), object matters(66)(See <Table 6>).

Accordingly, people not majoring in Oriental paintings showed to prefer artists' names and subject matters of the paintings even like when retrieving text records. Nevertheless, the majority of the respondents seemed to acknowledge the importance of 'object matters' as a retrieval access point. Moreover, on top of existing retrieval access points, respondents wanted to retrieve paintings by other unique descriptive elements such as the style of painting, the ground materials, color materials, style of line drawing, styles of brush strokes, and style of composition.

〈Table 6〉 Comparison with User Groups on the Preferred Access Points

(#: frequency)

No.	Elements	Domain expert users				Common users	TOTAL
		Orient painting	LIS	Visual design	Total		
1	Name	31	38	35	104	107	211
2	Gender	3	5	3	11	17	28
3	Nickname	9	20	6	35	46	81
4	Social Status	8	4	3	15	7	22
5	Birth-death year	7	13	10	30	28	58
6	Birthplace	5	8	7	20	17	37
7	Deathplace	4	2	2	8	4	12

8	Title	18	32	34	84	93	177
9	Production year	19	25	19	63	53	116
10	Production period	16	20	14	50	53	103
11	Subject keyword	14	33	31	78	69	147
12	Description	24	20	26	70	57	127
13	Object matters	24	35	24	83	66	149
14	Style of painting	20	12	7	39	42	81
15	Style of line drawing	21	7	7	35	27	62
16	Style of composition	21	8	5	34	24	58
17	Style of brush stroke	24	7	7	38	23	61
18	Shape types	15	8	4	27	16	43
19	Mounting technique	15	5	11	31	16	47
20	Mounting shape	8	4	0	12	7	19
21	Size	19	11	10	40	27	67
22	Size(ho)	9	11	5	25	28	53
23	Format types	6	17	11	34	14	48
24	Color materials	17	8	9	34	30	64
25	Blush materials	15	6	8	29	19	48
26	Ground materials	25	8	7	40	26	66

<Table 7> compares the preference in retrieval access points when retrieving Korean paintings by domain expert users and of common users. There is not much difference in preference between the two groups up to the top 7th preferred access points such as artists' names, titles, object matters, subject keywords, description, production year, and production period. However, the retrieval access points in the 8th to 15th place differ considerably, and the differences in the level of demand also vary substantially. This is to say, domain expert users put emphasis on these access points in order of size(40), ground materials(40), style of painting(39), style of brush stroke(38), nicknames(35), style of painting(35), style of composition(34), format(34), color materials(34). On the other hand, common users laid importance in access points in order of artists' nicknames(46), the style of painting(42), color materials(30), size: Ho(28), the year of birth(28), style of line drawing(27), size(27).

〈Table 7〉 Ranking of Access Points

Ranking	Total	Domain Expert Users	General Users
1	- Name	- Name	- Name
2	- Title	- Title	- Title
3	- Object Matters	- Object Matters	- Subject Keywords
4	- Subject Keywords	- Subject Keywords	- Object Matters

5	- Description	- Description	- Description
6	- Production Year	- Production Year	- Production Period - Production Year
7	- Production Period	- Production Period	
8	- Nickname - Style Of Painting	- Size - Ground Materials	- Nickname
9			- Style Of Painting
10	- Size	- Style Of Painting	- Color Materials
11	- Ground Materials	- Style of Brush Stroke	- Size(Ho) - Birth-Death Year
12	- Color Materials	- Nickname - Style of Line Drawing	
13	- Style of Line Drawing		- Style of Line Drawing - Size
14	- Style of Brush Stroke	- Style Of Composition - Format Types - Color Materials	
15	- Birth-Death Year - Style Of Composition		- Ground Materials
16			- Style Of Composition
17	- Size(Ho)	- Mounting Technique	- Style of Brush Stroke
18	- Format Types - Blush Materials	- Birth-Death Year	- Blush Materials
19		- Blush Material	- Birthplace - Gender
20	- Mounting Techniques	- Shape Types	
21	- Shape Types	- Size(Ho)	- Mounting Techniques - Shape Types
22	- Birthplace	- Birthplace	
23	- Gender	- Social Status	- Format Types
24	- Social Status	- Mounting Shapes	- Social Status - Mounting Shapes
25	- Mounting Shape	- Gender	
26	- Deathplace	- Deathplace	- Deathplace

