Automatic Group Happiness Intensity Analysis

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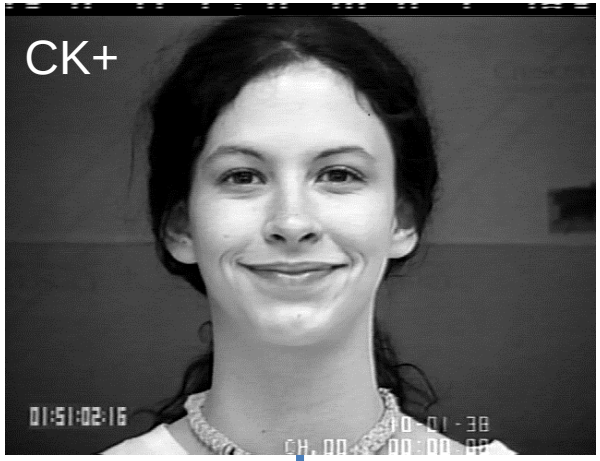
From Single Subjects to Crowds



Single subject

Crowd

Group

Motivation

- Social computing is a very active topic of research
- 1.8 B images / day uploaded to social media
- Including a large number of images from social events
- How can we manage them for efficient representation?
  - Image album creation
  - Image retrieval
  - Video summarisation
  - Candid shot selection
  - Opinion mining

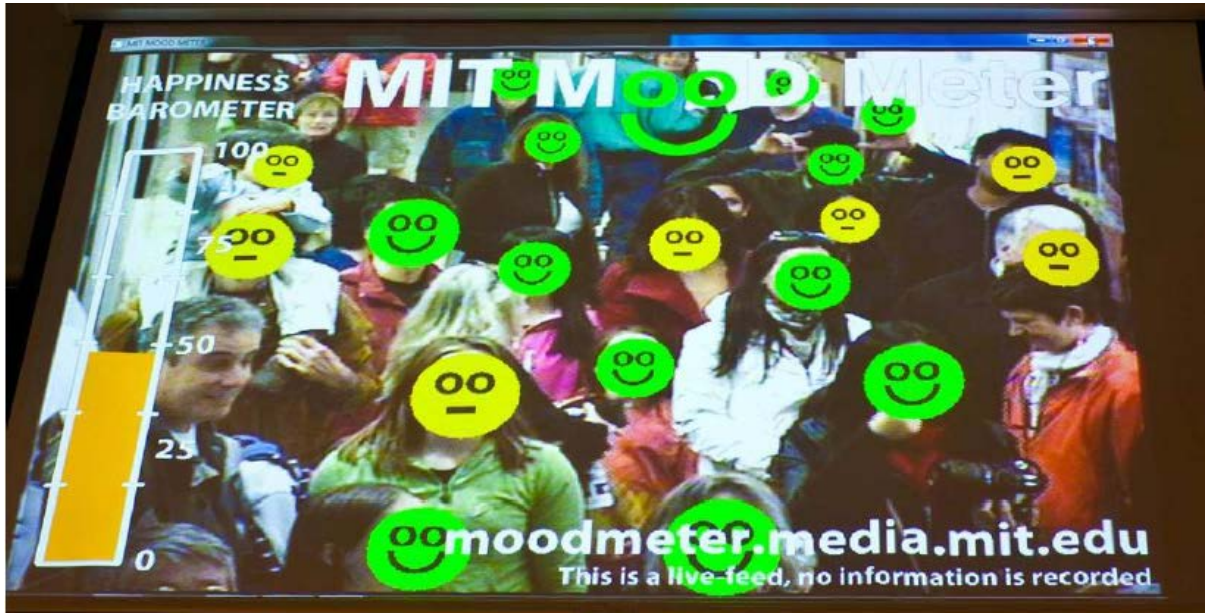
Prior Work

- Gallahger et al. 2009
  - Analysed the effect of group structures on age and gender recognition
  - Constructed Min-Span tree based on face locations
  - Improved the accuracy of age and gender recognition

Figure from the original paper

Similar Work

- Hoque et al. 2012
  - MIT Mood Meter – four cameras installed at different locations on MIT campus to infer mood of passers-by
  - Based on averaging of smile intensities



System snapshot from the original paper

Other Group Problems

- Candid portrait selection from video (Agarwala et al. 2011)
  - Learned regression model over ensemble of features representing: eye blink, face clarity and other attributes
- Urban Tribes (Murinoo et al. 2012)
  - Group category classification based on low-level and mid-level features
- Crowd Analysis
  - Rodriguez et al. 2011
  - Analyse crowd motion
  - Abnormal activity recognition

