

Waving-hand steganography for a movie on a high-frame-rate LED display

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1. Introduction

In recent years, it is important to increase people's attention on digital signage because of the increase of LED digital signage. In order to provide joyful experiences when viewing digital signage, we have proposed waving-hand steganography using a high-frame-rate LED panel, where an embedded secret image is decodable by viewing through a waving hand [1]. We realized technique of switching two images at a high frame rate and embedding information in color sequential display [2]. These were steganography for a still image.

The purpose of this paper is to realize waving-hand steganography for a movie. We report embedding information in a movie and decoding with a waving hand.

2. Principle

The LED panel used in this study can update the displayed image at a high frame rate (960 Hz) [3]. One unit is 40×40 pixels, and the pixel pitch is 6mm. The video signal, which contains 16 fields of 960-Hz images, is transmitted at 60 Hz from a PC.

The principle to embed a secret text into 16 fields is illustrated in Fig. 1. Then, example of display video image is shown Fig. 2. The part that does not contain the embedded information is branched to "Embedded No" in Fig 1. The RGB values of the background portion are reduced to a quarter of the value and are shown on the LED panel repeatedly. Therefore, we perceive 16 times as bright as one field image.

On the other hand, the part that contains the embedded information is processed on the "Embedded Yes" in Fig. 1. 16 fields are composed of RGB color components of the background portion and the black. Because the 16 fields are updated at a sufficiently high frame rate that our eye cannot perceive the color change, we perceive the same color as the original background. As shown in the right of Fig. 1, the total RGB values in the 16 fields are four times to the RGB values before the embedded process under normal viewing condition.

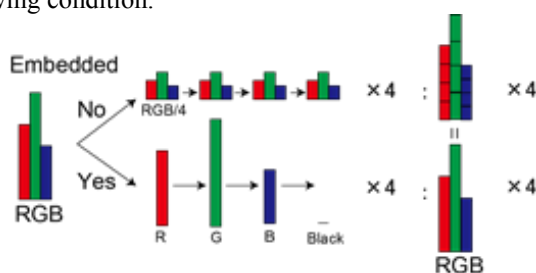


Fig. 1. Principle to embed a secret image information.

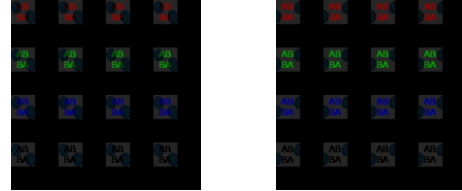


Fig. 2. Example of input image which contains 16 fields.

3. Experiments

The frame rate of display video is 60fps. Photographed images of our high-frame-rate LED display without decoding gesture are shown in Fig. 3. As in the case of a still image, it is not possible to recognize the embedded information in the case of normal observation. We decoded waving-hand steganography by waving a hand. Examples of decoded results are shown in Fig. 4. The movie was taken with waving a hand in front of the camera lens. The embedded information was successfully decoded. Because a part of the fields is shielded by the hand, the color of the decoded characters is changed.



Fig. 3. Observed results without decoding gesture.

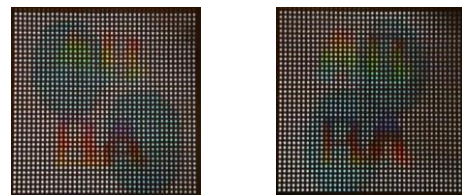


Fig. 4. Decoded results by waving a hand.

4. Conclusion

We have applied waving-hand steganography for a movie and succeeded in embedding information in the movie as in the case of still image. Furthermore, we have recognized that embedded information by viewing through a waving hand.

References

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