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Leveraging Geometry and Appearance Cues for Recognizing Family Photos

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Problem description



Problem description



Is it possible?

Photo labeling

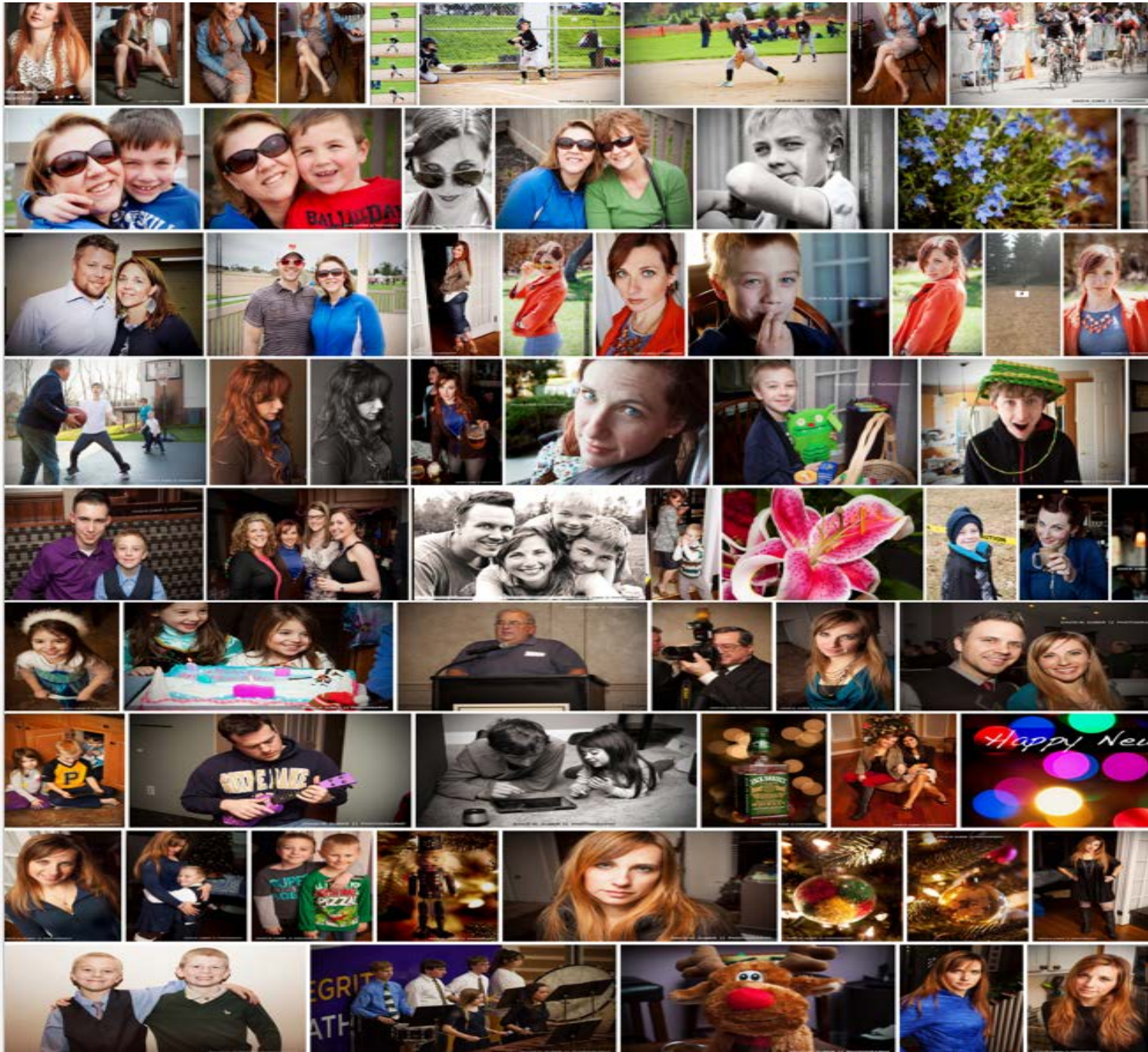


Photo labeling

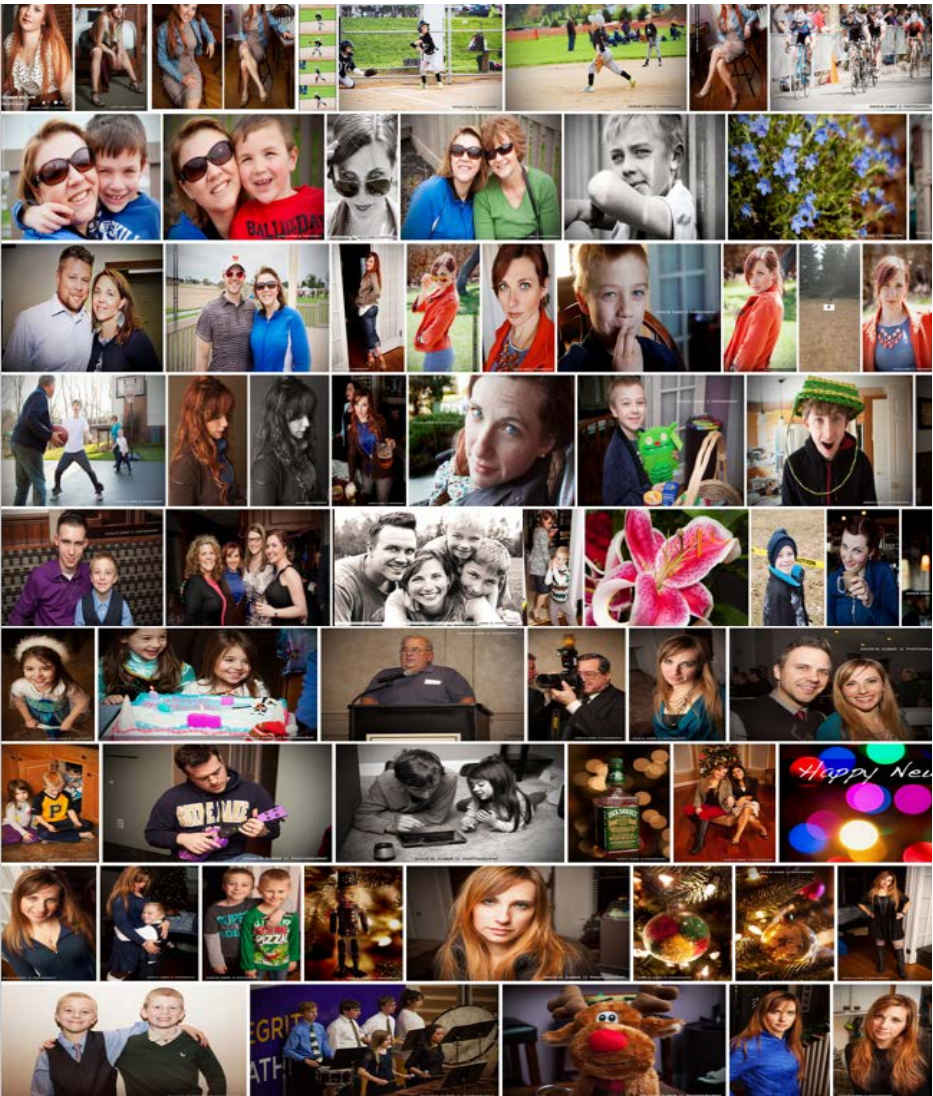
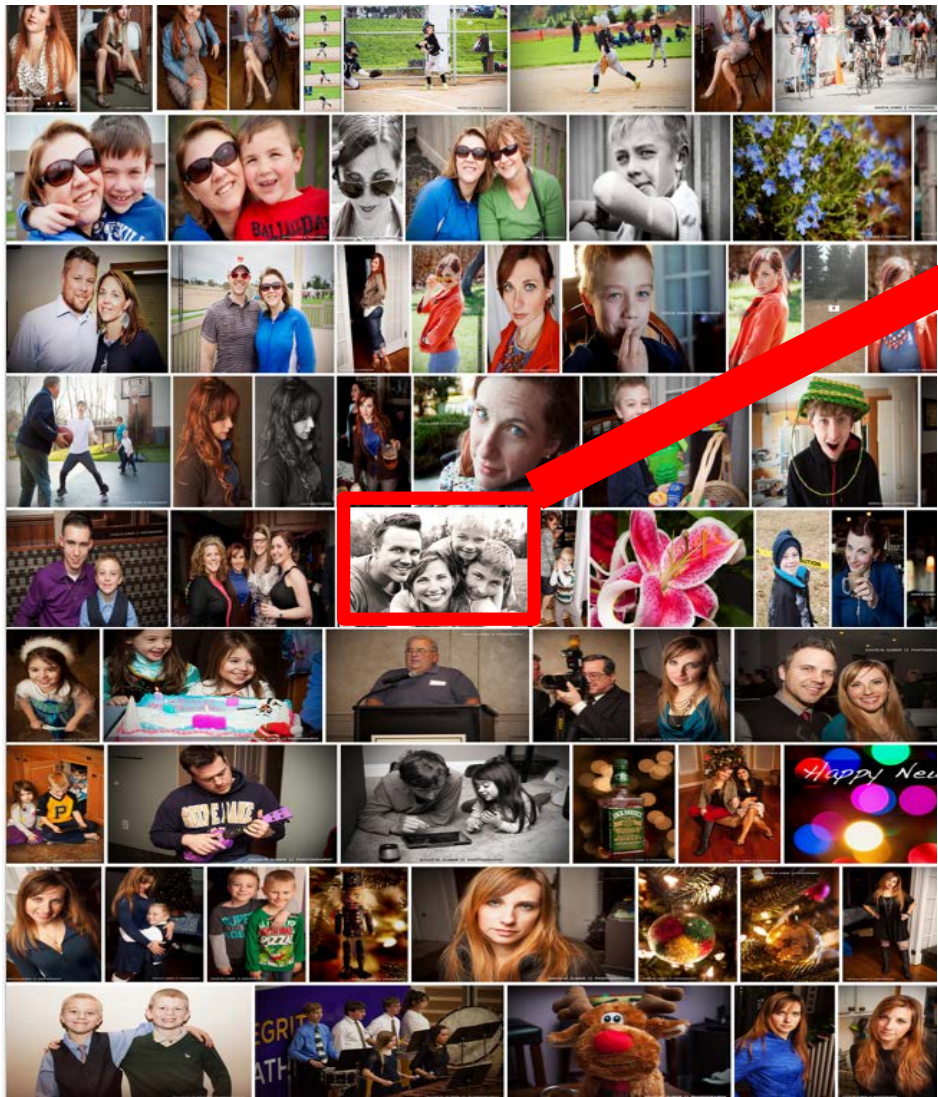


