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WP3: Uni-modal Segmentation and Authentication

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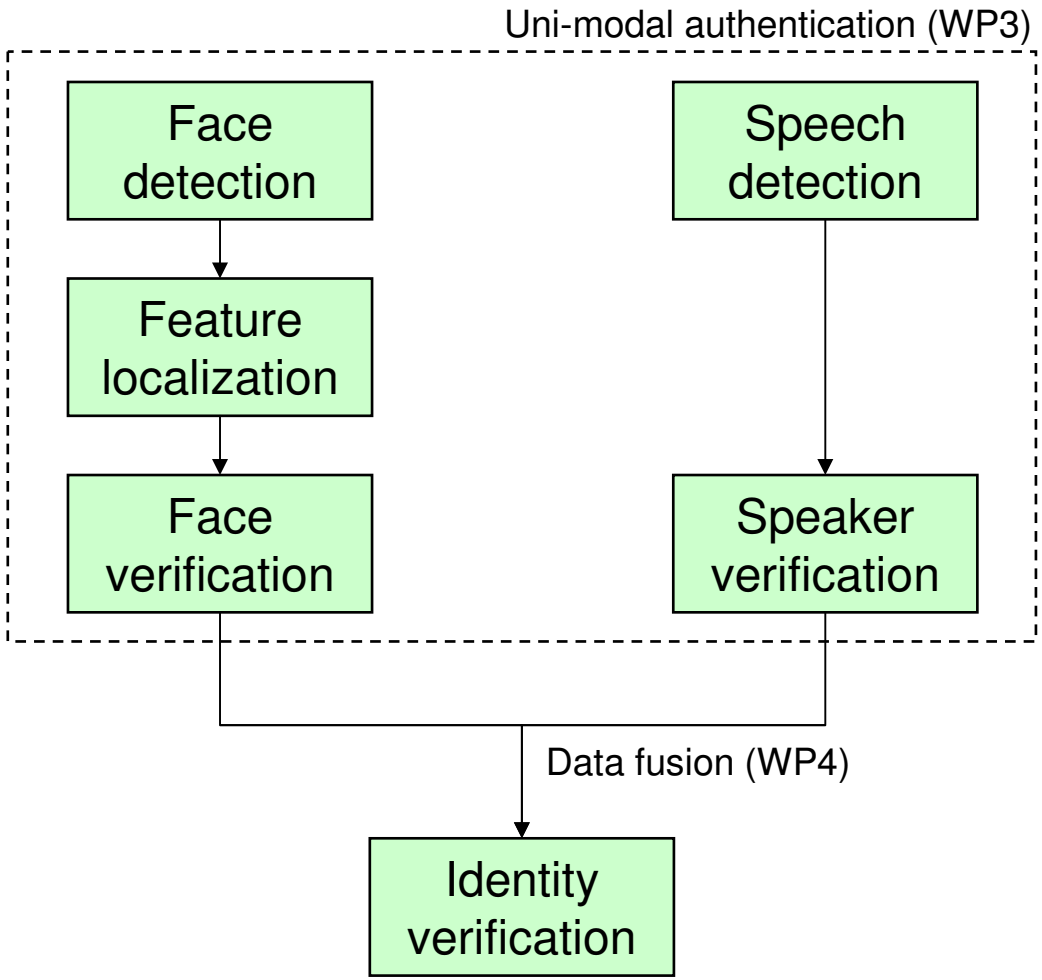
WP3 Summary



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WP3 Summary

- Face authentication
  - Face detection (IDIAP/UOULU)
  - Feature localization (UMAN)
  - Face verification (IDIAP/UNIS)
- Speech authentication
  - Voice activity detection (BUT/LIA)
  - Speaker verification (BUT/LIA)

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WP3 Summary

- Deliverables
  - D3.1 (m8) Baseline system software (UMAN)
  - D3.2 (m12) Report on description and evaluation of baseline systems (UMAN)
  - D3.3 (m18) Advanced system software (UOULU)
  - D3.4 (m22) Report on description and evaluation of advanced systems (UOULU)

