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INTERGRATED MULTILAYER METADATA BASED ON INTELLECTUAL INFORMATION TECHNOLOGY FOR CUSTOMIZATION SERVICES OF IMAGES WITH DIFFERENT USAGE PERMISSION OF LICENSE

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ABSTRACT

Tags and metadata are used to manually retrieve public domain images, but it would require a lot of time and money to build such a system into an automated one. Therefore, it is necessary to extract the tags and metadata utilizing intelligent information technology, and semantic metadata is preferred for this purpose rather than simple metadata for each image content. In this paper, we have designed and implemented multi-layer metadata that can be used for customized search recommendation based on intelligent information using MPEG-7, Dublin core, and CCRel. The metadata of public domain images are described with the right of usage, feature information and semantic information, and they are expressed in an XML document form so that they can be exchanged on the web easily.

Keywords: *Intelligent Information Technology, Public Domain Works, Free-use Licenses, Metadata*

1. INTRODUCTION

Recently, the demand for digital image retrieval is increasing in various fields such as electronic library, medical information system, and scientific fields [1]. As the access of the user's image database is expanded, a method for efficiently managing the data and searching for the accurate data is emerging, and studies are being conducted on a method for expressing various kinds of semantic information of the data at a high level [2].

Image information retrieval is currently provided by several web search engines such as "Shared Yard", but the retrieval from bibliographic information of non-standardized images is not efficient. There is always the possibility of infringing copyright because there are no special restrictions on people to freely use, copy, modify and redistribute the shared works [3]. Therefore, there is a need for a system that classifies and searches for verified works for free-use licenses and provides customized services based on intelligent information technology.

For such a system, it is necessary to describe expanded metadata so that copyright information, visual feature information, and content-based information of an image can be integrated and retrieved at the same time [4,5,6]. In this paper, we propose an integrated multi-layer metadata structure by adding MPEG-7, Dublin core, which are representative standards of metadata, and CCRel standard, which describes copyright information. The proposed metadata structure can also be easily exchanged on web since they are represented in XML-type documents, which enables customized services for shared works based on intelligent information technology.

2. RELATED STUDIES AND REQUIREMENTS

2.1 Metadata Standards

The Dublin Core metadata format is a set of consistent metadata elements that outline data across a broad range of subject areas, such as Title, Author, Subject, Publisher, and Date. In this format, metadata can be created, managed and used from such a simple level as 15 basic data elements up to a detailed level.

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Interoperability of metadata among index systems can also be pursued. This format is a standard in the form of a simple structure that can replace existing metadata such as MARC because it is expensive and time consuming due to structural problems when displaying information resources in the network [7]. However, there are limits in describing the meaning and content characteristics such as location, time, relationship and types of objects, in order to apply Dublin Core standard to search engines, based on tags and keywords that user selects.

The MPEG-7 metadata standard is an international standard for describing structure information and semantic information on multimedia contents, and provides efficient contents access through metadata. It is possible to describe metadata, such as images, graphics, 3D models, audio, voice and visual editing information, facial expressions, personal characteristics and color or texture [8]. MPEG-7 consists of 7 parts, and it uses Part-3 visuals to provide a method to automatically extract and present content-based features such as image colors, textures, and shapes. It also uses Part-5 MDS(Generic Entities and Multimedia Description Schemes) to describe general multimedia presentation and expression schema parts [9, 10]. However, when the copyright owner uploads an image and sets a license to the search engine, there is a limitation in that it is difficult to describe the copyright related information for displaying the license information to the user.

2.2 Representation of Right

The Creative Commons License (CCL) is a freely used license that allows users to use the work freely if they observe certain terms and conditions set by the copyright owner. Anyone can use it for free, and no user has to pay for it. The terms of the CCL include license condition, attribution, noncommercial use, and the license can be issued using a combination of these terms. CC REL (Creative Commons Rights Expression Language) is the Rights Expression Language (REL) for copyright, license content and related information that CC has been advising since 2008. CC REL is based on the W3C RDF and it has been used by content creators, distributors, and senders, as well as users and application developers since it is more convenient, scalable, and integrated than the previous recommendations [11]. However, there is a limitation in that basic production information, visual characteristics and semantic characteristics except basic copyright information of image work cannot be described.

