Mobile Biometrics - Face Recognition

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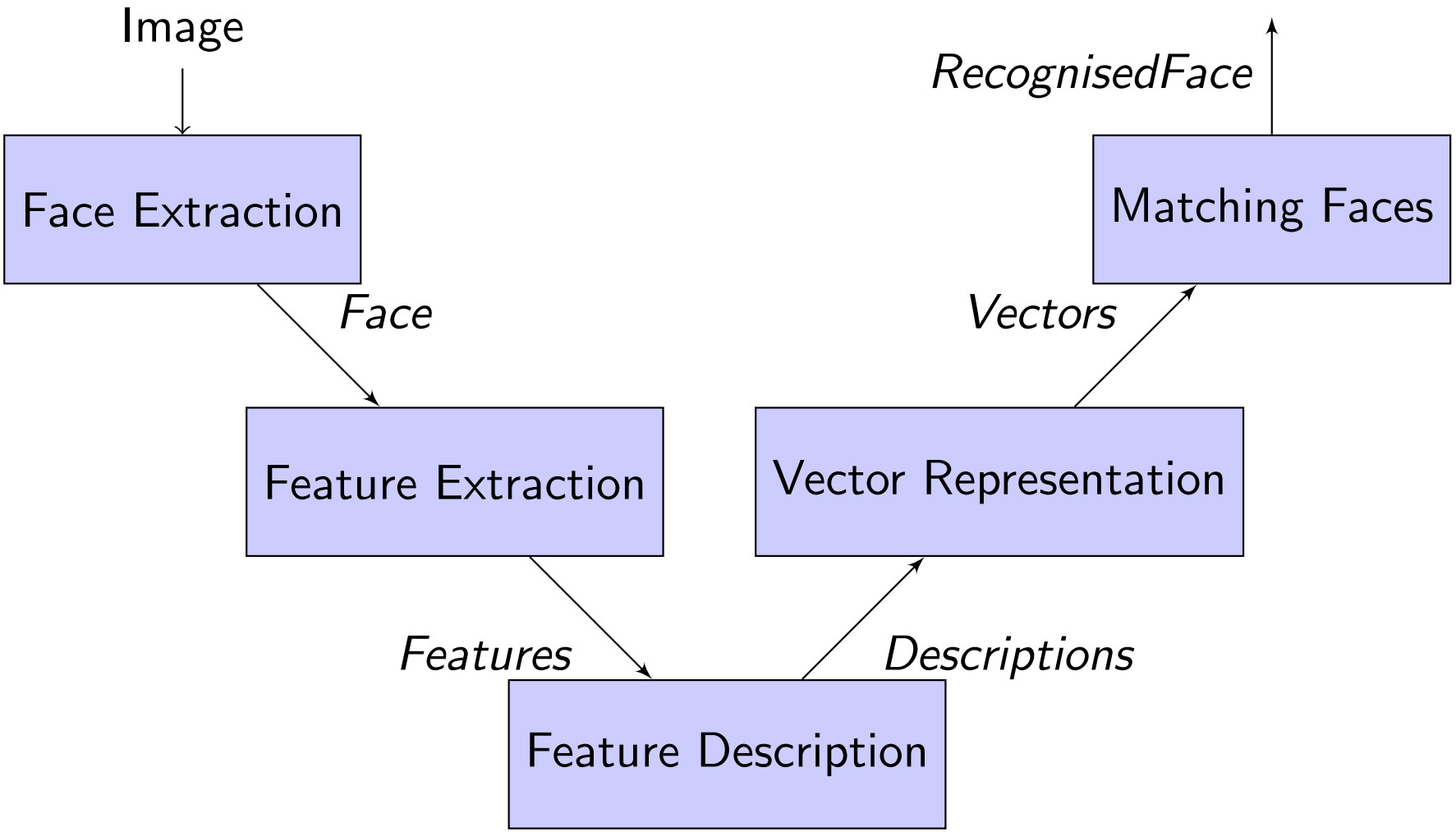
Contents

Issues

- Checking the image contains a face
  - Lighting, scale and rotation invariant
- Using the correct internal representation
  - Need to be able to compare them
  - Small changes should have little effect
- Matching the faces correctly
  - Need to be able to compare them

Face Recognition Algorithm



Viola-Jones

- Used to separate the face from the background
- Uses a trained Haar feature cascade classifier
- Detects all the faces in the picture
- Fast and lighting invariant
- Not rotational invariant

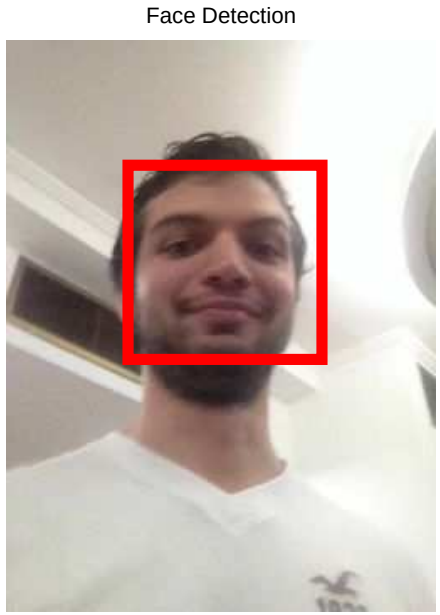


Figure: Face Detection with Viola-Jones

Dense vs Interest Points

- Samples a grid around every pixel as a feature
- More points so it's robust, however this also makes it slow