Photo labeling



David M. Zuber [+ Follow](#)

family
I love my family.

54,235 views 62 likes 11 comments

yoanhee Hong, Mauro Haddad Nieri and 60 more people faved this

bob3791 3y What a Great family shot! You guys are Wonderful

wdnshoe 3y Awesome Pose, Love the Light and Tones.

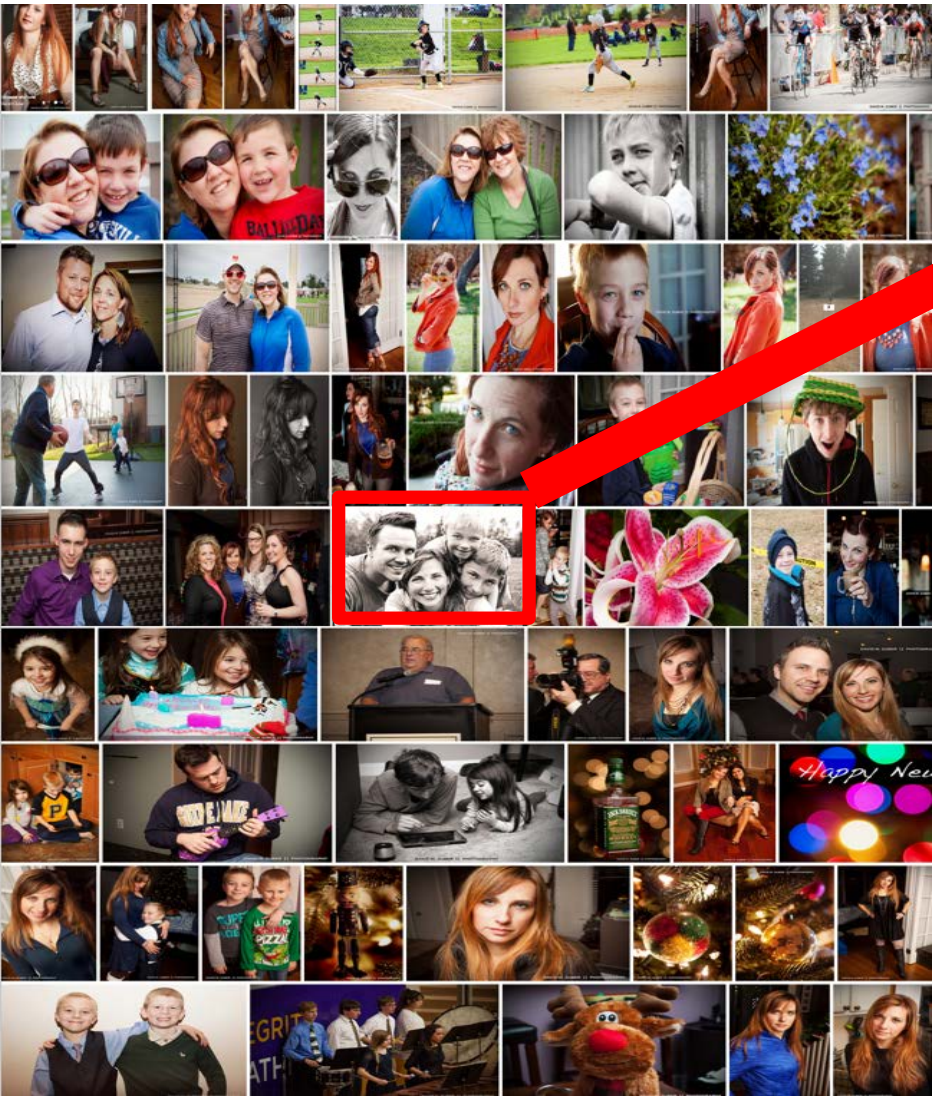
..trickipenema.. 3y nice portrait

All 3y great family .. great eyes .. great smiles .. the youngest angel looks like the father , the other angel looks like the mother ..

This photo is in 2 galleries

Things I'm Thankful For 18 photos

Photo labeling

A large photo of a family (father, mother, and two children) smiling together. Below the photo is a social media interface showing a gallery titled "family" with 54,235 views, 62 likes, and 11 comments. The photo is identified as a Canon EOS 50D.

