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VALIDATING THE EFFECTIVENESS OF USING DIGITAL WATERMARKING TECHNOLOGY FOR E-COMMERCE WEBSITE PROTECTION

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Abstract

With the popularization of the Internet and e-commerce and the expansion of e-government services, a variety of recorded data and documents that are relevant to such transactions and services are constantly created and exchanged electronically. This typically takes the form of multimedia content sold over the Internet, which in fact began with the distribution of digitized music, and currently a wide variety of content-based businesses are being launched. In such situations, it is important to preserve the reliability of electronic data and documents by ensuring that the content cannot be altered. In addition to its superior quality, digital content has the characteristics that it is also easy to handle and its quality does not deteriorate even if the content is duplicated. On the other hand, due to the fact that the quality does not deteriorate, digital content also bears the risk that it can be easily duplicated illegally. The problem of content usage abuse that has accompanied the popularization of the Internet and advances in digital technology is one of the barriers obstructing the operation of digital content-based businesses, and the damage that this abuse causes is growing. One technology that can resolve these problems is digital watermarking. Digital watermarking technology leaves evidence that can be used to enforce the copyright of the digital content, and it embeds the creator's information into the digital content itself. In this research, an Internet search engine was operated with the objective of detecting abuse of digital content early, as well as identifying websites disclosing digital content without authorization. By using digital watermarking technology, we provided a means for resolving the problem of damage incurred to e-commerce websites due to copyright infringement. We also embedded information into the content, deterred the abuse of content usage through detection, and verified the results.

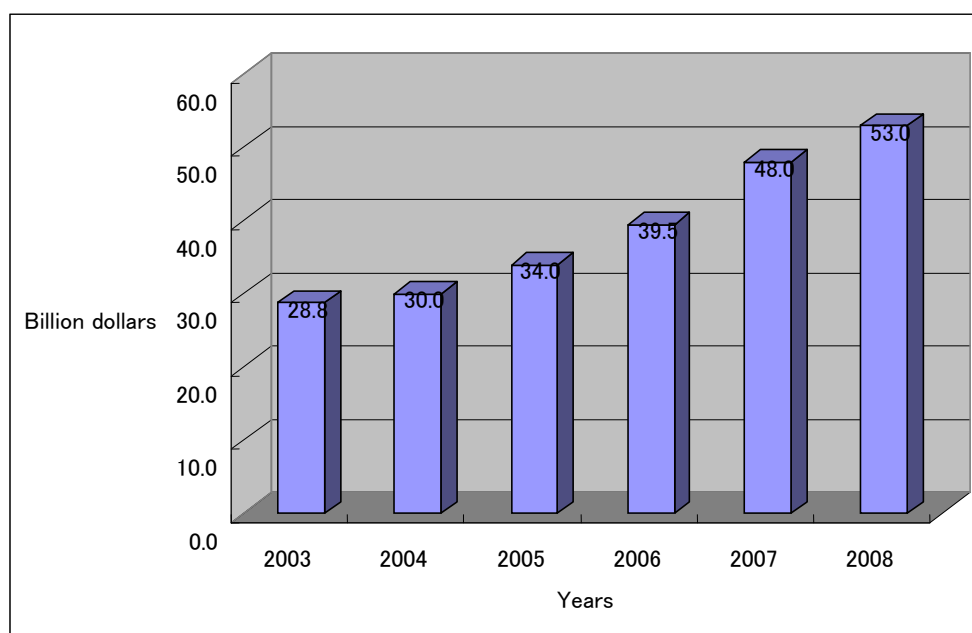
Keywords: Information Systems, E-commerce, Security, Digital watermark, Copy protection.

1 INTRODUCTION

With the spread of new copyright-management businesses that use digital technologies and networks, the government is working on policies for copyright protection that include legal reform, and improvements to enable a structure for smooth rights processing. Organizational activity for the enforcement of the Act on Management Business of Copyright and Neighboring Rights for reform of the copyrights centralized control system and the establishment of rights management tools, and the construction of J-CIS (copyright centralized information management system), which will be the centralized access window for copyright information, are both making progress. In response to this, the WIPO Copyright Treaty and the WIPO Performances and Phonograms Treaty were adopted by WIPO (World Intellectual Property Organization) in December 1996 as an international framework. As a result, Japan also revised the copyright law in 1999. In this revision, to reinforce the rights of copyright holders and secure the effectiveness of rights that apply new technology, regulations were created restricting the manufacture of devices that bypass copy protection or other technical means of rights protection, as well as regulations on the alteration of copyright management information. The copyright law was revised again in 2000. Provisions were established for court procedures to strengthen recovery mechanisms in the case of rights infringement. In addition, to strengthen deterrence of rights infringement, measures such as raising the upper limits on monetary penalties for infringements by corporate bodies were implemented. In regards to

digital contents, a variety of international bodies are making progress in their efforts to create standards. There are also a variety of media and technologies that standards bodies of related technologies are targeting.