Challenges

- Static vs Dynamic
- Affect labels?
- Data?
- Factors affecting “group level” expression?
  - Global features – where are people standing, who is standing with whom and scene information
  - Local features – Age/Gender/Visibility/Smile Intensity/Pose/Eye blink

Challenges

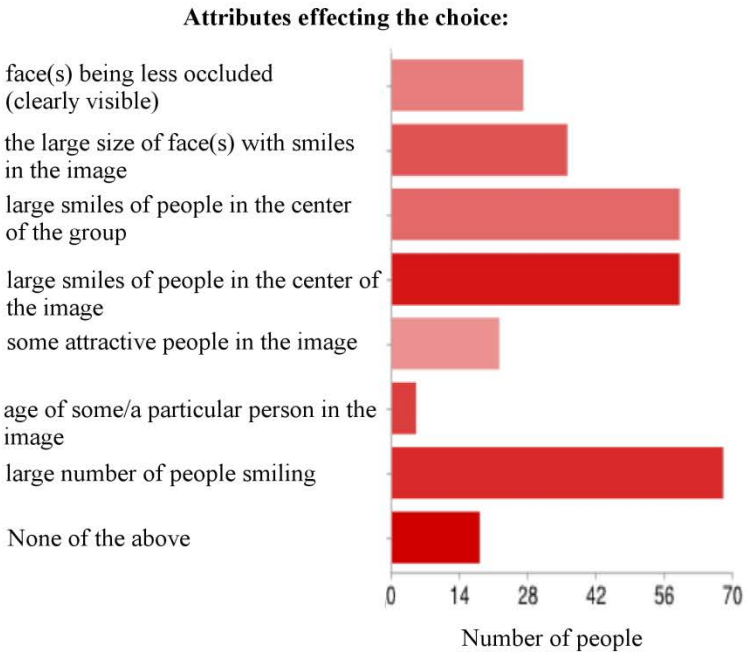
- Face detection and alignment
- Occlusion and Illumination
- Labelled Data

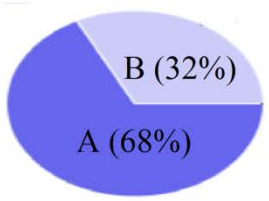
Survey

- 149 Subjects: Independent of labellers

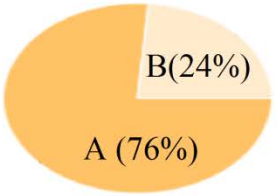
A

B





Which of the two image is happier as a whole?



Which of the two group is happier?

Is the reason for your choice the pleasant scene (background/situation)?

Any other reason for your choice?

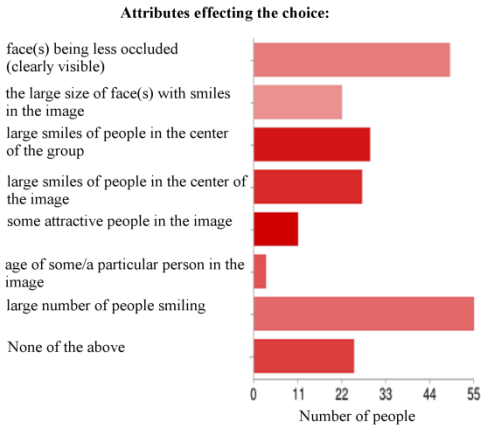
Colourful scene in the left image | Those who are not happy seems to influence the decision as well | Context | Background | No | nothing | no | No | None | No | Large smiles | Togetherness of the group, dress attire | Green backgroun | ...

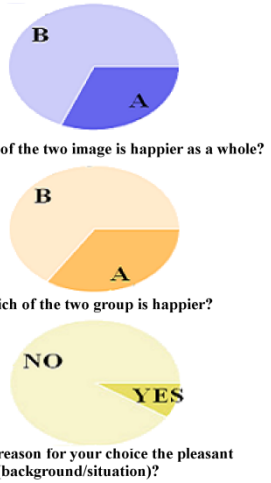
Survey Results - Factors

- Top-down factors:
  - Neighbours, scene, group
- Bottom-up factors:
  - Individual expression
  - Attributes: Attractiveness, spontaneous, age, gender, large faces, central faces, visible faces/occlusion etc.

A

B





Data?

