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Technology to prevent unauthorized copying of displays by utilizing differences in sensitivity between human beings and devices

- Prevent disclosure of confidential and personal information through unauthorized copying of displays -

Dr. Isao Echizen, Associate Professor at the National Institute of Informatics (Director General: Masao Sakauchi), has developed a new technology for preventing unauthorized copying of information shown on a display. This new technology applies a technology that was announced in September 2009 to prevent unauthorized copying of films by using the difference in sensitivity between human beings and devices. A near-infrared ray unit, which has no effect on human vision, is installed on existing displays to enable the prevention of unauthorized copying of information shown on the display. In addition to preventing disclosure of confidential and personal information through the unauthorized copying of displays, an issue in recent years, it is expected that the new technology will have broad application as a technology for preventing unauthorized copying of works of art, factory equipment and other objects subject to a ban on photography.

Summary

Technologies to prevent unauthorized copying through encryption are widely used to prevent the disclosure of personal and confidential information or to protect the copyright of pictures and images, but it has been pointed out that once digital information is converted to analog and shown on a display or a screen, a digital camera can capture the analog information on display and invalidate the encryption (the analog hole issue).

There are already frequent occurrences of copyright infringement cases where digital cameras have been used for unauthorized copying of footage shown on screens in movie theaters, and then illegally sold or made available on movie distribution sites or as bootleg copies. In Japan alone, losses due to unauthorized copying of films is said to be 18 billion yen.[1] There have also been cases of disclosure of personal information where staff members at medical facilities have used digital cameras to photograph displays showing patient records and using the images for external presentations without permission.[2] In addition, there are concerns about the

[1] According to the Japan and International Motion Picture Copyright Association, Inc. (2005)
[2] Apology and report concerning disclosure of personal information:
http://www.saimiya.com/content/owabi.html

increasingly high quality of unauthorized images due to improvements in the functions of display devices and photographic equipment in the future. The prevention of unauthorized copying of displays and screens is an essential countermeasure, requiring urgent steps to prevent information disclosure and to protect copyright.

For these reasons, in September 2009, Dr. Isao Echizen, Associate Professor at the National Institute of Informatics, developed a technology that prevents unauthorized copying of films shown on a screen. This technology focuses on the differences in spectral sensitivity characteristics between human beings and imaging devices. By installing a near-infrared ray light source, which superimposes noise on video images without any impact on human vision, on the back of existing movie screens, it is possible to prevent unauthorized copying of the images shown on the screen without adding any new functions to the digital camera.

On this occasion, we have successfully developed a new technology by applying this technology to the unauthorized copying of displays. Similar to the technology previously applied to screens, this technology facilitates copyright protection for picture and image content, and prevents disclosure of confidential and personal information through the unauthorized copying of displays by simply equipping existing displays with a unit to prevent unauthorized copying, without adding any new functions to the digital camera.

Conventional measures to prevent unauthorized copying of screens and displays

In the past, a method using digital watermarking has been proposed for controlling unauthorized copying of pictures and images shown on screens and displays. This method uses watermarks to embed unique information in pictures and images, the purpose being to identify the movie theater or office where the unauthorized copying occurred by detecting the watermark in the unauthorized copies of pictures and images. However, psychologically, the conventional method of using digital watermarking may deter acts of unauthorized copying by dishonest persons, but it is unable to prevent the actual act of unauthorized copying using a digital camera or other photographic equipment. [3] Also, even if it were possible to detect the time and place of the unauthorized copying from the distributed content, it would be difficult to identify the offender without equipment in the movie theater or office (surveillance cameras etc.)

[3] In order to prevent acts of unauthorized copying with conventional methods, it is necessary to insert a function to prevent unauthorized copying consisting of a recording controller and a digital watermark detector in the photographic equipment, but since the premise would be to insert these functions in all commercially available photographic equipment, preventing unauthorized copying with conventional methods is impossible for pragmatic reasons.

