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Information Society

Image Filtering

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Enic Telecom Lille 1

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(collaboration with Bruno Jedynak
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Plan

→ **Pornographic image filtering.**

→ **Symbol recognition.**
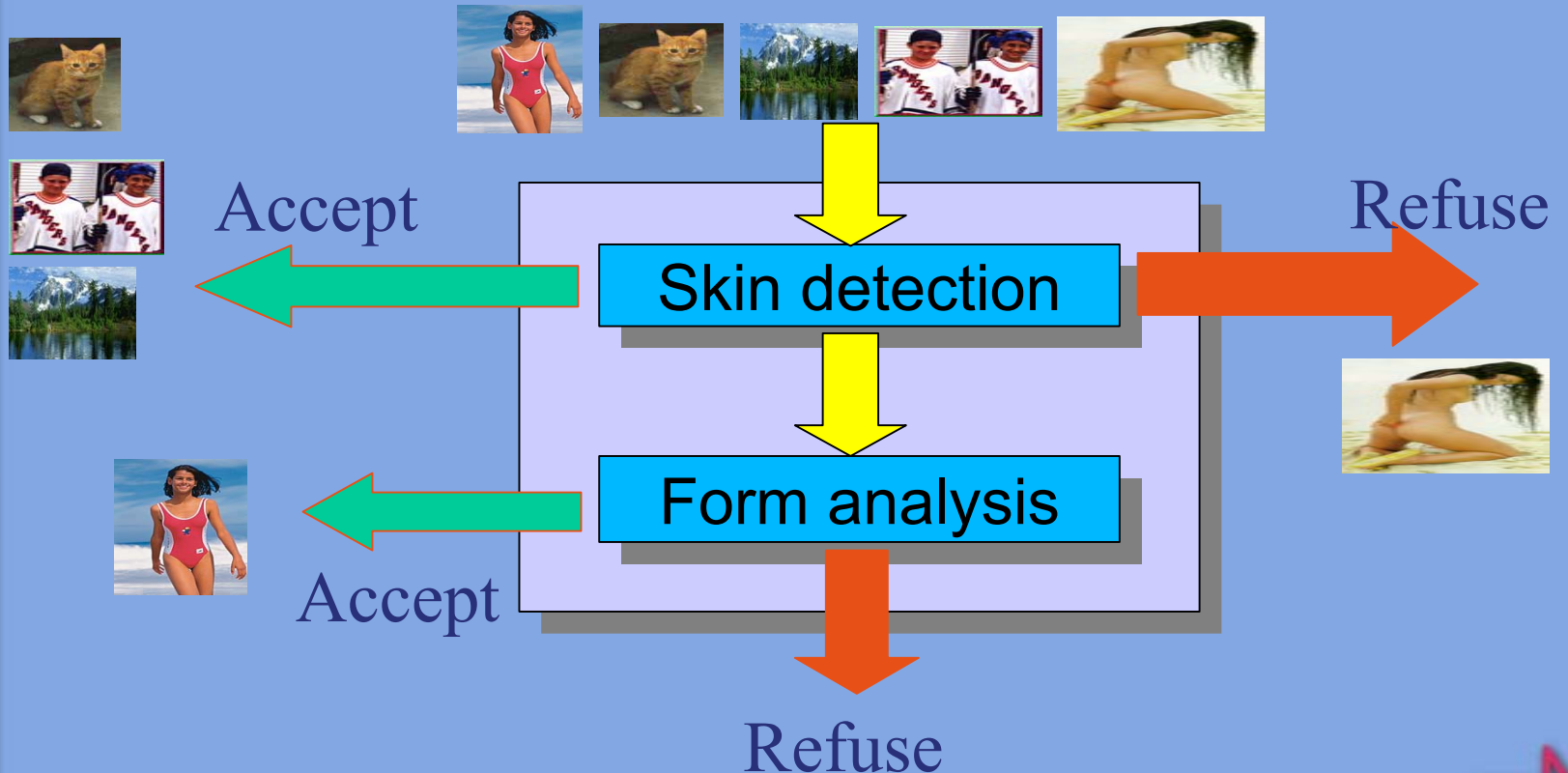
→ **Conclusion and perspective.**