2.3 Limitations of Previous Studies and Suggestion of Metadata Structure

Currently used metadata structures such as DC, Dig35 and MPEG-7 do not include elements that can describe enough information about copyright licenses. When uploading a work to the image search system, therefore, it is inconvenient to input and store the copyright information in a different database separate from the metadata. In addition, since metadata except for MPEG-7 contain only the simple description elements of basic information such as image title, subject, related keyword, creation date, origin, and so on, the existing metadata structure has a limitation in that the description of semantic content and visual information such as color and texture is impossible.

In this paper, we propose an integrated multi-layer metadata structure that can describe free-use license information, in addition to existing standard metadata components such as basic image information, visual information and semantic information. It is possible to expand the technical elements according to the selection of the metadata descriptor, and these metadata can be shared on the web since they are expressed in the form of XML document, which is a mutually compatible language among different metadata standards.

2.4 Analysis of Integrated Multilayer Metadata Requirements

In order to construct a customized image retrieval system for public domain works, it is necessary to design a metadata structure that clearly shows the intention and the scope of the usage condition of the copyright owners to prevent copyright infringement, and allows the users to use it freely within the permission. Content-based information mapping that can describe the various information such as subject, object and tag, is also required to provide customized retrieval and suggestion functionality of public domain images based on intelligent information technology [12]. The summary of requirements is tabularized in Table 1.

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Table 1. Metadata Requirements For Customized Services Of Public Domain Images

NO.	Name of Requirement	Detailed description of Requirement
EQ-1	Display basic information such as name, format, date, and publisher of a file within an image asset	In order to express basic image generation information, metadata standard should be defined and applied.
EQ-2	The intention of the copyright owner's permission to use and related terms regarding the image work is clearly displayed	It must be able to express copyright information and reflect all the terms of use (commercial purpose, redistribution, distribution with change, etc.).
EQ-3	Feature classification for visual separation of image assets	It should be able to express visual information (color, texture, object shape, histogram, etc.)
EQ-4	Representation of the content features of images, such as subjects, objects, and tags	It should be able to express semantic information (object, event, relation, time, subject, place, etc.).
EQ-5	Simultaneous search and step-by-step query processing using the integrated information of copyright, visual feature, and content-based information of the image	For integrated retrieval of images, it is necessary to solve the hierarchical separation of metadata structure and duplication problem between descriptions.
EQ-6	Integrated implementation of different metadata standards based on the structure design	It should be compatible with the metadata standards of other variants, and human and machine readability, web operation and representation of logical structure should be satisfied.

3. INTERGRATED MULTILAYER METADATA FOR CUSTOMIZATION SERVICES OF PUBLIC DOMAIN IMAGES

According to the requirements in Section 2, an integrated multilayer metadata structure is designed. The information of the image works is hierarchically classified by elements, and detailed attributes are assigned to each layer. A structure suitable for describing features in each layer is selected and the format of the proposed standard in metadata coding is followed.

3.1 Integratd Multi-layer Metadata Structure of Images

We propose a multi-layer metadata structure that can classify verified works with different license conditions by combining the tags and the keywords selected by the user, and the metadata can be used to search for the copyright information, visual feature information and content based information of images. The metadata are structured into 4 layers and staged query processing can be done by assigning detailed attributes for each layer. Figure 1 shows an integrated multilayered image metadata structure to illustrate free-use license information, visual capabilities information, and semantic information for public domain images.

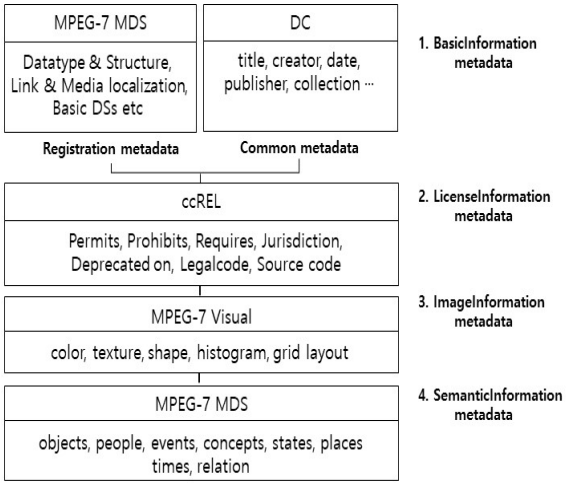

Figure 1. Expandable Integrated Multi-Layer Metadata Structure

In Figure 1, the image metadata structure is divided into four layers, each layer name is Basic Information Metadata, LicenseInformation Metadata, ImageInformation Meatadata, and Semanticinformation Metadata. Detailed descriptions of each layer are given in Sections 3.2, 3.3, 3.4, and 3.5 below.

