Face Processing in
Social Networking Services

NTIA Privacy Multistakeholder Process:
Commercial Facial Recognition Technology
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IBG at a Glance

- IBG has conducted independent biometric testing since 1996
- Hundreds of thousands of man-hours in biometric research, design, and integration (e.g. fingerprint, face, iris recognition)
- Expertise in emerging modalities, sensors, and software
- Cutting-edge expertise in virtual, online, and electronic identity technologies, concepts, and platforms
- Extensive commercial and government customer base

Background

- IBG evaluates online face processing technologies, capabilities, and performance
- While online face processing is the largest commercial use of biometrics, its performance and capabilities are not well-understood

Who's in These Photos?

The photos you uploaded were grouped automatically so you can quickly label and notify friends in these pictures. (Friends can always untag themselves.)
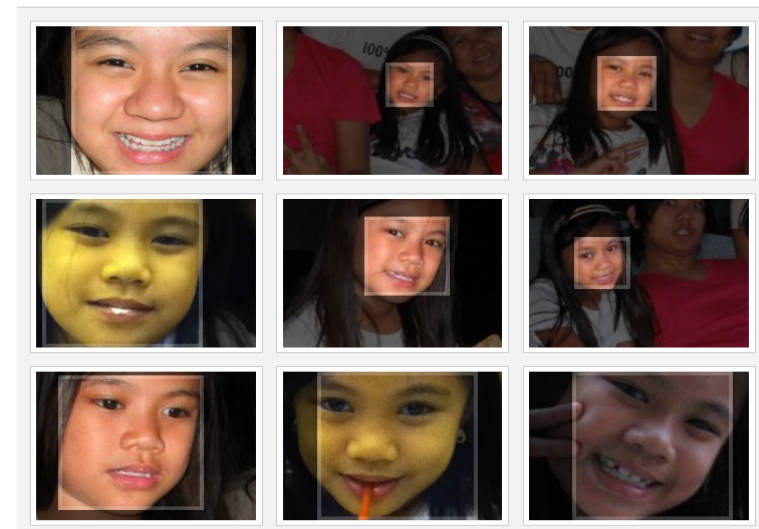
Face Processing Functions

- ## Detection
  - Automated location of one or more faces in an image

- ## Cropping
  - Extraction and presentation of an image's facial region

- ## Recognition
  - Search of a face image against enrolled face images to identify potential matches

- ## Grouping
  - Automated organization of face images into sets based on appearance similarity

- ## Tagging
  - Automated or facilitated process of assigning names to faces in online photos

Face Processing Myth: Image Quality

Myth

Face recognition requires
high-quality images

Reality

SNS face processing systems can <u>detect and match</u> low-quality faces

Profiles, faces with low inter-ocular distance, bad lighting

Faces acquired through different classes of camera

Future

Matching and detection technologies should continue to improve
(though other factors are involved)

Face Processing Myth: Online Face Searches

Myth

You can conduct a "global" face search against the whole Internet

Reality

No, you cannot

Most online face images are not searchable (private, not shared)

Searches are within one's contacts / friends

Sites that offer 1:N searches against public images lack identity data

Future

Facebook, Google have shown no interest in enabling open searches

Other entities are surely saving every public
and/or accessible face image for future use

Relevant Face Processing Technologies

- Facebook
  - By far the largest "consumer" usage of biometrics
  - Rich social graph available to deliver improved tag suggestions