- Labelled Faces In The Wild (Huang et al. 2007)
  - Celebrity images from the internet
  - Standard database for face recognition in the wild
  - No group images and no expression information
- GENKI (Whitehill et al. 2009)
  - Smile/Non-smile images from the internet
  - No group images and intensity level labels
- Acted Facial Expressions In the Wild (Dhall et al. 2012)
  - Data from movies
  - Single and multiple subjects in clips, few in number
  - No intensity information

Data (2)

- Collected HAPpy People Images (HAPPEI)
  - Keyword based search on Flickr (graduation ceremonies, weddings, birthdays)
  - Viola Jones detector for fast rejection
  - Annotated with Label Me toolbox (Russel et al. 2007)
  - **Smile Intensity** (Neutral – Small Smile – Large Smile – Small Laugh – Large Laugh - Thrilled) for 8500 faces
  - **Image level intensity** (0:10:100)
  - **Occlusion amount**
  - **Head / face pose**
  - 4891 images labelled
  - http://cs.anu.edu.au/few

Collage of Images from HAPPEI

Face Analysis

- Face detection
  - Viola-Jones detectors, frontal and profile
- Face alignment
  - Pictorial Structures (Everingham et al. 2008)
- Facial features
  - Pyramid of Histogram of Gradients (Bosch et al. 2008)
  - Local Phase Quantisation (Ojansivu et al. 2008)
- Intensity estimation
  - Compared various regression methods: GPR, KPLS, PLS and SVR

Group Expression Model

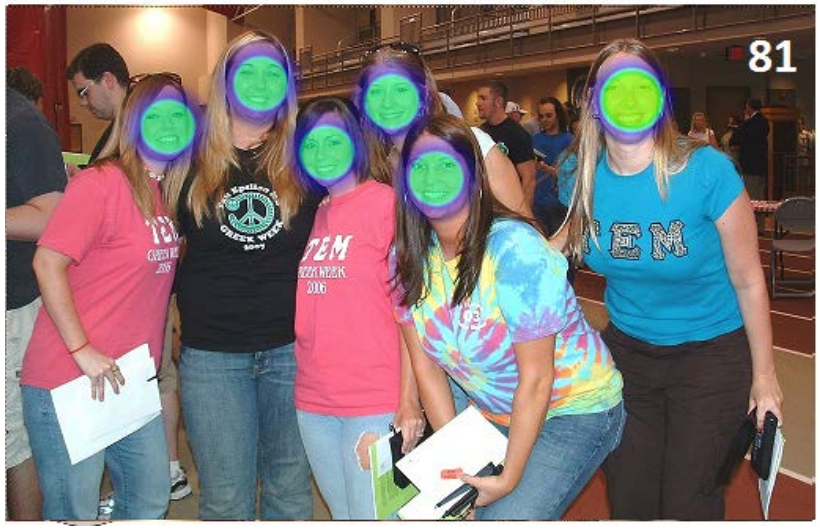
Average model

- Given an image I containing a group of people G a simple model can be defined as:

$$GEM = \frac{\sum_i I_{Hi}}{s}$$

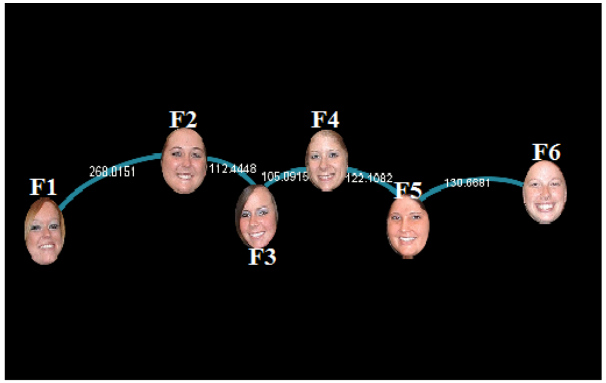
I_{Hi} : Happiness intensity of a single face i

s : Number of faces in G



Global Factors

- Model global structure of the group as a fully connected graph
  - Primm's Min-Span tree algorithm
- **Distance between the eyes**
- **Relative face size**
- **Relative distance** of each face w.r.t. centroid
- Compute global weight for each face



