Ingeniería Eléctrica
FACULTAD DE CIENCIAS FÍSICAS Y MATEMÁTICAS
UNIVERSIDAD DE CHILE

EL 5206 Identificación Periocular

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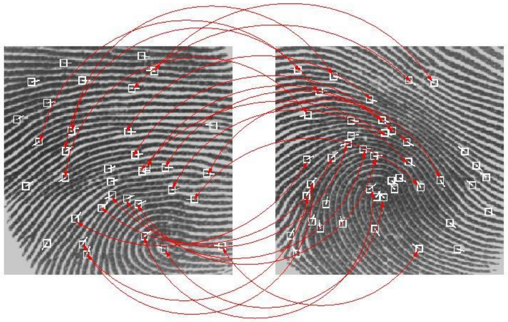
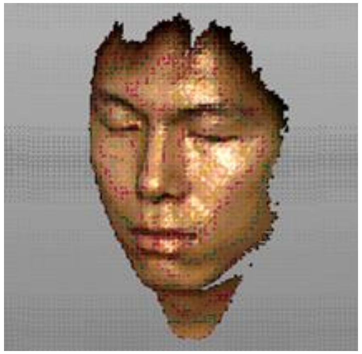
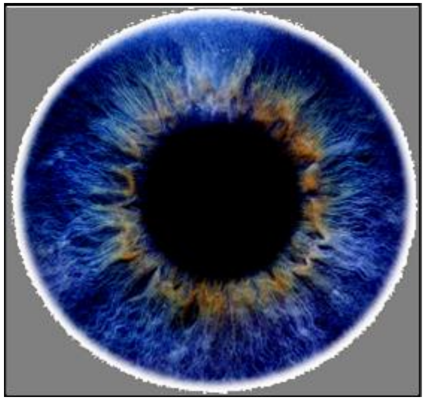
Modalidades Biométricas más Frecuentes