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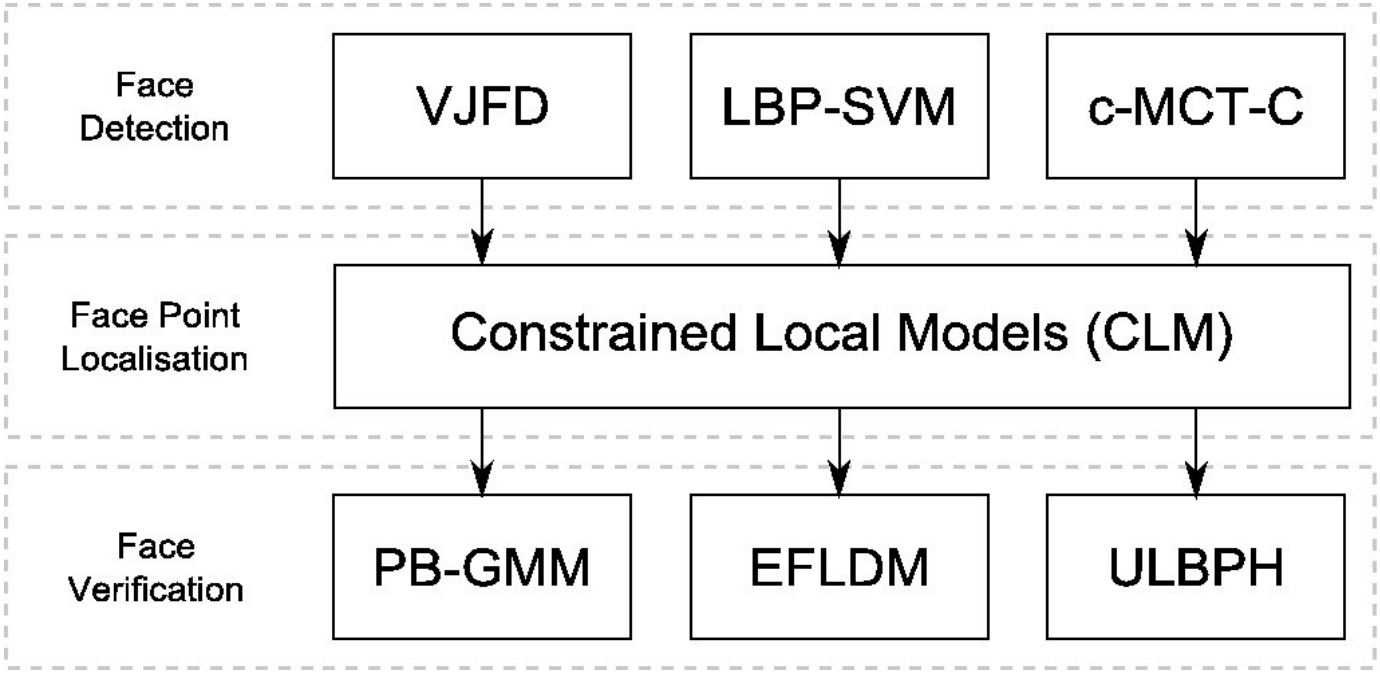
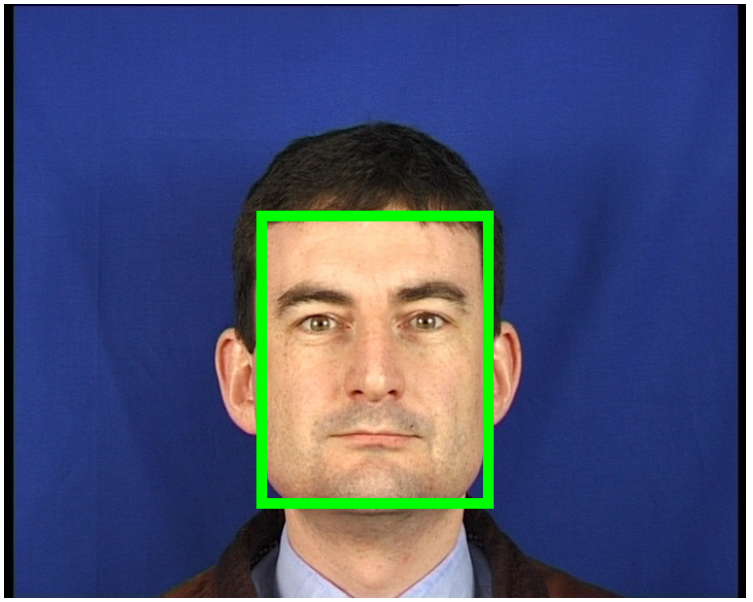
Baseline face authentication