Family

family

54,235 views 62 likes 11 comments

Canon EOS 50D 28.75mm

1/4.0 28.0 mm

1/100 f50 400

Flash (off, did not fire) Show EXIF

This photo is in 2 galleries

Things I'm Thankful For 18 photos

Photo labeling

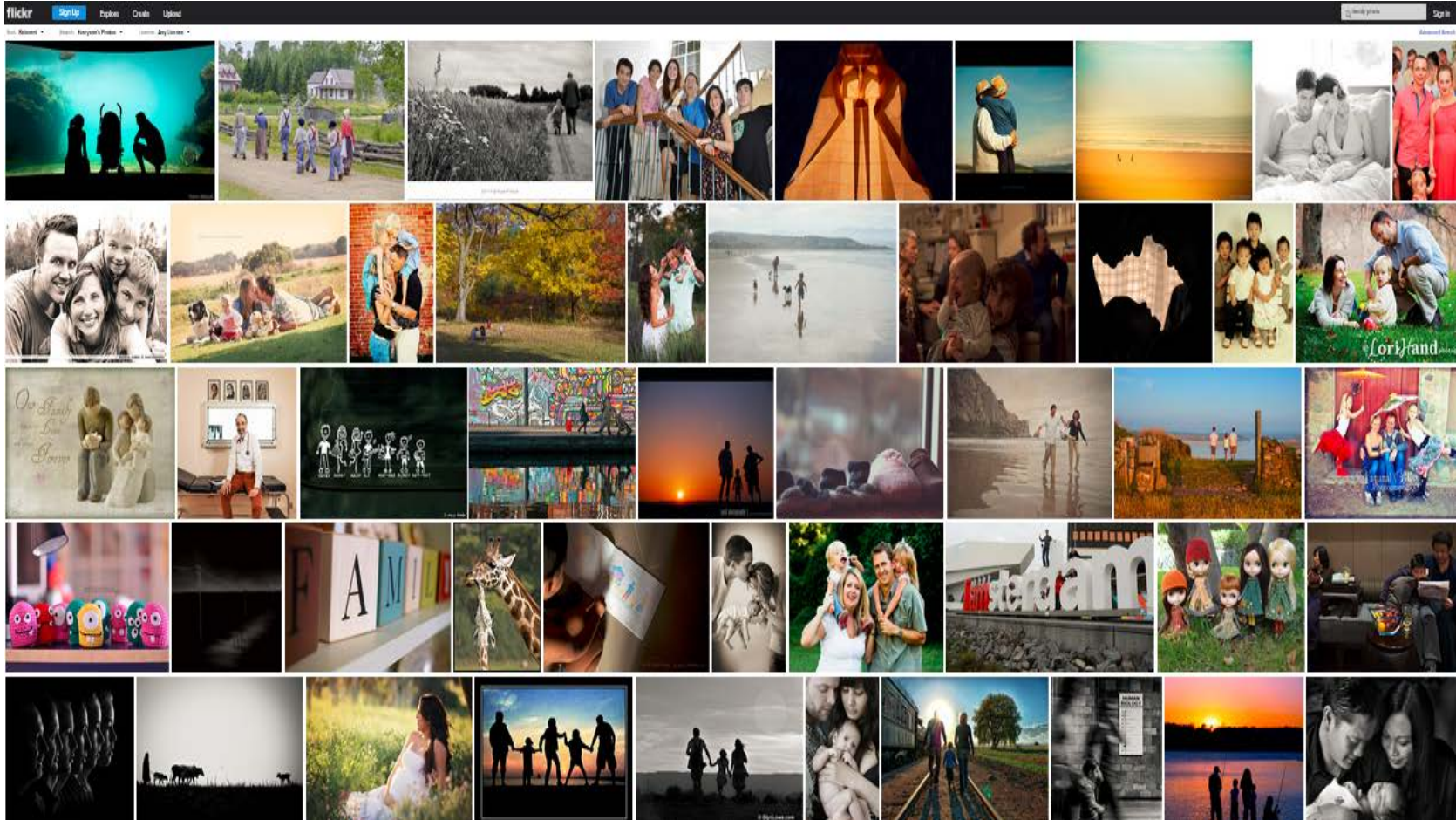
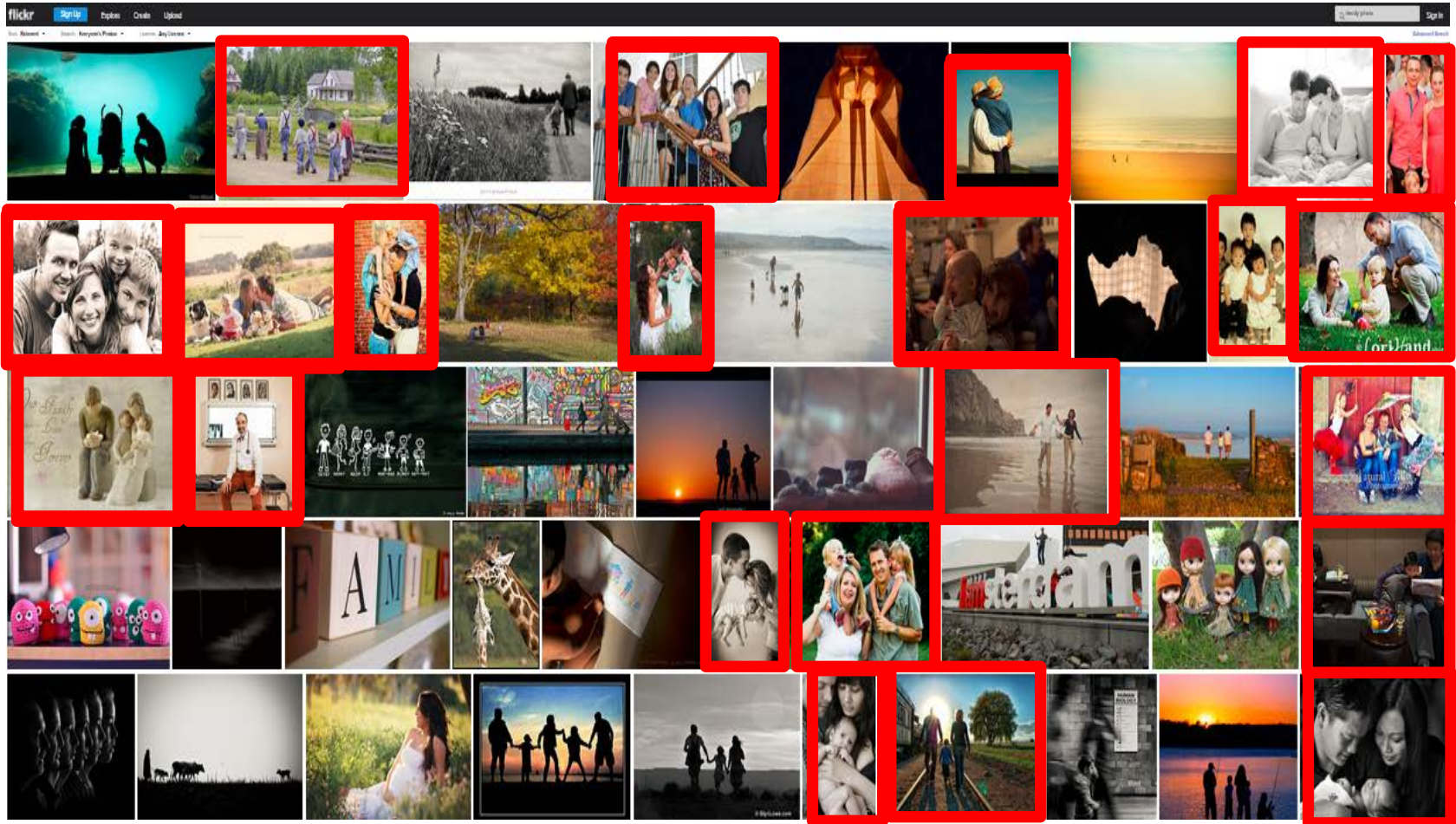
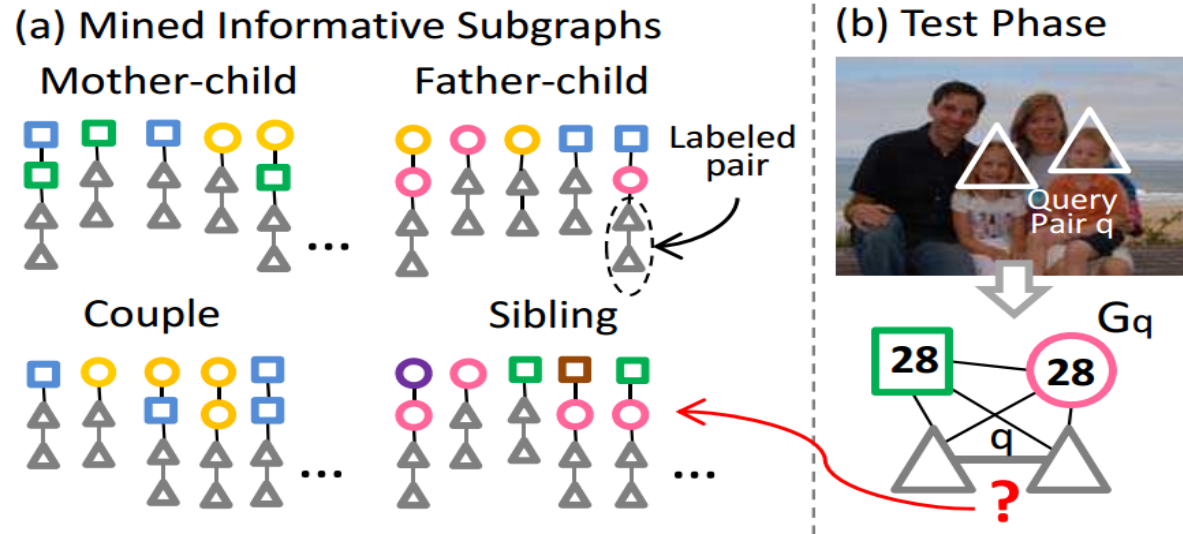