- Google+
  - Google's SNS, for which face processing was activated in December 2011
  - Potential for expansion of face processing to services such as search, Android, location, and YouTube
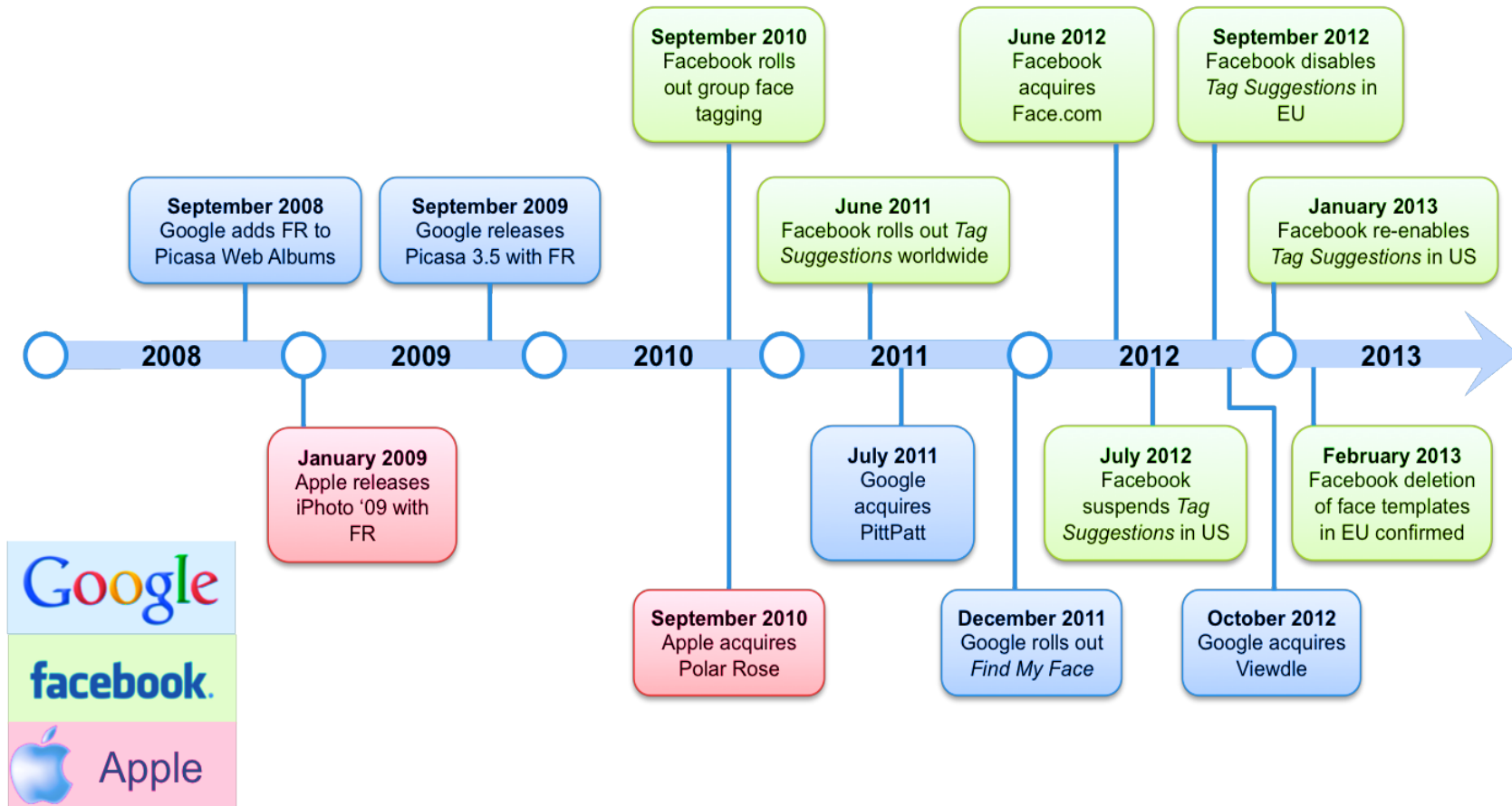
- PittPatt
  - Founded in 2004 by members of the Carnegie Mellon University Robotics Institute
  - Acquired by Google in 2011; no longer in development
  - Used by government agencies to process low-quality images