– Identificación de individuos o caracterización de su comportamiento en base a datos medidos sobre su anatomía (huellas dactilares, rostros, iris, palma de la mano, etc.) o su comportamiento (voz, firma, caminata, desplazamientos, etc.).







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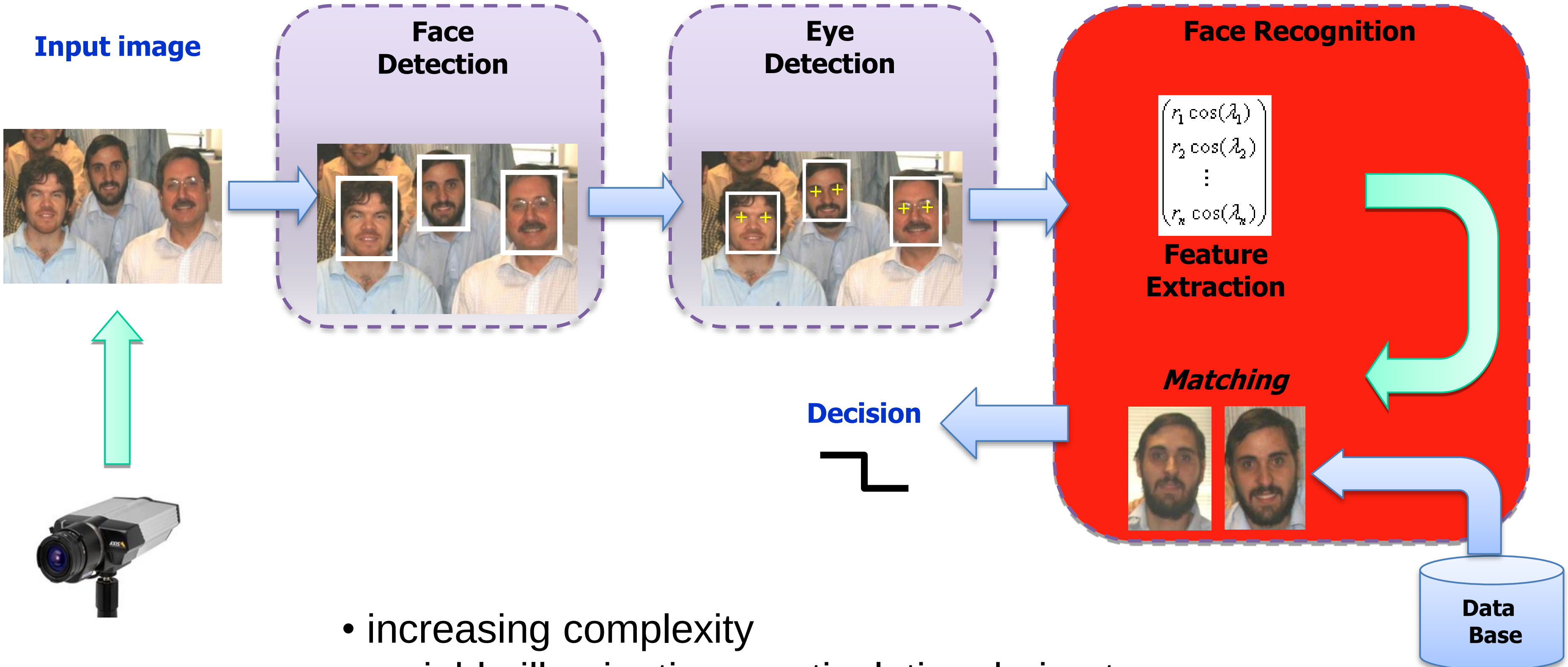
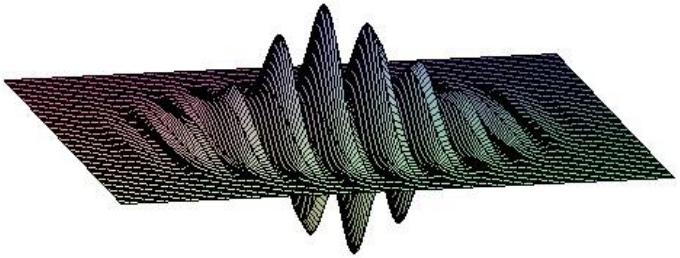
Feature extraction and matching