Motivation

→ More than 4 millions webpages reveal that 70,1% of web pages contain images,

→ URL : need manual updating,

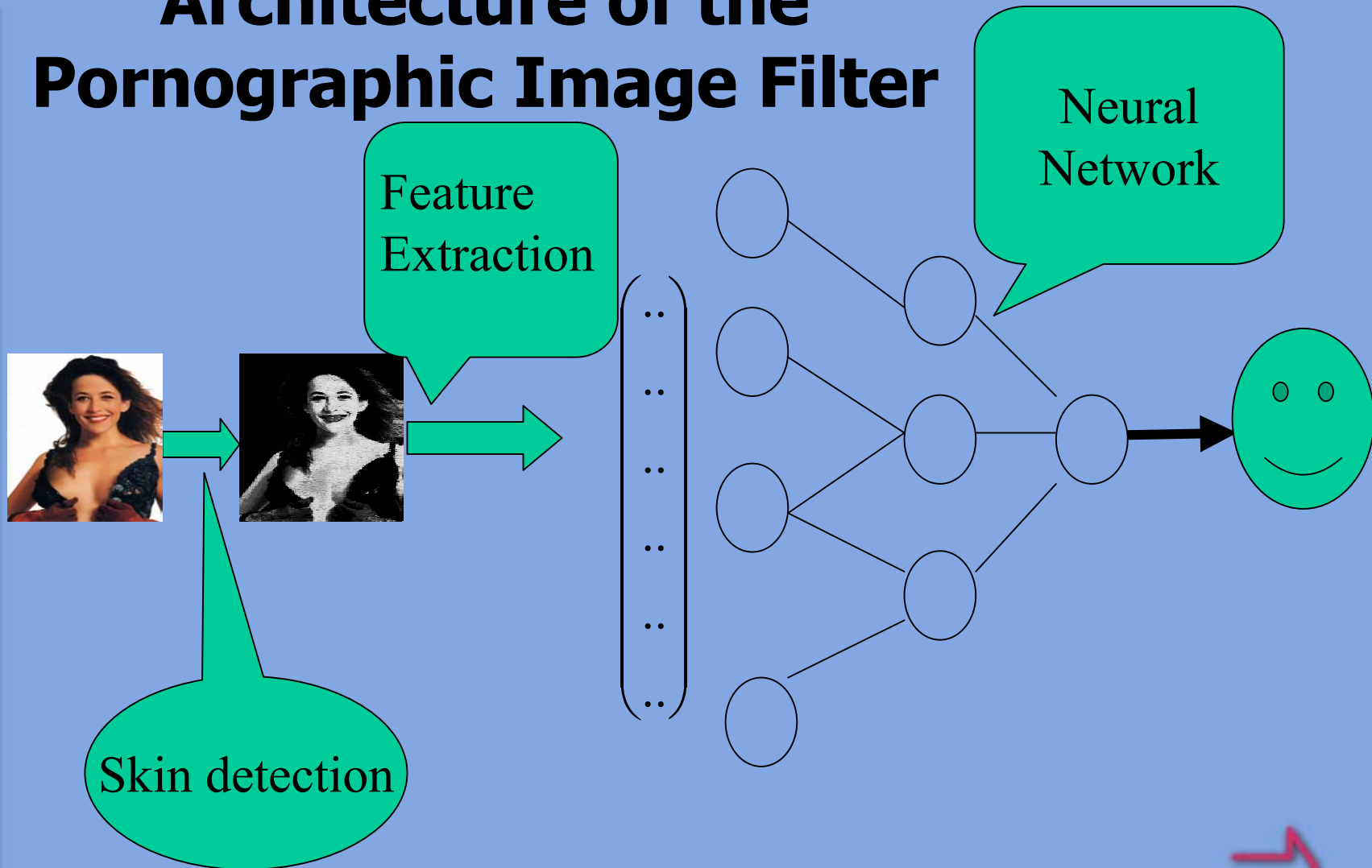→ A lot of pornographic web pages contain very few text.
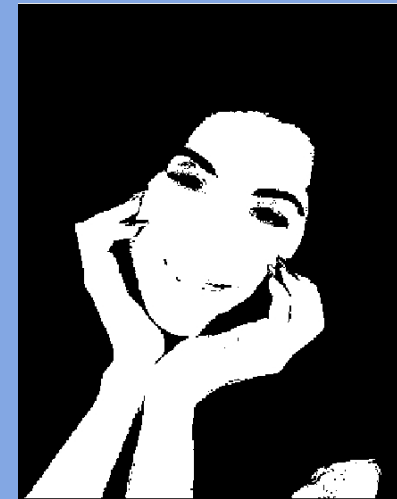
Architecture of the Pornographic Image Filter