Milestones in Online Face Processing

September 2010
Facebook rolls out group face tagging

June 2012
Facebook acquires Face.com

September 2012
Facebook disables *Tag Suggestions* in EU

September 2008
Google adds FR to Picasa Web Albums

September 2009
Google releases Picasa 3.5 with FR

June 2011
Facebook rolls out *Tag Suggestions* worldwide

January 2013
Facebook re-enables *Tag Suggestions* in US

2008   **2009**   **2010**   **2011**   **2012**   **2013**

January 2009
Apple releases iPhoto '09 with FR

July 2011
Google acquires PittPatt

July 2012
Facebook suspends *Tag Suggestions* in US

February 2013
Facebook deletion of face templates in EU confirmed

September 2010
Apple acquires Polar Rose

December 2011
Google rolls out *Find My Face*

October 2012
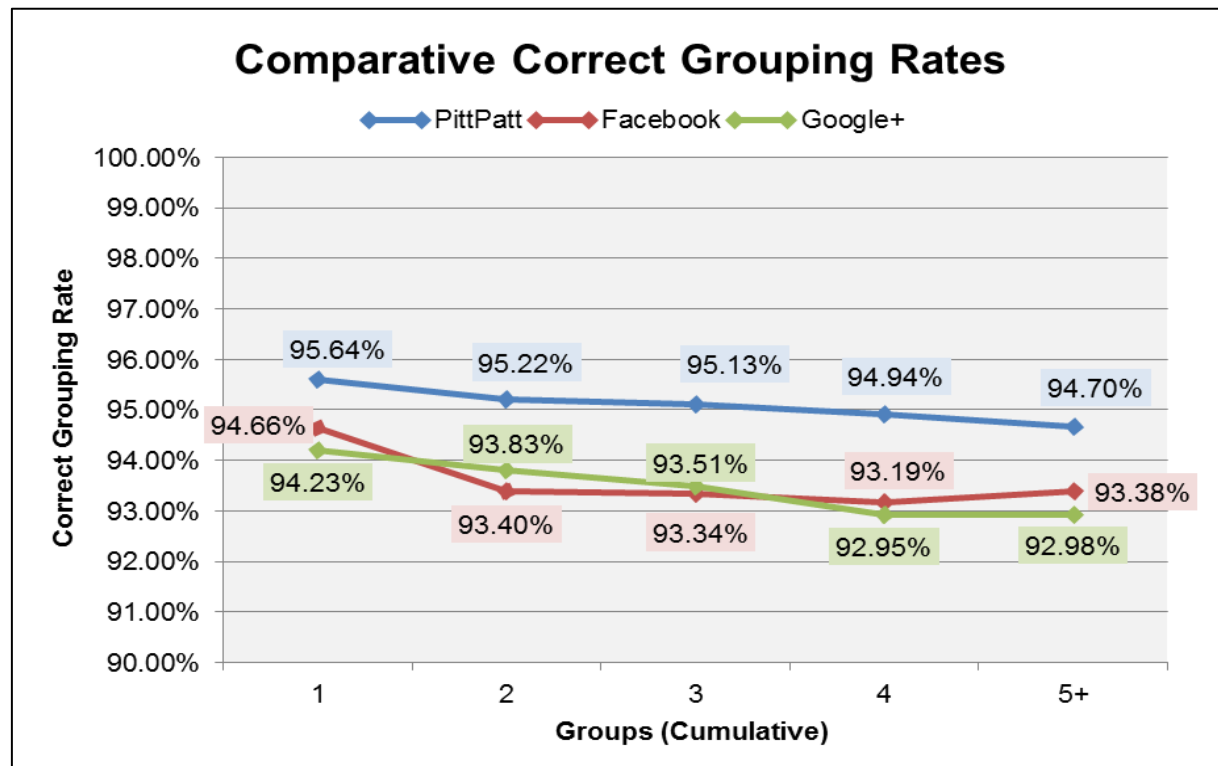Google acquires Viewdle

Google
facebook.
Apple

Dataset Processing

- IBG created software that automates photo submission and results parsing for and Facebook / Google+
  - Otherwise the process is manual, burdensome, and error-prone
- SOCIAL-ID: photos collected by IBG as well as from public sources
- SOCIAL-GT: customized testing software that interacts with online face processing sites and services; used by analysts for adjudication

Face Grouping Performance

- Correct grouping rates are similar for the three services
- PittPatt has a slightly lower error rate than Facebook or Google+
- For datasets with a pronounced primary identity, approximately 19 out of 20 groupings will be correct