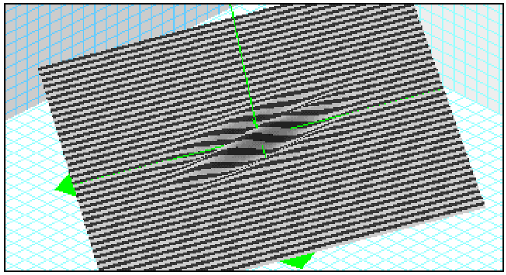
- increasing complexity
- variable illumination, gesticulation, hair, etc.

Gabor Jets

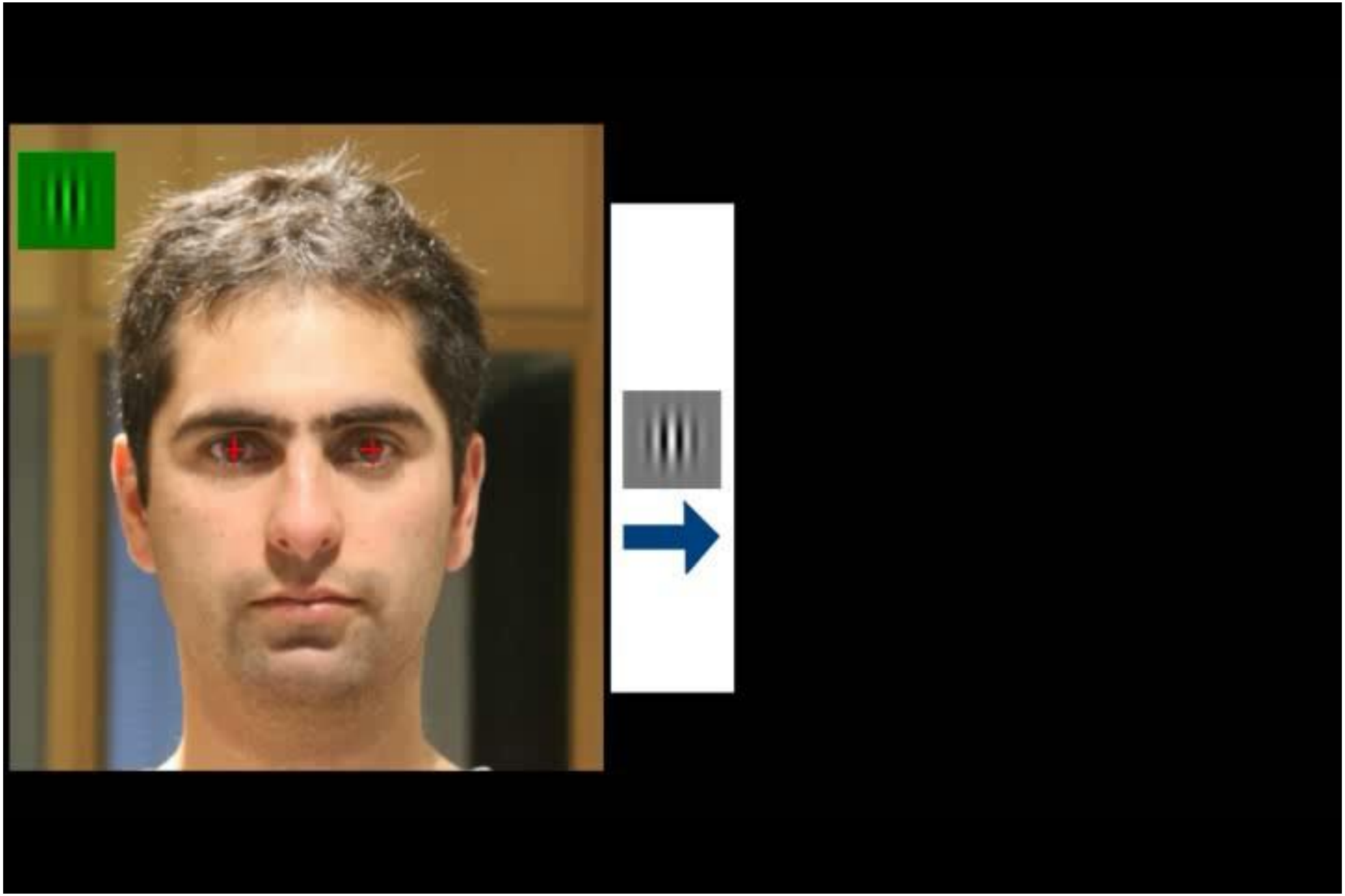
- Gabor Jet: Conjunto de funciones Gabor 2-D complejas que coinciden en posición y longitud de onda (λ), pero difieren en orientación



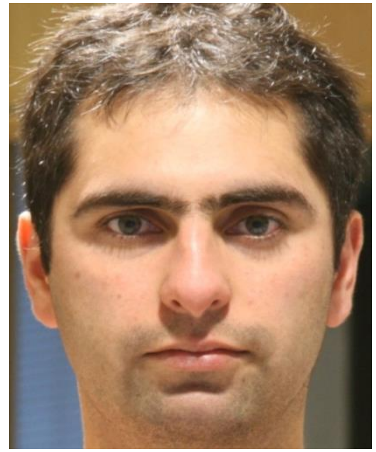
$$h(x, y; \sigma, \omega_0, \phi) = \frac{1}{2\pi\sigma^2} \exp\left(-\frac{1}{2} \frac{x^2 + y^2}{\sigma^2} \right) \cos\left(\omega_0 \left(x \cos\phi + y \sin\phi\right)\right)$$