Accept

Refuse

Skin detection

Form analysis

Accept

Refuse

Architecture of the Pornographic Image Filter

Feature Extraction

Neural Network
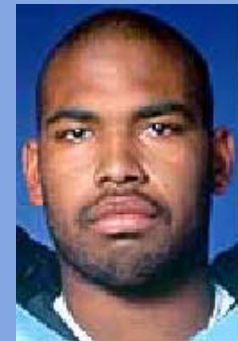
Skin detection

Skin Detection

Motivation:

There is a strong correlation between images with large skin patches and pornographic images.
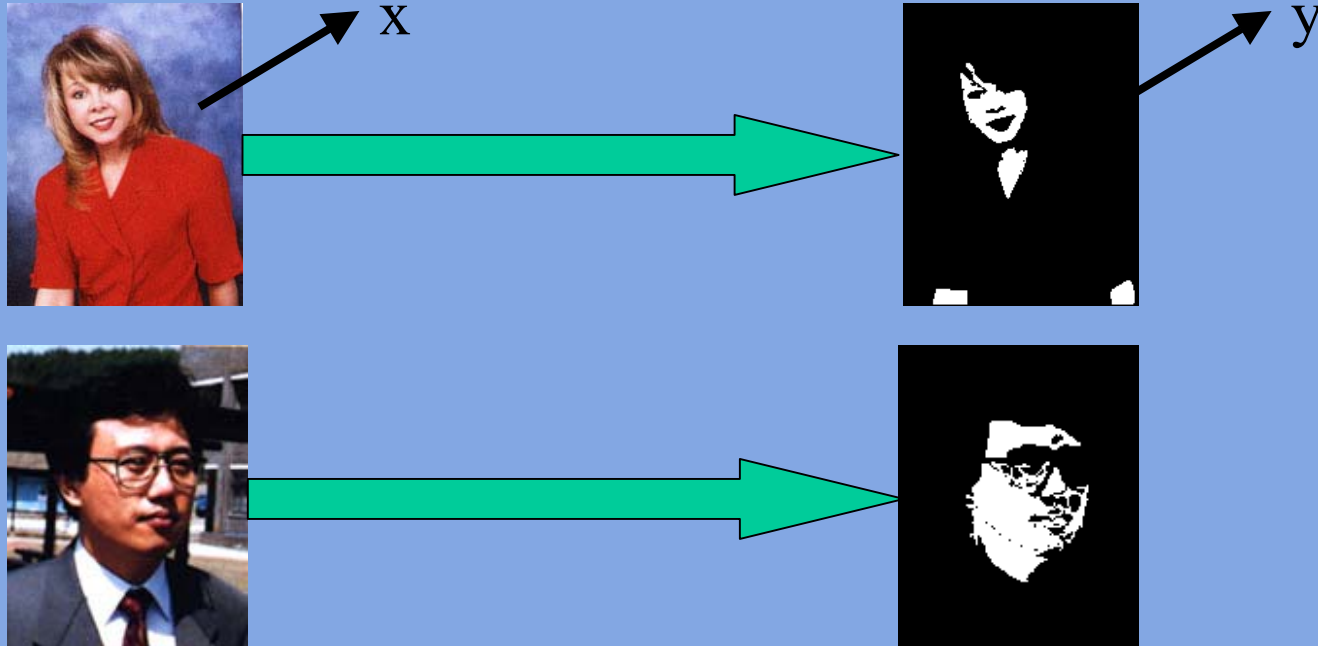
Difficulties

→ 1. Variations of the skin colors

Difficulties

→2. Variations of the capturing conditions (Illumination, camera, compression, noise...)

Training Image Database

x

y

Compaq labeled image database: 18,696 images.
Nearly 2 billion pixels in the training set.

Maximum Entropy Principle

→ Task :

→ To infer the (image, label) joint distribution model from the training data.

