IM@GIX

An Electronic Commerce Digital Image Bank

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Abstract: This paper describes the usage of specific web application designed for the Electronic Commerce of Digital Still Images using some of the state-of-the-art technologies in the field of digital imaging, namely copy right protection. Still images are not only traded using this platform but also value is added to the images through the means of cataloguing, metadata and watermark insertion. This work is performed using some auxiliary tools, which are also referred in the present paper. This paper also proposes and discusses a methodology for streamlining the production of still digital image content. The methodology proposed and described here, called DIGIPIPE, encompasses several steps which range from the simple image digitalization until the image trading, without omitting the image copy rights protection procedures.

1 INTRODUCTION

Digital content electronic commerce is gaining a growing importance in our modern days. Successful examples appear everyday in the World Wide Web and the online trading digital goods and services grows in terms of popularity and importance. In particular, and for what concerns the present paper, the digital still images e-commerce, cases like Corbis (http://www.corbis.com) and Photodisc (http://www.photodisc.com) are the two most significant of the growing importance of this type of business. Other types of media content are also gaining importance in digital content trading market: music and video. Music web stores are flourishing in the World Wide Web, in particular due to the advent of the MP3 music format, which facilitates music exchanges. However, infringements to the copy rights of such digital content occurs and MP3 (music) and DivX (video) formats, although they facilitate file exchanges over the Internet, are two of the most important responsible. Although the menaces the digital content trading market faces, digital imaging trading can profit from e-commerce since most its customers (marketing agencies, newspapers, magazines) can directly access the digital image bank and search the appropriate digital image for their special needs, negotiate, buy and acquire it. Disintermediation is a key aspect in this type of business.

In order to explore in depth this new trading market it is necessary to defend these digital goods rights owners. Copyright is an essential aspect providing the legal basis for protecting the associated work value. However, the copyright value depends upon the legal tools that rights owners or other interested parties use to protect it. This aspect is being especially important in the digital world where technology makes easy for users to copy and distribute images or other type of content. Without a concise protection scheme capable of enforcing the owners copy rights they will not put those works to trade turning unviable the overall process. In order to be successful is necessary to protect and also manage the rights associated with perceptible value content in a way that is attractive to the overall players.A simple schema regarding rights protection possibilities can be pictured according a representation of increasing protection levels or stages.

- Stage 1: No protection; for maximum dissemination;
- Stage 2: Warning on copyright; could dissuade a possible abusive use;
- Stage 3 Passwords; prevent unconditional access;
- Stage 4: Low resolution images; gives content no commercial value;
- Stage 5: Distortion/stamps; inhibits unapproved use of commercial value content (images, songs…);
- Stage 6: Watermarking; encapsulating right owners identification, turn possible tracking unlicensed users and prosecute people that made an infraction; to be more feasible to prosecute possible infractions, content must be registered.
- Stage 7: Encryption; could deter possible infractions applying sophisticated techniques to control access and content usage;
- Final Stage: Rights management; to control the usage of content, using a global infrastructure for supporting the main rights owner's requirements. That infrastructure consists of a set of sub-systems (certificate authorities, licensing authorities, payment system, registering authorities and others) which are capable of enabling the trust between all the concerned elements on the commercialisation chain. In order to increase the levels protection efficacy these measures must considered and applied globally this way enabling new business models. The key technology that will allow creators, publishers and distributors to frustrate and dissuade possible pirate is based on cryptography. All the marking and protection schemes in which it is integrated will stipulate and state the way content is accessed and used. If the overall process is based on standards, it will be easy to convince the interested in the commercialisation chain to fully explore this new way of doing business with digital goods. Obviously to fully exploit these new forms of use there must exist also new ways to distribute these digital assets; and this can turn obsolete the traditional ways bringing opportunities not yet completely defined to new out comers. To support the overall infrastructure making possible this new way of doing business there must exist a set of sub-systems enabling a rights management platform. Registering authorities, meta-data infrastructure, license authorities, financial institutions, trusted third parties and content management entities are the basic elements of that infrastructure and turn possible support the commercialisation process enabling a rights management system that can give enough trust to overall players on the commercialisation chain.