3.2 First Layer

In Figure 1, the image metadata structure is divided into four layers. BasicInformation

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Metadata, which is the highest layer, is the image basic information area and contains common elements such as Register metadata and Common metadata. Registration Metadata is a set of Ds and DSs that can describe the contents of a multimedia document. It is usually stored in the header of an image file and defines primitive datatypes and description tools. We have selected the MPEG-7 MDS standard and the details are shown in Table 2 below. The information in the image header is represented using the data structure of the image header is represented by using the datatype structure of the part, link & media localization, and basic elements of the basic DSs in basic element part of the entire MDS structure [10].

Table 2. Description of MPEG-7 MDS (Layer 1) elements

No	Element	Element Description
1	Datatype & structure	- Basic data types and mathematical structures - integer, vector , matrix, histogram
2	Link & media localization	- Reference D: Referencing to part of description - Reference To Segment D: referencing to the description of a segment - Time elements: media stream - Media streaming time or actual time - MediaURL D (display URL of AV content), MediaLocator DS (specify specific image, location) with location of AV content
3	Basic DSs	- Basic DS definitions available on other DSs - The basics that can be used for semantic representation metadata of the four layers. ex) Description of people, Description of places, Description of events, Entity-relationship graph

Common Metadata in the first layer describes all 15 resources on the web, including file name, format, date, and publisher. The DC standard that standardizes the basic conventions used in metadata is selected for image basic information representation. The detailed elements consist of title, creator, date, publisher, collection, subject, type, format, description, and coverage. Table 3 below shows an example of XML data construction using RDF.

Table 3. XML referencing RDF for the default domain (DC)

```
<?xml version="1.0"?>
<rdf:RDF:xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"xmlns:dc="http://purl.org/dc/elements/1.1/">
<rdf:Description>
<dc:title>Wedding ceremony</dc:title>
<dc:creator>Jeong Yi</dc:creator>
<dc:publisher>Jeong Yi Photography</dc:publisher>
<dc:subject>wedding</dc:subject>
<dc:date>2017-01-22</dc:date>
  <dc:collection refine="collectionName">Shared assets DB </dc:collection>
<dc:description>Bride and groom wedding</dc:description>
<dc:format xml:lang="KR" refine="KC_format"> Photos and images (002) </dc:format>
<dc:language scheme="RFC1766">eng</dc:language>
<dc:right refine="copyright">Jeong Yi</dc:right>
<dc:identifier・ refine="universalID" scheme="ISBN"> J0-471-510 64-3 </dc:identifier>
<dc:management refine="UCI">UCI : G001+KADO05-KISTI. 080720.D0.1234.img</dc:management>
</rdf:Description></rdf:RDF>
```

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Table 4. Description of CCREL elements

NO	Element	Definition	Detail Element	Detail Element Description
1	cc:permits	Permission to use works	cc:Reproduction	Copy works in various forms
			cc:Distribution	Redistribute the works
			cc:DerivativeWorks	Create secondary work reproduced
2	cc:prohibits	Restrictions on permitted use	cc:CommercialUse	Use the work for business
3	cc:requires	Compliance for permitted use	cc:Notice	Provide instructions for the license applied to the work
			cc:Attribution	Show original author
			cc:ShareAlike	Redistribution of Secondary Works uses the same license
			cc:SourceCode	Provide source code when distributing original work
4	cc:jurisdiction	Country of License	-	-
5	cc:deprecatedOn	Date on which the license becomes invalid	-	-
6	cc:legalCode	Applicable license agreement	-	-

In the example in Table 3 above, the prefix rdf uses the URI defined in "http: //www.w3.org/ ..." and the prefix dc declares it will use the URL defined in "http://purl.org/ dc / ... ". Since we have decided to apply the metadata format defined above, we can use it without any declaration

3.3 Second Layer

The second layer, LicenseInformation Metadata, is copyright-related information. It describes licenses that allow free use of other people under certain conditions for the creation. The standard is CC right to express copyright license content and related information rights. The expression language ccREL was selected. The detailed elements are defined as shown in Table 4. Table 5 below is an example of building XML data for author-based nonprofit licenses using ccREL.