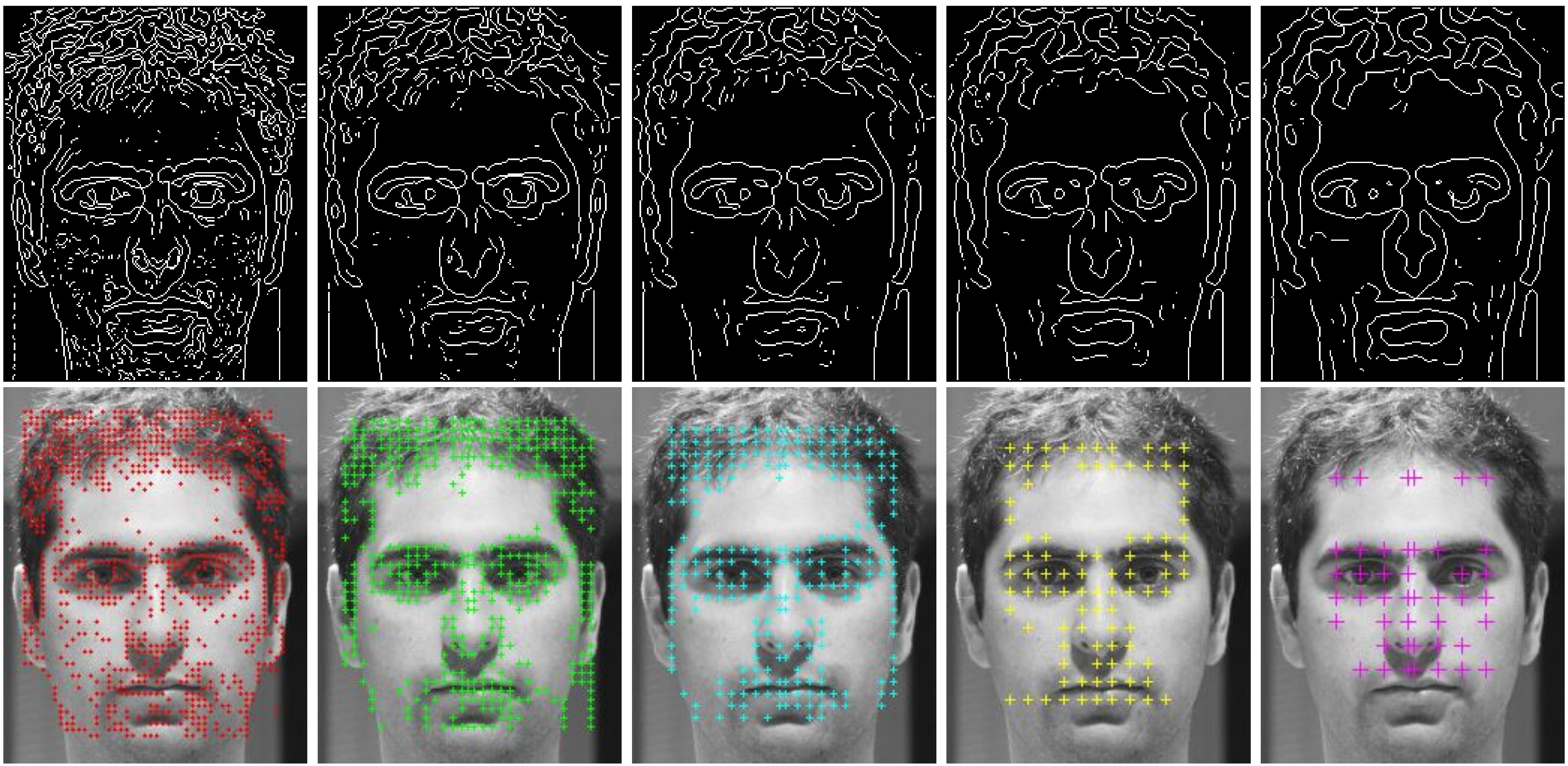
Face feature extraction



Face feature extraction



Multi-resolution



Base de Datos GrayFeret

- Imágenes de 256x384 en tonos de grises
- 5 subconjuntos:
  - Fa: 1196, 1 foto/individuo. Se utiliza como galería
  - Fb: 1195, 1 foto/individuo, mismo día, cámara e iluminación
  - Fc: 194,~1 foto/individuo, mismo día, diferente cámara e iluminación
  - Dup1: 722, ~2 fotos/individuo, hasta 34 meses de diferencia
  - Dup2: 234, ~2 fotos/individuo, por lo menos 18 meses de diferencia
- Ejemplos