1.1 The Corbis Corporation Case

Corbis entitles themselves as *"The leading provider of photography and fine art over the Internet"* and with some reason. The Corbis Collection is made up of the world's most significant photography and fine art from more than 3,000 creative sources. With more than 65 million images, 2.1 million online, Corbis is offering a wide range of choice and is the leading provider of digital images to both the consumer and creative professional markets [1].

Corbis also uses an extensive Internet technology to allow customers to quickly and conveniently access and purchase images and related products. Once digital images are distributed over Internet, it is easy they go to the wrong hands. To protect its digital value and dissuade possible infraction Corbis use digital watermarks. Carrying information about the source along with the image in a way that can't be identified or manipulated is possible turning viable to embed copyright information [2]. Digimarc, a Corbis partner in the area of digital watermark applies is own technology creating a new distributing and license platform. Digimarc can identify web sites that use those images legally or illegally. The imperceptible data embedded in the image could link viewers to image specific destinations once the image is opened or scanned. Tracking these images make possible to dissuade and deterring possible image usage infringements.

1.2 The Photodisc case

PhotoDisc is a pioneer in the development and marketing of digital stock photography products and electronic delivery of images. Its products are offered on a royalty-free basis, which allows customers to pay a one-time fee to use an image on a perpetual, non-exclusive basis for almost any purpose. Was acquired on February 9, 1998 by Getty Images Inc. [3] that have another important subsidiaries in the digital image area (Art.com, Inc., EyeWire Partners, Inc., Visual Communications Group (VCG),…). Photodisc essentially is a provider of royalty-free imagery and a provider of imagery on the Internet. The principal customers are creative Professionals and are essentially contemporary stock photography in the area of advertising, graphic design, licensed and royalty-free broadcasting, Website images and illustrations and design, marketing and corporate communications. Registered users may download a low resolution image (72 dpi) without a watermark; non-registered users get the comp images with a watermark. The watermark will be on there unless we purchase the image. Users can store temporarily images in a light

box, and allowing (client, partners…) to have a look at the selection having this mode an excellent way to composing.

2 THE IM@GIX PLATFORM

One of the biggest problems that the Electronic Commerce of digital images faces is the protection of the author's rights. Digital Rights Management (DRM) is a hot issue in Electronic Commerce and in fact is a problem that both Corbis and Photodisc cannot solve completely. They both impose generic contractual conditions and use visible watermarks, but those features seem to be insufficient as DRM (Digital Rights Management) measures.

Im@gix is a Portuguese software solution developed for the image trading over the Internet having the DRM as one of the main goals of the application. This DRM application uses registration, meta-information and watermarking technology to uphold author's rights on the digital object (in these case, digital still images).

Two different parts compose the software application: the registration station and the electronic commerce application. While the first is used primarily to register each of the images with a unique id, the second is used to make the images available on the Internet to everyone.

2.1 Registration Station

A registration station is responsible for the assignment of unique identifiers to the media content – in the images case, an unique registration number is assigned to each image. This unique identification number is called license plate, which is compliant with a JPEG standard (JURA – JPEG Utilities Registration Authority) [4]. This license plate has a special format (11-PT-1098-xxxx) and identifies uniquely the image in the system (and globally in the world). The registration process is described in more detail in a next section of the present paper.

Registration authorities play an important role in the DRM scenario since they assure the unicity of the digital content, making content forgery harder. Also, registration authorities can play a decisive role in case of copy right judicial disputes.

2.2 Electronic Commerce Application

The Electronic Commerce Application encompasses the front-end of the Im@gix platform. This front-end is used to electronically trade the digital images to the final consumer, working like a vertical portal for digital images. The final consumer can access this front-end through a normal web browser and browse through the image catalogue, search for a specific image attribute, negotiate the image conditions and then order the image. This application is composed by a set of components, which are specified and described in the next few sections.

2.2.1 Image Catalogue

The image database structure is organized in such a way that a great number of information about an image is also stored. In fact, the image database has a structure compliant with DIG[1]35. The image catalogue has three different organizations: by author, by collection and by category. It is possible for the user (potentially a consumer) to navigate both through the author, collection or category path.