Table 5. Attribution representation for free-use license area _ XML representation of non-commercial licenses

```
<rdf:RDF
xmlns:cc="http://creativecommons.org/ns#"
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-
syntax-ns#">
<rdf:Description
rdf:about="http://creativecommons.org/license/
by-nd/3.0/">
<cc:requires
rdf:resource="http://creativecommons.org/ns#Notic
e"/>
<cc:requires
rdf:resource="http://creativecommons.org/ns#Attrib
ution"/>
<cc:permits
rdf:resource="http://creativecommons.org/ns#Distri
bution"/>
<cc:permits
rdf:resource="http://creativecommons.org/ns#Repr
oduction"/>
</rdf:Description></rdf:RDF>
```

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Table 6. Descriptions of MPEG7 VISUAL elements

Element	Detail Element1	Detail Element2	Detail Element Description
Basic Structures	Grid Layout		Color, texture description of images divided into sections
	Histogram		Represent a specific video feature as a histogram
Basic Feature	Color Description	Color Space	Define color space in specific application, convert RGB, YUV, HSV
		Dominant Color	A Descriptor that is used when a certain color or a small number of colors are sufficiently dominant in all or part of the image to represent the characteristics of the image
		Color Histogram	Color histograms used in search and retrieval applications in large databases
		Color Quantization	Supports linear, non-linear quantization and look-up tables
		GoF/GoP Histogram	Extending from the color histogram of a single image to the color histogram of a collection of multiple images of a video segment
		Color-Structure Histogram	The purpose is to search for images using color
		Color Layout	Spatial distribution of color
		Harr Transformed Binary Histogram	Compact Descriptor of color, qualitative representation of color histogram
	Texture Description	Edge Histogram	Represents the spatial distribution of the edges of an image with four edges and one non-directional edge in directionality.
		Homogeneous Texture Descriptor	Used when indexing image data using patterns of specific parts
		Texture Browsing	Quantitative texture representation, filtering and then determining the image's Regularity, Coarseness
		Homogeneous Texture	Implementations using Projections and 1-D filtering operations are used to extract features

3.4 Third Layer

The third layer, ImageInformation Metadata, uses visual elements such as color values, shape values, text, and layout of images to describe visual characteristics. The standard uses visual attributes of part-3 of MPEG-7, which enables various feature descriptions of images. The detailed attribute definitions are shown in Table 6 and Table 7 below shows an example of Color Layout of MPEG-7 Color [9].

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Table 7. Color layout property XML of visual information area

```
<?xml version="1.0"?>
<Mpeg7 xmlns = "urn:mpeg7:schema:2001"
xmlns:xml="http://www.w3.org/XML/1998/names
pace"xmlns:xsi =
"http://www.w3.org/2001/XMLSchema-
instance"xmlns:mpeg7 =
"urn:mpeg7:schema:2001"xsi:schemaLocation =
"urn:mpeg:mpeg7:schema:2001 Mpeg-7-
2001.xsd"><VisualDescriptor
xsi:type="ColorLayoutType"><YDCCoeff>31</Y
DCCoeff><CbDCCoeff>16</CbDCCoeff><YACC
oeff63>18 26 24 12 12 17 13 16 15 13 14 17 15 13
15 . . . .. . . . . . . . . . . . . . . . . . . . . . . . .. . . . . .
```

3.5 Fourth Layer

The semantic information metadata of the last lowest layer describes the overall meaning of the image and the relationship between the objects. It is a step that can be extended continuously, and it is possible to describe the unstructured data. Define Descriptions that can be used as intelligence information such as subject, time, event, place and relation of image, and describe the detailed elements of Basic DSs defined in Layer 1. The detailed attribute definitions are shown in Table 8 below [10, 12].

Table 8. Description Of MPEG-7 MDS (4th Layer) Elements

No	Element	Element Description
1	object	Describing object information
2	people	Person or object information description
3	events	Event information description
4	concepts	Subject information description
5	states	Situation information description
6	places	Place information description
7	time	Time information description
8	relations	Provide information for users to recognize and access important information resources related to the knowledge information resource, and specify individual location information so that the relationship between information can be identified.

Table 9 shows the semantic information metadata of the fourth layer of the integrated multi-layer metadata structure in xml format. The picture of the wedding ceremony of the bride and groom in the wedding room of Figure 2 is described.

