An Innovative Approach for Indexing and Searching Digital Rights

Walter Allasia, Francesco Gallo
EURIX
Torino, Italy
{*allasia,gallo*}*@eurixgroup.com*

Filippo Chiariglione
CEDEO.net
Torino, Italy
filippo@cedeo.net

Fabrizio Falchi
ISTI-CNR
Pisa, Italy
fabrizio.falchi@isti.cnr.it

Abstract

Our aim is the management of the metadata related to the digital rights in centralized systems or networks with indexing capabilities for both text and similarity searches, providing the basic infrastructure enabling the private use and the commercial exploitation as well. We present an innovative approach that treats the DRM metadata as metric objects, enabling similarity search on IPR attributes between digital items. Moreover we show how the content base similarity search can help both the user to deal with a huge amount of similar items with different licenses and the content providers to detect fake copies or illegal uses.

1. Introduction

In the last years a multitude of devices able to consume and produce good-quality digital content has become accessible to a big part of the population, and the number of individuals, left aside the professionals, using them is exponentially growing. People from all over the world are creating images and audio/video files, and most of the times are happy to share them with others by means of electronic mail, Web sites, chats, multimedia messaging services and several distributed systems.

Our cultural heritage is no longer made up of videos, images and text documents provided by "institutional" public or private bodies only, but also by every connected device as well.

However, people do start feeling the importance of associating Intellectual Property Rights (IPR) information to the created content before they release it to the public, for several reasons, such as to obtain the correct attribution of the ownership of the content or to allow the consumption of content only under some conditions (for example to limit the usage of the content to a restricted set of users), just to mention a few.

In order to be able to guarantee the preservation and access of these digital items, we have to take into account the Digital Rights Management (DRM) information associated with them during the creation phase and especially during the search.

Several approaches have been proposed so far for managing digital rights and many standards are available for representing them. However, usually open as well as trusted systems provide a simple *attribute search* on a single specific type of license.

We are proposing here a different approach for indexing and searching the information related to the licenses of the digital items, towards a more flexible and interoperable environment.

2. Backgrounds

Many network infrastructures are arising in order to provide the bases for Web sharing and searching functionalities on digital items. Most of them are peered oriented networks, such as eMule [1] or BitTorrent [2] for images and audio/video files and Joost [3] for video streaming. Furthermore there are several multimedia platforms which enable the automatic audio/video processing for cataloging and indexing digital items [4] that, in combination with the network infrastructure, will provide powerful solutions for digital content management.

Before introducing the novel approach for dealing with DRM at query time, a number of related concepts are discussed in the following sections.

2.1. Digital Rights Management

The digital items residing in most of network infrastructures mentioned above are currently not associated with IPR information, moreover service providers and users want to be aware of the license related to the searched content and want to know what are the actions that can be done on the downloaded digital items.

There are many standard initiatives that are trying to provide the basis for a DRM infrastructure, such as MPEG [5], OMA [6], DVB [7], DMP [8], Coral [9], TV-Anytime [10] as well as many proprietary solutions.

The DRM landscape is still very much fragmented, and it would be very challenging today to predict if, when and how there would be a standard and widely adopted DRM solution prevailing over the others, particularly in such an heterogeneous environment as the Web.

Fortunately the expression of the kind of the license is evolving in a more agreed way. Even if from the point of view of the copyright law there are still some differences between the license and the actions that a DRM system is able to provide according to that license, some standards on the expression of the license are arising and are commonly used. Anyway we have to point out the important difference between the *license*, a *statement concerning rights to use content* and the *enforcement* that the terms of the license are indeed followed by the user. This article deals with the definition of the license and in particular the search capabilities of a digital item by its license. We do not want to provide any guideline nor implementation of the software for controlling the respect of use of the license as a DRM system has to guarantee. We want to provide an innovative approach for managing the license attributes in order to be able to search for a similar (as well as for different or not similar) digital object as query with its related digital license.

