Flexible Visual Cryptography Scheme Without Distortion

Feng Liu SKLOIS•IIE•CAS Atlantic City, New Jersey, USA 23~26 Oct. 2011

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What's visual cryptography

- A (2,2)-VCS example
 - Pixel expansion *m*
 - Contrast α



Limitations of known VCS's

- Image distortion
 - Large nivel evenneion Sklois







- Poor visual quality
- Incorrect
- Not flexibl
- Poor comp
 - general ac
 - color VCS
 - extended



Houetal!'s scheme [22]

The basic idea

• Principle of fountain



Simulation

Share image 📥 Pool

Secret pixel i nozzle



Our scheme--Construction 2

Input: S_I, m_N, m_o

- Generate the pool
- Distribute the nozzles and initialize a list L_{pi} for each nozzle p_i
- Determine all the lists L_{pi} by finding the nearest nozzle for each subpixel
- Fill out the pool by the water according to L_{pi}

 $\sqrt{M_N}$

Output: S_1, S_2, \dots, S_n

Our scheme--Construction 3

Input: S_I, m_N, m_o

- Generate the pool
- Distribute the nozzles and initialize a list L_{pi} for each nozzle p_i
- Determine all the lists L_{pi} by dividing the pool with subpixels of integer multiples of m_o
- Fill out the pool by the water according to L_{pi}

Output: S₁, S₂, ..., S_n



Experiments & comparisons

• Experiments on the flexibility and non-distortion



- Both proposed constructions are non-distortion (Construction 2 for example)
- The overall pixel expansion is real flexible where m_N can be any value bigger than zero

Experiments & comparisons (cont.) Comparison on the visual quality



- Construction 2 has competitive visual quality of Yang et al.'s scheme [25] from an overall viewpoint
- Construction 3 has better visual quality especially on the evenness

Experiments & comparisons (cont.)

Schemes Criteria	Constru ction 2	Constru ction 3	[20]	[19]	[21]	[22]
Flexible	Yes	Yes	No	No	No	No
Distortion	No	No	No	No	No	No
Schemes Criteria	[23]	[24]	[28]	[29]	[30]	[25]
Flexible	Yes*	No	No	Yes*	No	Yes*
Distortion	Depends	No	Depends	Depends	Depends	No

- Yes*: Range of the overall pixel expansion is limited
- Depends: Yes if m is a square number, otherwise No

Further directions

- Combine with other techniques
 - general access structure VCS [Ateniese I&C 1996]
 - color VCS [Liu IET IS 2008]
 - extended VCS [Liu IEEE TIFS 2011]
- Further improve the visual quality
 - use variance to evaluate the visual quality
 - design schemes with smaller variance

Tha ks Email: fengliu.cas@gmail.com Homepage: http://as.ac.cn/~liufeng/

Experiments & comparisons (cont.)

• Comparison on the incorrect representation problem



- Hou et al.'s VCS [21] has the incorrect representation problem
- Both proposed constructions can correctly represent secret images with thin lines

Experiments & comparisons (cont.)

 Compared with Yang et al.'s non-distortion schemes in [19] and [20]



References

- [Ateniese I&C 1996] G. Ateniese, C. Blundo, A. De Santis, and D.R. Stinson. Visual cryptography for general access structures. In Information and Computation, volume 129, pages 86-106, 1996.
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