5. Development of Image Retrieval Interface for Korean Paintings

5.1 Constructing Retrieval Interfaces

Under the premise that retrieval access points will vary from different groups of users, the study constructed two separate search screens and result display screens for common users and specialists. In other words, in each interfaces the most preferred descriptive elements by the users in a given group are selected as retrieval access points, so that the image retrieval interface for common users is quite

different from specialists'. For constructing retrieval interface, the study utilizes My SQL, SQL GATE, Jsp, J2EE6.0, and XML.

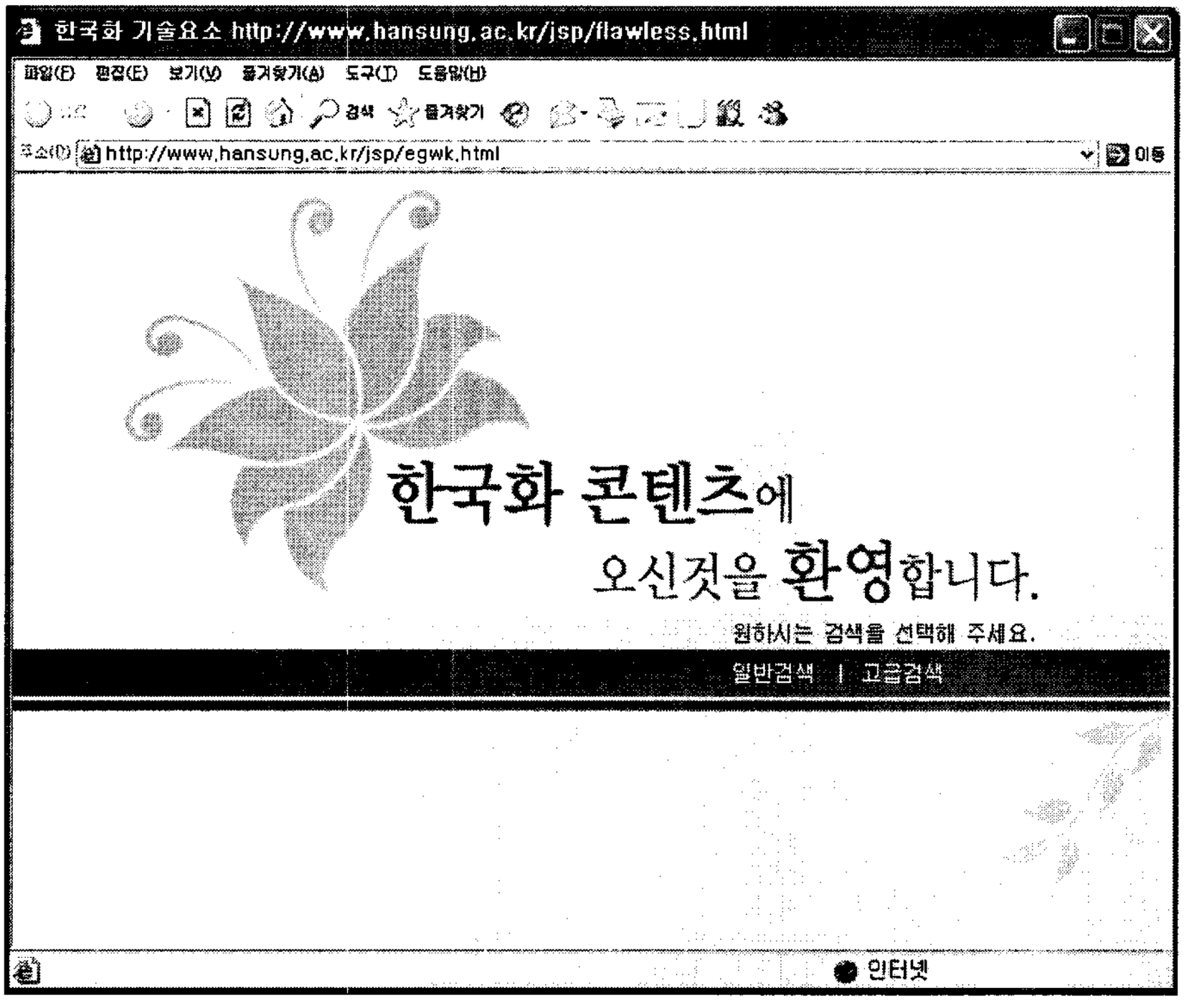
5.2 Retrieval Interface for Korean Paintings