Fa


Fb


Dup1

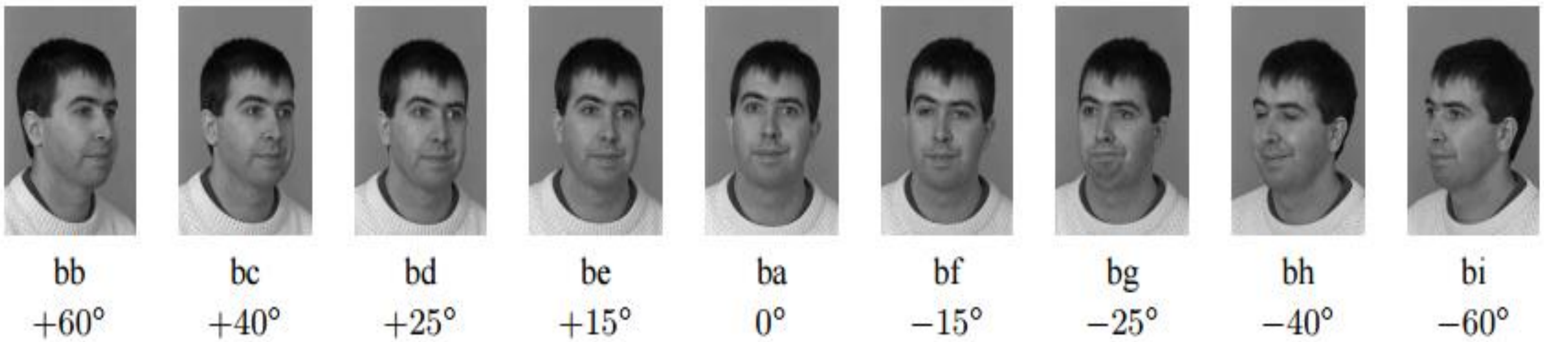

Dup2


Fa


Fc

Bases de datos

- **Base de datos - Partición**



FERET

CMU PIE

Table 4
Rank-1 face recognition rate on different subsets of FERET database for different face recognition algorithms published in the literature.

Methods	Accuracy (%)				Number of errors				
	Fb	Fc	Dup1	Dup2	Fb	Fc	Dup1	Dup2	Total
LMG [43][a]	**99.5**	**99.5**	**85.0**	79.5	**6**	**1**	**108**	48	**163**
LGBPWP [41][a]	98.1	98.9	83.8	**81.6**	23	2	117	**43**	185
Weighted LLGP_FR [40][a]	99.0	99.0	80.0	78.0	12	2	144	51	209
Weighted HGPP [38][a]	97.5	99.5	79.5	77.8	30	1	148	52	231
Weighted LGBPHS [37][a]	98.0	97.0	74.0	71.0	24	6	188	68	286
LGT [39][a]	97.0	90.0	71.0	67.0	36	19	209	77	341
Weighted LBP [37,26][a]	97.0	79.0	66.0	64.0	36	41	245	84	406
GFC [37,35][b]	97.2	79.9	68.3	46.6	33	39	229	125	426
EBGM [37,34][b]	95.0	82.0	59.1	52.1	60	35	295	112	502

[a] Results extracted from original source
[b] Results extracted from the first referenced paper, and the original method is the second referenced paper.

Table 5
Face recognition rate on different subsets of the FERET database for our proposed methods and compared to the best results published up to date in the literature LMG [43]. Subindex 1 indicates FERET training set Train1, subindex 2 indicates FERET training set Train2.

Methods	Accuracy (%)				Number of errors				
	Fb	Fc	Dup1	Dup2	Fb	Fc	Dup1	Dup2	Total
LMG [43]	99.5	99.5	85.0	79.5	6	1	108	48	163
LMG–GSJ$_1$	99.7	99.5	86.3	81.2	4	1	99	44	148
LMG–GSJ$_2$	99.7	99.5	86.3	82.1	3	1	99	42	145
LMG–EJS$_{1a}$	**99.8**	**100**	**88.0**	84.2	**2**	**0**	**87**	37	126
LMG–EJS$_{1b}$	99.4	99.5	**88.0**	**87.2**	7	1	**87**	**30**	**125**
LMG–EJS$_2$	99.5	99.5	87.0	85.9	6	1	94	33	134
LMG–BIP$_1$	99.6	99.5	86.0	82.9	5	1	101	40	147
LMG–BTH$_1$	99.7	99.5	86.8	82.1	4	1	95	42	142

Table 6
Face recognition rate on different subsets of the FERET database for our proposed methods combined and compared to the best results published up to date in the literature LMG [43]. Subindex 1 indicates FERET training set Train1, subindex 2 indicates FERET training set Train2.