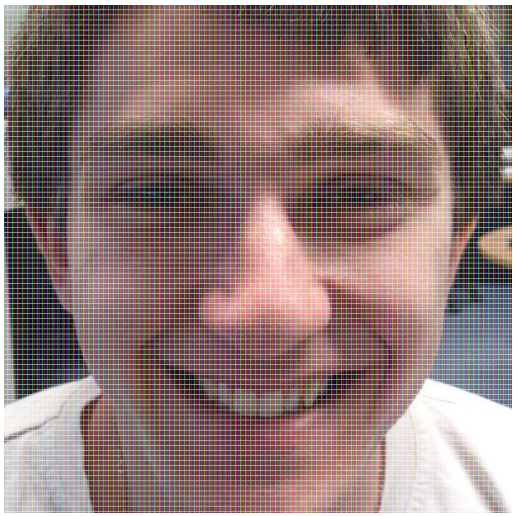


Figure: Dense Features

- Samples on interest point calculated by Harris corner detector or SIFT detector
- Fast, but might take into account too many irrelevant points

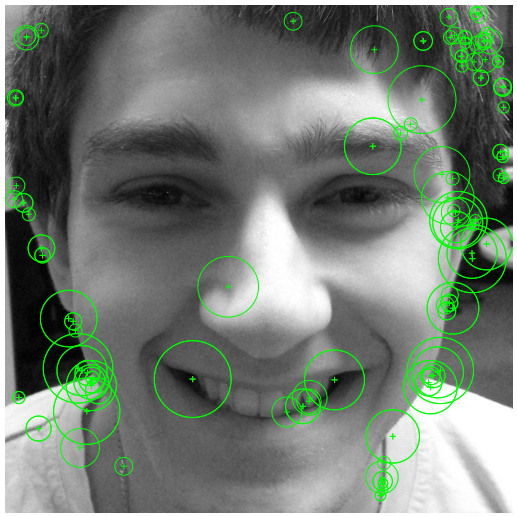


Figure: Interest Points

SIFT vs ORB

- SIFT has 128 Dimensions while ORB is only 32
- Similar accuracy

Figure: SIFT Features

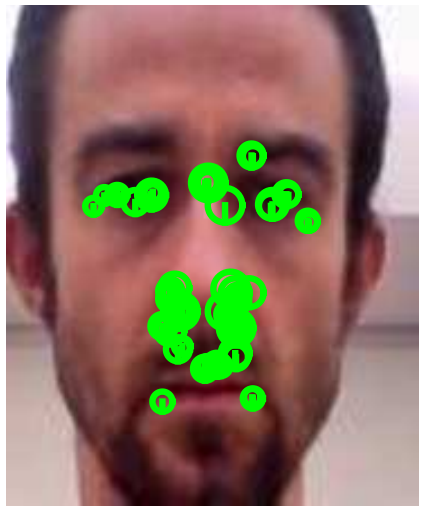


Figure: ORB Features

Bag of Visual Words (BoVW)

- Dense Sampling
- K-means
- Database Representation
- Test Image Histogram Representation
- Matching (KNN)

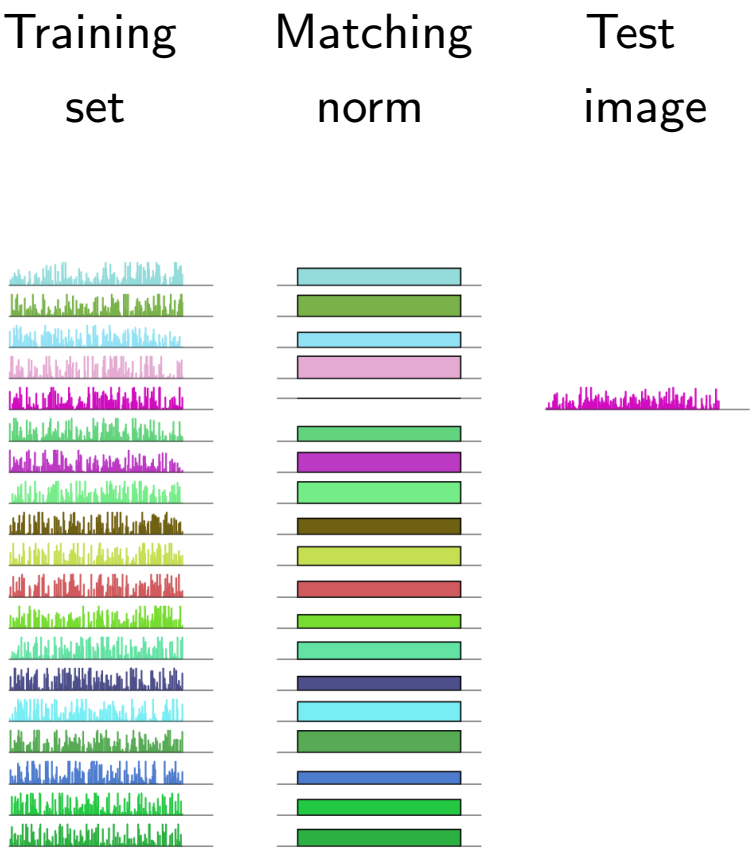
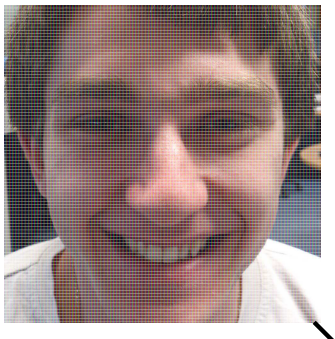