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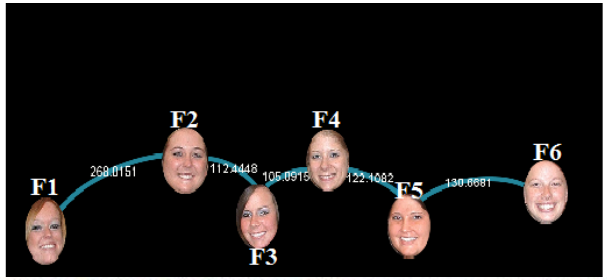
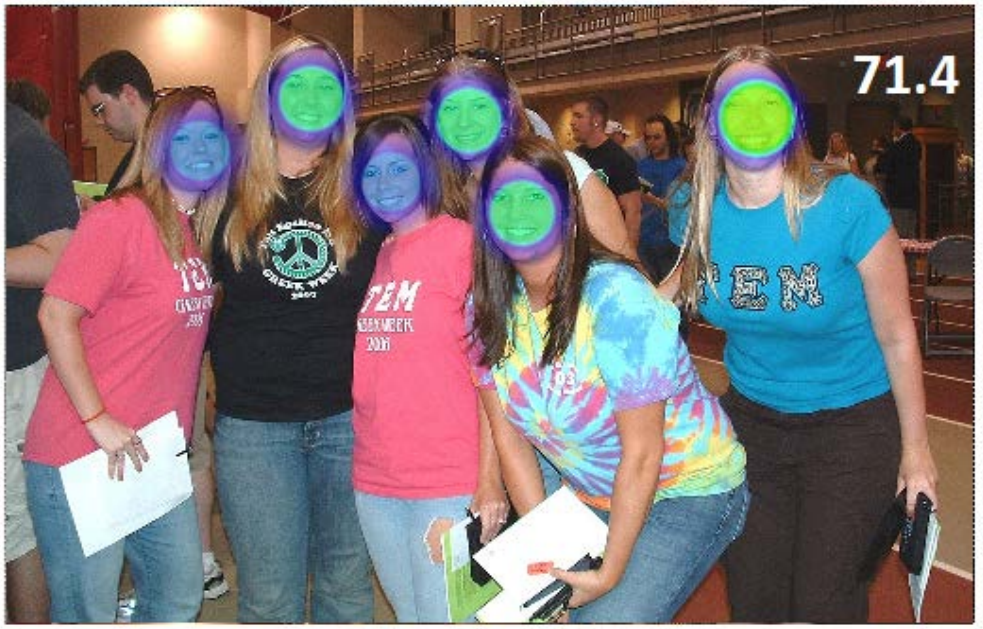




Local Factors

- **Occlusion**
  - Penalise I_{Hi} for presence of occlusion
  - Four level of occlusion intensity
  - Learned Kernel Partial Least Square (Rosipal et al. 2011)
  - For a face f_i with occlusion intensity y_i local weight λ_i is

$$\lambda_i = |1 - \gamma y_i| \qquad (5)$$

- **Happiness Intensity**
  - Low-level features – PHOG
  - KPLS regression

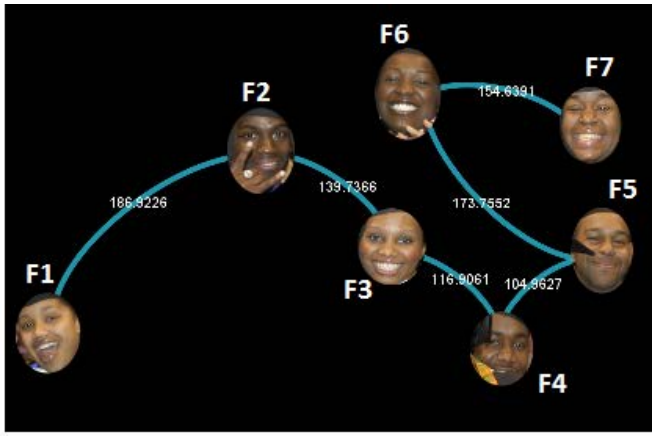
Weighted Group Expression Model

- The relative weight for each face is the dot product of local and global weights

$$\pi_i = \lambda_i \psi_i$$

- Weighted GEM can be defined as:

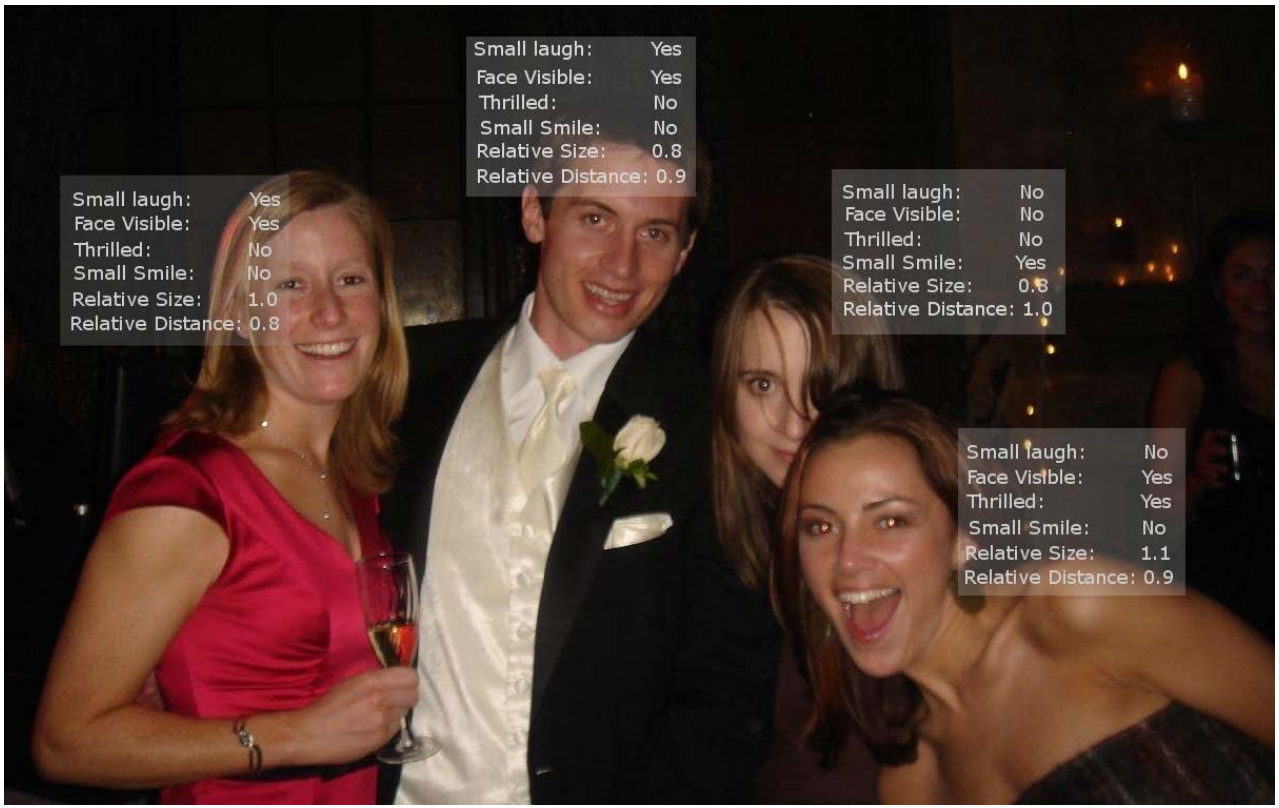
$$GEM_w = \frac{\sum_i I_{Hi} \pi_i}{s}$$



- *Top Left:* Original image in HAPPEI with happiness intensity score of 70.
- *Top Right:* Min-span tree depicting connection between faces
- *Bottom Left:* Happiness intensity heat map using averaging
- *Bottom Right:* Happiness intensity heat map with social context, **the contribution of the occluded faces** (F2 and F4) towards the overall intensity of the group is penalised

Social Features as Attributes

So far focussed on data-driven features, but there has been plenty of research in social signal processing lately that suggests using social features as attributes is beneficial.



Manually defined attributes

Social Features as Attributes (2)

- Apply the global weights during soft assignment
- Relatively weighted soft assignment can be defined as:

$$t_k = \sum_{i}^{N} \sum_{j}^{M} \frac{\psi_j}{2^{i-1}} sim(j,k)$$

- Manually defined and data-driven attributes histograms are combined and a topic model based on Latent Dirichlet Allocation (Zhu et al. 2009) is learnt

