

An Image-Sharing Method With User-Friendly Shadow Images

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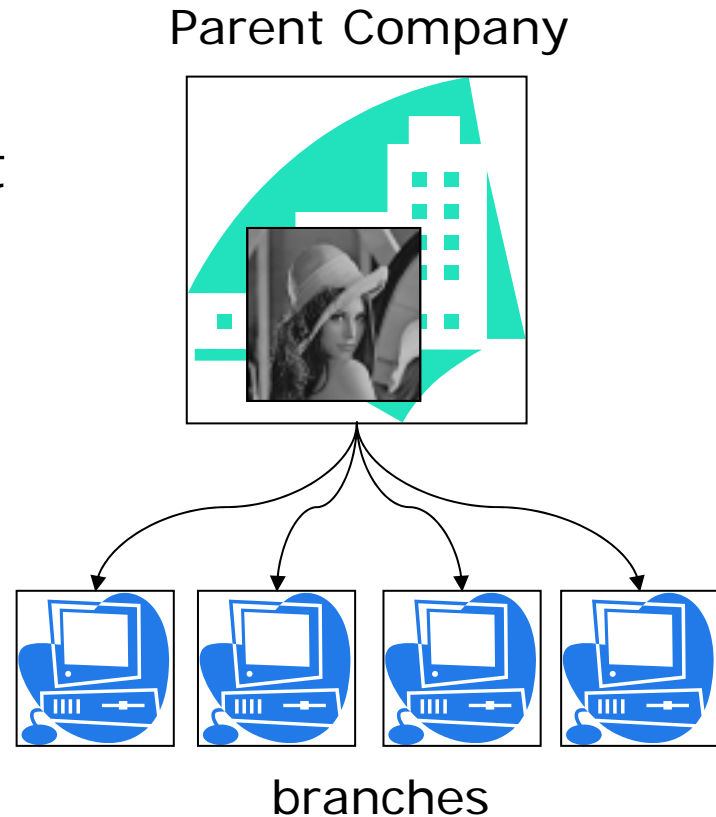
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Image-Sharing

- Non-distributed storage
 - ✗ Need a large space.
 - ✗ The destruction is permanent when crashing.
- Distributed storage

Hint: make use of VSS
(visual secret sharing)



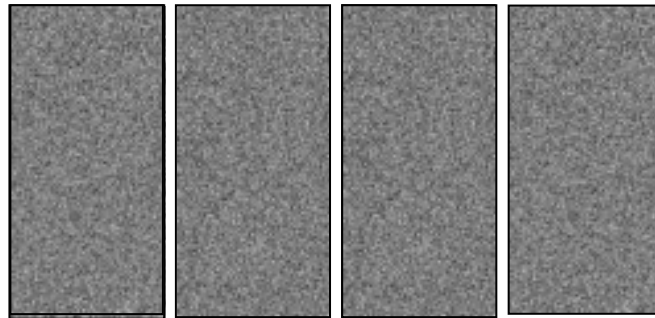
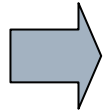
(2,4) Visual secret sharing

□ “Secret Image Sharing”, *Computer & Graphics*, 2002.



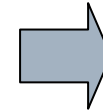
Original Image

110	112
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Shadow Images

S_1	S_2	S_3	S_4
222	83	195	56

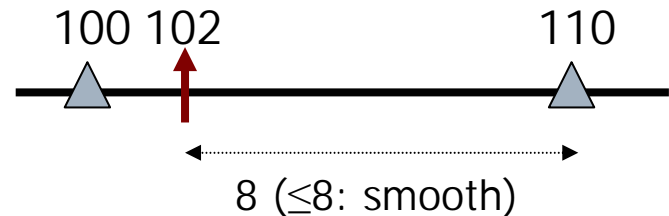
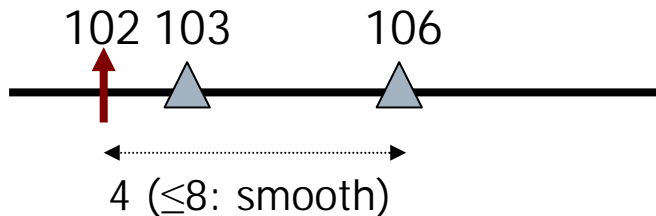
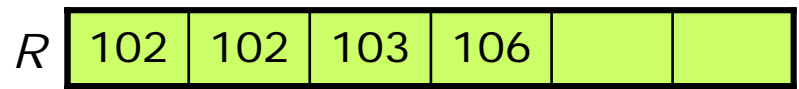
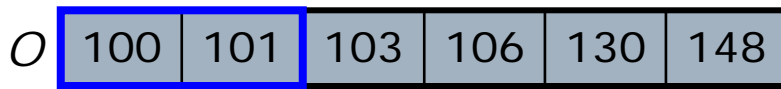