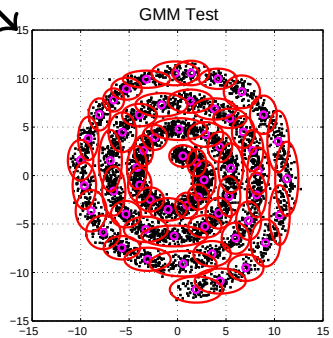
Figure: Bag of Visual Words Histogram Matching

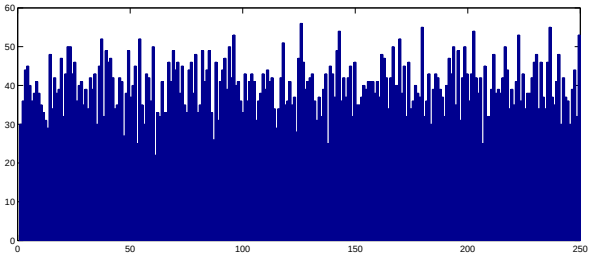
Fisher Vectors

- Takes BoVW one step further

" Compact" Representation







$$\Phi_k^{(1)} = \frac{1}{N\sqrt{w_k}} \Sigma_p^N \alpha_p(k) \left(\frac{x_p - \mu_k}{\sigma_k} \right)$$

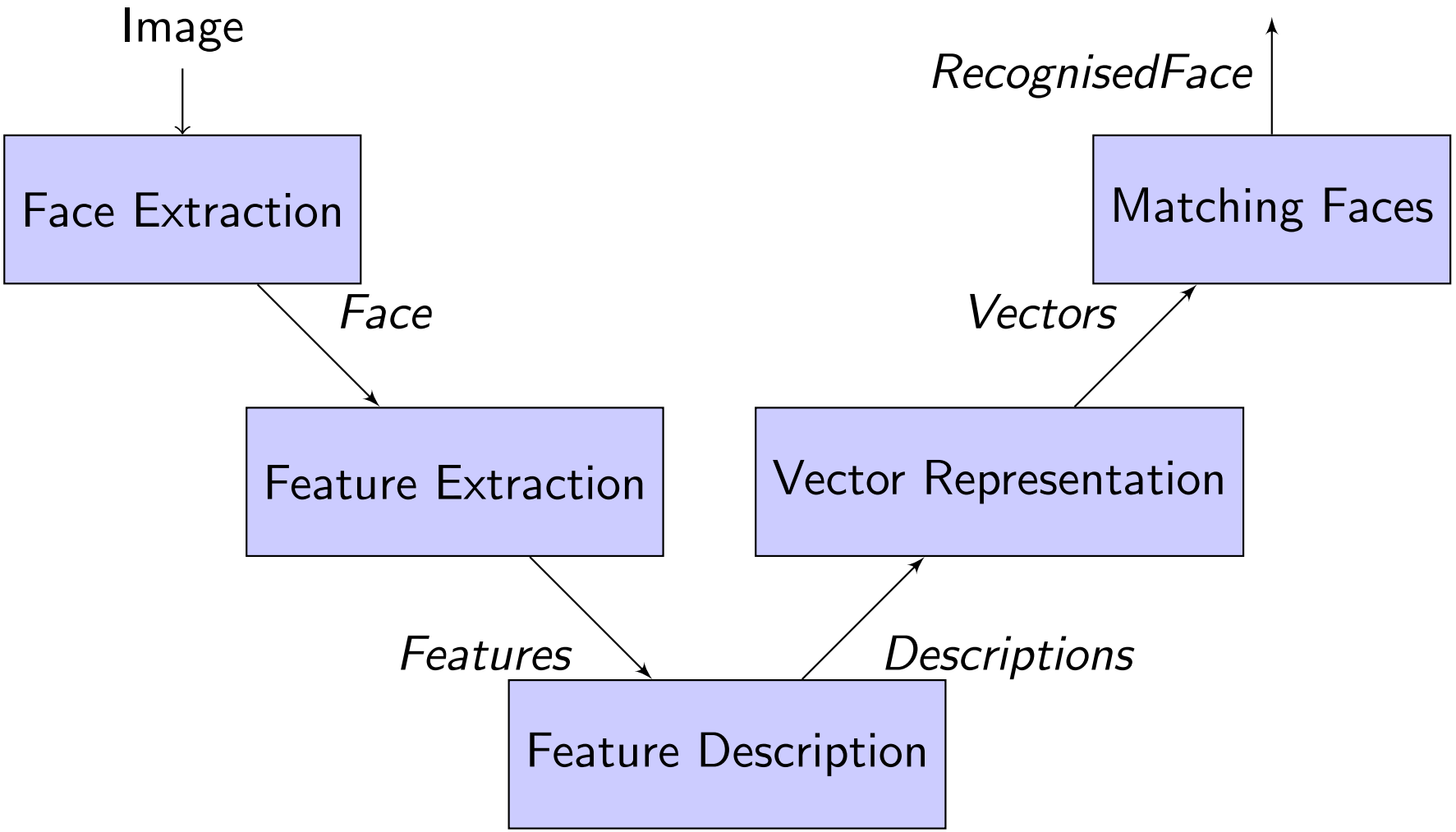
$$\Phi_k^{(2)} = \frac{1}{N\sqrt{2w_k}} \Sigma_p^N \alpha_p(k) \left(\frac{(x_p - \mu_k)^2}{\sigma_k^2} - 1 \right)$$