Experiments

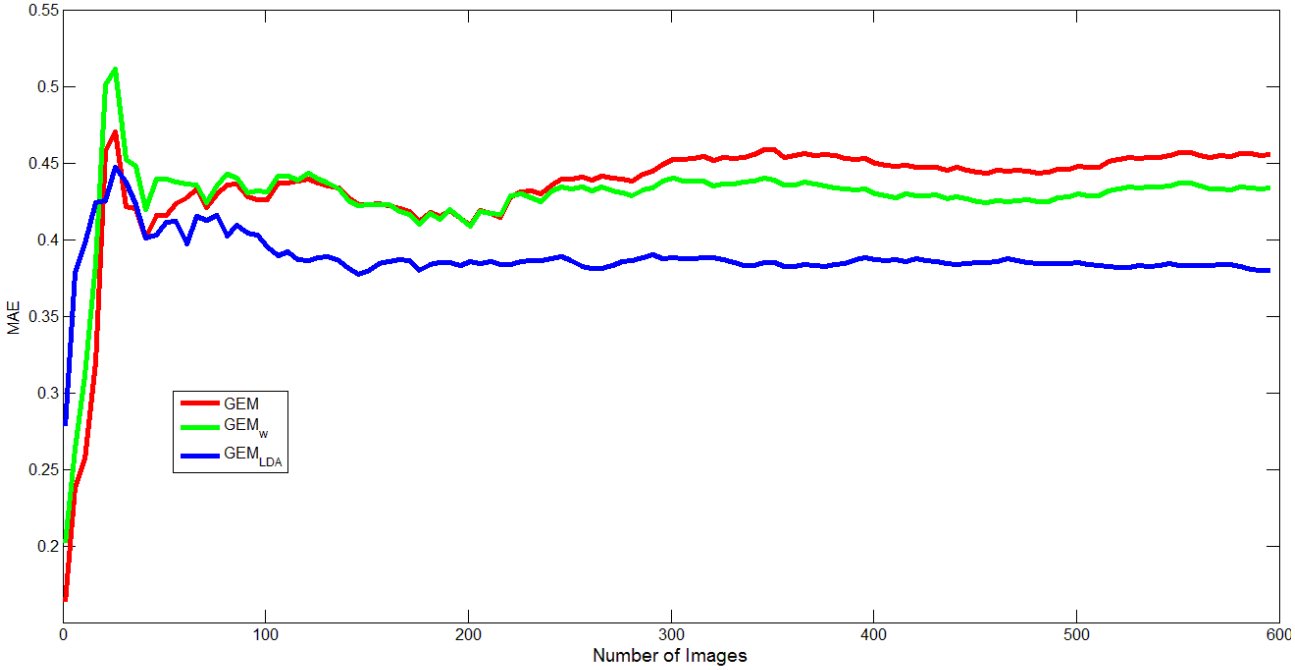
- Human labellers vs weighted model
- Comparison of the three GEM models
- Candid photo selection

Experiments – Model vs Human

15 subjects labelled happiness intensity for images of different events from the HAPPEI database

Experiments – GEM vs GEM_w vs GEM_{LDA}

- Mean Average Error
  - GEM : 0.45
  - GEM_w : 0.43
  - GEM_{LDA} : 0.37



Experiments – Group Shot selection

- Inspired by Agarwala et al. 2011
- From a group of images of the same event, pick the ‘happiest’

Images from HAPPEI and personal album

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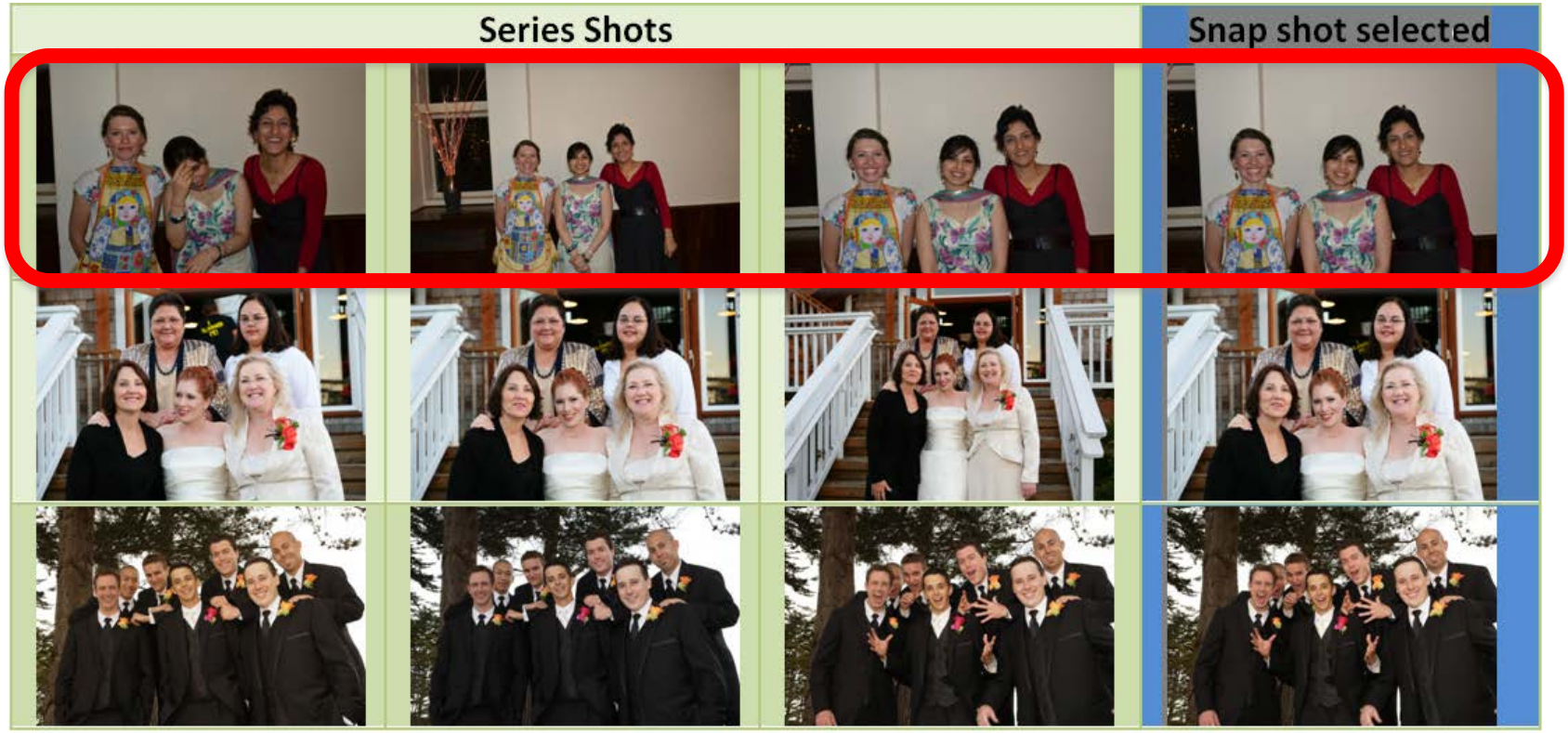