Photo labeling

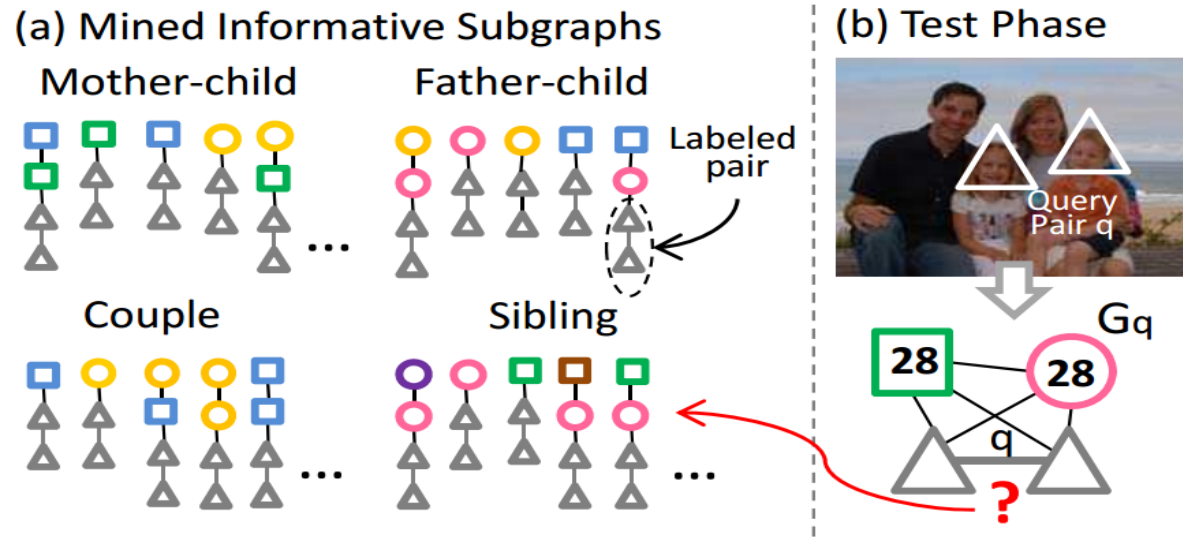


Related work



- Chen et al. Discovering Informative Social Subgraphs and Predicting Pairwise Relationships from Group Photo, MM, 2012.

Related work



(a)



(b)



(c)



(d)

- Chen et al. Discovering Informative Social Subgraphs and Predicting Pairwise Relationships from Group Photo, MM, 2012.

Cues



Geometry



Appearance

Cues



Geometry



Appearance

Geometry Model

1. Convex Hull is used as the basis to represent the geometry of people position.

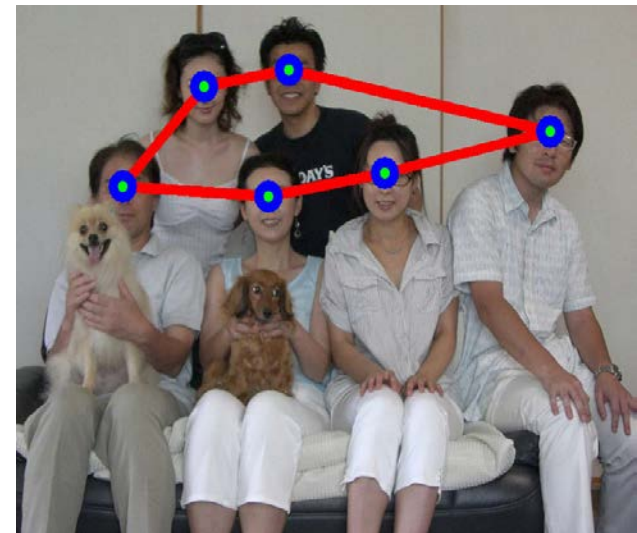
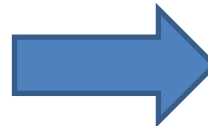
$$\left\{ \sum_{i=1}^n a_i s_i \mid (\forall i : a_i \geq 0) \wedge \sum_{i=1}^n a_i = 1 \right\}$$



Geometry Model

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$$\left\{ \sum_{i=1}^n a_i s_i \mid (\forall i : a_i \geq 0) \wedge \sum_{i=1}^n a_i = 1 \right\}$$



Geometry Model

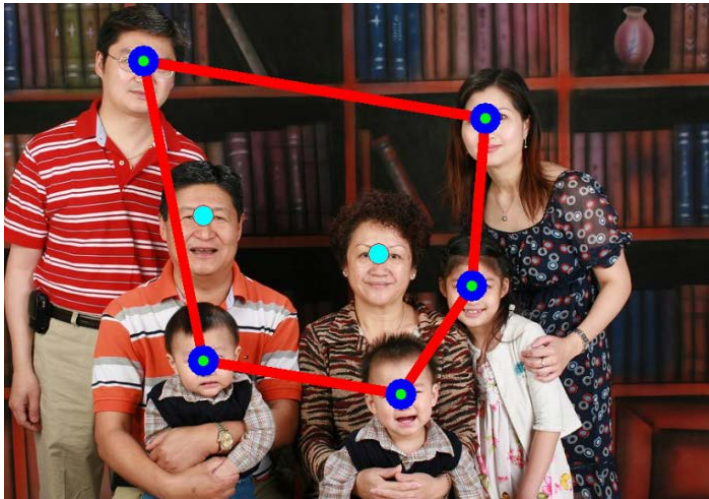
2. Incorporating all the vertices



Geometry Model

2. Incorporating all the vertices

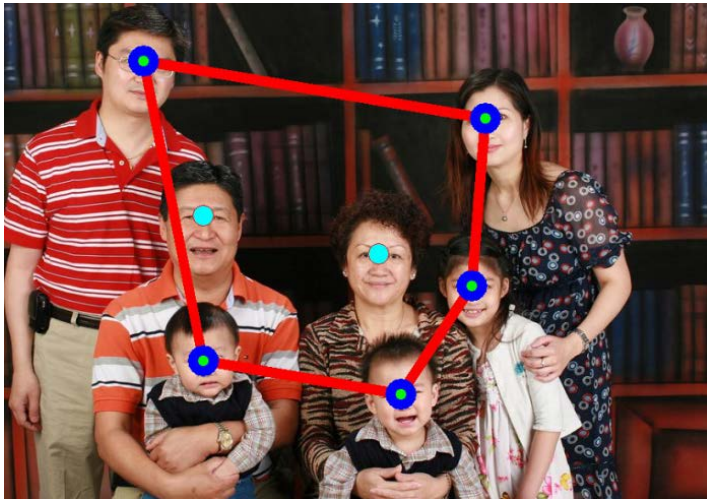
$$d = \sqrt{(u_i - x_{ai})^2 + (v_i - y_{ai})^2}$$