Figure: Fisher Vector Process

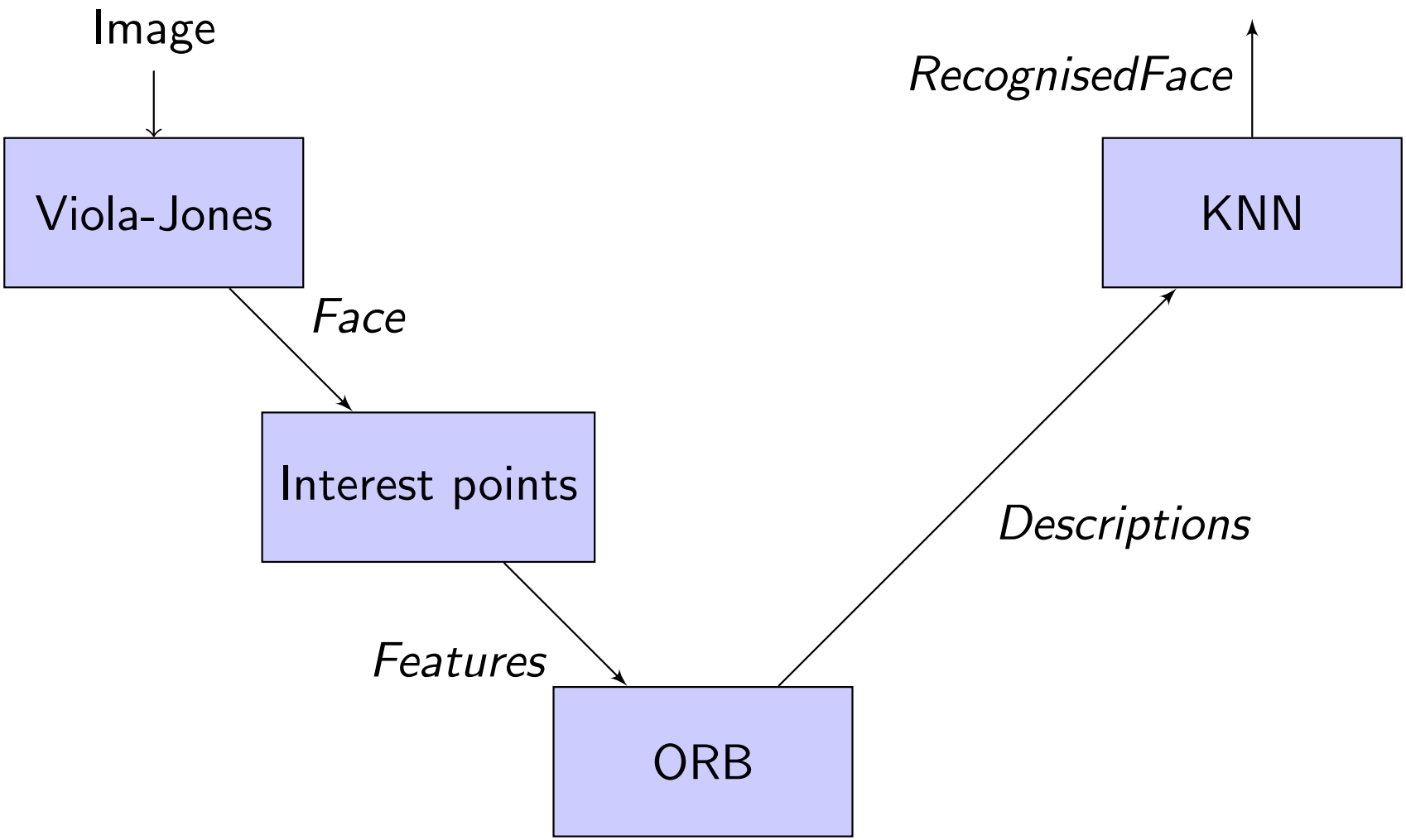
Mobile Specific Issues

- Camera resolution
  - Two cameras, one worse than the other
- Phone orientation
  - The phone can be held in many different orientations
  - It can also take the picture at different angles
- Limited computing power
  - The memory is limited
  - Processor can be slow
- Sift patented
  - Made it difficult to implement on opencv for Android