→ Tool :

→ Maximum Entropy Principle
Choose a probability model which is consistent with the training data, but otherwise as uniform as possible.
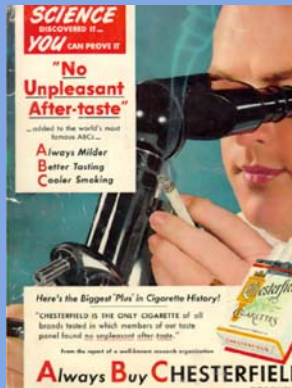
Maximum Entropy Principle

Steps:

- Calculate the (color, label) histograms.
- Write down the maximum entropy model within the ones that have the calculated histograms.
- Estimate the parameters.
- Use the model for classification.

Examples of Skin Detection
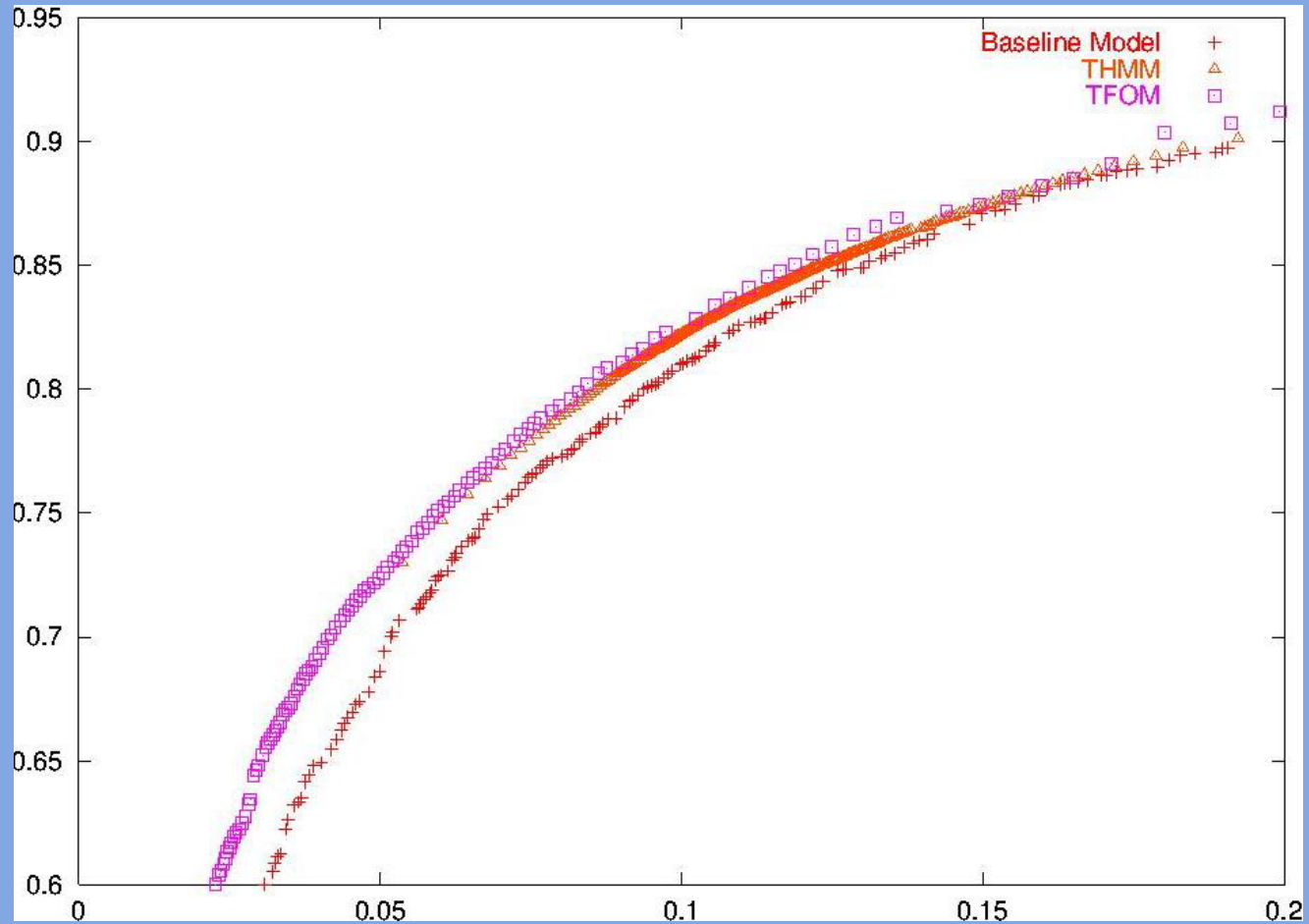

Baseline model　　THMM　　TFOM

Baseline model: assuming conditional independence between pixels

THMM: hidden Markov model with tree approximation for probability inference

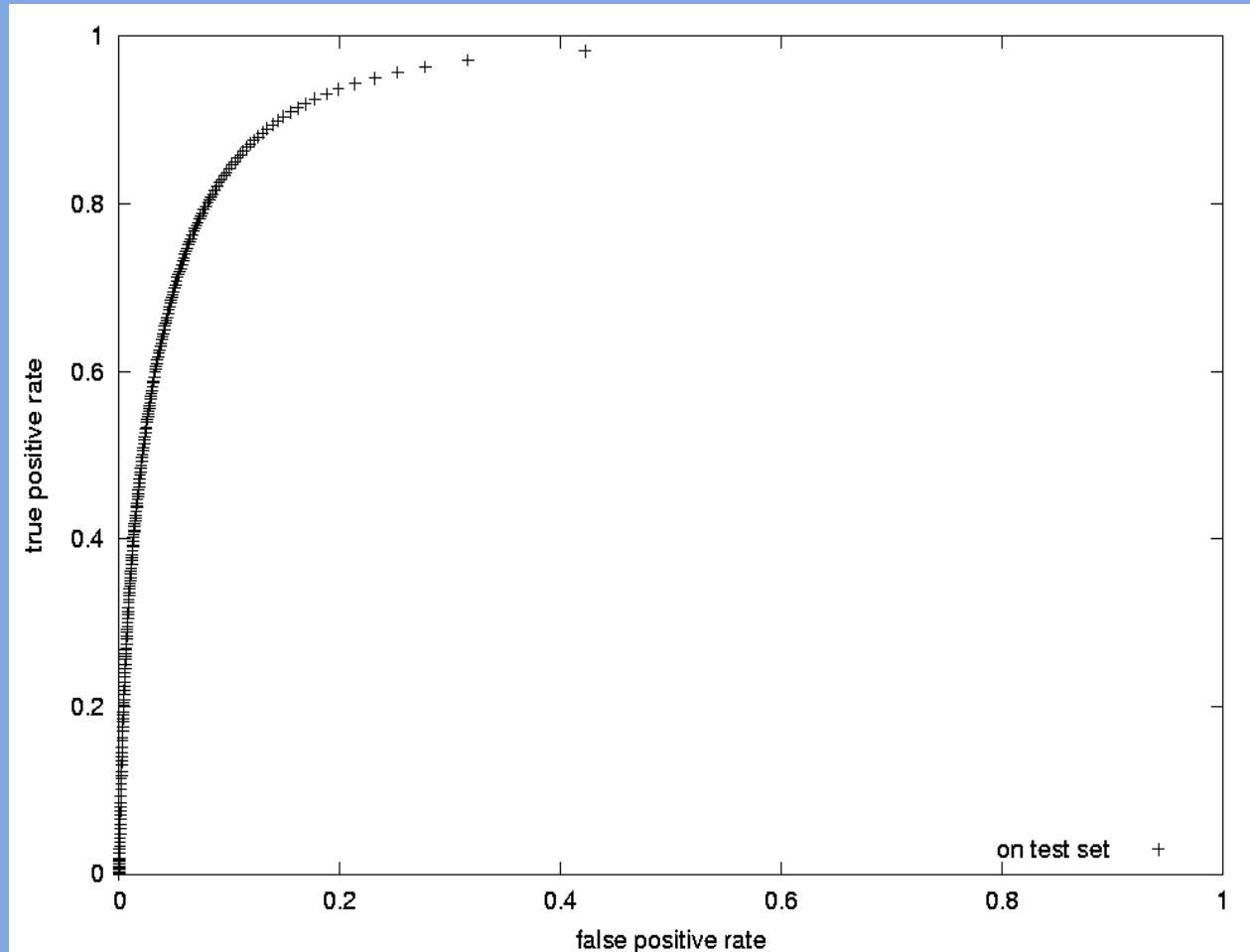**TFOM**: first order model with tree approximatioin for probability inference
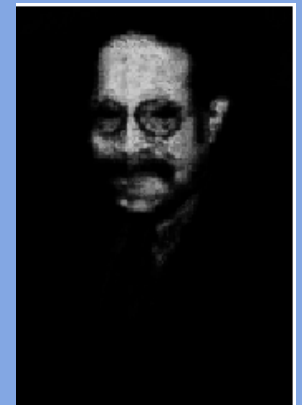
ROC Curves