The focus of the DIG35 Initiative Group is on defining metadata standards. By establishing standards, the Initiative Group seeks to overcome a variety of challenges that have arisen as the sheer volume of digital images being used has increased. Among these are efficiently archiving, indexing, cataloguing, reviewing, and retrieving individual images, whenever and wherever needed.

From the consumer's standpoint this means avoiding the digital equivalent of an unorganised shoebox full of photos. For businesses, it means maximizing precious assets in the form of well-organized and accessible image archives.

The key focus areas of the DIG35 Initiative Group include: (a) Defining a standard set of metadata for digital images that can be widely implemented across multiple image file formats, (b) providing a uniform underlying construct to support interoperability of metadata between various digital imaging devices, (c) ensuring that the metadata structure provides both a common inter-application exchange format and a high-degree of extensibility for enhanced use by specific applications and (d) educating the industry at large regarding the importance of metadata usage, preservation and exchangeability.

The author browse option allows the users to browse through the image catalogue by choosing an author and navigating through the images available for that author. The user can also view a specific image collection of a particular author, if the author has defined and organized their images into collections.

The category browse option, displays all the image categories, which contains images offering

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[1] Digital Imaging Group

the possibility for the user to choose images from a specific category.

2.2.2 Advanced Image Search

One of the most important features of these types of applications is the possibility they offer to users search for a particular image. This is quite important since most of the times the user has the need for a specific type of image, with very specific characteristics in a very short period of time (publishers, marketing agencies).

Im@gix platform provides this feature to incoming users providing the possibility to perform a search by a large number of criteria and also by its logical combination (author name, title, license plate, description, keyword and others).

2.2.3 User Administration

User administration is a standard feature in most Electronic Commerce Applications and in Im@gix is not an exception. In particular, User Administration in Im@gix is important because one of the key features is to protect the image usage rights, which must be connected to the user unique identification. This user identification will be used to fingerprint the acquired image in order to trace images. This process is described in detail in the next sections. Apart from this feature, this component is used to process the registration of new users on the Electronic Commerce Application.

2.2.4 Secure Image Contract Negotiation

The contract negotiation is an important way of DRM. Both Corbis and Photodisc provide a generic image license for each of the image they sell. However, this is only a generic license equal for all images, but in some cases it makes sense that some images have different license conditions and consequently different values.

Im@gix application also provides the possibility to implement this type of business models, however other ones can be choose that uses a specific type of license for each of the images. The user after choosing an image can also choose which types of utilization will be used on the image. According to the type of usage choose for the image there will be a difference on the price of the image. After the user chooses all the conditions and the price, he receives a contract that he must sign electronically.

2.2.5 Secure Payment

Im@gix provides several payment methods for the payment of an image, and those payment methods are secure, using SSL/TLS protocol. This protocol is one of the most used to secure transactions over the World Wide Web, and requires normally the authentication of the Electronic Commerce Application. This platform can support multiple payment methods, but currently only credit card payment is supported.

2.2.6 Secure Image Download

The final image is available in TIFF format (TIFF is the most used format for digital imaging workers), which results in a large image file.

There are two possible ways of delivering the image to the consumer: either it can be offline or online. The offline manner is useful when the user does not have a good Internet connection. The image is save on a CD-ROM and sent to the user using the choose delivery method. If the available Internet bandwidth is sufficient the user can directly download the acquired image from the image bank. This download is processed in a secure way using SSL/TLS protocol.

3 DIGIPIPE METHODOLOGY

One of the goals of this paper is to describe the methodology used by the Im@gix platform, which is called DIGIPIPE – Digital Imaging Pipeline. This methodology describes the process of streamlining the production of digital still images, and trading them in an Electronic Commerce Application using DRM solutions. Digital images can be obtained from different source: both from the digitalisation of non digital material, or more recently, directly from digital cameras which are growing in importance due to its reduction in price.

Digital cameras are an important advance in the world of photography and images. By using digital cameras, it is possible to capture photos directly in digital format, compress them in a specific choose file format and afterwards store it in a digital removable device (a SmartMedia card, for instance) or connected it directly to a computer using a USB cable or an infrared connection.