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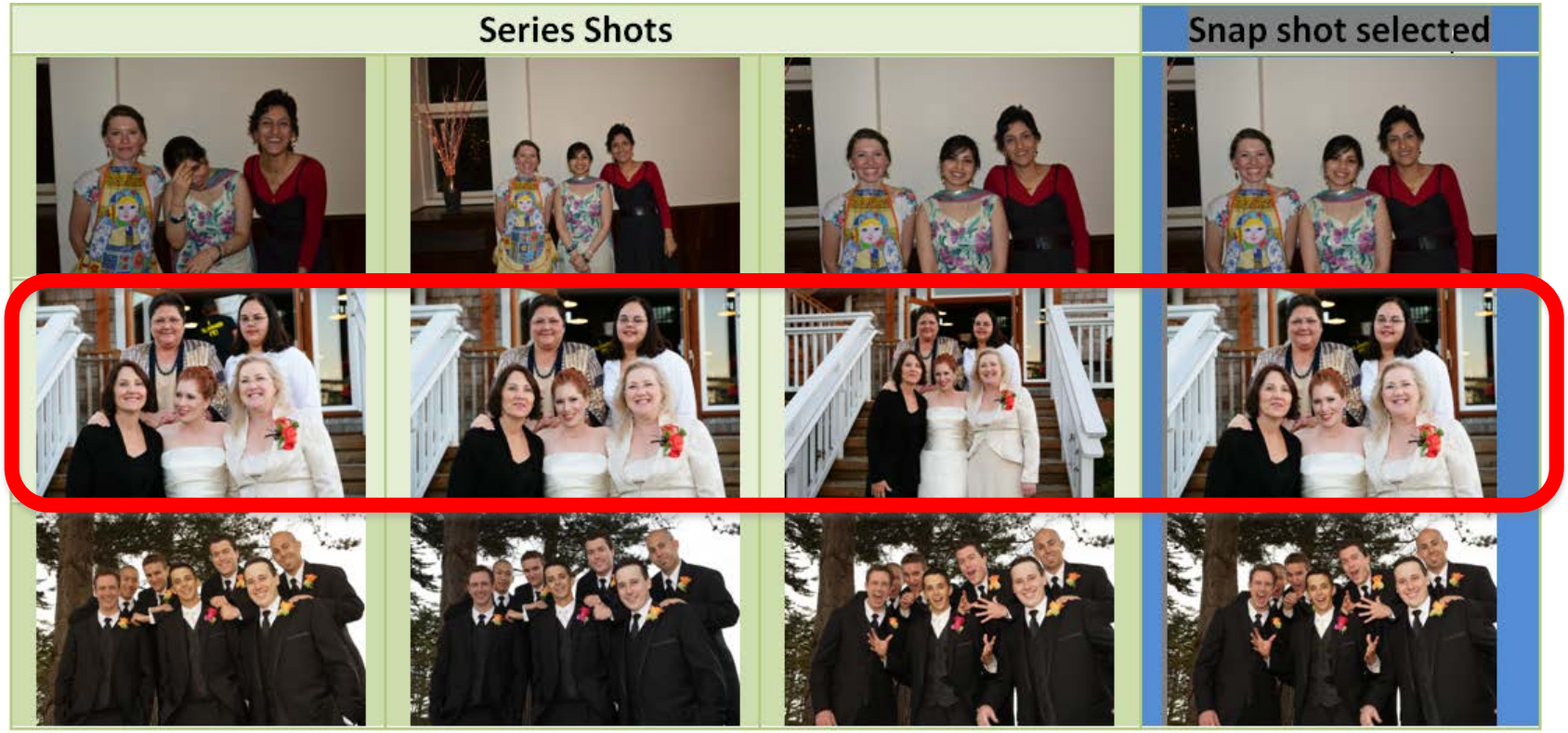