Figure 2. Photograph of a bride and groom at a wedding ceremony

Table 9. XML Representation of SemanticInformation Metadata

```
<Semantic><Label>
<Name>Wedding ceremony of Bridegroom and
Bride</Name></Label>
<SemanticBase xsi:type="EventType" id="EV1">
<Label><Name>Marriage</Name></Label>
<Relation xsi:type="ObjectEventRelationType"
name="hasAgentOf" target="#A01"/>
<Relation xsi:type="ObjectEventRelationType"
name="hasAccompanierOf" target="#A02"/>
<Relation
xsi:type="ConceptSemanticBaseRelationType"
name="hasPropertyOf" target="#C1"/>
<SemanticPlace><Label>
<Name>Wedding Hall</Name></Label>
</SemanticPlace>
<SemanticTime><Label>
<Name>10 : 45am, January 22,
2017</Name></Label>
<Time><TimePoint>2017-01-
22T10:45+02:00</TimePoint></Time>
</SemanticTime></SemanticBase>
<SemanticBase xsi:type="AgentObjectType"
id="AO1">
<Label><Name>Bridegroom</Name></Label>
<Agent xsi:type="personType">
<Name><GivenName>Bride</GivenName></Nam
e></Agent></SemanticBase>
<SemanticeBase xsi:type="ConceptType"
id="C1"><Label><Name>Relationship</Name></
Label>
<property>Couple</property><property>Love</pr
operty></SemanticeBase></Semantic>
```

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4. IMPLEMENTATION AND VALIDATION

We have implemented a metadata generation system that automatically generates XML formatted code conforming to the integrated multi-layer metadata structure proposed in this paper, and analyzed whether the generated metadata satisfies the requirements applied to customized services of images with different license based on intelligent information technology. The implementation system is divided into an input unit through which the user can input the fact information and characteristic information of the image work and a processing unit which generates the XML code. The system implementation is based on Java, an object-oriented development language developed by Sun Microsystems. The basic UI is designed using JDK6.0 for Java runtime environment and eclipse3.3 for I DE development environment. Figure 3 below shows a screen in which a user registers an image and inputs meta information according to a designed metadata structure.

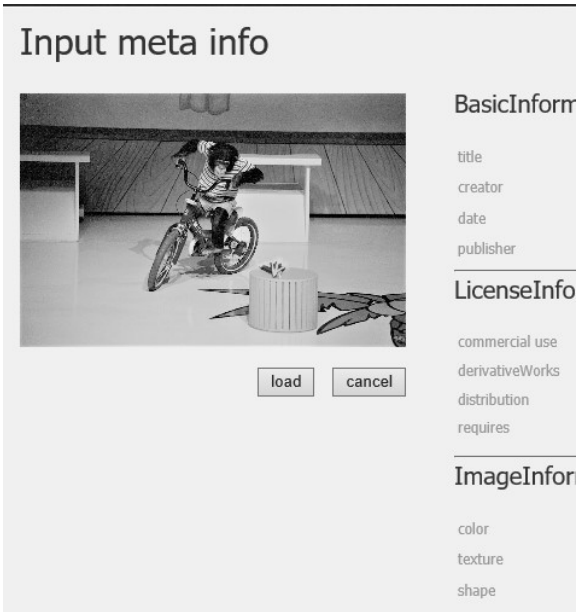

Figure 3. Input screen for image Meta information

The user uploads the image to the left screen and registers basic creation information, license permission range, visual feature and semantic feature information for the image on the right screen and registers it. The image meta information is then output in xml format, as shown in Figure 5, 6, and 7 below.

```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-
    xmlns:dc="http://purl.org/dc/elements/1.1/">
    <rdf:Description>
        <dc:title>Biking chimpanzee</dc:title>
        <dc:creator>Jogn</dc:creator>
```

Figure 4. Generated XML document of BasicInformation layer

Figure 4 shows that the BasicInformation information input to the image is represented in xml format. Figure 5 and Figure 6 below show that ImageInformation information and SemanticInformation information are expressed in xml format, respectively.

```
<DescriptionUnit xsi:type = "DescriptorCollectionTy
    <Descriptor xsi:type = "DominantcolorType">
        <spatialConherency>0</spatialConherency>
        <Value>
            <Percentage>4</Percentage>
            <Index>3 3 18</Index>
        </Value>
```

Figure 5. Created XML document of ImageInformation layer

```
<Semantic>
    <Label>
        <Name>Biking chimpanzee</Name>
    </Label>
    <SemanticBase xsi:type="EventType" id="EV1">
        <Label>
            <Name>riding bike</Name>
        </Label>
        <Relation xsi:type="ObjectEventRelationType" nam
            target="#A01" />
        <Relation xsi:type="ObjectEventRelationType" nam
            target="#A02" />
        <Relation xsi:type="ConceptSemanticBaseRelationT
```

Figure 6. Created XML document of SemanticInformation layer

Based on the generated xml document code as shown in Fig. 4, 5, and 6, it will be used in a future intelligent information-based image asset search engine. We verify whether the metadata is implemented according to the requirements derived from Section 2 through the satisfactory check of requirements and compared with the case of using only one existing metadata standard. Table 10 below shows whether the proposed metadata structure satisfies the requirements or not.