It is found in the analysis of user's seeking behaviors on images that the purpose of retrieving art works differs accordingly with the characteristics of the users' group. Consequently, on the assumption that search platform should be different from common users' to specialists', the study constructed two different sets of retrieval interfaces according to the demands of common users and specialists. <Figure 1> is the first screen that leads to Korean painting contents retrieval. As can be seen, users can either choose simple search screen or the advanced search screen which provides a number of option to formulate complex queries.

5.2.1 Retrieval Interface for Common Users

1) Interface screen for simple search

Simple search allows for users to directly retrieve and browse images by using the 15 elements chosen by common users. First, the users are able to directly input the name of creator, creators' pen name/nick

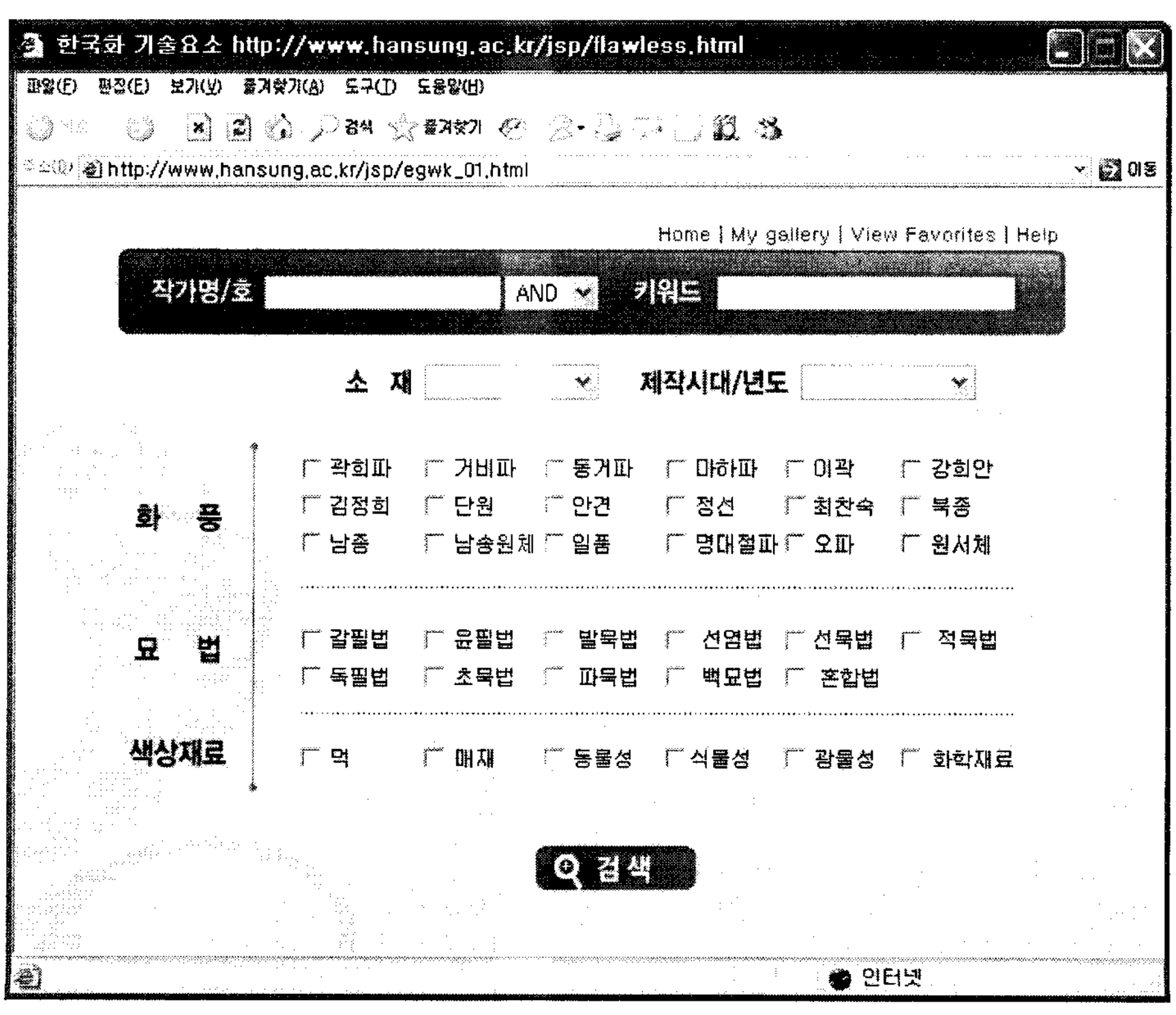


〈Figure 1〉 The First Screen of Retrieval Interface

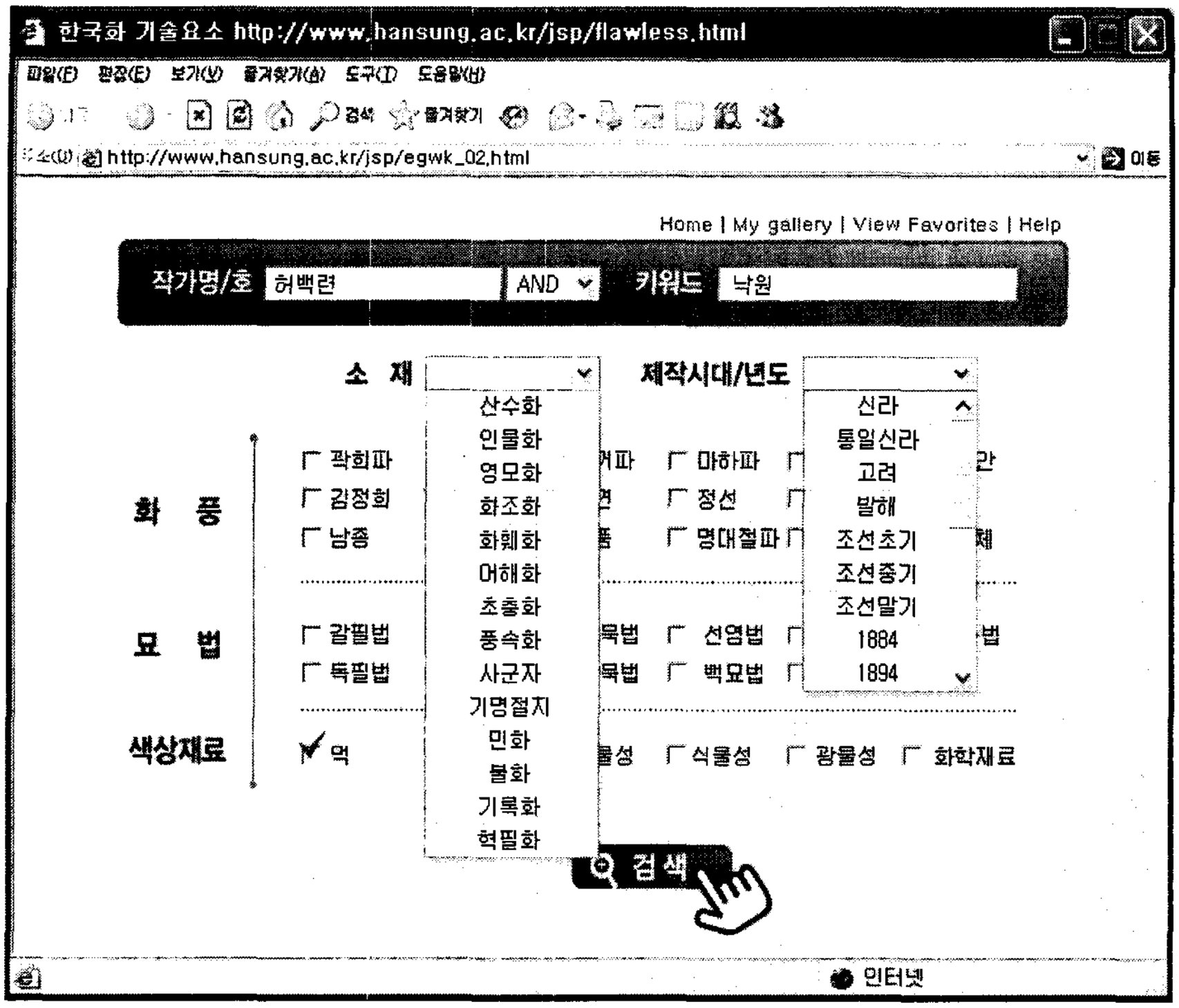
name, title/title keywords, or subject keywords that they knows. The system allows users to combine name of creator with keywords using by Boolean logic and to restrict within search results by selecting the menu of object matters and/or of production period/year(See <Figure 2>). Next, 18 attributes of style of painting, 11 attributes of style of line drawing, 6 attributes of color materials are made into menus so that users are able to browse Korean paintings through specific attributes. Therefore, even if a user does not know exactly the name of styles or types that related to a painting, they can easily browse or narrow down retrieval results by using the menu arranged.