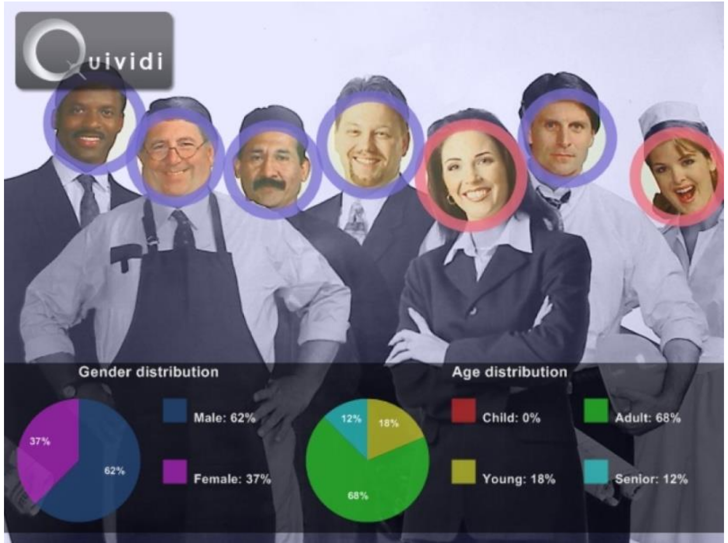
Methods	Accuracy (%)				Number of errors				
	Fb	Fc	Dup1	Dup2	Fb	Fc	Dup1	Dup2	Total
LMG [43][a]	99.5	99.5	85.0	79.5	6	1	108	48	163
LMG–GSJ–BTH–BIP$_1$	99.7	99.5	86.6	83.8	4	1	97	38	140
LMG–GSJ–BTH–BIP$_2$	99.6	99.5	86.8	83.8	5	1	95	38	139
LMG–EJS–BTH$_1$	**99.8**	99.5	88.9	85.9	**2**	1	80	33	116
LMG–EJS–BTH$_2$	99.5	**100**	88.1	86.3	6	**0**	86	32	124
LMG–EJS–BIP$_1$	99.5	**100**	87.8	86.3	6	**0**	88	32	126
LMG–EJS–BIP$_2$	99.2	99.5	87.4	86.3	10	1	91	32	134
LMG–EJS–BTH–BIP$_{1a}$	99.5	**100**	88.8	**87.6**	6	**0**	81	**29**	116
LMG–EJS–BTH–BIP$_{1b}$	**99.8**	99.5	**89.2**	86.8	2	1	**78**	31	112
LMG–EJS–BTH–BIP$_2$	99.6	**100**	88.2	86.3	5	**0**	85	32	122

[a] Results extracted from original source.

Mallas deformables

Introduction

- Why gender classification?
  - The face provides crucial information about gender, age, ethnicity, age and identity
  - Retailers would like to know about the behavior of customers
  - Applications in real time electronic marketing, marketing research, demographic information collection, biometric authentication, social networks, and others




Hombre
Hombre

LBP

- Si *h(I(xc,yc),I(x,y))* es un operador de comparación tal que *h=1* si *I(xc,yc)<I(x,y)* y *h=0* en otro caso, entonces

$$LBP(x,y) = \bigcup_{(x',y')\in N(x,y)} h(I(x,y), I(x',y'))$$

N(x,y) una vecindad de *(x,y)* y $\bigcup$ el operador de concatenación.