Up to now, a few solutions for expressing digital rights have been standardized, such as MPEG-21 Right Expression Language (REL) [11], Open Digital Rights Language (ODRL) [12], TV-Anytime RMPI [13] , Adobe Content Manager, [14], CreativeCommons (CC) [15], and Publishing Requirements for Industry Standard Metadata (PRISM) [16].

In this paper we will concentrate on the digital items (mainly audio/video files) produced by individuals and professionals and made available on the Web with associated rights information. Hence we are focusing our attention here on the language for expressing their licenses.

In order to be able to calculate a metric distance between licenses, a common Rights Expression Language (REL) has to be chosen. In our analysis we adopted MPEG-21 REL for the following reason:

1. it is an ISO Standard;

2. it is widely considered the most flexible and powerful tool to digitally express rights;

3. several *profiles* of the REL standard have already been defined within MPEG: the Mobile And optical Media (MAM) [17] , the Dissemination And Capture (DAC) [18] and the Open Release Content (ORC) [19] profiles;

4. it is being adopted as the default language for the expression of the rights in a number of standard specifications dealing with DRM issues such as in most Multimedia Application Formats (MAF) [20] specifications in MPEG and DMP Interoperable DRM Platform, as well as by several European IST Projects such as AXMEDIS [21].

The three REL profiles mentioned above were conceived for allowing the expression of MPEG-21 REL licenses able to represent equivalent rights expressions such as OMA ODRL [22], TV-Anytime RMPI and CC licenses. Therefore it is possible to convert ODRL, RMPI and CC licenses into equivalent MPEG-21 REL licenses when governed content is ingested in the network considered in this paper. The similarity search algorithm can then be applied on content belonging to different application domains.

The full MPEG-21 REL standard has more functionalities than those supported by the three considered profiles: MAM, DAC and ORC. However, as a first step, we will focus on a subset of the language. The MPEG-21 REL schemas, although not having a normative value, are split into six different namespaces: *Core*, *Standard Extension*, *Multimedia Extension*, *Multimedia Extension 1*, *Multimedia Extension 2* and *Multimedia Extension 3*. The analysis described in this paper will be based on licenses validating against the six namespaces mentioned above but only containing the elements and complex types defined in the three profiles considered.

2.2. Similarity Search

The notion of similarity has been studied extensively in the field of psychology and has an important role in cognitive sciences. A similarity search can be seen as a process of obtaining data objects in order of their distance or dissimilarity from a given query object. It is a kind of sorting, ordering, or ranking of objects with respect to the query object, where the ranking criterion is the distance measure.

From a database prospective, similarity search is based on gradual rather than exact relevance. A distance between objects is used to quantify the proximity, similarity or dissimilarity of a query object versus the objects stored in a database to be searched. Though this principle works for any distance measure, we restrict the possible set of measure to the metric distance. Because of the mathematical foundations of the metric space notion, partitioning and pruning rules can be constructed for developing efficient index structures. Therefore, in the past years the research has been focused on metric spaces [23].

2.3. The metric space approach

Although many similarity search approaches have been proposed, the most generic one considers the mathematical metric space as a suitable abstraction of similarity [23]. The simple but powerful concept of the metric space consists of a domain of objects and a distance function that measures the proximity of pairs of objects.

Let $M = (\mathcal{D}, d)$ be a metric space defined over a domain of objects $\mathcal{D}$ and a total (distance) function $d : \mathcal{D} \times \mathcal{D} \rightarrow \mathbb{R}$. The following properties always hold in M $\forall x, y \in \mathcal{D}$:

$d(x, y) \geq 0$ (*non-negativity*),
$d(x, y) = 0$ iff $x = y$ (*identity*),
$d(x, y) = d(y, x)$ (*symmetry*),
$d(x, z) \leq d(x, y) + d(y, z)$ (*triangle inequality*).

The metric space approach has been proved to be very important for building efficient indexes for similarity searching. A survey of existing approaches for centralized structures (e.g. M-tree [24] and D-Index [25]) can be found in [23] and [26].

Very recently even scalable and distributed index structures based on Peer-to-Peer networks have also been proposed for similarity searching in metric spaces, i.e. GHT* [27], VPT* [28], MCAN [29], M-Chord [30] (see [28] for a comparison of their performances).