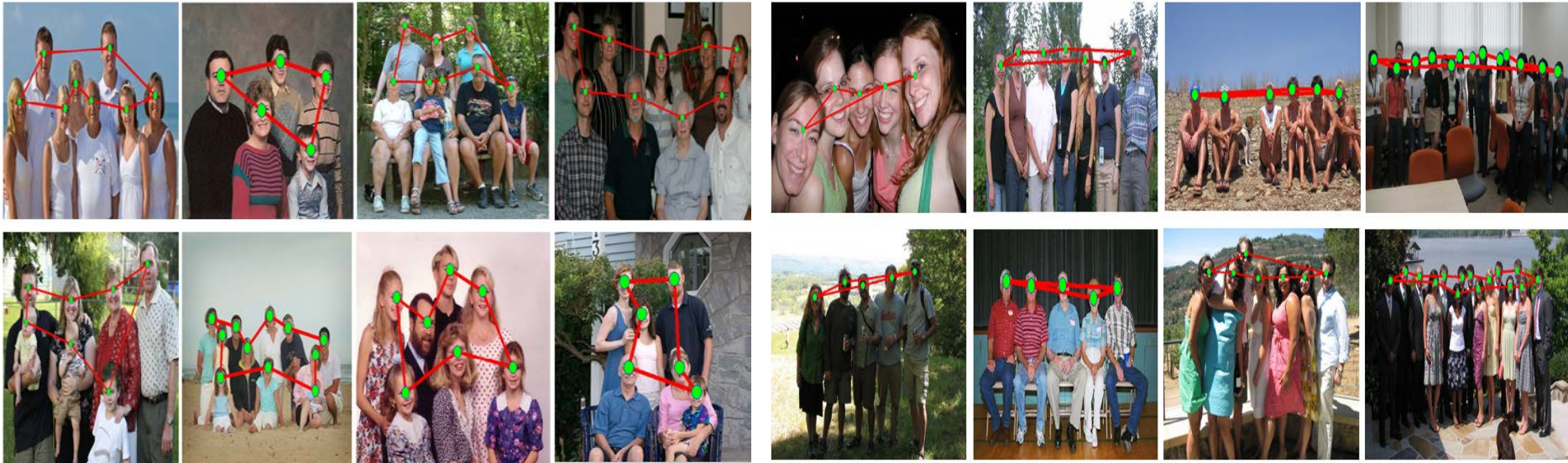
Geometry Model

2. Incorporating all the vertices

$$d = \sqrt{(u_i - x_{ai})^2 + (v_i - y_{ai})^2}$$



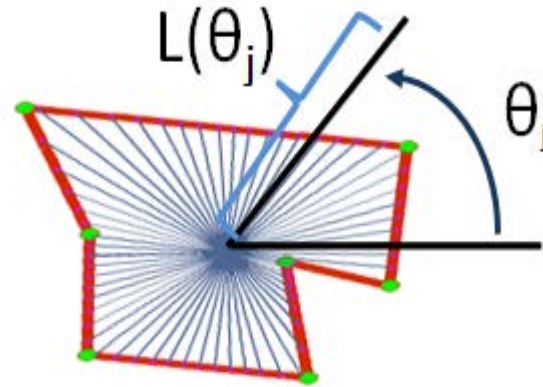
Geometry Model



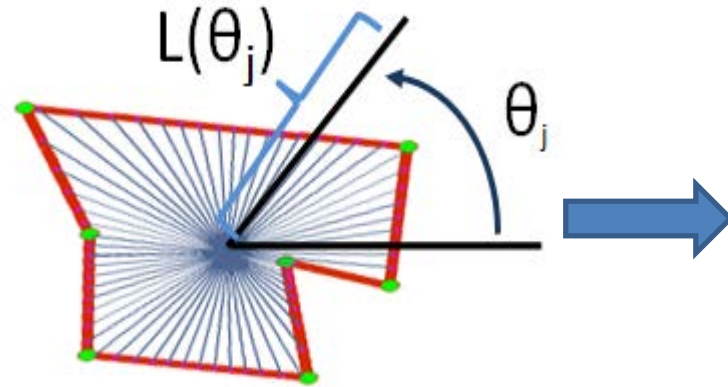
Geometry Model



Geometry Model



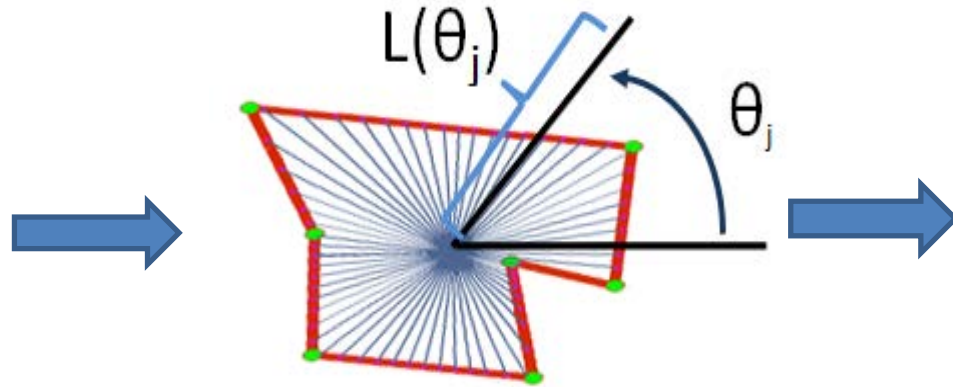
Geometry Model



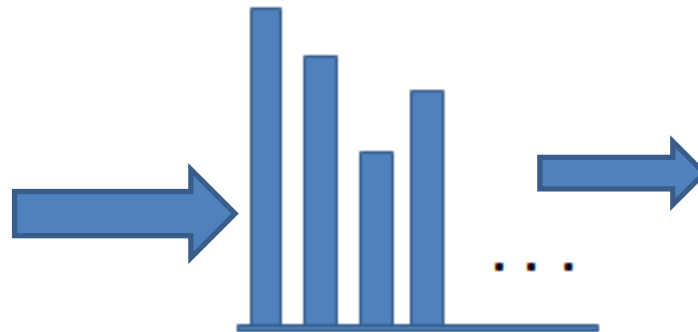
FFT of $L(\theta_j)$



Geometry Model

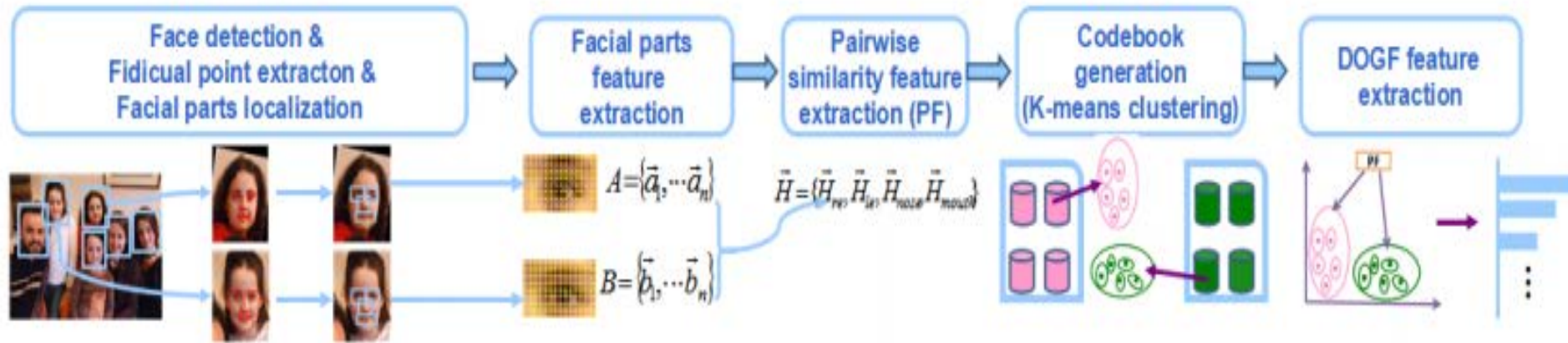


FFT of $L(\theta_j)$

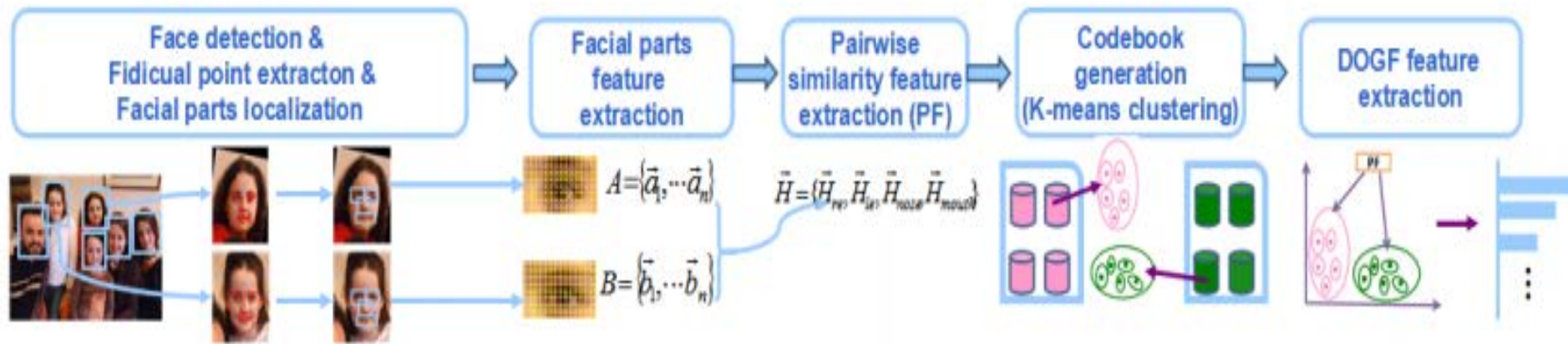


Classification

Degree Of Group similarity Feature (DOGF) feature extraction