1) VJFD- Viola-Jones Face Detector (UOULU)
2) LBP-SVM – Local Binary Pattern with Support Vector Machines (UOULU)
3) c-MCT-c – Cascade of Modified Census Transform classifiers (IDIAP)
4) CLM – Constrained Local Model (UMAN)
5) PB-GMM – Parts based Gaussian Mixture Model (IDIAP)
6) EFLDM – Enhanced Fisher Linear Discriminant Model (UNIS)
7) ULBPH – Uniform Local Binary Patter Histogram (UNIS)

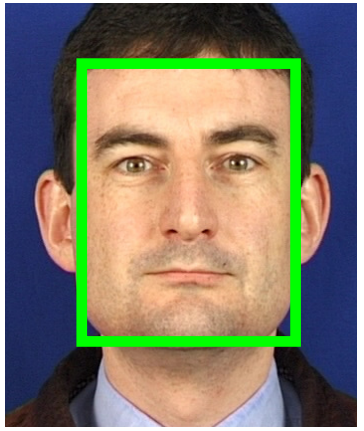
Face detection

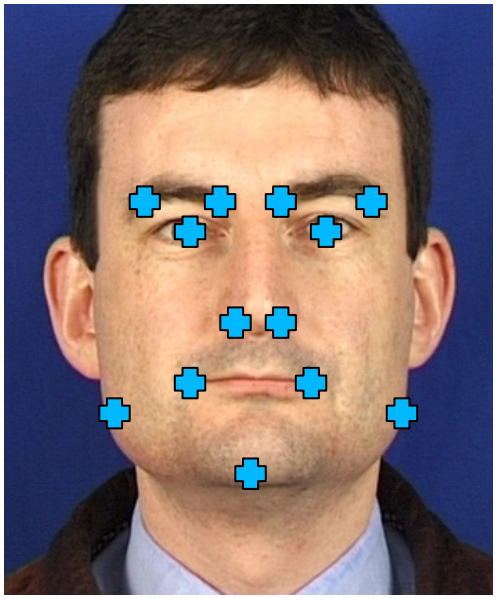
- Given an image containing a face, recover its bounding box
- We can then crop out just the relevant information



Feature localization

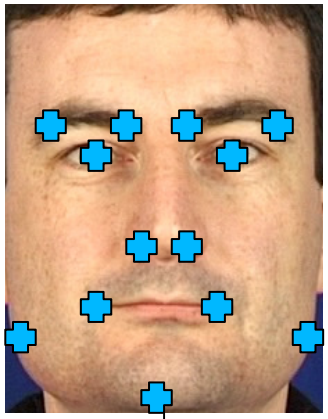
- Given the cropped image of just a face, find the locations of individual features
  - Eyes, nose, mouth, …
- We can then transform to a normalized co-ordinate frame
  - Remove expression and head rotation





Face verification

- Given the normalized image of a face and a model of the claimed identity, determine whether the user is who they claim to be