Recovered Image
(by any **two**
shadow images)

$$S_k = (110 + 112 \times k) \bmod 251$$

Proposed scheme

□ (2,4)Sharing



$$f_1 = 103 - 102 + 8 = 9$$

$$f_2 = 106 - 102 + 8 = 12$$

$$S_k = (9 + 12k) \bmod 17$$

$$(1,4), (2,16), (3,11), (4,6)$$

$$102 + 4 - 8 = 98$$

$$102 + 16 - 8 = 110$$

$$102 + 11 - 8 = 105$$

$$102 + 6 - 8 = 100$$



$$110 - 102 + 8 = 16$$

$$100 - 102 + 8 = 6$$

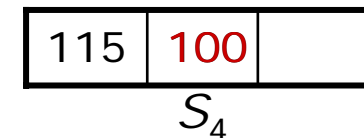
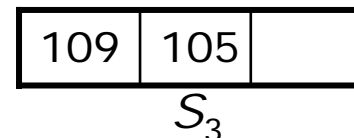
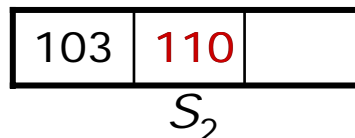
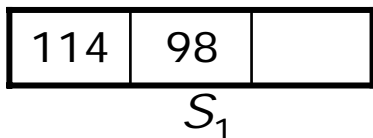
$$(2,16), (4,6)$$

$$f_1 = 9, f_2 = 12$$



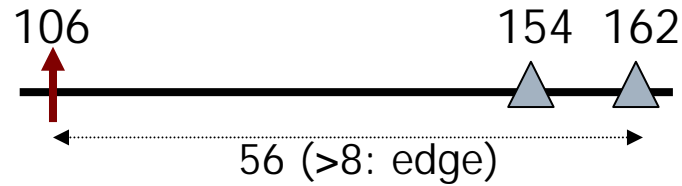
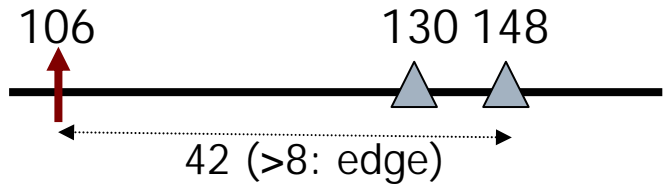
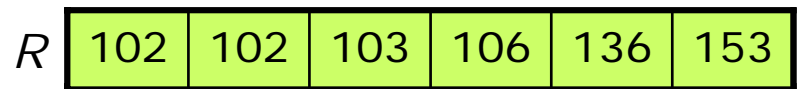
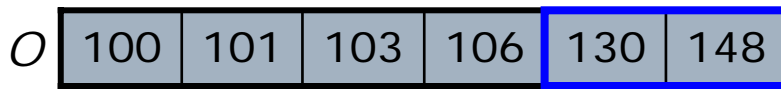
$$9 + 102 - 8 = 103$$

$$12 + 102 - 8 = 106$$



Proposed scheme (con't)

□ (2,4) Sharing



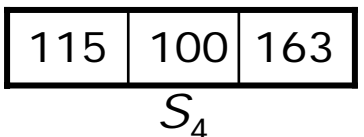
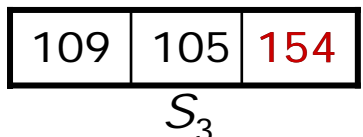
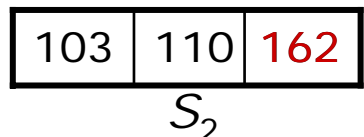
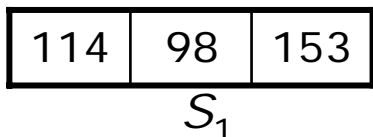
Base = $\left\lceil \frac{148}{17} \right\rceil \times 17 = 153$

$g_1 = \lfloor 130/17 \rfloor = 8 \Rightarrow 153 + 0 = 153$
 $g_2 = \lfloor 148/17 \rfloor = 9 \Rightarrow 153 + 9 = 162$
 $153 + 1 = 154$
 $153 + 10 = 163$

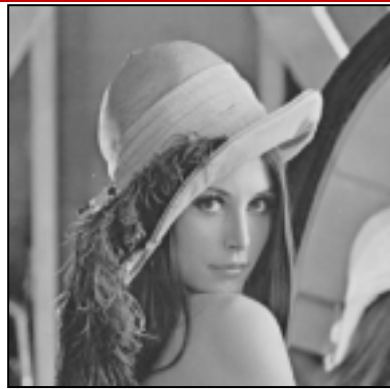
$162 - \left(\left\lfloor \frac{162}{17} \right\rfloor \times 17 \right) = 9$
 $154 - \left(\left\lfloor \frac{154}{17} \right\rfloor \times 17 \right) = 1$
 $(2,9), (3,1)$
 $g_1 = 8, g_2 = 9$

$E_k = (8 + 9k) \bmod 17$

$(1,0), (2,9), (3,1), (4,10)$



Experiments



512x512 (8-bit)
Original image



512x256
Shadow images



Image recovered
from **any two**
shadow images
(PSNR: **37.98**dB)



Image expanded
directly from one
shadow image
(PSNR: **24.20**dB)

Experiments (Con't)

	The recovered images		The expanded shadow images	
	MSE	PSNR	MSE	PSNR
Jet (2, <i>m</i>)	6.61	39.93	225.91	24.59
Jet (4, <i>m</i>)	9.99	38.14	583.27	20.47
Lena (2, <i>m</i>)	10.36	37.98	247.00	24.20
Lena (4, <i>m</i>)	15.25	36.30	582.06	20.48
Monkey (2, <i>m</i>)	19.08	35.33	632.04	20.12
Monkey (4, <i>m</i>)	22.76	34.56	1387.60	16.71

Conclusions

- Propose a user-friendly image-sharing method.
 - Fast transmission ($1/r$ times)
 - Easy to manage (user-friendly shadow)
 - Fault tolerance
 - Secure storage
 - Reduced chances of pirating