ROC Curve of TFOM

Examples of Skin Detection by TFOM
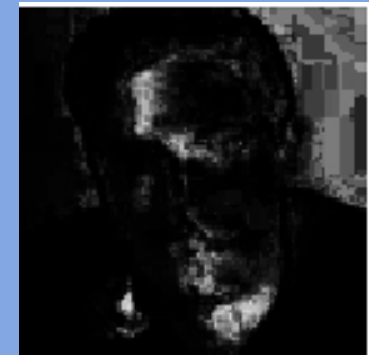

Kathy Haller and Robert Kelly

Examples of False Positive

Examples of False Negative
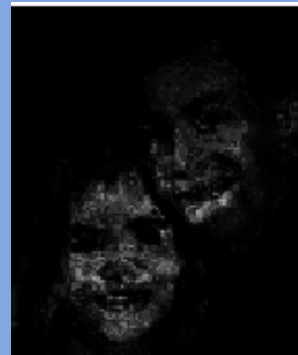
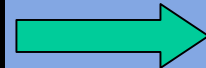# Comparison [Vez 03](same test database)

Method	TP	FP
Bayes SPM in RGB, [Jones and Rehg1999]	**80%** 90%	**8.5%** 14.2%
Bayes SPM in RGB, [Jones and Rehg 2000]	93.4%	19.8%
Poesia Algorithm, Maxent [2002]	80%	8%
Gaussian mixture [Jones and Rehg1999]	80% 90%	9.5% 15.5%
SOM in TS [Brown et al. 2001]	78%	32%
Elliptical boundary in CIE-xy [Lee and Yoo 2002]	90%	20.9%
Single Gaussian in CbCr [Lee and Yoo 2002]	90%	33.3%
Gaussian Mixture in IQ [Lee and Yoo 2002]	90%	30%
Thresholding of I axis [Brand and Masson 2000]	94.7%	30.2

Feature Extraction
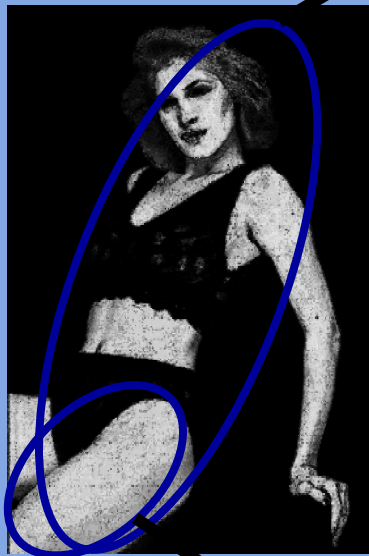
GFE(Global Fit Ellipse)