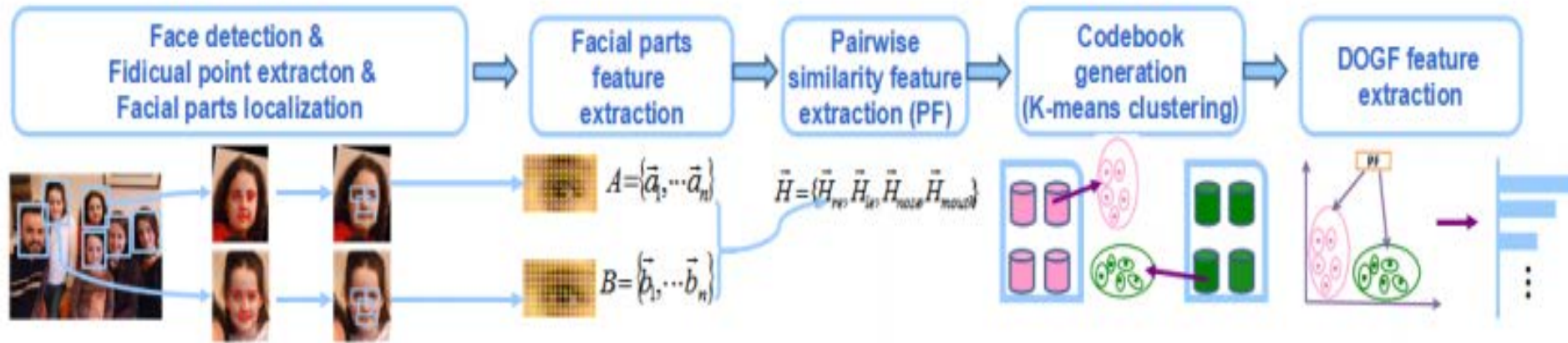


Degree Of Group similarity Feature (DOGF) feature extraction



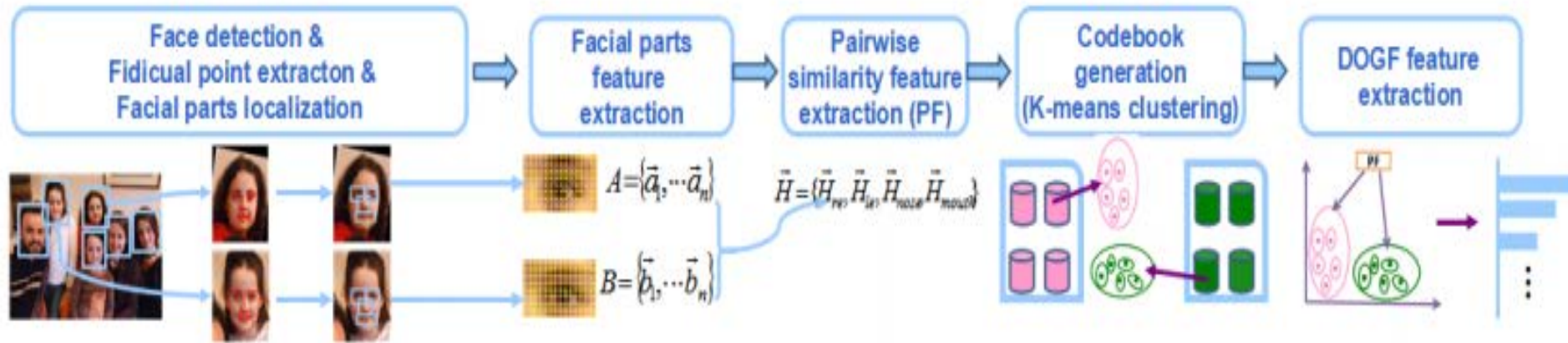
- Pairwise Feature (PF) Extraction

Degree Of Group similarity Feature (DOGF) feature extraction



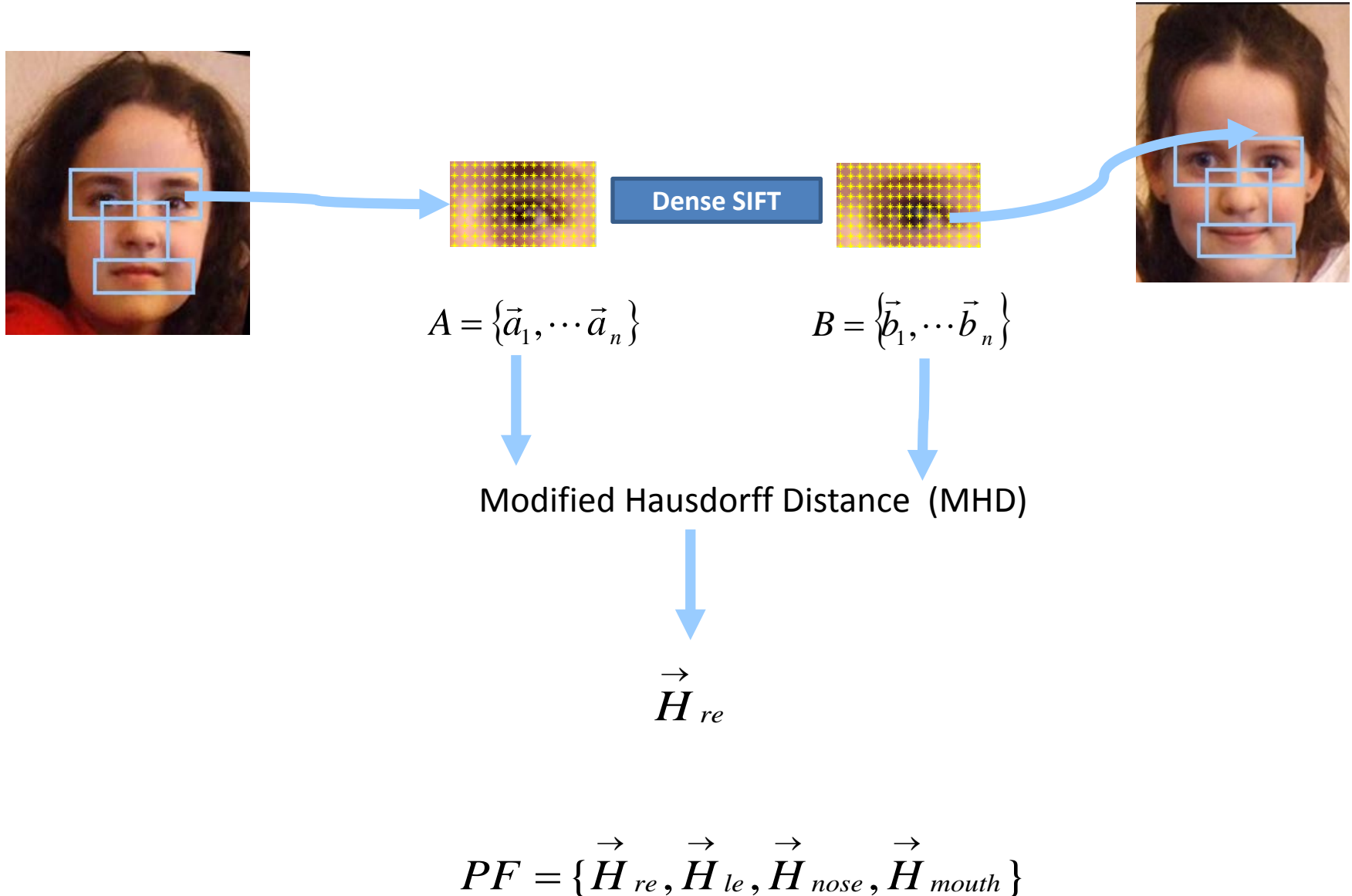
- Pairwise Feature (PF) Extraction
- Facial Codebook Construction

Degree Of Group similarity Feature (DOGF) feature extraction

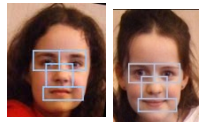


- Pairwise Feature (PF) Extraction
- Facial Codebook Construction
- Formulation of DOGF Feature