Currently many research projects are investigating these fields, such as SAPIR [31], a project funded by European Research Area in the 6^{th} Framework Program, that aims to develop cutting-edge technology that will break the barriers and enable search engines to look for large scale audio-visual information by content, using the *query by example* paradigm. SAPIR intends to propose new solutions for an innovative technological infrastructure for next-generation Multimedia Search Engines. This research effort should lead towards a distributed, P2P based, search engine architecture, as opposed to today parallel search engines within a centralized Web data warehouse.

3. The proposed solution of metric distance for licenses

It is worthwhile to underline that in order to be able to handle the rights associated to digital contents, they should be defined during the creation phase of the items. Hence the GUI that a sharing system should provide has to take into account the multiple choice of available licenses. Flickr [32], for example, is currently providing at least one type of license definition (CreativeCommons). So far the search engine for the rights is nothing but an attribute search, looking for the same value of a specific attribute of the expressed license.

We suggest that for enabling efficient and distributed queries on digital rights the metadata expressing the license can be considered as special features in a given space, instead of simple attributes. Hence we can perform the similarity search on digital rights by finding out the appropriate distance function.

A typical REL license is composed of a number of *grants* and an *issuer*, the latter being the entity granting a *right* to the *principal*. Every grant, in turn, may still contain three main types of information: the principal, identifying whom a right is granted to; the right: an action that a principal may perform on the associated resource; and the resource, the *object* which the right in the grant applies to. Figure 1 shows a simplified model of REL license where some components are omitted for clarification purposes.

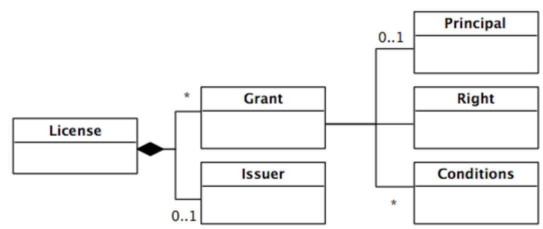

Figure 1. A simplified model of REL license.

The *issuer*, in the most general case, could be seen as an element not adding significant value as a parameter in a search. However, there are some cases in which the lack of metadata describing the content item could make the information contained within the issuer element rather important. For instance, an issuer specialised in issuing licenses for a specific type of content could become a target for searches for that specific type.

The principal, as well as the right, are certainly very fundamental for any similarity search. If the target of a search is the content having an associated license specifying a principal p_1 and a right r_1, the result of the search not matching exactly (p_1,r_1) would certainly score bad in terms of distance from the search target.

It has to be noted that in ORC licenses (those expressing in REL the CreativeCommons licenses) the principal is never specified, meaning that anyone is granted the rights specified by the license. All ORC licenses would immediately satisfy the principal requirement in a search. Instead, for all the cases in which the principal is a well defined entity (e.g. a *device* with a unique certificate, or a *domain* or a unique *user identifier* contained in a Smart/SIM Card), if this value doesn't match the same specified value, the result should certainly be interpreted as distant from the target. If a principal is specified in a license, this has a high relevance.

In an open network it can be the only distinctive parameter and in a local network (e.g. a home domain) the principal can be used to identify one of a restricted number of users.

Moreover, a number of content items may be governed by a license granting access only to users or devices belonging to a specific domain. In this case, in order to obtain more meaningful results, it is important that when a similarity search is performed, the principal parameter contains all the *identities* a user has, including, for instance, any domain which the user is subscribed to. In some circumstances, a user may have the opportunity to join a domain or obtain a license for a content item at a later stage, therefore even if the license of a content item does not grant a right specifically for the principal being searched, the user may become a valid principal in the future, hence the result of the search could get an high score in terms of distance even if the principal found is not the same as the principal searched for.