features

- Average probability in the image
- Average probability in the GFE
- Number of regions in the image
- Position of the LFE
- Orientation of the LFE
- Shape of the LFE
- Relative area of the LFE
- Average probability in the LFE
- Average probability outside the LFE
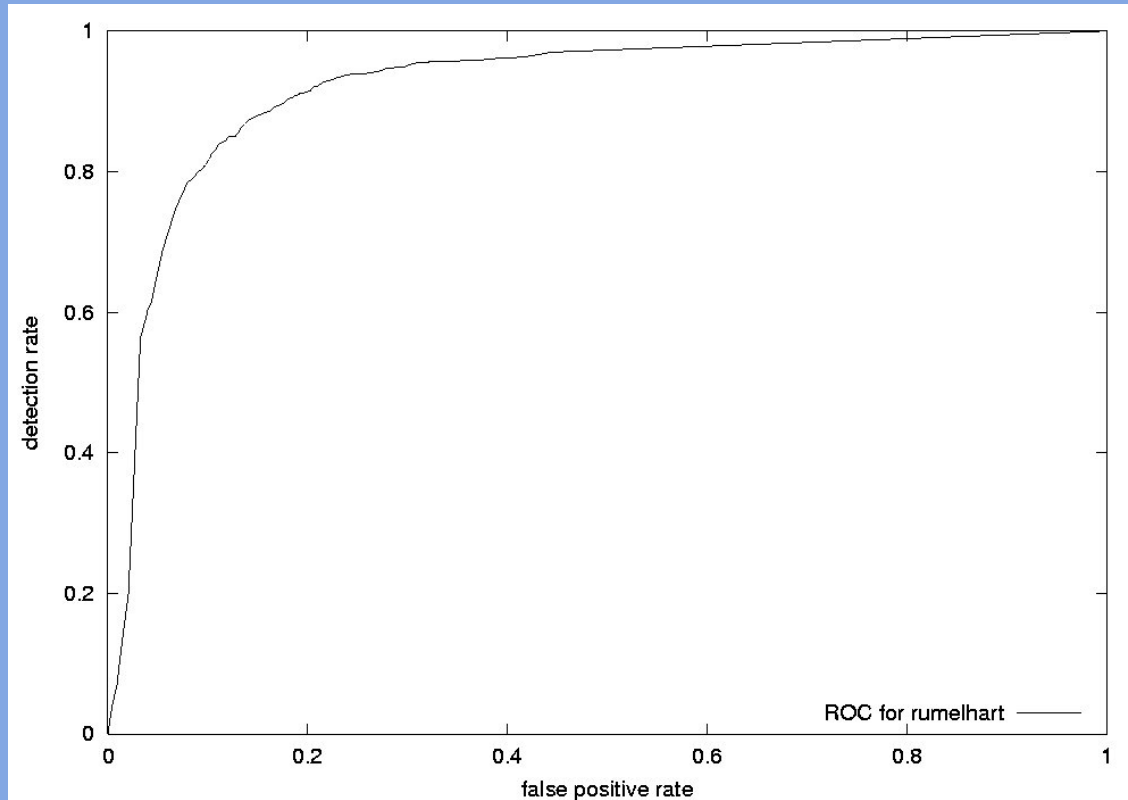
LFE(Local Fit Ellipse)

Learning of Pornographic Image Neural Network

→ Bosson and Cawley[2002]:
The neural network offers a statistically significant performance over several other approaches.

→ Training set:
1,297 pornographic images collected by the end users and 3,787 other images
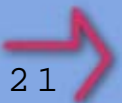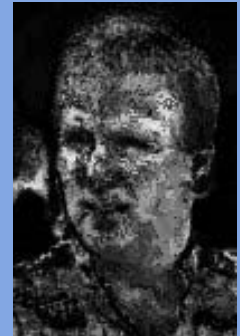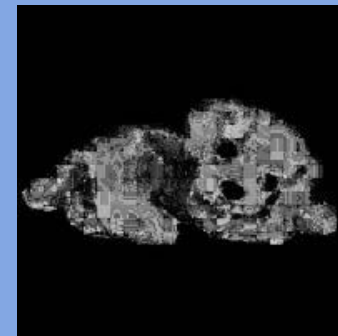
ROC Curve of the Test Database

Test database:1297 pornographic images
3787 other images
Elapsed time: 0.19s/image

Exemples of False Detection

$$O_p=0.006828 \qquad O_p=0.000005 \qquad O_p=0.899044 \quad O_p=0.938251$$

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Symbols filtering

→ Symbols recognition is one the challenging problem in pattern recognition community.

→ No general solution to this problem and few solution exist.
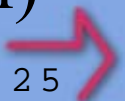
Symboles recognition