Pairwise Feature (PF) Extraction

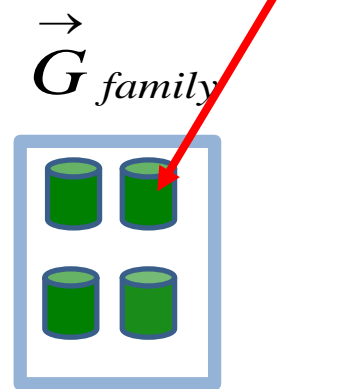
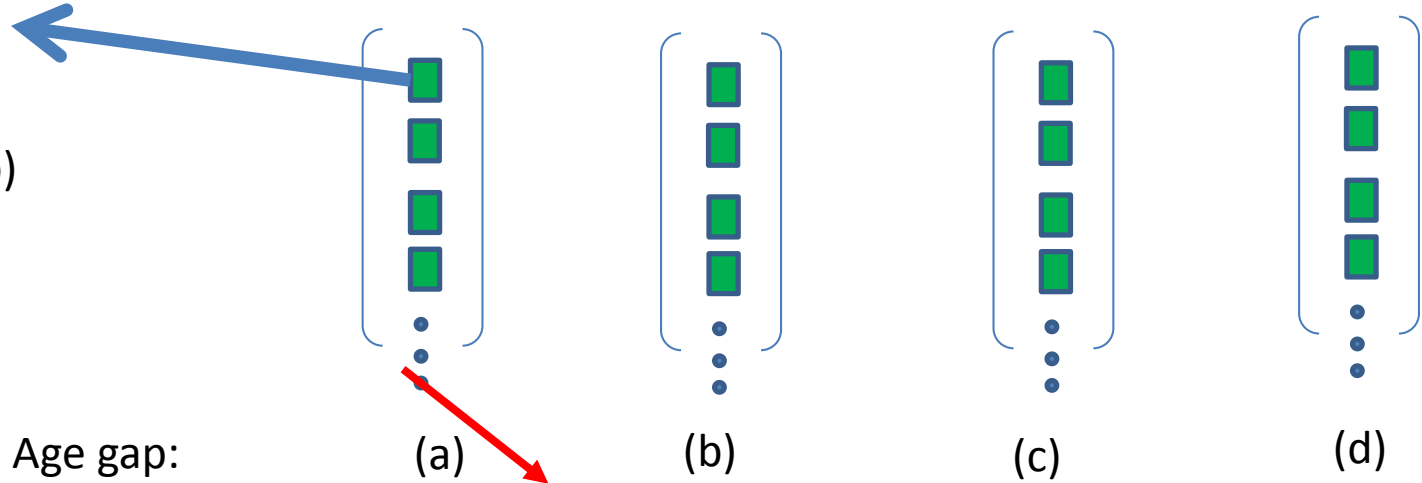


Facial Codebook Construction

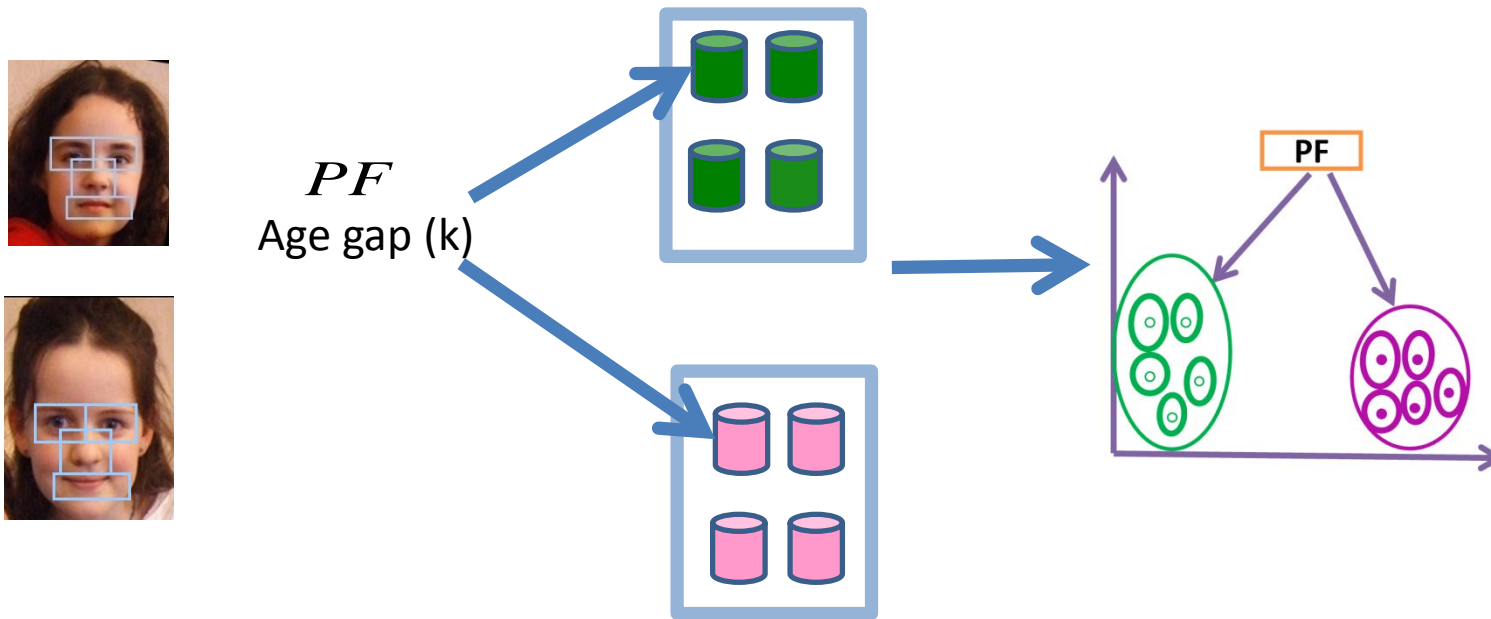


Age Gap (p): (a) $P < 10$; (b) $10 < P < 20$; (c) $20 < P < 40$; (d) $P > 40$

PF
Age gap (p)



DOGFB feature extraction



$$d_1 = d(\vec{H}_j, \vec{G}_{mk})$$

$$d_2 = d(\vec{H}_j, \vec{G}'_{mk})$$

$$\vec{d}_j = [d_1, d_2]$$

$$\vec{F} = \frac{1}{J} \sum_{j=1}^J \vec{d}_j$$

J : Number of facial pairs

Model Fusion

Score level fusion

$$R_c(x, y) = \sum_m w_m e^{-\frac{\|x-y\|^2}{2\sigma_m^2}}$$

w_m can be set a priori or via cross-validation.

w_m is set using cross-validation.

Experiments

Dataset:

	Family photos	Non-Family photos
Dataset One [Chen et al. MM 2012]	1167	1263
Dataset Two (New)	1420	1420

Note:

1. Dataset One is used in [Chen et al. MM 2012].
2. 16818 individuals are included in Dataset Two.
3. All photos used in our experiment contain at least three individuals.
4. Five-fold cross- validation.