As previously stated, the handling of digital contents is highly anticipated in the future business scene, but on the other hand the news is not all good. Because digital data can easily be copied, the user could sell it to a third party without permission, and there is also the possibility that the contents will be illegally copied while in route over the Internet. Because there are no markings on the contents themselves that shows who holds the copyright, who sold it, or who purchased it, it is difficult to determine the route even if the contents are redistributed. If there is no evidence, then even if the contents are illegally copied it is impossible for the copyright holder to prove the justification of his claim. Because of this, if illegal copies of the contents are made on a regular basis then the distributor cannot collect an income appropriate for the contents provided, and the business model will collapse. From the perspective of digital content businesses that use the Internet and plan their business model on the ability to retain their digital contents, the anticipation for success is high. On the other hand, they also bear the risk of loss due to illicit copies of their contents. In recent years there has been a big change to the environment related to digital music.



*Figure 1. Amount of damage by illegal copy
(Source: Business Software Alliance)*

The objective of digital watermarking is to leave evidence that will affirm the copyright of contents, embed the owner's information into the digital contents that are being used, and provide a service that will detect the illegal use of digital contents early. This research will resolve the damage that e-commerce websites incur from copyright infringement with its proposed solution, and verify the effectiveness of stopping illegal content use and authentication by embedding information into digital contents and using detection.

2 CONTENT PROTECTION TECHNOLOGIES AND THEIR ACTUAL PERFORMANCE OUTSIDE OF JAPAN

There are many videos, images, and voice data published on Internet web pages. Entertainment-related websites have pictures of TV stars, and websites for mail-order business have many products and catalogs on them. There are cases in which the contents are taken and copied without permission and loaded onto the user's website, and there are also malicious cases where logos with registered trademarked are copied.

There are also many problems where invasions of privacy occur when a person's picture is published on a web page they do not know. One reason that digital contents are used illegally on web pages is that there are no measures in place to prevent the illegal use of these digital contents.

Taking measures with the objective of protecting digital contents will make it possible to enforce the copyright even when illegal use has occurred (by verifying the copyright holder). This allows legal measures to be taken against the illegal website that is infringing on the copyright. Moreover, providing this as a comprehensive solution will give life to a new business scheme for digital contents distribution.

There are great expectations for business opportunities centered on digital contents in this Internet age. However, the susceptibility to unauthorized copying stands out. According to the 21st century vision for information and telecommunications as seen by the Ministry of Posts and Telecommunications, in 1995, 33% of the 29 trillion yen communication industry was digital contents. However, the Ministry expects that in 2010 the market will have grown to 125 trillion yen, 55% of which will be digital contents. For the solid growth of the promising industries a contents protection technology that will be the mechanism to protect copyright holders and their content is necessary.

Contents protection technology is an all-inclusive concept that includes the prevention and deterrence of unauthorized copying of contents, and copyright protection technologies. One effective technology for digital contents protection is "digital watermarking." Digital watermarking technology development began around 1995, and its full-fledged application began in about 1998. Digital watermarking places an imperceptible mark into the digital contents itself that identifies the copyright holder. The mark can be used as evidence for tracking in the event that the contents are copied. Digital watermarking does not prevent unauthorized copies. However, it can be applied broadly and is effective in enforcing copyright.

3 SERVICE APPROACH

We will explain the service approach constructed for this research. The functionality included in the solution, roughly divided, is as follows:

3.1 Embedded Functionality

Digital marking technology makes it possible to embedded information about the copyright into the contents. There are two types of view configurations for the digital watermarking information, the visible type, and the invisible type. With the visible type of watermarking the embedded information can be seen on the surface of the contents. Conversely, with the invisible type of watermarking processing is done so that the embedded information cannot be seen. With the invisible type, the embedded information cannot be perceived with human senses. Moreover, when contents that have digital watermarks are printed the information is preserved, so it has the effect of hiding the existence of the copyright information.

The idea behind the embedding function, which is one of the service approaches, is as follows:

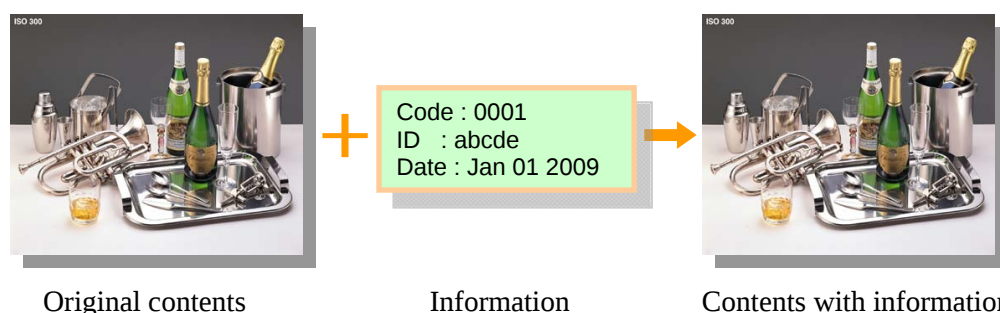


Figure2. Conceptual Diagram for Embedding

Watermarking stamp (visible) technology is a digital watermarking function in which a translucent stamp is placed on an image, and the stamp can also be removed from that image. An image can be created with

a color stamp of a logo or bitmap of your own creation placed onto an image in JPEG format. By using a separate “watermark stamp removal program” the image user can easily remove the watermark from the stamped image and return the image to its original form. By applying this stamp to important images published on the Internet the images can be generally published without being circulated without the owner’s consent. Moreover, by distributing the “removal program” to specific users who access the same images, they can view the clean original images without watermarking even though they are accessing the same website as the other general users.

The conceptual diagram for the embedded system is as follows:

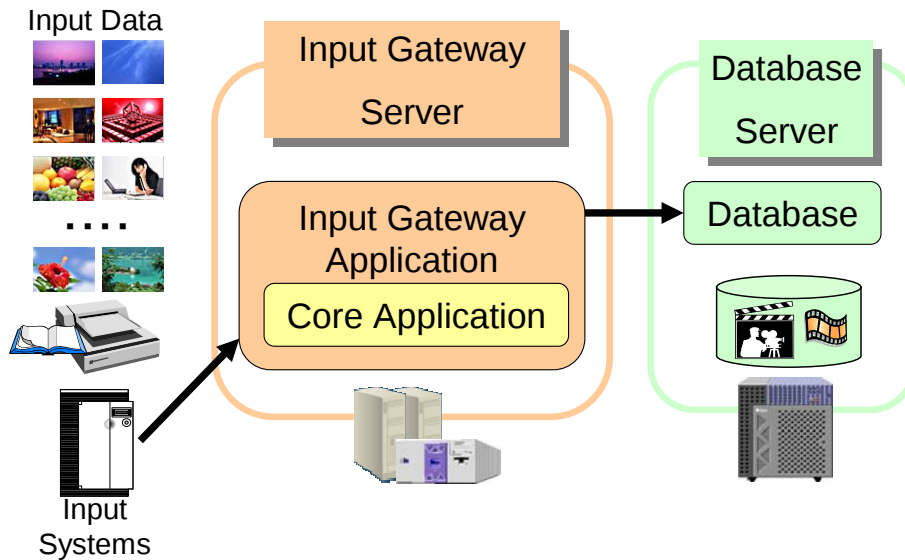


Figure3. Conceptual Diagram for the Embedded System

Applications that use the digital watermarking core library can automatically embed the copyright information. It provides a service that increases the value added by strengthening compatibility with conventional picture processing functions, including the existing system, automating the embedding process, and facilitating the sharing of management information. Moreover, it can be constructed more cheaply than when compared to constructing a new system.

3.2 Detection Function (Illegal Use Monitoring Center)

The embedded copyright information can be extracted when it is required. As the next service approach, we will show the concept for the model that provides the detection service.

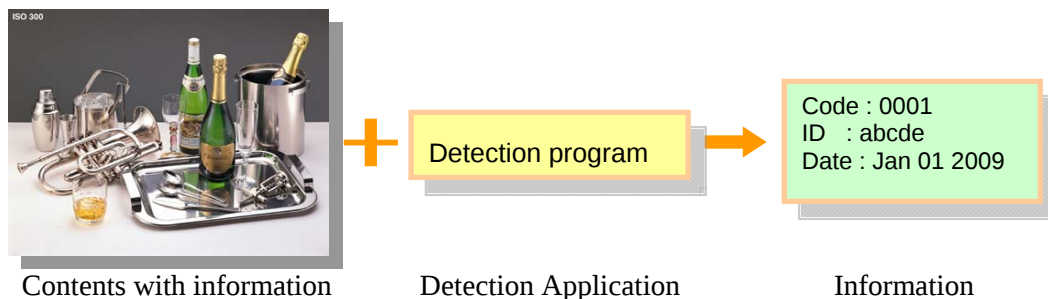


Figure4. Conceptual Diagram for Detection

In the previous section we showed an overview of how the core application embeds digital watermarks, and now we will explain the mechanism to detect the embedded copyright information. There are two types used for the detection method, the original reference type, and the original non-reference type. With the original reference type the original contents are necessary for detection, and conversely the original non-reference type is a method that does not require the original contents. This detection function is used

to discover contents that are illegally used, and then the embedded information is used to create a copyright infringement website report. With the detection function as its core, this is positioned as an illegal use monitoring center that searches through the embedded information.