40	50	45
25	30	27
40	15	20

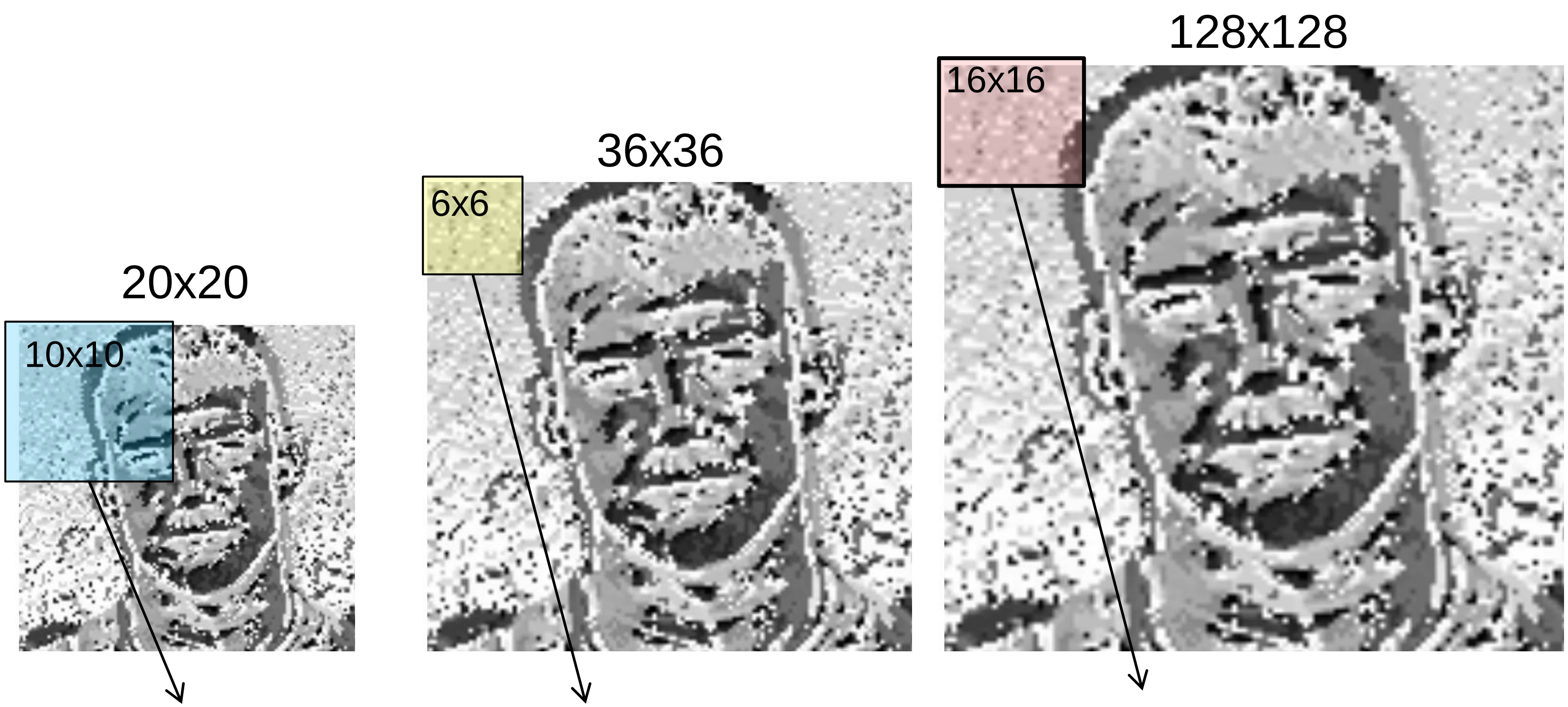
Comparación → Operador *h*

1	1	1
0		0
1	0	0

$\xrightarrow{\bigcup}$

	11100010	

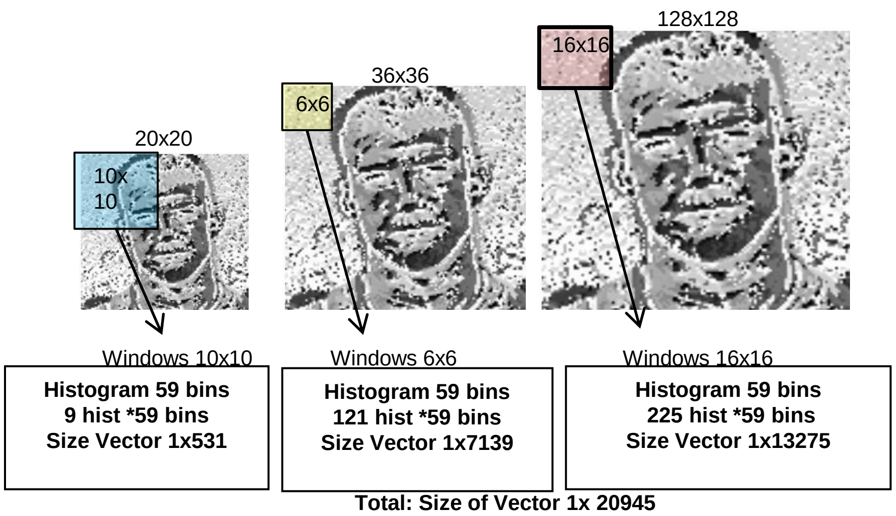
LBP Features

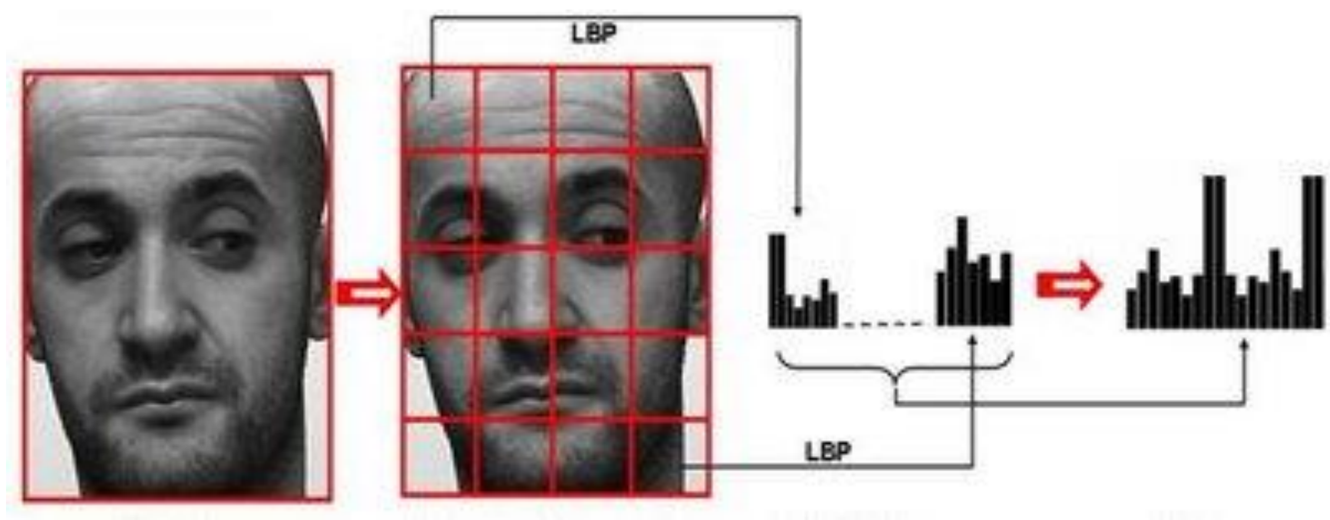


Windows 10x10	Windows 6x6	Windows 16x16