Experiments

Correctly-classified samples using geometry model only



Family Photo



Non-Family Photo

Experiments

Misclassified samples using geometry model



Family Photo



Non-Family Photo

Experiments

Correctly-classified samples using appearance model



Family Photo



Non-Family Photo

Experiments

Misclassified samples using geometry model and correctly classified after fusion



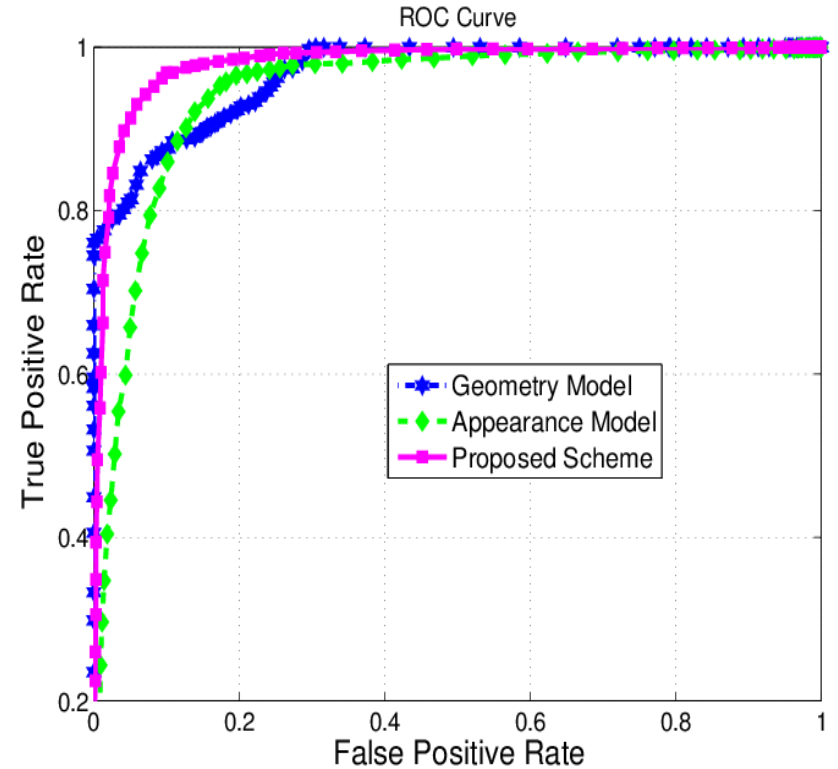
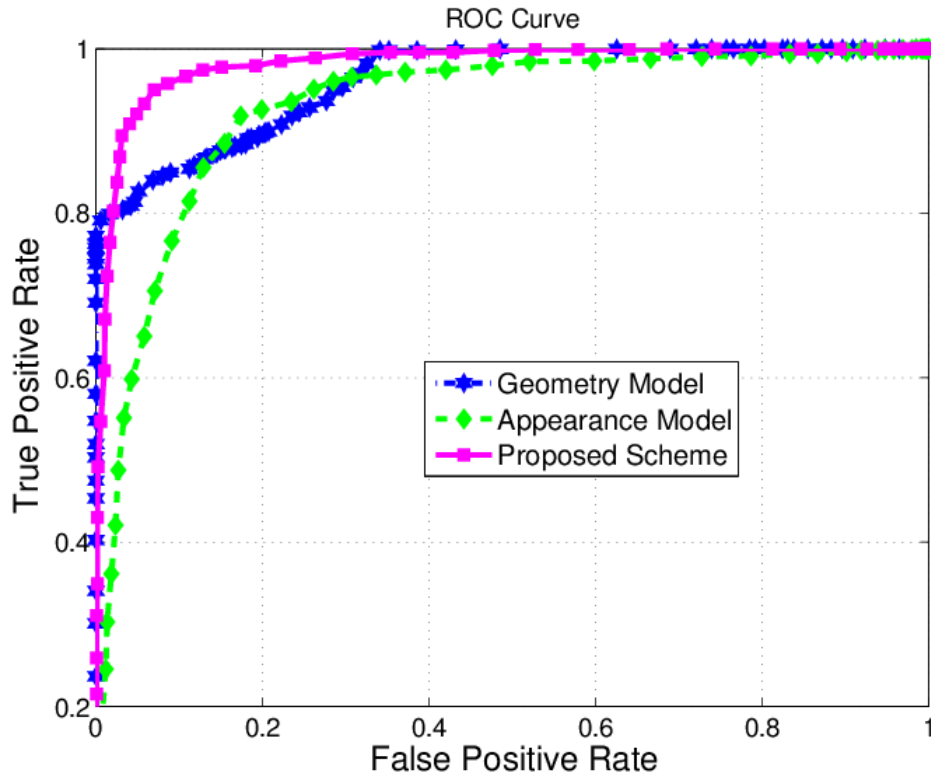
Family

Experiments

Method	Dataset One	Dataset Two
Chen et al [MM 12]	90.03%	-----
Geometry (Ours)	86.4%	87.3%
Appearance (Ours)	89.4%	89.0%
Fusion (Ours)	93.9%	93.4%

Experiments

ROC illustration of Dataset One and Two



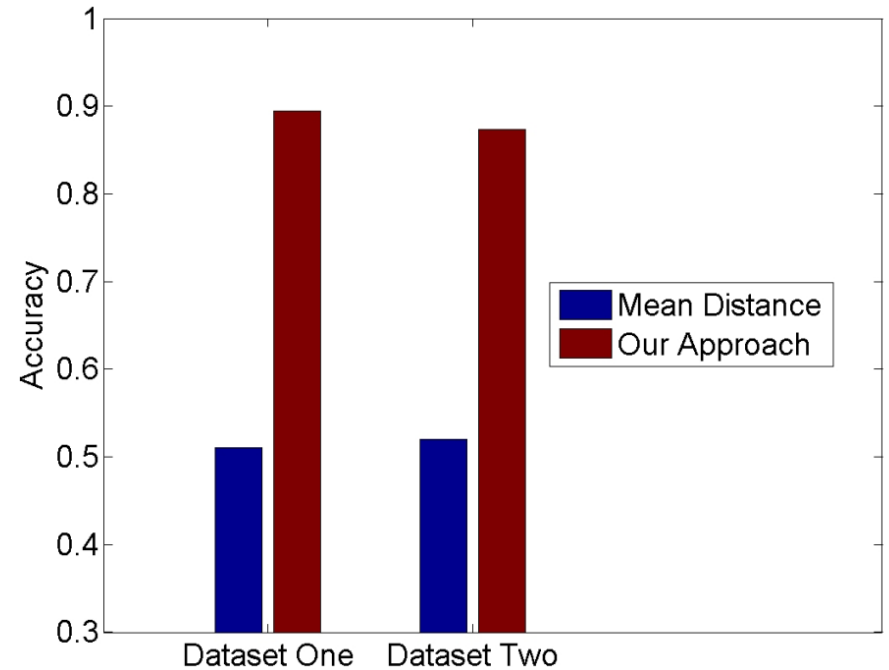
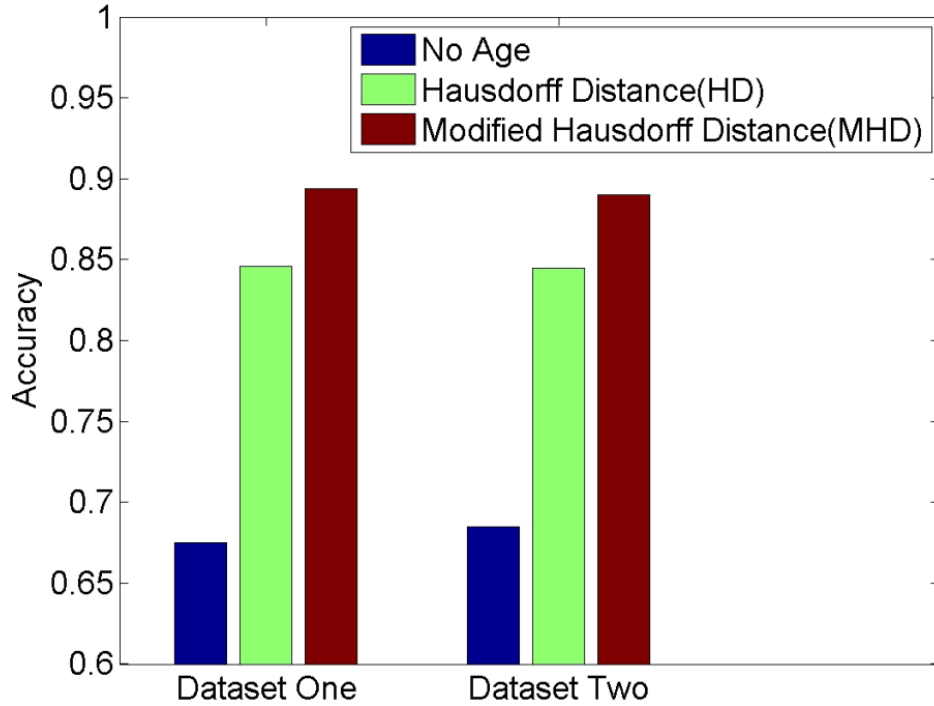
Experiments

Experimental Setting:

- 1 . Geometry model baseline: the distances calculated from the center to all vertices are used as the feature.
2. Appearance model:
 - a. Modified Hausdorff Distance(MHD) vs Hausdorff Distance(HD) .
 - b. Using age information vs no-age information.

Experiments

Bar illustrations of different schemes



Conclusions

1. A new global geometry feature is proposed to represent the standing pattern of people in a group photo and we have obtained very promising results.
2. Our method demonstrated that fusing geometry with appearance feature is an efficient scheme for recognizing family photos.
3. In our future research, we like to explore automatically labeling photos for other groups (such as work colleagues, students, etc)

Thank you !