The same applies to the right; if the right found is not the same as the right searched for, the distance from the optimal result is certainly high. However, if the user has the chance to acquire the specific right he is looking for at a later stage, the distance would be reduced. Those specifications supporting the super-distribution model, such as ISO/IEC MPEG Media Streaming MAF standard [33], as well as the DMP IDP, enable specifying in the content item itself the location from where a license can be obtained, therefore if this information is present, it must be considered as a key factor.

Finally, the *conditions* under which a principal may exercise a right may play a decisive role, too. Only if all conditions in a license are fully met, a right can be exercised. While some conditions are deal-breaking (e.g. the geographical location in which a content item can be played: either the user is in that area or he is not), others may still be acceptable by the user even if they are not the preferred choice.

We propose in Figure 2 an example of rights and conditions for DAC and ORC profiles where the candidate attributes to be compared are reported. Rights can be represented mainly by binary attributes, while conditions include also numerical and textual attributes.

DAC		ORC	
Rights	**Conditions**	**Rights**	**Conditions**
possessProperty	validityInterval	possessProperty	territory
governedCopy	exerciseLimit	execute	drmSystem
governedMove	territory	play	derivationConstraint
derive	validityIntervalFloating	print	outputRegulation
execute	validityTimeMetered	modify	seekPermission
play	outputRegulation	adapt	startCondition
print	seekPermission	delist	copyrightNotice
enlist	startCondition	enlist	nonCommercialUse
delist	simultaneousAccess	governedCopy	sourceCode
drmSystem	noSkipConstraint	governedMove	
export	destinationPrincipal	aggregate	
extendRights	destinationCondition	embed	
	securitySystem	governedAdapt	
	proximity	governedAggregate	
	scrambling	governedEmbed	
	timedExerciseLimit		
	timeShiftDuration		

Figure 2. Example of rights and conditions for DAC and ORC profiles.

3.1. IPR-based distance functions

In this section we analyse the problem of defining a metric distance (i.e. a dissimilarity measure) between two licenses. We focus on comparing two licenses considering only the information related to the principal expressed in the query. For simplicity we will not consider the issuer in searching for similarity. However, it would be easy to modify the defined distance taking into account also the issuer and assigning a greater distance value to those licenses having different issuers. Thus, the distance is evaluated considering the rights and conditions that are associated with a given principal in both licenses.

Let $\mathcal{D}$ be the domain of metadata related to the license of any given object. For any object $x \in \mathcal{D}$ we use the following notation:

- $r_1, r_2, ..., r_{n_r}$ are the n_r possible rights;
- $c_1, c_2, ..., c_{n_c}$ are the n_c possible conditions;
- $x_{i,1}, x_{i,2}, ..., x_{i,n_c}$ are the n_c condition values for the i-th right.

We define the global distance $d(x, y) \in [0, 1]$ as the weighted sum of the distances between the rights, i.e.

$$d(x,y) = \frac{1}{\sum_{j=1}^{n_r} w_i} \cdot \sum_{i=1}^{n_r} w_i \cdot d_{r_i}(x,y) \tag{1}$$

where $d_{r_i}(x, y) \in [0, 1]$ is the distance between the two licences considering the i-th right, and w_i are weights used to give more or less importance to the various rights. Note that $\sum_{j=1}^{n_r} w_i$ normalizes the distance between 0 and 1.

We define the distance $d_{r_i}(x, y) \in [0, 1]$ between two licenses x and y considering only the right r_i as:

- $d_{r_i}(x, y) = 0$, if r_i is not present in both licences;
- $d_{r_i}(x, y) = 1$, if r_i is present only in one license;
- $d_{r_i}(x, y) = \frac{1}{\sum_{j=1}^{n_c} w_{i,j}} \cdot \sum_{j=1}^{n_c} w_{i,j} \cdot d_{c_j}(x_{i,j}, y_{i,j})$, otherwise (i.e. if the right is present in both licences). $d_{c_j} \in [0, 1]$ is the distance between the j-th conditions

for the right i in the two licenses, while w_{i_j} are weights used to give more or less importance to the various rights. Note that $\sum_{j=1}^{n_c} w_{i,j}$ normalizes the distance between 0 and 1.