Method to prevent unauthorized copying utilizing differences in human and device sensitivity

In September 2009, Dr. Isao Echizen developed a technology for preventing the unauthorized copying of images shown on a screen. This technology utilizes the differences in spectral sensitivity characteristics between human beings and imaging devices. As indicated in Fig. 1, human beings have a visible wavelength range from 380nm to 780nm according to the International Commission on Illumination, which makes recommendations on standard specifications for light. To maintain the sensitivity, the CCD, CMOS and other image sensors used in digital cameras have a broad range of sensitivity (200nm to 1100nm) outside the visible range. With this technology, it is possible to degrade the quality of images and pictures taken with existing digital cameras by installing a near infrared light source at the center back of the screen to superimpose noise on the photographic images alone and without any impact on human vision. To integrate picture and sound, movie screens feature countless holes approximately 1mm in screen diameter (sound holes). This technology can be inserted without processing the screen itself in order to use these holes for near infrared exposure. By causing the infrared light source for the system to flicker at approximately 10Hz based on the Bartley effect,[4] the interference with unauthorized copying is heightened.

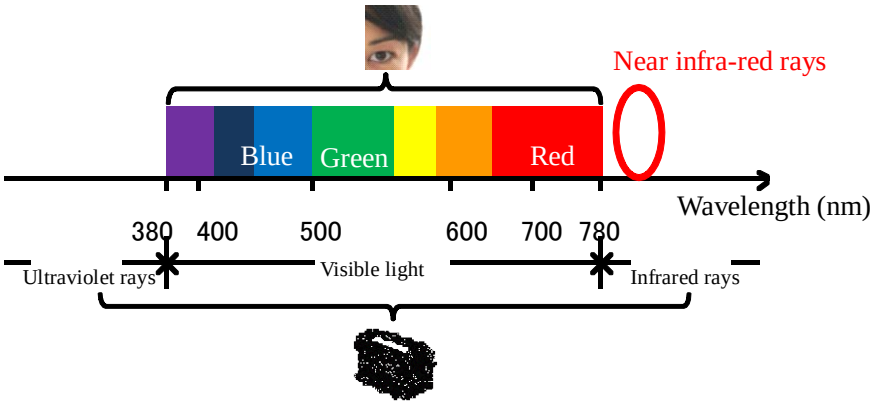

Fig. 1: Difference in sensitivity between human beings and digital cameras

Applications of the new technology to prevent unauthorized copying of displays

On this occasion, Dr. Isao Echizen has applied the anti-copying technology that utilizes the difference in sensitivity between human beings and devices, to a technology to prevent unauthorized copying from displays, and developed a new technology that uses an anti-copying unit intended for liquid crystal displays (Fig. 2). By simply installing the anti-copying unit at the front of the display, there is no impact on normal viewing of the display. But when a digital camera photographs a display where this unit has been installed, the noise is superimposed over

[4] When the frequency for intermittent light (flickering light) is about 10Hz, the visual effect is brighter to the human eye due to the absolute strength of intermittent light.

the whole image due to the near infrared rays, and the readability of the information shown on the display is degraded to a considerable degree. (Fig. 3). This anti-copying unit is not only applicable to preventing disclosure of confidential and personal information shown on the screen, but it can also be applied to the prevention of unauthorized copying of works of art and facilities inside factories (Fig. 4)

(a) Front of unit

(b) Back of unit

(Mounted on a 17-inch LCD)

Fig. 2 Outline of the anti-copying unit

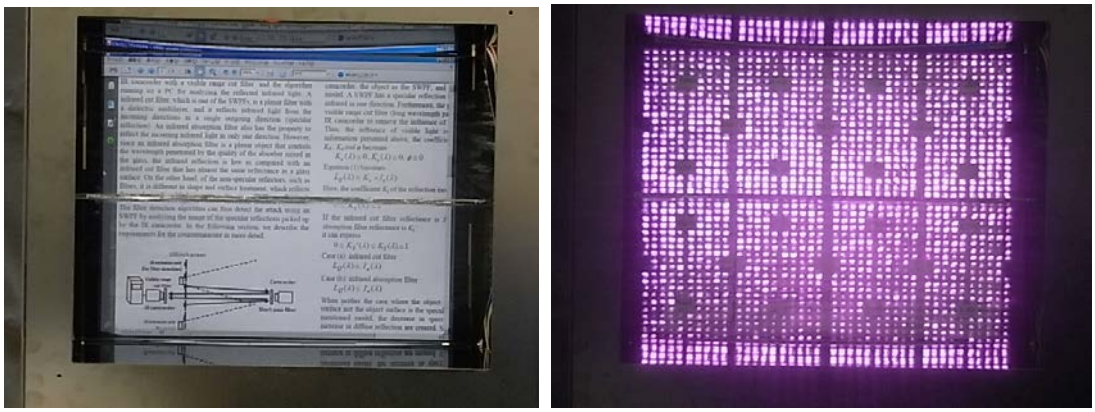

Fig. 3 Interference effect on unauthorized copying of images (17-inch LCD)