The methodology proposed here encompasses 12 well-defined steps, which one with their particularities and specificities: pre-selection, digitalisation, selection, retouching, pre-cataloguing, tilling, registration, watermark insertion, CD-ROM production, and portal publication, cataloguing and

trading. Each of these steps is defined in the next few topics.

As most of the methodologies, they tend to serve only as guidelines for best practices. DIGIPIPE, therefore also provides the guidelines for speeding up the production and commercialisation of digital images and in which copy right protection is a key issue. Not all the steps of the process are mandatory and most of them can be omitted or stepped over.

Step	Name
1	Pre-Selection
2	Digitalisation
3	Selection
4	Retouching
5	Pre-Cataloguing
6	Tilling
7	Registration
8	Watermark Insertion
9	CD-ROM production
10	Portal Publication
11	Cataloguing
12	Trading

Table 1 - The DIGIPIPE methodology phases

3.1 Pre-Selection

Pre-selection is the initial phase of the DIGIPIPE methodology and is the process responsible for performing a first selection to the images that have d enough quality to be digitalized and possibly published in the portal afterwards.

The author delivers the images in non-digital format (35mm, 6x9 mm slides, paper or other formats) to the Im@gix platform administrator and together they perform an interactive and exhaustive process for selecting the best quality images that will pass into the next phase.

Some of the choosing criteria, which are important in this phase, are: (a) Image technical quality: both the author or the administrator can reject images which are technically considered as being of bad quality; (b) Image type: if the author or the administrator consider that the image is not adequate for the purposes; (c) Image themes : if the image independently of it quality don't fit in any site themes could be rejected;

Selected images go into the next methodology phase whilst the rejected images are returned to the author. This phase will never take place if the images are already in digital format, for instance if they are obtained by a digital camera.

3.2 Digitalisation

This phase uses a high-quality image scanner to produce high-quality digital images (or the images are obtained directly from a digital camera). This scanner must be able to support multiple slide formats and must be able to produce high-resolution images (600 to 1200 dpi, or superior), resulting in an uncompressed file of several tens of megabytes.

The images (slides) must be perfectly cleaned in order to remove dust and scratches from the film (sometimes this process is not possible). This could interfere in the final quality of the digitised images.

The images selected in the previous phase of the methodology are the digitised by the Im@gix operator resulting in a file, which is then saved to the hard disk.

3.3 Selection

The selection phase is the final selecting phase in this methodology and will filter the digital image that will pass to the next phase of the methodology.

The digital images are loaded from the hard drive and opened in an image editing software in a perfectly colour calibrated screen monitor (Adobe Photoshop is a good software for performing such task). The administrator, through visual observation of the digital image determines if the image is selected or rejected, based on the level of imperfections resulting from the digitalisation phase (changes in colour, scratches in the image, among other imperfections). The author can, optionally, participate in this phase if necessary. The rejected images can return to the digitalisation phase or definitely rejected and returned to the author.

3.3 Retouching

This phase is used to correct minor visual imperfections detected in the digital image after performing a visual observation. This phase can occur at the same time then the previous one.

Like in the previous phase, the digital images are loaded from their digital support and opened in an image editing software on a perfectly colour calibrated screen monitor.

The administrator performs an accurate visual examination of the image and if necessary performs some retouch operations. These operations could include some of the following: cropping, colour balancing and correction and others. The images can be stored once again in the digital support or rejected if the retouching process results were not satisfactory. In this last case, the images must be

digitised once again. If the images were acquired directly from a digital camera then it is impossible to re-digitalize them again, and the pictures will need to be re-taken.

3.4 Pre-Cataloguing

In this phase, some additional information about the image is collected and stored on a database. Although in this pre-cataloguing phase it is not mandatory the author's presence it may occur that in some cases it can reveal useful its collaboration. The images are loaded from digital support and opened in an image editing software by the administrator. The administrator then fills a small electronic form containing some information about the image: (a) Category and subcategory (this information is gathered from a thesaurus of available categories and subcategories); (b) Initial description; (c) Author name; (d) Collection info (for this information it is important the author's cooperation).

This information is automatically filled on the database and is the first information about the image.