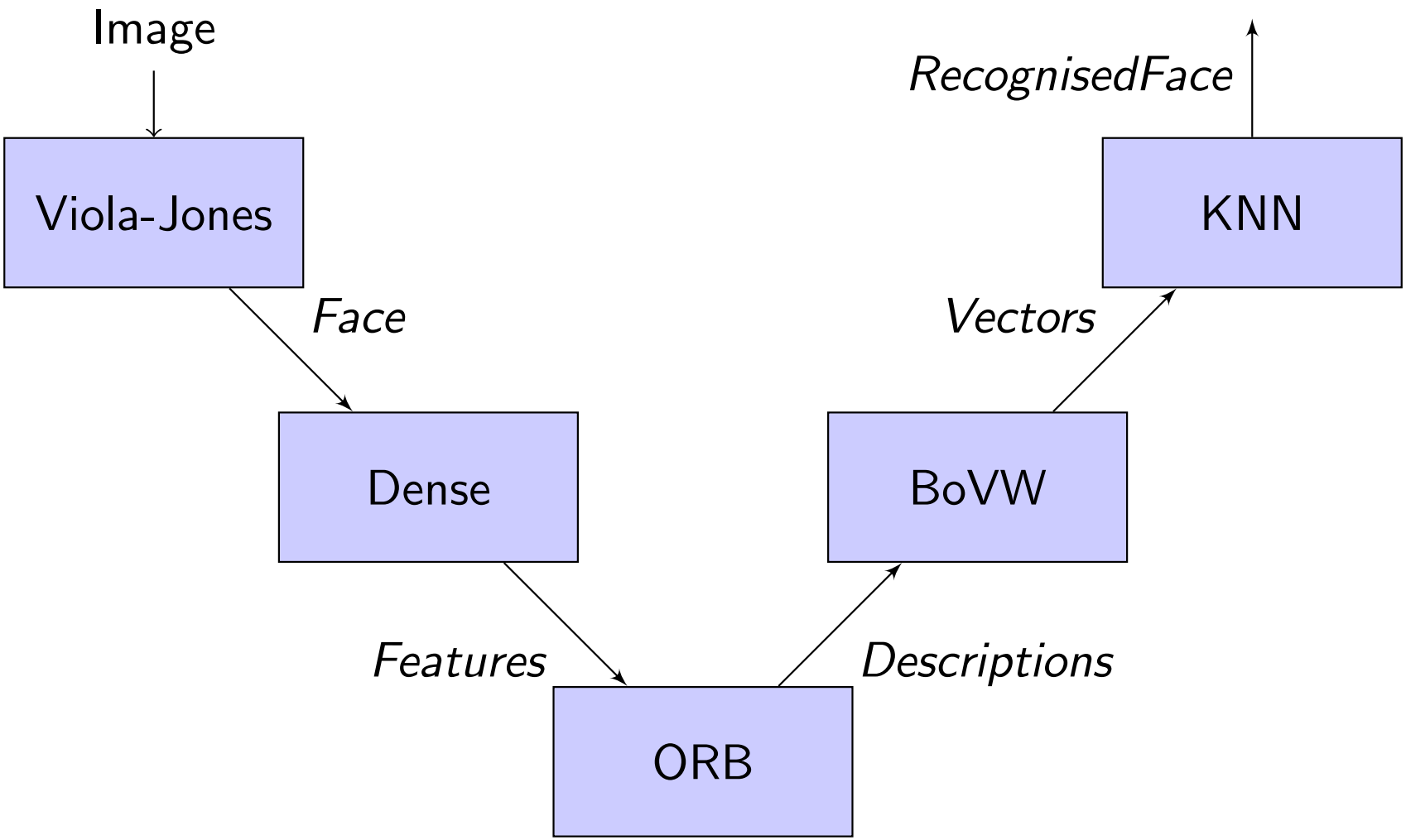
Face Recognition Algorithm



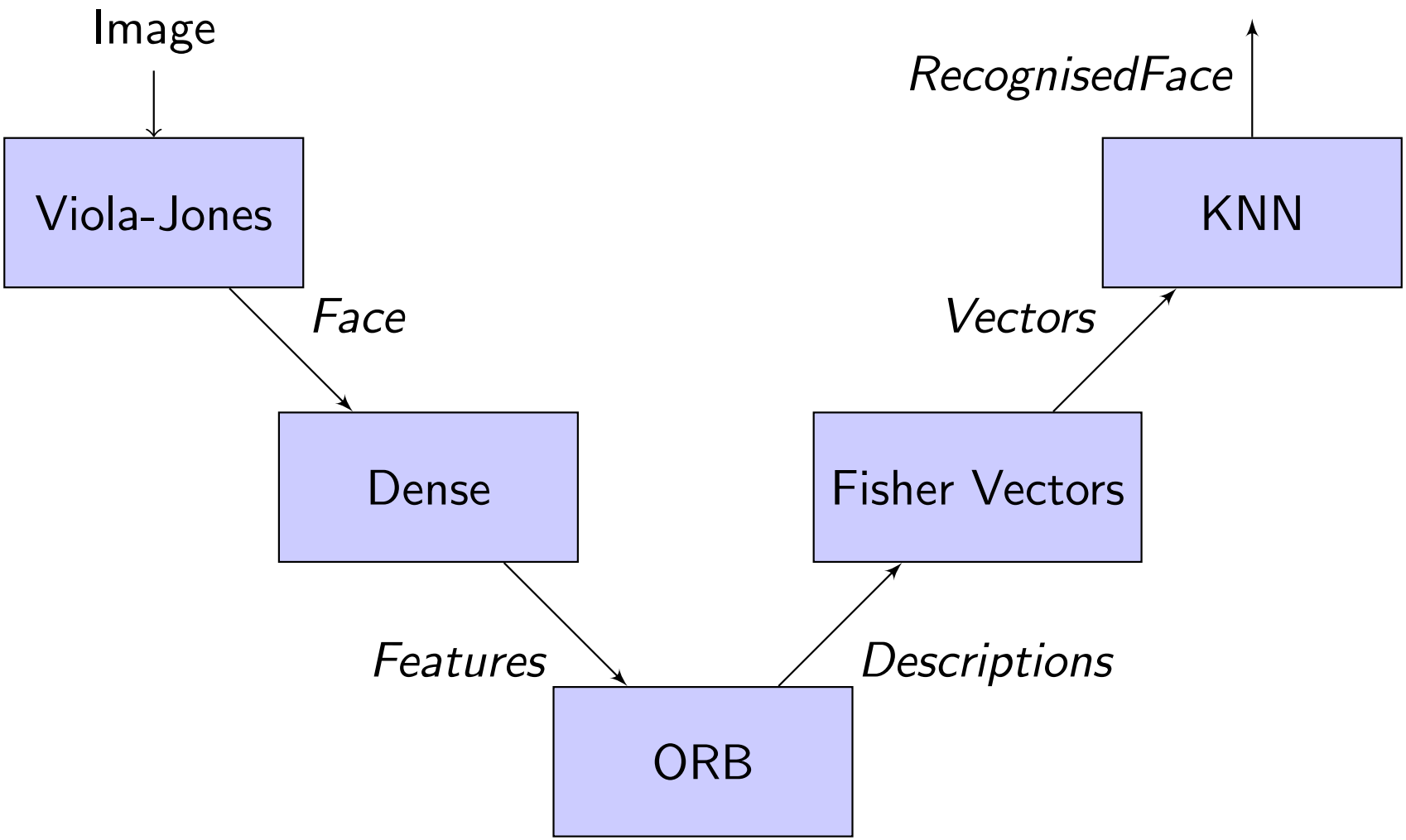
First Face Recognition Algorithm



Second Face Recognition Algorithm



Third Face Recognition Algorithm



Algorithm Comparison

Training dataset size	Fisher Vectors	BoVW
20%	91.25%	69.7%
50%	98.50%	77%
80%	100%	86.25%

Table: Compares accuracy of methods as training set size increases using AT&T Faces Dataset