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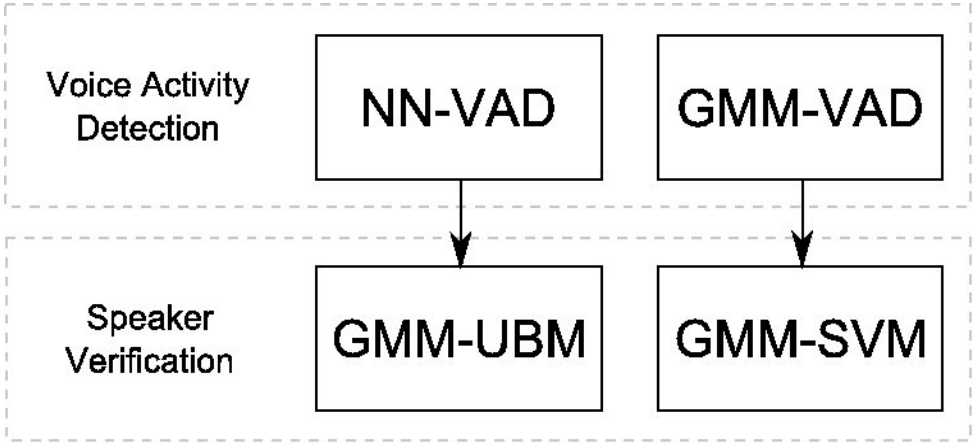
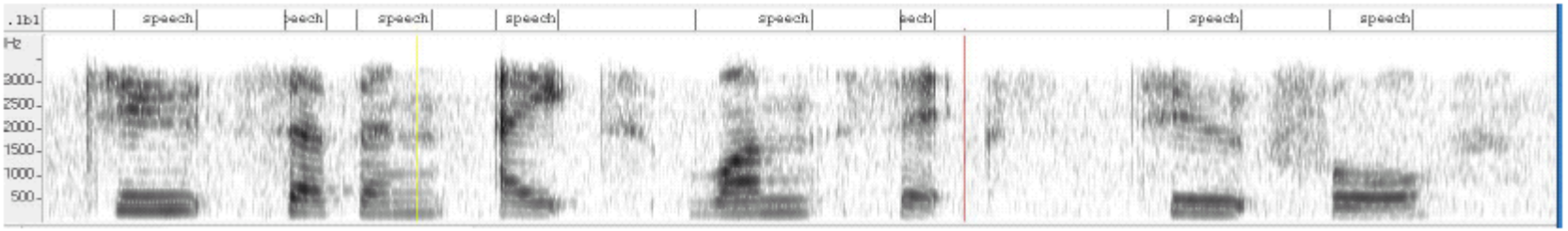
Baseline speech authentication



1) NN-VAD – Neural networks based Voice Activity Detection (BUT)
2) GMM-VAD – Gaussian Mixture Model based Voice Activity Detection (LIA)
3) GMM-UBM – Gaussian Mixture Model and Universal Background Model Paradigm (BUT)
4) GMM-SVM – Gaussian Mixture Model and Support Vector Machines (LIA)

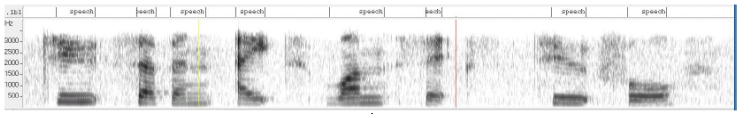
Voice activity detection

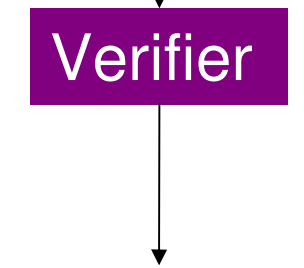
- A given speech recording will consist of both speech (signal) and silence (noise)
- VAD determines what is what within the recording and throws away the useless bits



Speaker verification

- Given some speech and a model of the claimed identity, determine if the user is who they say they are
- Likelihood ratio
  - Does the user sound significantly more like X than the average man?





Accept/Reject

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Project status

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D3.1 – Baseline system software

- Software tools completed for baseline algorithms
  - Face detection, feature localization and verification
  - Speech detection and verification
- Problems
  - Nothing from LIA in SVN repository
  - Sparse documentation in places
  - File-naming errors
- Questions
  - Source/binary files in repository?

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D3.2 – Baseline system report

- Report completed before Christmas
- Problems
  - Datasets not always consistent (BANCA or NIST?)
- Questions
  - Writing guidelines (e.g. active/passive voice) needed?
  - Best way to implement all detectors and all verifiers on all datasets?

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Project progress (UMAN)

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Summary

- Phil Tresadern joined August 2008 (5 months)
- Harish Bhaskar joined September 2008 (4 months)
- Contributions to deliverable D3.1
- Co-ordinated deliverable D3.2
- Commenced research towards deliverable D3.3