3.5 Tilling

The process of tilling consists in the production of several different image sizes from the original image. The Im@gix platform uses three different tiles: thumbnail, preview and original. Why is the tilling important? Tilling is particularly important due to the current bandwidth limitations of the Internet allowing a much faster browsing through the images.

This methodology suggests the usage of three different image resolution levels, but more levels can be defined, and actually that depends on the business models that the administrator wants to implement: (a) <u>Thumbnail</u>: is used to perform a faster display of the image on web pages; (b) <u>Preview</u>: this level is used to capture details of a particular image; (c) <u>Original</u>: this is the original image in its original size - the image that will be traded.

3.6 Registration

The registration phase is one of the most important in this methodology and constitutes an important DRM feature. In this phase, the digital object is uniquely registered and a unique identifier is issued – the license plate (LP). This LP will be used on all system to identify the image [4].

The LP is unique image identification and is composed of the following:

- An identifier of the type of the digital object (e.g. 11 means that this is a still digital image);
- An identifier of the registration authority: it is composed by the ISO country code and a number;
- A sequential number: indicating the number of registration within the registration authority.

The registration process works in the following way:

- The original image is loaded from the digital support;
- A cryptographic hash function is computed from the image file data, using MD5 hash algorithm. The obtained hash value warrants the of the image uniqueness, since the possibility the two different images get the same hash value is probabilistically very low (MD5|image_file|);
- A new license plate number is assigned and attached to the hash value of the image;
- Both values are stored on the registration database;
- The pre-cataloguing phase data is loaded from the database and inserted as metadata inside the image file together with the license plate.

This registration process uses a tool called RCM [2], a web-browser based tool integrated in the Im@gix platform, which registers all the authors' images in a valid Registration Authority.

3.7 Watermark Insertion

This phase is also very important in any DRM solution. This is perhaps the most effective way to protect a digital image [5]. During this phase two different types of watermarks will be used: visible watermarks to embed a visible logotype (WM[logo, image]) on the image preview level, and an invisible watermark that will be used to embed the information (license plate) on the original image (WMpriv[LP, image]). This methodology does not adopt any specific watermark algorithm or technology and is up to the administrator to choose the most appropriate for its needs. A good example of such technology is provided by companies such as Digimarc [3]. The original image is loaded from the digital support and using an invisible watermarking algorithm, the LP information is embedded in the image. The resulting image data is stored. The preview image is also loaded from the digital support and using a visible watermarking algorithm, an image logotype is stamped on the preview image. The resulting image is stored on the support.

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[2] This tool is available at http://rcm.adetti.iscte.pt
[3] http://www.digimarc.com

Metadata allows image files to contain additional information beyond the pixels in the image itself. This data about the image can be used in a variety of ways, including:

- To enhance the content of the image (by adding an audio track, for instance)
- To provide in-depth information on the image and its creation, such as date and time, focus distance, light levels, GPS location, etc.
- To allow for easy indexing, identification, categorization and usage-control according to image type, copyright conditions, originator, subject matter, location, etc.

The ability to efficiently embed additional information directly into the image file also opens up a variety of new and powerful applications scenarios. For instance, metadata could be used to automatically provide distributed Internet applications with machine-readable embedded information, thereby conserving bandwidth, streamlining usage and simplifying requirements for user intervention. At this stage the original image is protected both with an invisible watermark which contains information about the registration authority and with the metadata which contains information about the image author. The SPIFF file format is used to store the metadata information.

3.8 CD-ROM production

At this stage it could be useful to produce a CD-ROM or DVD catalogue containing the registered and watermarked images. This CD-ROM/DVD is then delivered to the author. This catalogue will be produced both in HTML and XML and will be visible using a normal web browser. It will contain all the three levels of image resolution and the pre-cataloguing information. The CD-ROM catalogue is then sent to the author, transmitting the image protection phase of this methodology. If the author is not planning to trade the images over the Internet then the next phases of this methodology are not necessary.