Once a general definition of a distance function is given, the the distance $d_{c_j}(x_{i,j}, y_{i,j})$ between two values $x_{i,j}$ and $y_{i,j}$ of the j-th condition must be defined considering the specific attribute type. However, we must deal with the fact that the given condition could be not associated with the given right in one or both of the licenses. Thus, while the distance between two conditions of the same type must be defined considering the type of the condition (see next sections), all the condition distances must follow two rules:

- $d_{c_j}(x_{i,j}, y_{i,j}) = 0$, if c_j for the right r_i is not specified in both the license x and y;
- $d_{c_j}(x_{i,j}, y_{i,j}) = d_{c_j}(x_{i,j}, u_{c_j})$, if c_j for the right r_i is specified in only one (x) of the two licenses. u_{c_j} is the most unrestrictive value for condition c_j. In fact, if the condition is not present it means that it is not necessary.

We now give some example of distances for specific condition types.

3.1.1. Binary conditions

In many cases conditions are expressed by binary values, describing whether or not a given condition is necessary for the given right. In this case (i.e. $x_{i,j}, y_{i,j} \in \{0, 1\}$) we can use the L_1 norm, which assumes binary values as well. Hence the distance is directly computed as:

$$d_{c_j}(x_{i,j}, y_{i,j}) = |x_{i,j} - y_{i,j}| = x_{i,j} \oplus y_{i,j} \ . \qquad (2)$$

Please note that a specific weight to this distance can be given by setting $w_{i,j}$. Obviously, for binary value $u_{c_j} = 0$.

3.1.2. Numeric conditions

For conditions expressed with a number (i.e. $x_{i,j}, y_{i,j} \in \mathbb{R}$), which for example can represent a fee for accessing to the digital content, it is possible to apply the L_1 norm or the euclidian distance. However, more sophisticated metric distances could be used for specific numerical attributes. For instance, we suggest to define the distance between fees as $|\log(x_{i,j}) - \log(y_{i,j})|$, multiplied by a normalization factor α:

$$d_{c_j}(x_{i,j}, y_{i,j}) = \alpha \left| \log\left(\frac{x_{i,j}}{y_{i,j}}\right) \right| \ . \qquad (3)$$

According to Equation 3, the distance between \$5 and \$10 is the same as the distance between two fees of \$50 and \$100 respectively. We believe that given a fee as query, the user is interested on the proportion between its query and any given fee. Unfortunately in this case any non \$0 fees would be at infinite distance from \$0 objects. Incidentally, in the case of fees this feature may reflect a common attitude, because users that are looking for free digital content are not interested in non free items. For instance, they are not willing (or able) to purchase items on the Web, or they are browsing for material just because it is free.

Anyway, to avoid this problem we suggest that whenever the fee value is smaller than a given threshold x_{min}, the value used for evaluating the distance is automatically set to x_{min} (this value is assigned also to u_{c_j}). In this way, if for example we assign to x_{min} the value \$0.01, the distance between \$0 and \$1 becomes the same of the distance between \$1 and \$100, which is a reasonable assumption. It is worth noting that the distance is still a metric.

To keep the distance in the range $[0, 1]$ we do not only need a minimum but also a maximum value x_{max} for the fees. The value x_{max} will be assigned to any fee having a value above the upper limit x_{max}. Therefore, only for the purpose of evaluating a distance between two fees we will limit the fee value in a given interval $[x_{min}, x_{max}]$. The α factor is given by $|\log(x_{min}) - \log(x_{max})|$.

It should also be noted that there are other possible approaches for measuring differences in prices, for example the *gap-ratio* computed by the following equation:

$$d_{c_j}(x_{i,j}, y_{i,j}) = \frac{x_{i,j} - y_{i,j}}{y_{i,j}} \ . \qquad (4)$$

Anyway the gap-ratio is not symmetric and thus it cannot be used for the proposed metric approach.