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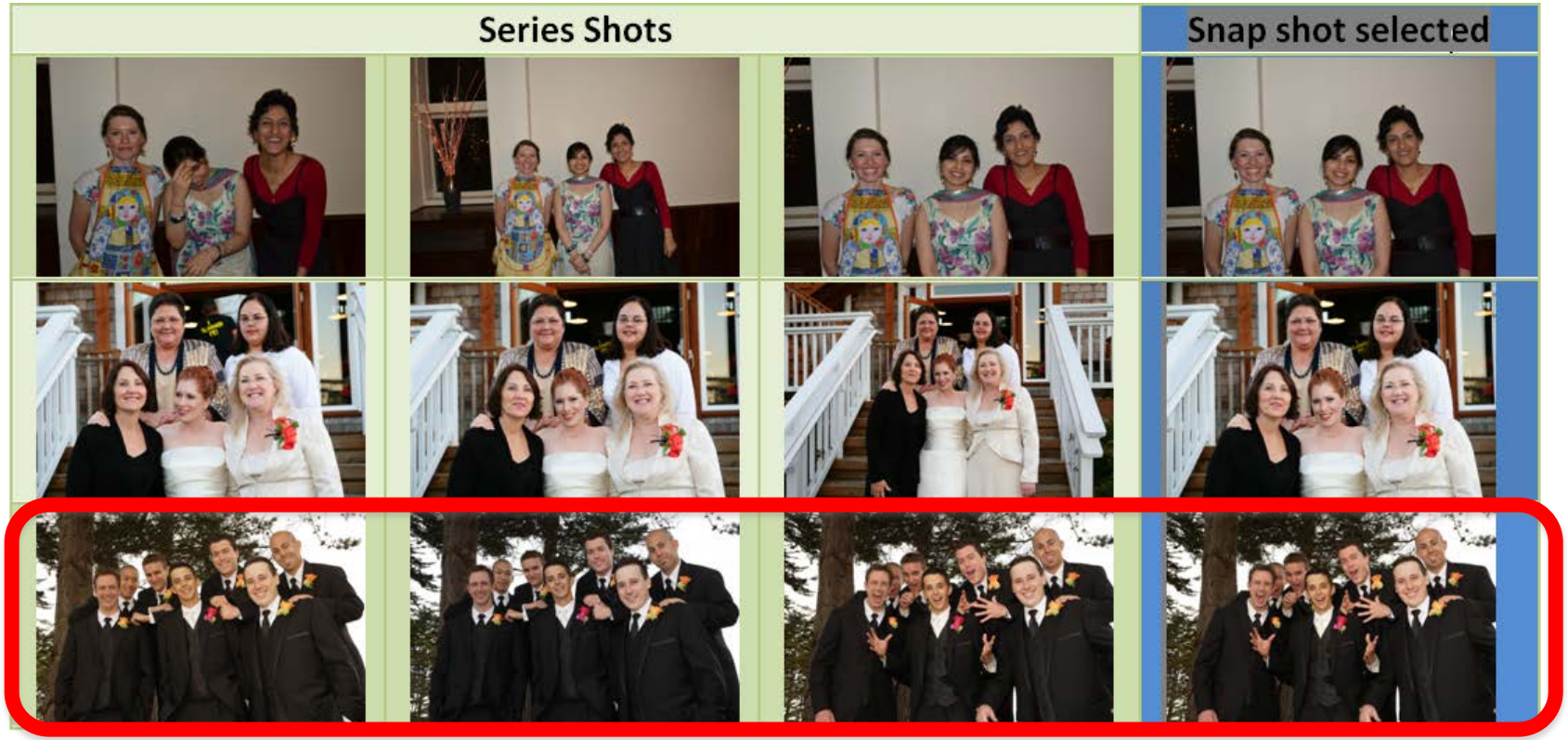

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Conclusions

- Proposed a group level happiness intensity framework
- Defined global (top-down) and local (bottom-up) features
- Compiled a new 'in the wild' labelled database (HAPPEI) http://cs.anu.edu.au/few

Future Work

- Exploring different group modelling techniques
- Extending work to positive and negative emotions (FG 2015)
- Extending framework to videos
- Adding scene information

Thank you

– Questions?