3.9 Cataloguing

The Electronic Commerce Application will provide a mechanism for the author to add some information about himself and about the images published on the portal. Such information includes:

- Image title: a descriptive title of the image;
- Image detailed description: a detailed description of the image, describing as most as possible all the elements contained in the picture;

- Image category and subcategory: the category and subcategory where the image will be placed (obtained from thesaurus of categories and subcategories);
- Image collection and collection information: if the image belongs to a particular collection then this information and also information about the collection itself is taken in account;
- Image keywords: this is a set of keywords used to describe the image. This is important for searching purposes, therefore the process of keyword selection is crucial;
- Author information: general information about the image author;
- And other relevant information.

This cataloguing information is stored in the database and most of this information is provided and managed by the author using a web interface.

3.10 Portal Publication

This phase is where the author decides to trade the images and they are published in the WWW through the Electronic Commerce Application. This will organize the images in such a way that they will contain some value for the final user. Three types of organization are present in this platform:

- Organization by author: the images are organized by author, and is possible for the user to navigate within all the images of a given author;
- Organization by collection: images are also organized by collections and one author can have multiple collections. The user can, therefore navigate on a particular author images collection;
- Organization by Category: images are also organized by categories and subcategories. This will allow the users to guide their searches over the Im@gix platform.

This provides the user an improved navigation experience and allows the user to choose the most appropriate image for their needs.

3.11 Trading

When the user is presented at Im@gix site he is notified with a copyright notice. The images are then selected and sent by the delivery method choose to the user. The negotiation process involves several steps that are specified in the following topics [6]:

- Choose the image: first of all, the user chooses the image to buy. It is possible to observe this image in different resolutions and to access information about the image;

- Choose the image Usage type: after selecting the image an interactive negotiation process starts, where the user must specify which will be the usage of the image. This usage has several parameters. These parameters are bounded with the contract the users signs when he buys the image:
  - o Generic Usage: the generic usage of the image the user is buying;
  - o Specific Usage: each generic usage is composed by a more specific usage type that the user must also choose;
  - o Specific Usage Conditions: these conditions specify several other contract conditions: (1) Edition: the edition number where the image will be used (in some usages this does not apply); (2) Distribution: the image distribution; (3) File Format: the final file format; (4) Exclusivity: exclusive rights over the image during a period of time; (5) End Date: the contract end date; (6) Temporary Price: price automatically computed from the user choices. This is not yet the final image price, since it will depend on the delivery method.
- Accepting the contract: after choosing all the contract conditions, the user is presented with the final contract and he must choose whether to accept, reject or suspend the contract. In case the contract is suspended the user can later on begin with a suspended negotiation;
- Delivery Address: this is where the user will fill the delivery details for the image and invoice. The user is required to fill this information only once;
- Payment Method: the user can choose from several payment methods when buying the image;
- Delivery method: allows the user to specify which the delivery method for getting the image is. This will influence the final image price.

After this interactive trading process is finished the image and a copy of the contract is sent to the user.

4 CONCLUSION

To enable commercialisation of digital goods we must provide content protection and rights management in a way that can enable trust between parties. To do that Im@gix adopts a versatile platform and methodology.

To enable a commercialisation chain the overall infrastructure makes usage of access and control techniques that can give enough assurance to copyright owners. The protection schema possibilities are not forgotten and always is present implementing various simultaneously protection techniques that are synergetic enabling an enough trust level for copyright owners (copyright notice, registration, watermarking). These techniques are obviously insufficient if we don't have a system capable to support the management of content and associated rights (we must point to contract negotiation, cataloguing and metadata insertion). DIGIPIPE methodology enables this support but also in conjunction with Im@gix platform enables a versatile and trusted way of doing business. The overall infrastructure and methodology adopted contributes to trust giving to the user a versatile way to use digital images without the constrictions found on other platforms and gives also to copyright owners a trusted way to commercialise is goods without many concerns that they have in other platforms. Im@gix is a software solution for image trading over Internet and goes beyond other cases analysed. Applying DRM solution more deeply (registration, meta-information, and watermarking) and is own innovative DIGIPIPE methodology it have adequate conditions to be successful. Applying a business model where users can make a contract negotiation online associated with a secure electronic payment method this software can enable a robust and versatile electronic commerce platform. With these contributions it can more power to this new way of trading digitals assets in the digital world being an interesting case to watch at next years. The presented platform and methodology is currently implemented in a small company, called Portimax which is trying to explore commercially this platform and this methodology.

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