3.1.3. Term based conditions

For conditions whose value is a term from a given vocabulary, we propose a specific approach. If the j-th attribute of the i-th group is a term taken from a specific vocabulary of m terms, we can define the distance $d_{i,j}(x_{i,j}, y_{i,j})$ between the two values according to what reported in Table 1 where $term_0$ is used as u_{c_j} (i.e. whenever the given condition is not specified). In this way it is possible to define a specific distance between any given term and a not specified condition.

It is assumed that the values of α are manually chosen according to the semantic of the given terms. For $d_{i,j}(x_{i,j}, y_{i,j})$ to be a metric the matrix must be symmetric, thus $\alpha^{i,j}_{a,b} = \alpha^{i,j}_{b,a}$, all the diagonal values must be 0 and

$$\forall l \ , \ \alpha^{i,j}_{a,b} \leq \alpha^{i,j}_{a,l} + \alpha^{i,j}_{l,b} \ . \qquad (5)$$

A user interface should help the administrator setting the α values according to these requirements. A trivial solution is to set all $\alpha^{i,j}_{a,b} = 1$ when $a \neq b$, and in this case textual attributes are considered as binary attributes.

	$term_0$	$term_1$	$term_2$	...	$term_m$
$term_0$	0	$\alpha_{1,0}^{i,j}$	$\alpha_{2,0}^{i,j}$	...	$\alpha_{m,0}^{i,j}$
$term_1$	$\alpha_{0,1}^{i,j}$	0	$\alpha_{2,1}^{i,j}$	...	$\alpha_{m,1}^{i,j}$
$term_2$	$\alpha_{0,2}^{i,j}$	$\alpha_{1,2}^{i,j}$	0	...	$\alpha_{m,2}^{i,j}$
...	...	...	...	...	...
$term_m$	$\alpha_{0,m}^{i,j}$	$\alpha_{1,m}^{i,j}$	$\alpha_{2,m}^{i,j}$	...	0

Table 1. Distance values for attributes taken from terms in a given dictionary

3.1.4. Distance for sets

For conditions that have sets as value we suggest to use the *Jaccard's coefficient* (which is a metric). Assuming two sets $x_{i,j}$ and $y_{i,j}$, the *Jaccard's coefficient* is defined as follows:

$$d(x_{i,j}, y_{i,j}) = 1 - \frac{x_{i,j} \cap y_{i,j}}{x_{i,j} \cup y_{i,j}}\ . \tag{6}$$

For conditions based on sets we use the empty set as u_{c_j}.

3.1.5. Metric distance

We now prove that if all the distances used to compare the values of each right are metric, the proposed distance between two licenses is still metric. In other words, a weighted sum of metric distances is a metric distance too. In fact, $\forall x, y \in \mathcal{D}$ and for any given right $i = 1, ..., n_r$ and condition $\forall j = 1, ...n_c$ we get:

$$d_{i,j}(x_{i,j}, y_{i,j}) \leq d_{i,j}(x_{i,j}, z_{i,j}) + d_{i,j}(z_{i,j}, y_{i,j}) \Rightarrow$$

$$\sum_{j=1}^{n_i} w_{i,j} \cdot d_{i,j}(x_{i,j}, y_{i,j}) \leq$$

$$\leq \sum_{j=1}^{n_i} w_{i,j} \cdot [d_{i,j}(x_{i,j}, z_{i,j}) + d_{i,j}(z_{i,j}, y_{i,j})] \Rightarrow$$

$$d(x, y) \leq d(x, z) + d(z, y).$$

Thus, if all the distances defined for the conditions are metric, the proposed distance is metric too.

4. Significant use cases

Searching for a digital item can be done by similarity search and/or by textual attributes. For example we can look for an image or a sound similar to what someone provided as query to the search engine. Moreover we can add to our query some keywords that the search engine will take into account as specific attributes.