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Table 10. Satisfaction check on requirements derived in Section 2

REQ No.	Contents	O/X
REQ-1	Whether to select metadata standard that can express basic image generation information	O
REQ-2	Whether to select a metadata standard to express copyright information	O
	Availability of for-profit use expressions	O
	Availability of redistribution permission expression	O
	Availability of expressions that allow you to modify and distribute	O
REQ-3	Whether to select a metadata standard to express visual information	O
	Availability of color representation	O
	Availability of texture representation	Δ
	Whether object shape representation is possible	Δ
	Availability of histogram representation	Δ
REQ-4	Whether to select a metadata standard that can express semantic information	O
	Availability of object representation	O
	Availability of event expression	O
	Availability of relationship expressions	O
	Availability of time representation	O
	Availability of subject expression	O
	Availability of place expression	O
REQ-5	Whether hierarchical separation of metadata structures	O
	Whether to resolve duplicate issues between descriptions	Δ
REQ-6	Interoperability of metadata standards for variants	O
	Human and machine readability	O
	Availability on the Web	O
	Whether logical structure is expressed	O

The proposed metadata structure can be used to generate the basic construction information, copyright information, and semantic information of the image work. The integrated structure can be implemented using the XML document. However, in the visual information representation, the texture representation, the object shape, It is difficult for the user to directly input the expression. Therefore, it is necessary to study the algorithm that can automatically extract the visual feature value from the image in the future. Also, it is necessary to study a database storage structure that can automatically detect and delete duplicate problems between descriptions while integrating each standard. Table 11 below compares the descriptive elements of the existing image metadata and the designed metadata.

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Table 11. Comparative Analysis Of Description Elements Of Existing Standard And Proposed Metadata Structure

Classification	DC	EXIF	DIG35	MPEG7	Proposed metadata
Basic image information (size, format, etc)	O	O	O	O	O
Image creation Information(creation date, time, etc)	O	O	O	O	O
Content feature information (who, what, ect)	x	x	O	O	O
Visual feature information(color, shape, etc)	x	x	x	O	O
History information(editing, history, etc)	x	x	O	O	O
Free Copyright Information(ccRel, etc)	x	x	x	x	O

The DC standard and the EXIF standard can briefly describe data in a wide range of subject areas, and the DIG35 standard provides comprehensive and structured metadata in terms of content [7, 13]. Although the MPEG-7 standard provides most of the image information metadata, it does not provide free-use copyright information metadata [8]. The metadata structure proposed in this paper combines DC, MPEG7, and CCL metadata elements to provide copyright information, visual characteristics information, and content - based information. Therefore, it seems that it is suitable for intelligent information based image metadata representation.

5. CONCLUSION

In this study, we have investigated metadata that can be used in a search engine that can provide customized services for shared works based on intelligent information technology, and analyzed the existing metadata and rights representation language to derive the requirements. Based on the derived requirements, the structure of existing image metadata has been extended to express the free license information and semantic information of the public domain images. The metadata can be classified into multiple layers to describe the elements in each layer, and the set of descriptions and structure of representation describing various multimedia features have been defined and implemented. The metadata structure proposed in this paper combines DC, MPEG7, and CCL metadata elements to provide copyright information, visual feature information and content-based information. For verification, we have confirmed that the requirements shown in Section 2 are met after comparing the results with other metadata structures. As a result of the comparative analysis, the proposed metadata has been shown to be suitable for image representation.

In this way, the image retrieval system can perform not only simple retrieval, which depends on the keyword, but also various conditional retrieval, thereby satisfies the unstructured information demand of the user. In addition, it is possible to provide customized intelligent services based on user query records, and to increase the convenience of users by reducing the time and cost of checking copyright information in order to freely use public works.

In the future, it is necessary to do research on the design, implementation, and verification of a tool that provides a variety of free-use copyrighted works in the form of a web service or plug-in.

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