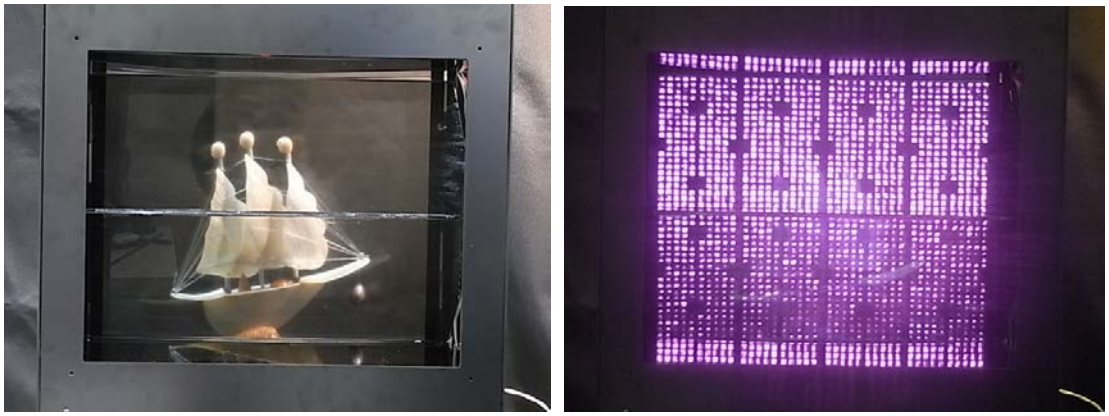

Fig. 4 Interference effect on unauthorized copying of image (actual object)

Fig. 5 illustrates the configuration of the anti-copying unit. As the diagram indicates, an infrared LED (peak wavelength 870nm) and a visible light cut filter that cuts the components in the visible range of the infrared LED are installed at the top and bottom of the anti-copying unit. In addition, a half mirror is installed in the center of the unit, superimposing near infrared rays on the display screen surface.

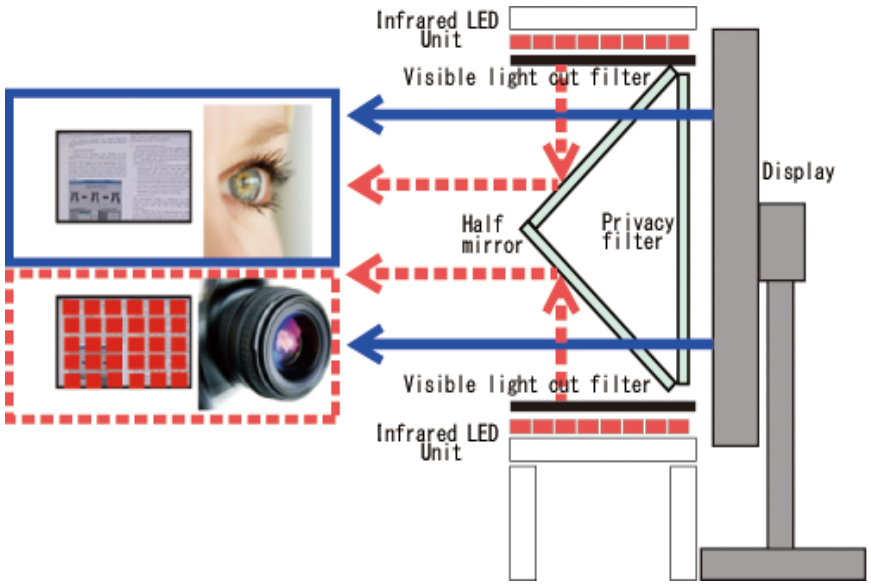

Fig. 5 Configuration of the anti-copying unit

Further, the demo exhibition of this technology is planned for the conference of the ACM Multimedia 2011 (MM'11) held in Scottsdale, Arizona, USA between November 28th and December 1st this year.

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