Moreover, by using the My gallery function, users can collect retrieved images they want to keep and by the View Favorites function, users could enjoy with a collection of the most frequently retrieved image. Also, out of the 15 retrieval access points that were selected earlier, 'size' and 'creators' year of birth' were not used as retrieval access points because these two were not considered as appropriate retrieval items.

<Figure 3> is an example of the simple search showing how retrieval is done when a user input the creator, 'Hur Baekryun' and the subject keyword,



〈Figure 2〉 Simple Search Screen



〈Figure 3〉 The Example of Simple Search

'Nagwon(Heaven)', then input the 'Sansuhwa (landscape) as an object matter and 'Mid-Lees' dynasty' as product period as well and at the same time is retrieving for paintings that used 'Danwon's style of painting' with a smearing technique using 'Muk(Chinese ink)'.

2) Display screen for simple search results

There are 5 sections in display screen for the simple search results. First, on the upper left hand side, the full title name of the retrieved image appears and on the right hand side, the number of pages of the retrieval results and the number of the page is presented. Right beneath that section on the left hand side, the paintings' image of the retrieval result is shown and its size can be controlled by users. On the right side of that section, the name of the artist, the artists' pen name/nickname, object matter, material, era/year, size and locating place of collection are presented. Moreover, underneath that section, detailed description of that image is included for the users' greater understanding of the retrieved paintings itself. Again, under that section is shown results of other Korean paintings that share the same style of painting, style of line drawing, and color materials, letting users browse through results by these three attributes of Korean paintings.

The results are sorted by titles, creators, chronology, and date or registration and also, shown in units of 5, 10, or 20 at once. Here, users can also choose the advanced search option(See <Figure 4>).

〈Figure 4〉 Display Screen of Simple Search Results

5.2.2 Retrieval Interface for Specialists

1) Interface screen for advanced search

The advanced search screen provides a number of options to formulate complex queries. Here, users can select a field to search and enter individual search terms or a phrase with specific Boolean search conditions. The interface specially provides a combo box for an object matter list, so that users select easily one of object matters without typing exact words of objects.

Underneath that retrieval formula box, a trio-structured menu is built such as menus of techniques, materials, and production period/year. For selecting techniques, there are 4 pull-down menus for such like: ① styles of painting with 20 attributes, ② styles of line drawing with 11 attributes, ③ styles of brush stroke with 19 attributes, and ④ styles of composition with 13 attributes. Also, for selecting materials, there are 2 pull-down menus such like: ① color materials with 6 attributes, ②