Add Person

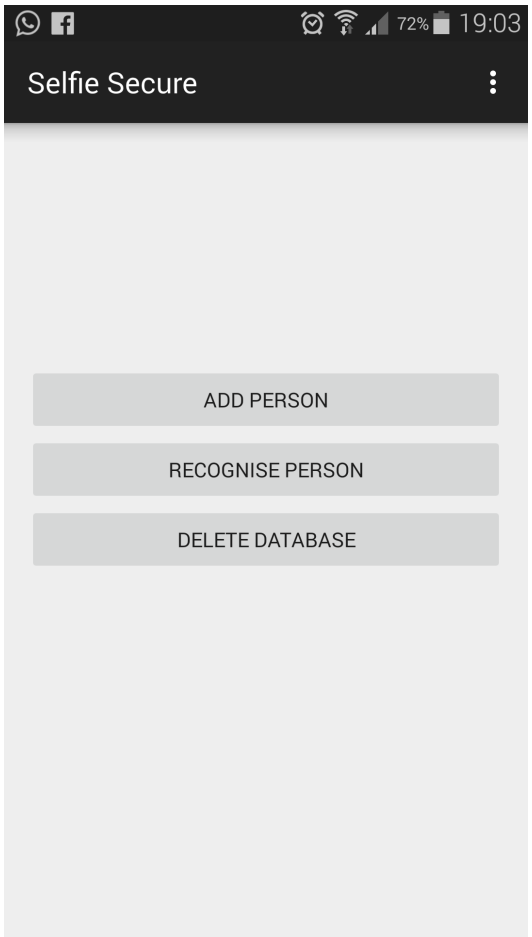


Figure: Main Screen

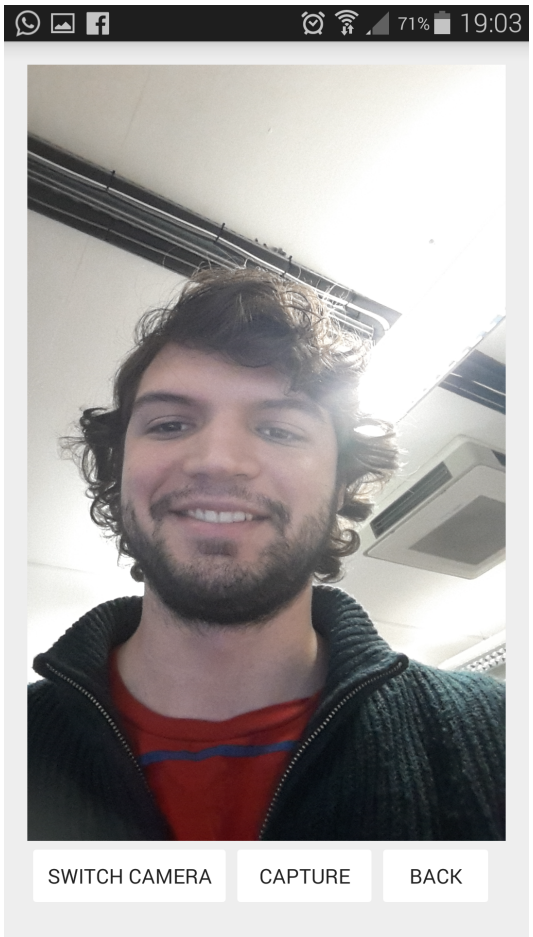


Figure: Take Picture

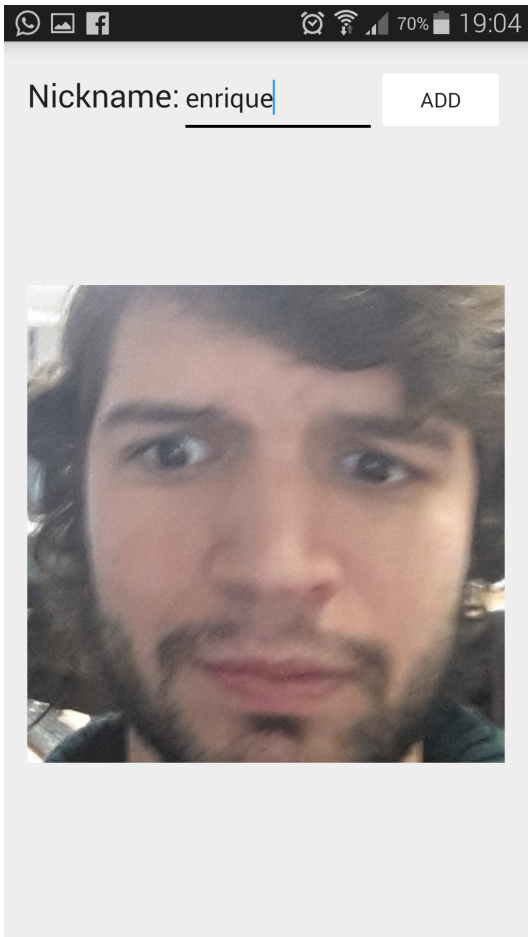
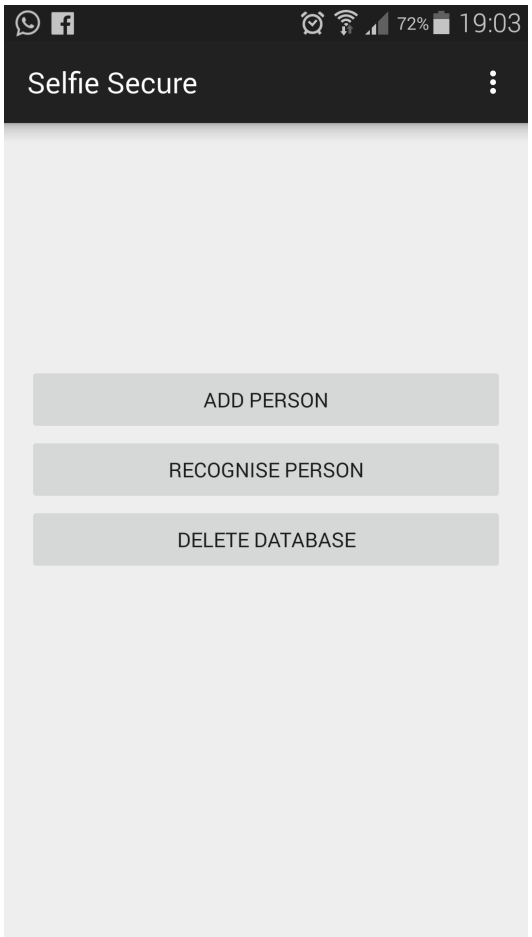