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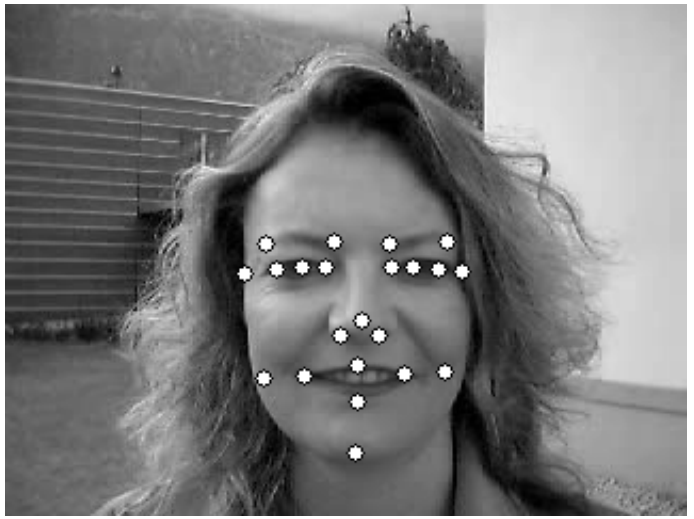
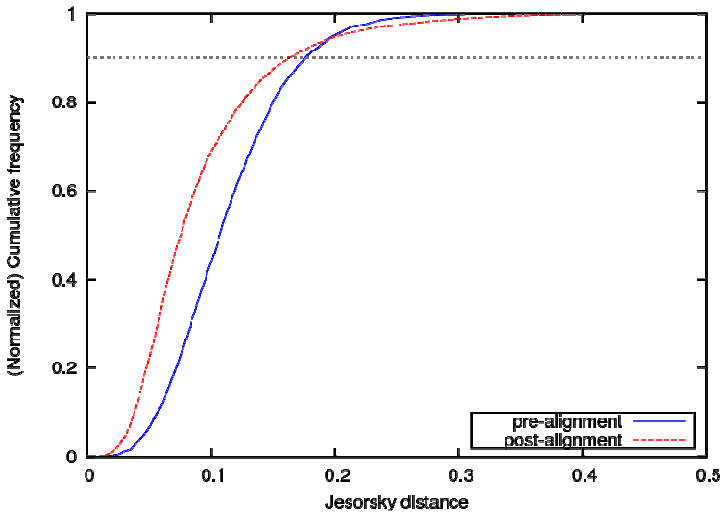
Work completed

- Produced baseline system software for facial feature localization (D3.1)
- Co-ordinated deliverable D3.2
- 2 data collection sessions completed (WP2)





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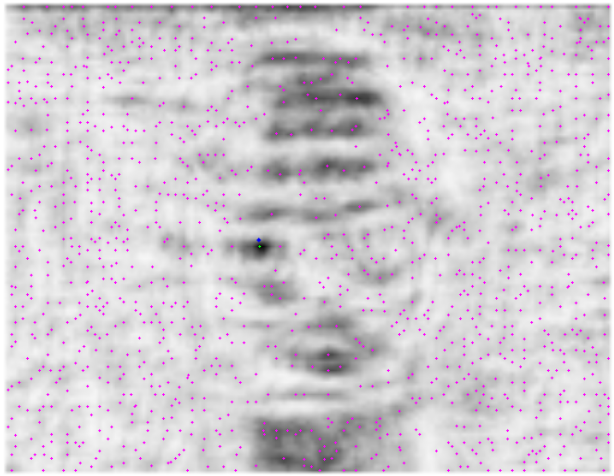
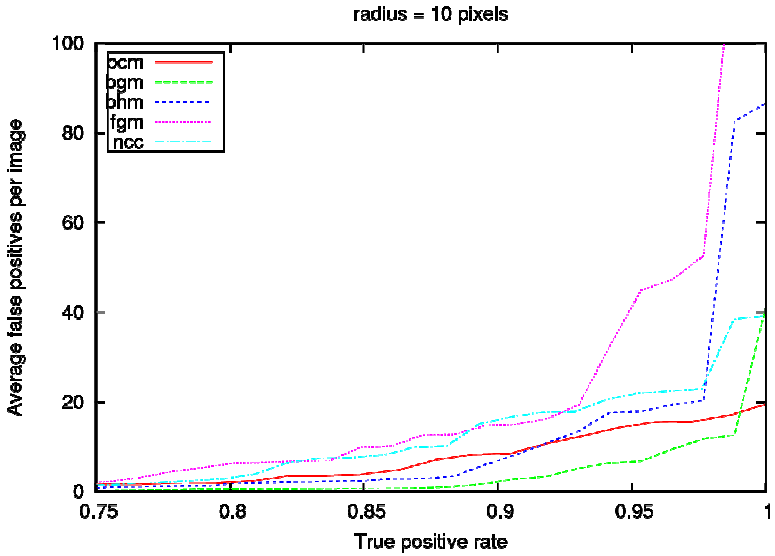
Work ongoing