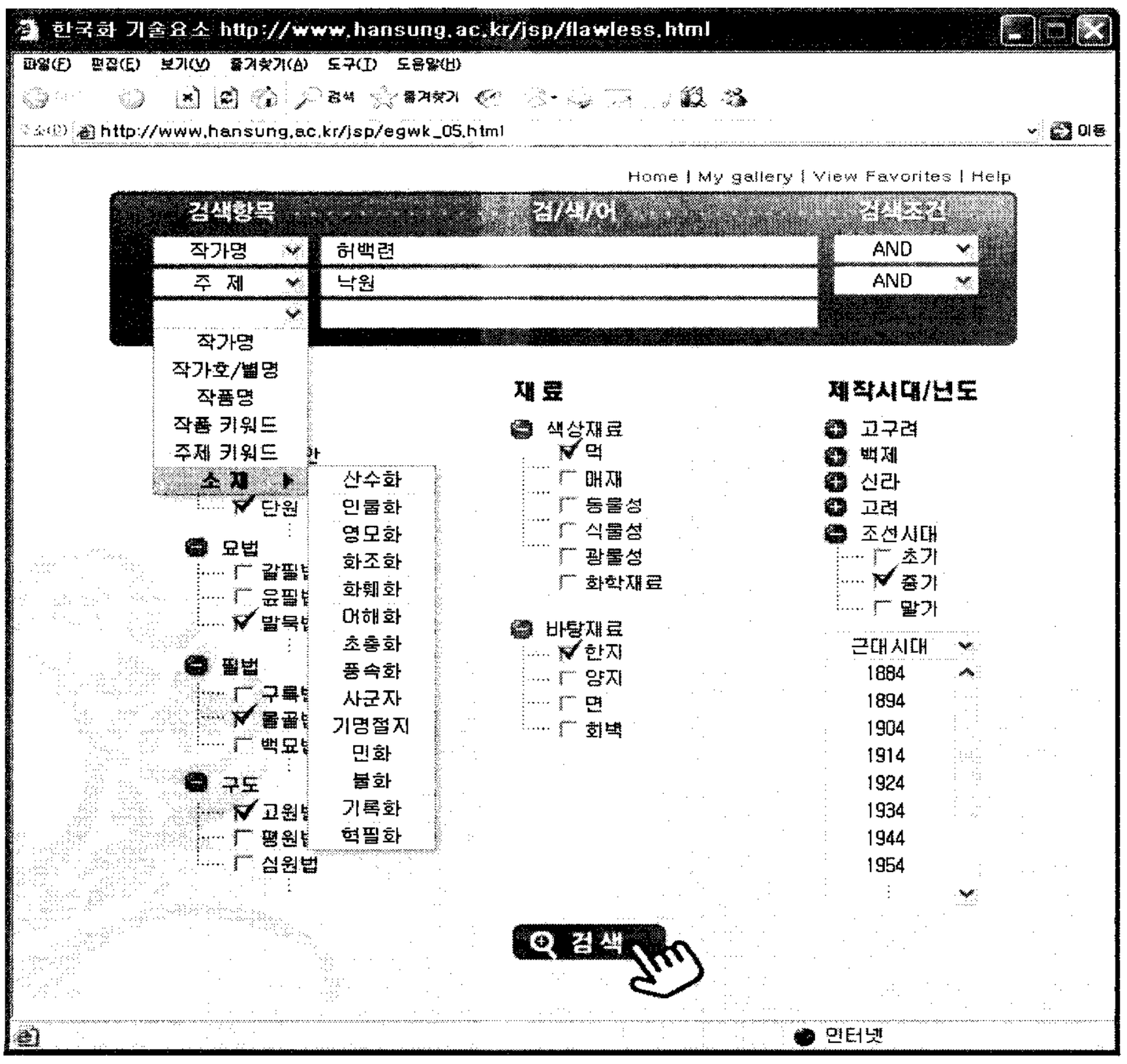
〈Figure 5〉 Advanced Search Screen

ground materials with 4 attributes(See <Figure 5>). The interface for advanced search also provides My Gallery function and View Favorites function.

<Figure 6> is an example of advanced search where the creator 'Hur Baekryun'and the subject keyword 'Nagwon (Heaven)' are typed in and then for the object matters, 'Sansuhwa(landscape painting)' is chosen. Furthermore, this picture shows a retrieval of Korean painting by choosing Danwon's style of painting, Bal-mook style of line drawing, Mol-gol style of brush stroke, Go-won style of composition, using Chinese ink on Korean paper in the Mid-Lee's dynasty.

2) Result display for advanced search

The overall structure of the result display for advanced search is same as that of simple search. But, advanced search allows users to browsing Korean paintings by style of paints, style of line drawing, style of brush stroke, style of composition, ground materials and color materials. Therefore, as can be seen in <Figure 7>, "Hasanchoje" was



〈Figure 6〉 The Example of Advanced Search

retrieved when 'Hur Baekryun' and the subject 'Nagwon' were searched.