Histogram 59 bins 9 hist *59 bins Size Vector 1x531	Histogram 59 bins 121 hist *59 bins Size Vector 1x7139	Histogram 59 bins 225 hist *59 bins Size Vector 1x13275

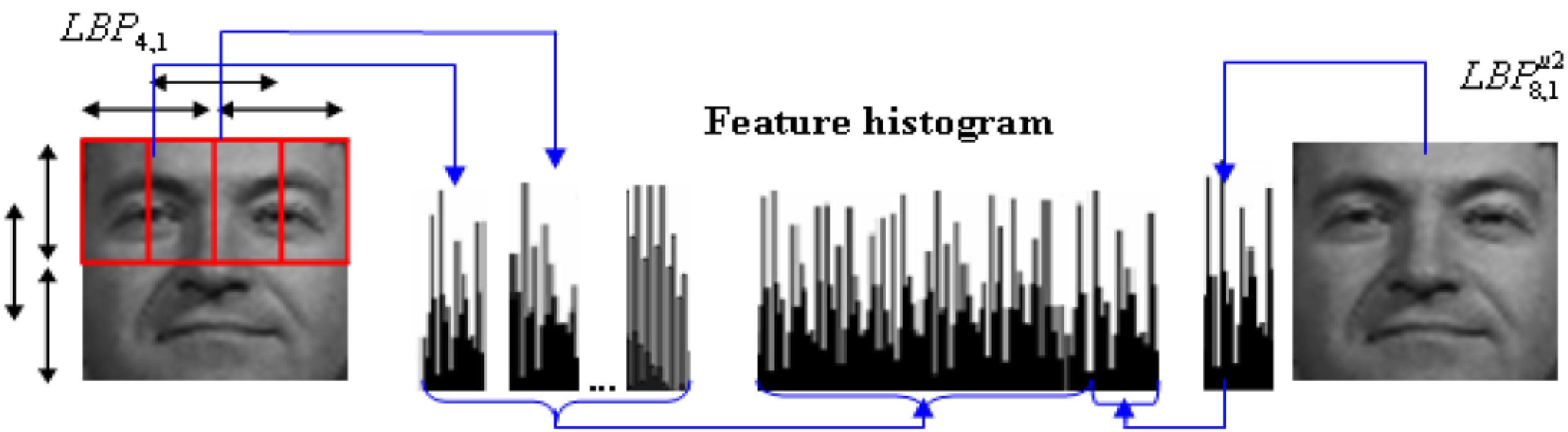
Total: Size of Vector 1x 20945 (c/traslape ventanas)

LBP Features





Feature extraction and fusion



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