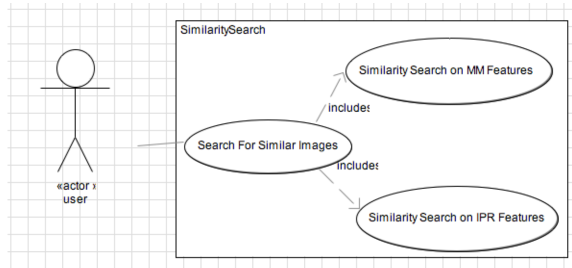

Figure 3. Use case diagram for similarity search

Nowadays most of the search engines available on the Web are providing nothing but the "full text" and/or "attribute" search capabilities. Even if many research projects are developing audio and image similarity search, the only approach concerning the licenses is based on attributes. Instead, according to our proposal, a user will be able for example to search for an image similar to the one provided considering both the multimedia content (content base) and the related license (provided by the user as well). Furthermore the user can apply for searching similar images regarding the multimedia content and a specific kind of license defined by mean of attributes.

In Figure 3 we are pointing out that the *similarity search use case* is made up of the inclusion of two distinct use cases described below, respectively the similarity search on multimedia features and the similarity search on IPR features. We have to consider the IPR features as all the possible attributes expressing a license. Focusing our attention to MPEG-21 REL the IPR features could be considered as example as all the attributes available for expressing the issuer, the principal, the rights and conditions. Hence the user can either provide a REL license (conforming to MAM, DAC or ORC profiles), or a list of attributes expressing the search criteria to the algorithm performing the search.

We can figure out at least the following use cases dealing with images:

1. the user is searching for images similar to a given one both considering its visual appearance and the provided license

2. the user is searching for images similar to a given one but with specific license "attributes"

In the first use case, let's consider as an example a user interested in an artistic image for his desktop. Let's also suppose that he finds a low resolution image on the Web of a painting whose he does not know who the painter is. If the user is interested in acquiring the same picture with higher quality, he could perform a query using the system described in this paper by providing in input the low quality image and the desired rights information, expressed in this case as an ORC license. The search engine will display as a result the ranking list of images similar in terms of "pixels" and rights information to the one provided. For example a result could be a picture of the same painting made by a tourist and released according to a CreativeCommons license and another result, probably distant from the previous in the result list, could be the photograph of the painting made by a professional photographer having an attached license expressed in MPEG-21 REL, expressing for example the price for downloading the high resolution picture. The user can then choose among the two results, according to both the quality of the image in the result list and the kind of license, having immediately the feeling of how far is the result from the provided object query.

In the second use case the user is able to identify objects stored in the network that are very similar to those provided in the query, but for example with a different license. Imagine a professional photographers agency that wants to be sure that nobody is using their own pictures in an illicit way. The agency can query the system by providing the picture to be searched and the attributes of an open license or something "similar" to an open one. If the system finds a result, it means either that someone has made the same picture or that someone is sharing an unauthorized copy of the picture. This use case is innovative because the current search engines are focused on content sharing without addressing the "control" of the content itself, delegating this feature entirely to the DRM systems.

5. Conclusions and future works

We have proposed an innovative approach for indexing and searching digital items based on their associated rights information expressed in MPEG-21 Rights Expression Language, according to specific profiles of this standard. The metadata shown are taken as examples and should be changed to fit the needs of the software infrastructure the user has to deal with. This approach is considering the IPR attributes as *special features* which a specific metric distance function can be applied to, enabling efficient querying on different IPR schema representations and complex rights expression structures.

Although several organizations are dealing with the expression of rights information, not so much has been done so far concerning the "retrieval" of the license associated to the digital items. The proposed approach does not claim to cover all possible rights statements and expression languages available nowadays. However, by selecting a joint of the three MPEG-21 REL profiles mentioned above, the solution will indeed support a large number of use cases. Furthermore we can also have a ranking list of results according to the metric function, by defining the distance between the license attributes and, eventually, by a mapping between license types that the user has to manage.

Since the definition of the distance between licenses depends on specific needs, the relative importance of the rights and/or conditions should be configurable. If the weights are defined by the system administrator, being the proposed whole distance a metric, the search can be efficiently performed using state of the art data structures for similarity search in metric spaces. If a few sets of different weights are used (e.g. for different user groups), the whole distances can be used to build distinct instantiation of the data structures. Instead, if the weights must be fully configurable at query time, algorithm for complex query execution should be used, causing a degradation in the system performance.

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