Accordingly, the user is able to know that "Hasanchoje" is a landscape painting painted in the Mid-Lee's dynasty, that it was painted on Korean paper with Chinese ink and that it is held in the National Museum of Korea. Moreover, the user is also able to find out that there are 31 paintings

〈Figure 7〉 Display Screen of Advanced Search Results

that share the same painting style as "Hasanchoje", 74 paintings that share the same style of line drawing, 36 paintings that share the same style of brush strokes, 13 paintings that share the same composition, 97 paintings that share the same ground materials, 61 paintings that share the same material in color.

6. Conclusion

In a knowledge based society, art galleries and museums have emphasized on utilizing soft resources rather than maintaining them. Moreover, these institutions focus on developing retrieval interface through the digitalization of Korean paintings. However, due to current retrieval and browsing systems is so simple and almost similar to them for text databases, users' satisfaction level to those systems is relatively low.

Therefore, this study suggests access-enhanced retrieval interface for Korean paintings which supports specific retrieval or wide-browsing through diverse access points expressed special characteristics of Korean paintings. For constructing retrieval interface, the study first constructed a set of descriptive elements suitable for the description of Korean paintings. And then, the study selected 15 most preferred descriptive elements which could be used as access points in the search interface through the investigation of users' preference on access points. Lastly, with the investigation result of 15 most preferred the access points, the researcher designed two types of retrieval interfaces and results display for simple search and advanced search. The results of the investigation are as follows.

First of all, this study selected descriptive elements which describe contents and characteristics of Korean paintings. Selected elements are creators(name, gender, pen name or nickname, social status, date of birth and death, birthplace, deathplace), titles, description, subject keywords, production date(production period, production year), objet matters, techniques(style of painting, style of line drawing, style of brush stroke, style of composition), physical matters(shape type, mounting technique, mounting shape), shapes(size, order of size(ho), format), materials(color materials, blush materials, ground materials).

Second, no element was excluded as access points among 26 descriptive elements of Korean paintings by the peered users. Although the most popular access point was the name of the artist, students majoring in Oriental Painting preferred ground material, description, object matters, and style of brush stroke. On the other hand, students majoring in LIS valued more in order of object matters, subject keyword, title while students majoring in Visual Design selected in order of title, subject keyword, and description. They especially showed low interest on style of brush stroke and ground materials compare to students majoring Oriental Painting. Futhermore, common users preferred in order of title, subject keyword and object matters. In general, users valued listed 5 the most:

artist's name, title, object matters, subject keywords, and description of image.

Third, most preferred descriptive elements including the name of the artist, title, materials, subject keywords and description were selected as main access points. In the retrieval interface, the 5 items are located on the retrieval formula box. On the other hands, style of painting, style of line drawing, style of brush stroke, style of composition, color materials, ground materials are used as browsing access points. But, in the simple search which common users use, only style of painting, style of line drawing and color materials as browsing access points. In addition, while list menu structure which enables users to see all access points was applied to simple search screen, tree menu structure was used in advanced search screen.

Last but not least, the study designed the display screen of the retrieval results as a final step. The retrieved images appear on the left side of the display screen, while the information on the artist, pen name or nickname, subject matters, materials, production era/year, size and location appears on the right screen. Specific explanations appear right below the image to help users' understanding. The bottom section is designed for users to browse relative images which have similar style of painting, style of line drawing, style of composition, color materials, and ground materials with the retrieved image.

In general, image retrieval systems are primary based on names of the artists, titles or subjects which are used as access points for text resources. Information access depends on the information retrieval systems used. For supporting to navigate freely the world of images and having more control over searching and browsing, the study proposes access-enhanced retrieval interface. Because the manual construction of metadata file might require money and time, the automatic extraction of descriptive elements such as object matters, style of painting, techniques and materials should be researched later. And, interfaces that support visualization of digital contents are very useful for users to search and browse them. Therefore, the next step will be suggesting an interface which enhances users' visual awareness and supports diversified browsing based on the ontology techniques.

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