- Improving facial feature detection (WP3)
  - Comparison of different appearance models for detecting the right eye as a preliminary example





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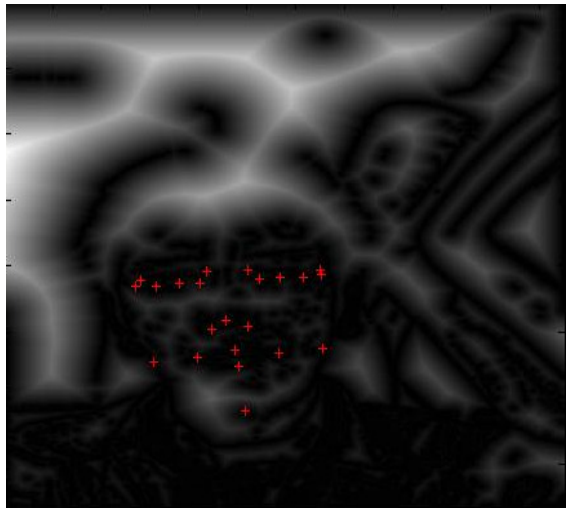
Work ongoing

- Graph-based face alignment methods (WP3)
  - Represent deformation field from one frame to the next by a grid of discrete displacements
  - Unary costs enforce consistent image-image matching
  - Pairwise costs enforce spatial priors



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Work ongoing

- Graph-based face alignment methods (WP3)
  - Markov Random Field solvers (e.g. TRW-S) used to minimize error function

Future work

- Extend comparison of facial feature detectors (D3.3)
  - Include more examples (e.g. AdaBoost)
  - Develop most promising models to improve accuracy and reduce false positives
- Incorporate improved facial feature models into graph-based localization scheme (D3.3)
- Liaise with UOULU with respect to evaluations of advanced systems (D3.4)

Future work

- Investigate data fusion techniques and model adaptation (WP4)
- Investigate scalability of feature detectors (WP5)
  - Consider implementation for maximum efficiency on low-power, fixed-point processors

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Publications

- None submitted to date
- Forthcoming conference deadlines
  - ICCV: 10th March 2009
  - BMVC: 27th April 2009

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WP4: Joint Bi-Modal Authentication and Model Adaptation

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WP4 Planning (UMAN)

- Lip-tracking
  - Synchronize audio and video
- Blink detection
  - Liveness detection
  - Eliminating images with eyes closed
- Head pose estimation
  - Frontal faces are easier to authenticate

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WP4 Planning (UMAN)

- Investigate the use of group-specific models for improved localization
  - Group subjects based on age, gender etc. and generate group-specific models
  - Select appropriate model using known data about subject
  - Evaluate any improvement in tracking due to group-specific model

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WP4 Planning (UMAN)

- Investigate the use of person-specific models for further improved localization
  - Given enough data from a specific person, develop a person-specific model
  - Model could potentially be stored in mobile phone (most phones are used by only one person)

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WP4 Planning (UMAN)

- Investigate model adaptation over time
  - Adapt model to track changes in appearance (e.g. growing facial hair)
  - Q: How do we decide when to update model?
- Will environmental effects (e.g. illumination) dominate over true changes in appearance (e.g. make-up, facial hair)

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WP5: Scalability

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WP5 Planning (UMAN)

- Appearance models:
  - Investigate their implementation on fixed-point processor. E.g. PCA may be difficult, histograms and Haar wavelets are a bit easier
  - Evaluate number of mathematical operations required for each evaluation. Can we reduce the number of math ops per evaluation and the number of evaluations required (e.g. cascade of classifiers)
  - How to reduce memory requirements? Feature selection methods (e.g. AdaBoost). How critical is it to estimate confidence?

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WP5 Planning (UMAN)

- Graph-based matching
  - Currently very complex and not well-suited for fixed-point, low-power processors
  - Can they be adapted to the processors that we will be working with?

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WP5 Planning (UMAN)

- Distribution
  - If not, how can we distribute processing between mobile and server? What is the trade-off between sending data to server for processing vs processing on the mobile?
  - What processes do we have in common? E.g. integral image/census transform may be computed for detection then used for localization and verification for free