The illegal use monitoring center is a function that uses a search robot on the Internet to search and acquire image information. If it discovers a website that infringes a copyright it records that website as a copyright infringing website. The center includes a function by which information about copyright infringing websites that are discovered using the illegal use monitoring center are recorded in a database, and the necessary information is collected and reported. It is clear that up to now services provided by other companies have stopped at the extraction of detection information, and do not provide a solution to provide the necessary documents to enforce the copyright, or provide a legal means to appeal. Therefore, we provide a solution with a process that includes the creation of copyright infringement website reports.

4 VERIFICATION RESULTS

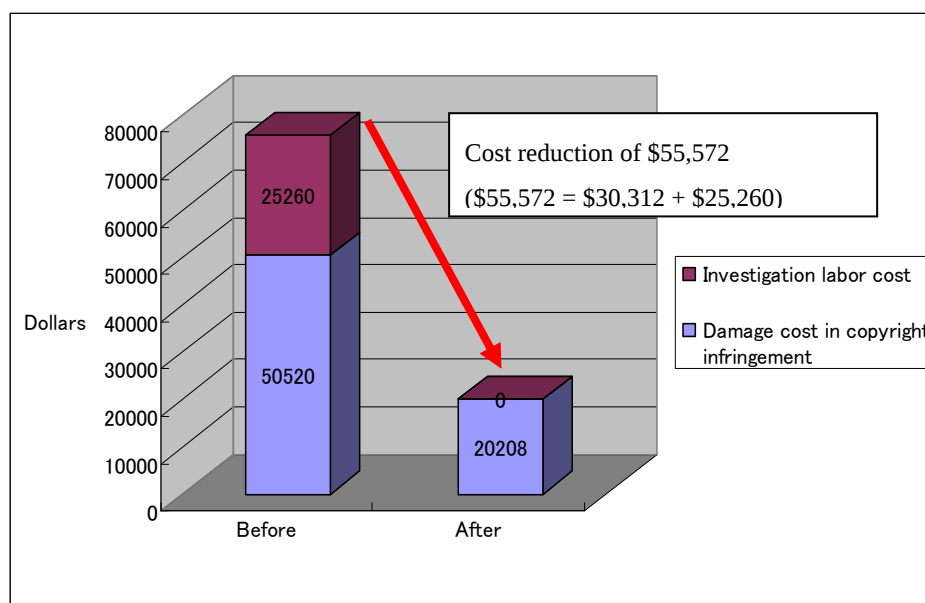
The total damages due to copyright infringement from illegal use to the e-commerce websites that we verified was 7.2 million yen per year. This is equal to 1 to 2% of total sales. The breakdown is as follows:

- (1) Damages due to copyright infringement:
\$50,520 per year (= \$421 per page × 10 pages per month × 12 months)
- (2) Investigator pay:
\$25,260 per year (= \$2,105 per month × 12 months)

The system was started January 1, 2008 on e-commerce websites on the Internet. The number of illegally used contents was reduced 60% when compared to the previous month. Converting the effectiveness of the measures taken to a monetary value results as follows:

- (1) Illegally used content reduction effect:
\$30,312 per year (= \$421 per page × 6 pages per month × 12 months)
- (2) Reduction in investigator pay:
\$25,260 per year (= \$2,105 per month × 12 months)

From the above we see that the effectiveness of the measures taken for each company, shown as a monetary value, is \$30,312 + \$25,260, which is \$55,572 per year.



*Figure5. Cost Reduction Effect due to Illegal Use Measures
(Source: From the joint survey with Kyodo News Service.)*

5 CONCLUSION

From these verification results we have confirmed that the problems were resolved by this solution. Because conventionally search was performed manually for static information, the operational costs were high and it was not a service that could be applied to each individual user. However, through this research those problems have been completely resolved, and we have confirmed that it is an effective measure to prevent the illegal use of contents in the news and image/video industries.

So why has the same technology or service not been developed until now? It is not to say that there has been no research done in this field, but there was no place to apply it in a business sense. Recently the Internet is spreading rapidly and social infrastructure is being put into place. The environment surrounding copyright that accompanies digitization is changing. Digitization and the rate of the spread of networks is expected to continue to develop more rapidly. We are waiting for copyright protection mechanisms and new profit structure models for digital content to be created in parallel.

In this research paper, we do not stop at systemizing one part of technology, we collected the client-users required specifications, and placed importance in provided it as a service while maintaining a win-win relationship with the clients. In the future the Internet will spread, more networks will switch to broadband, and more broadcasts will be digitized. In this environment all of the technologies that enable the smooth and safe distribution of digital contents will be related to each other and together come to form a single system. Therefore it is without a doubt that the effectiveness of that as a scheme will become evermore important.

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