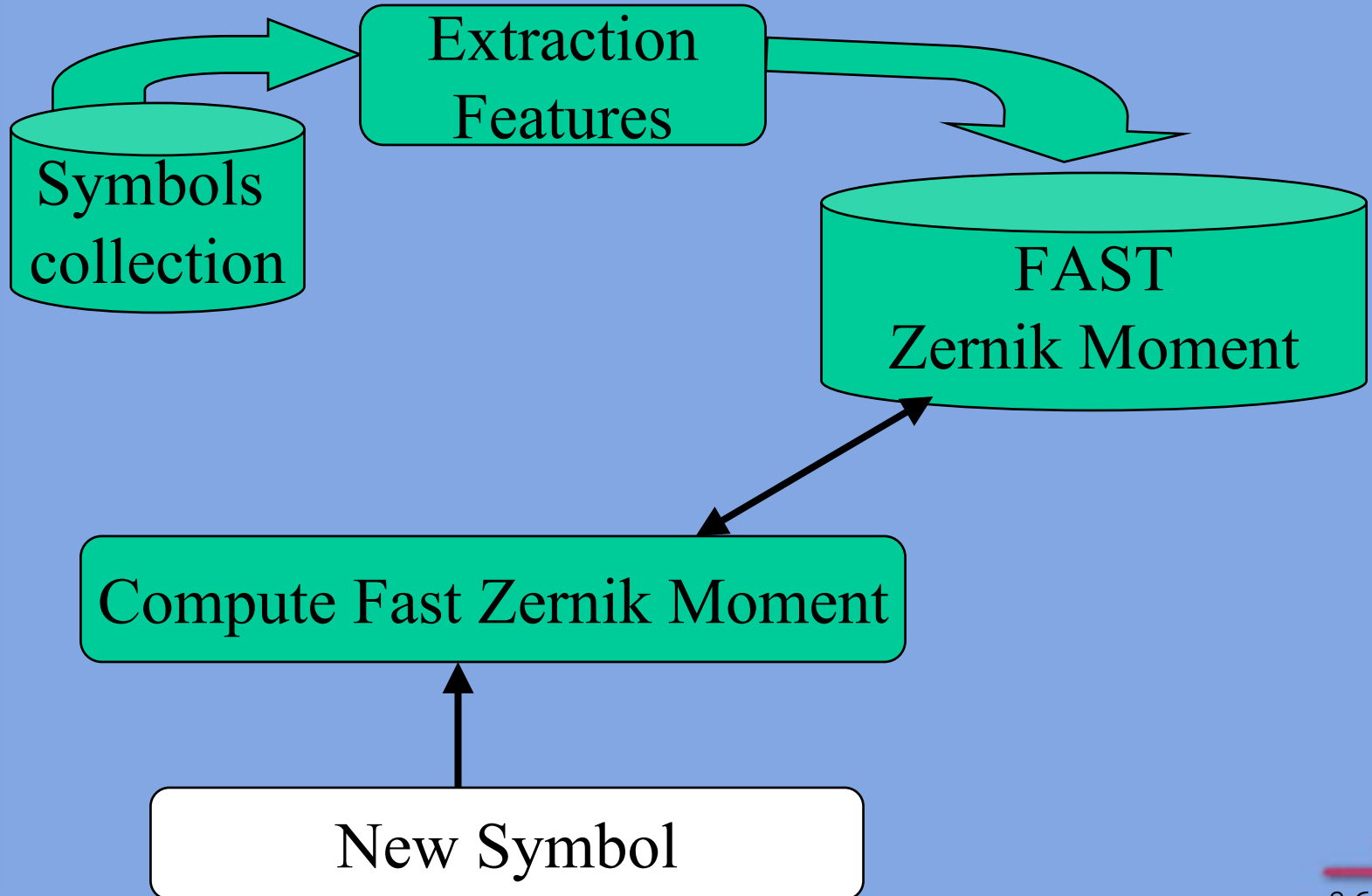## Edge detection

Invariant Descriptors,

- Moments descriptors,

- Zernik moments (recommended by Mpeg-7 for image retrieval)

Architecture

Extraction Features

Symbols collection

FAST Zernik Moment

Compute Fast Zernik Moment

New Symbol

Symbols recognition

194 Harmful symbols collected

21 symbols Non harmful

S.O.S. RACISME

Results

→ 375 harmful symbols (rotations with different angles, scaling with different ratios, translations with different pixels and JPEG compression with different quality factors), and 105 benign symbols downloaded from web.

→ The TN benign symbols is 0.89 and the TP rate for harmful symbols is 0.85.

→ The average elapsed time for each symbol is 0.13s.

Conclusion

→ Our adult image filter is more practical compared with those existing systems in terms of processing speed.

→ We propose the first web symbol filtering.

→ Http://cvs.sourceforge.net/viewcvs.py/poesia/PoesiaSoft/ImageFilter