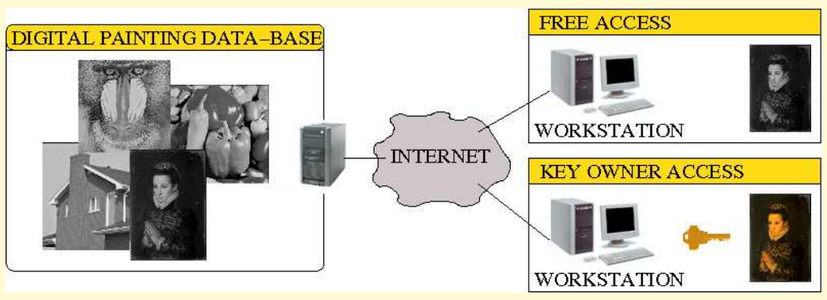
A 8-BIT-GREY-LEVEL IMAGE EMBEDDING ITS 512 COLOR PALETTE

Marc CHAUMONT and William PUECH
marc.chaumont@lirmm.fr and william.puech@lirmm.fr
LIRMM, UMR CNRS 5506, Université de Montpellier II

HIDING COLORS; PALETTE-BASED SCHEMES:

WHY HIDING COLOR INFORMATION ?

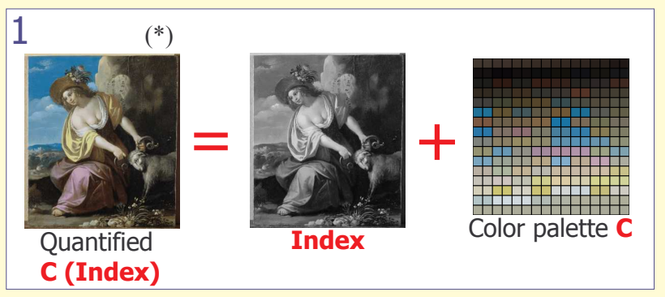


COLOR SECURED of image database.
↳ free access to grey-level images,
↳ key-manage access to the color information.

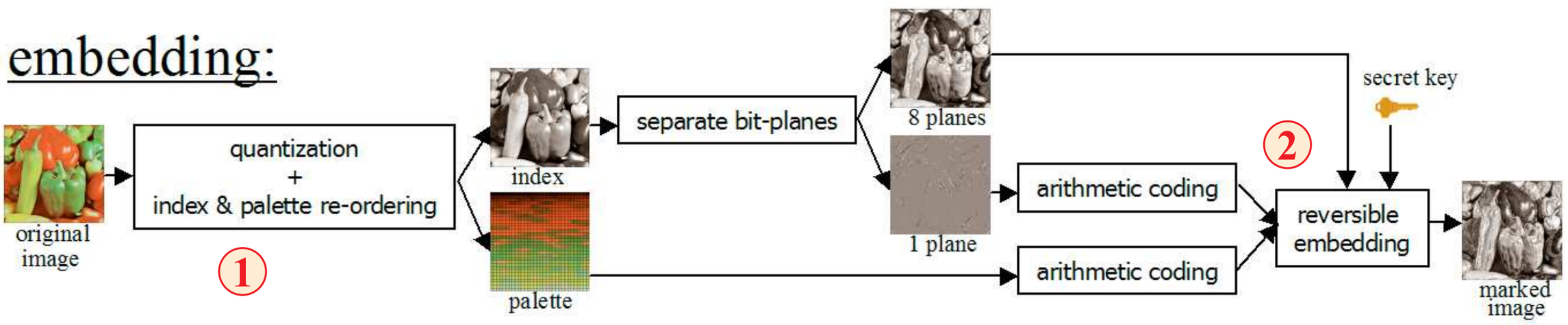
« A Fast and Efficient Method to Protect Color Images », SPIE'2007 → ***256 colors**; Heuristic approach.*
« A Grey-Level Image Embedding its Color Palette », ICIP'2007 → ***256 colors**; Optimisation approach.*
« A 8-Bit-Grey-Level Image Embedding its 512 Color Palette » → ***512 colors**; Reversible embedding.*

GENERAL PALETTE-BASED PRINCIPLE:

1. Find an index image and a color palette with:
   - A **color quantized image** close to the **color image,**
   - An **index image** close to the **luminance image,**
   - A **color palette** owning **consecutive close colors.**
2. Embed the color-palette into the index image.



A 8-BIT-GREY-LEVEL IMAGE EMBEDDING ITS 512 COLOR PALETTE:



① Quantization on 512 colors (9 bits):

STEP 1: Octree, then k-mean quantization,
STEP 2: Color palette re-ordering.

② Reversible embedding:

MESSAGE : - a bit-plane arithmetically encoded,
- the color-palette arithmetically encoded.

HOST IMAGE I : - the remaining 8 bit-plane.

ALGORITHM : - a congruence based approach.

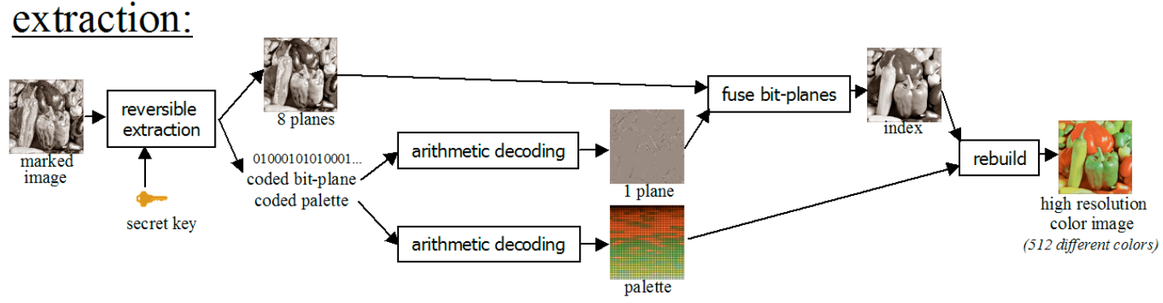
$$T : \mathbb{N} \times \mathbb{N} \rightarrow \mathbb{N}$$
$$T(x_1, x_2) = (n+1).x_1 - n.x_2 .$$

n = 4 in experiments

embedding pixel $\equiv 0 \leq T(I(i), I(i+1)) \ \ and \ \ T(I(i), I(i+1)) + n \leq 255$,
to-correct pixel $\equiv T(I(i), I(i+1)) < 0 \ \ or \ \ T(I(i), I(i+1)) + n > 255$,
original pixel ≡ stand before a *to-correct* pixel.

All embedding pixels:
- are T transformed: $I_T(i) = T(I(i), I(i+1))$,
- must embed a coefficient w belonging [1, n]: $I_w(i) = I_T(i) + w$.

extraction:



RESULTS AND CONCLUSIONS:

images	$PSNR_{(color\ image, rebuilt)}$	
	previous best method SPIE'2007	proposed method
airplane	39.90 dB	42.96 dB
house	39.27 dB	41.67 dB
lena	38.63 dB	40.93 dB
peppers	36.32 dB	38.95 dB
baboon	33.31 dB	35.86 dB

Conclusion:

- A watermarked image still semantically understandable,
- A rebuilt color-image of better quality (512 different colors),
- A more resistant approach to colorization attack.

Acknowledgments: *TSAR French Project ANR SSIA 2006-2008*

(*) Saint-Germain-en-Laye museum; « *a young woman holding a ram* », Jan van Bylert (1603-1671), oil on oak.