Comparative Correct Grouping Rates

PittPatt — Facebook — Google+

Groups (Cumulative)	1	2	3	4	5+
PittPatt	95.64%	95.22%	95.13%	94.94%	94.70%
Facebook	94.66%	93.40%	93.34%	93.19%	93.38%
Google+	94.23%	93.83%	93.51%	92.95%	92.98%

Face Grouping Performance

- Google+ correctly groups 500-600 more Primary Subject faces than PittPatt and Facebook, respectively, while incorrectly grouping only 60-70 more faces
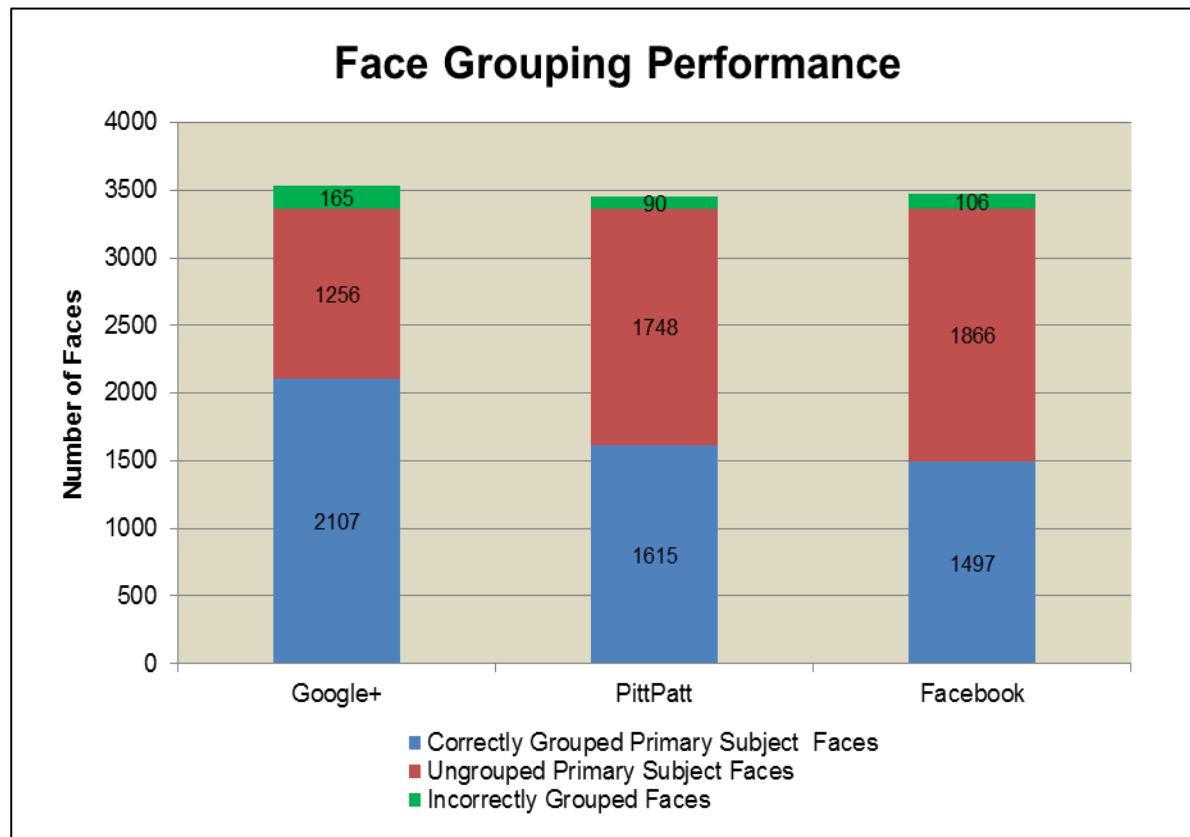
Conclusions

- Searches are predominantly in-network
- Online face processing services can achieve correct grouping rates above 90% on challenging images
    - Not reliant on frontal poses, neutral expressions, even illumination, etc.
- Online face processing is improving
    - Algorithms may be tuned based on user input (e.g. tagging/grouping confirmations)
    - Possible enhancements to core face processing technologies

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