Figure: Add Person

Recognise Person



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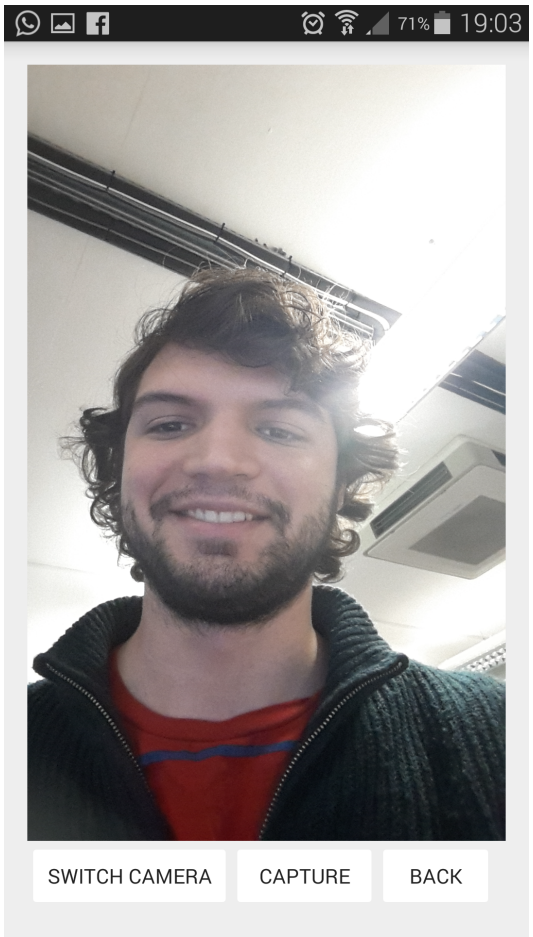

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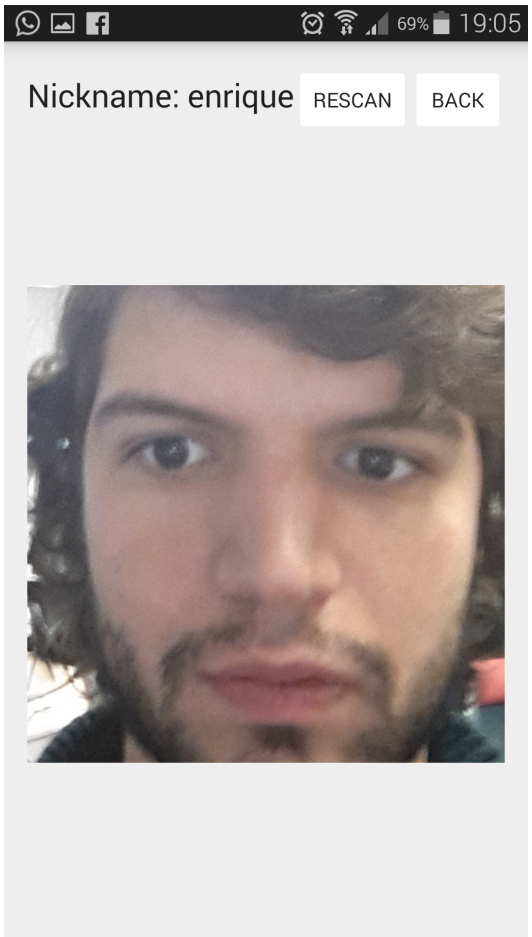

Figure: Recognise Person

Any questions?

References


F. Perronnin and C. Dance. Fisher kernels on visual vocabularies for image categorizaton. In Proc. CVPR, 2006.


Simonyan, K. and Parkhi, O. M. and Vedaldi, A. and Zisserman, A. Fisher Vector Faces in the Wild. British Machine Vision Conference, 2013.


E. Rublee, V. Rabaud, K. Konolige, and G. Bradski. ORB: an efficient alternative to SIFT or SURF. In Proc. of the IEEE Intl. Conf. on Computer Vision (ICCV), volume 13, 2011.


A. Vedaldi and B. Fulkerson VLFeat: An Open and Portable Library of Computer Vision Algorithms, 2008. Available at: <http://www.vlfeat.org/[Accessed 26th April 2015]


G. Bradski The OpenCV Library. Dr. Dobbs Journal of Software Tools, 2000. <http://www.opencv.org/[Accessed 26th April 2015]