

Facial Analysis for Real-Time Profiling

Bashar A. Rajoub and Moi Hoon Yap

Department of Computer Science,
Aberystwyth University

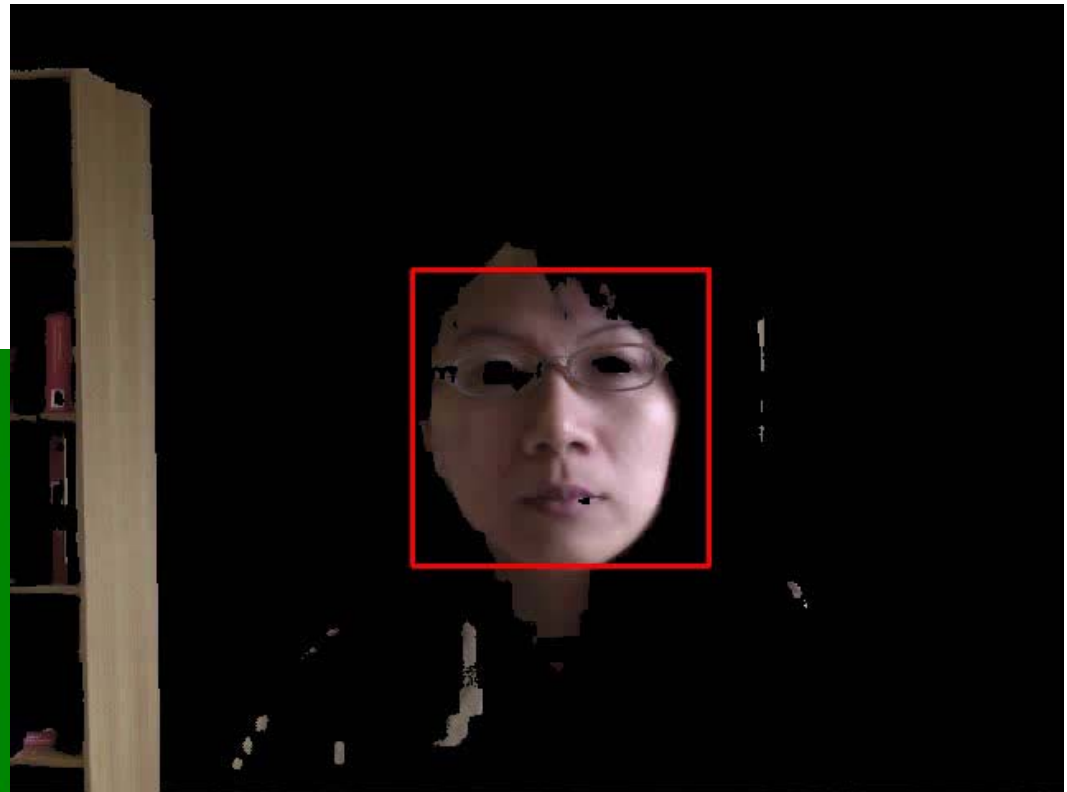
School of Computing, Informatics, and Media
University of Bradford

Overview

- ❑ Facial modelling in the visible domain
 - ❑ Improvement in face detection
 - ❑ MPEG-4 and FACS
 - ❑ Image processing algorithms
 - ❑ Eye movement Detection
- ❑ Facial modelling in the thermal domain
 - ❑ Previous work by others
 - ❑ Our approach and current results
- ❑ Pilot study

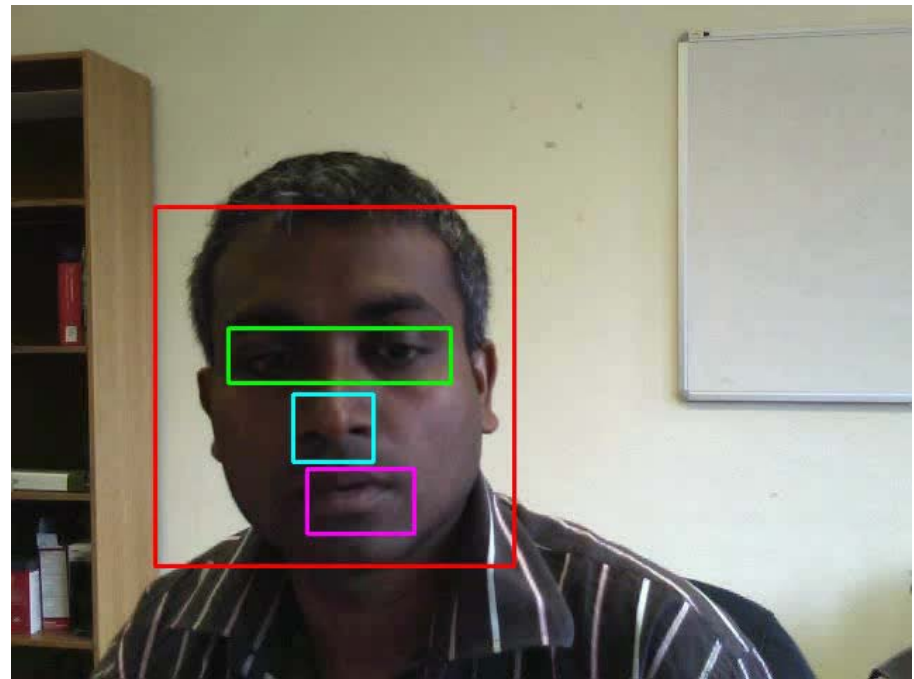
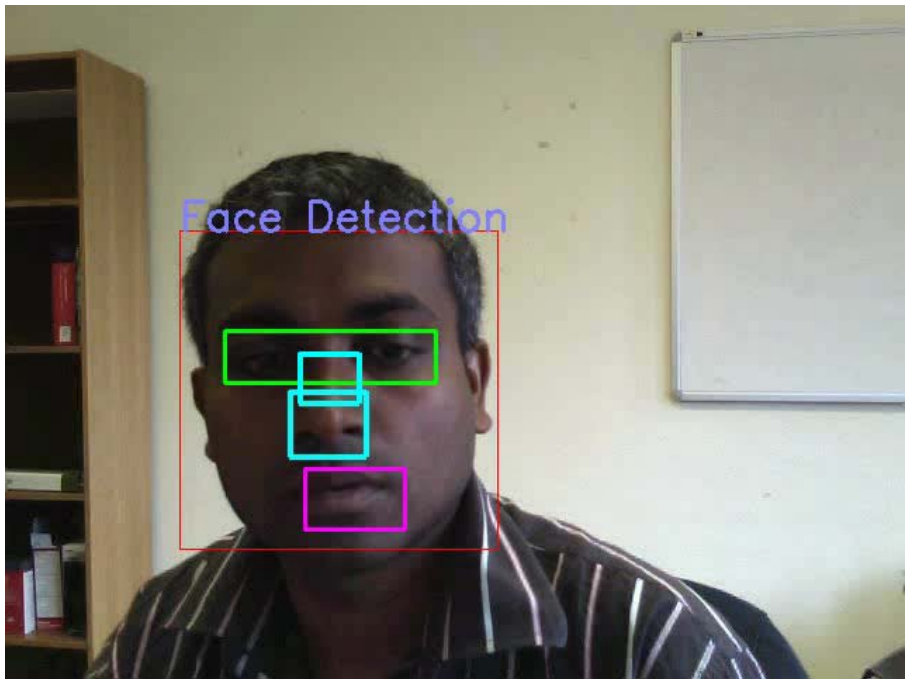
Improvement in Face Detection

- ❑ Improved the algorithm by a pre-processing stage (Colour Segmentation)



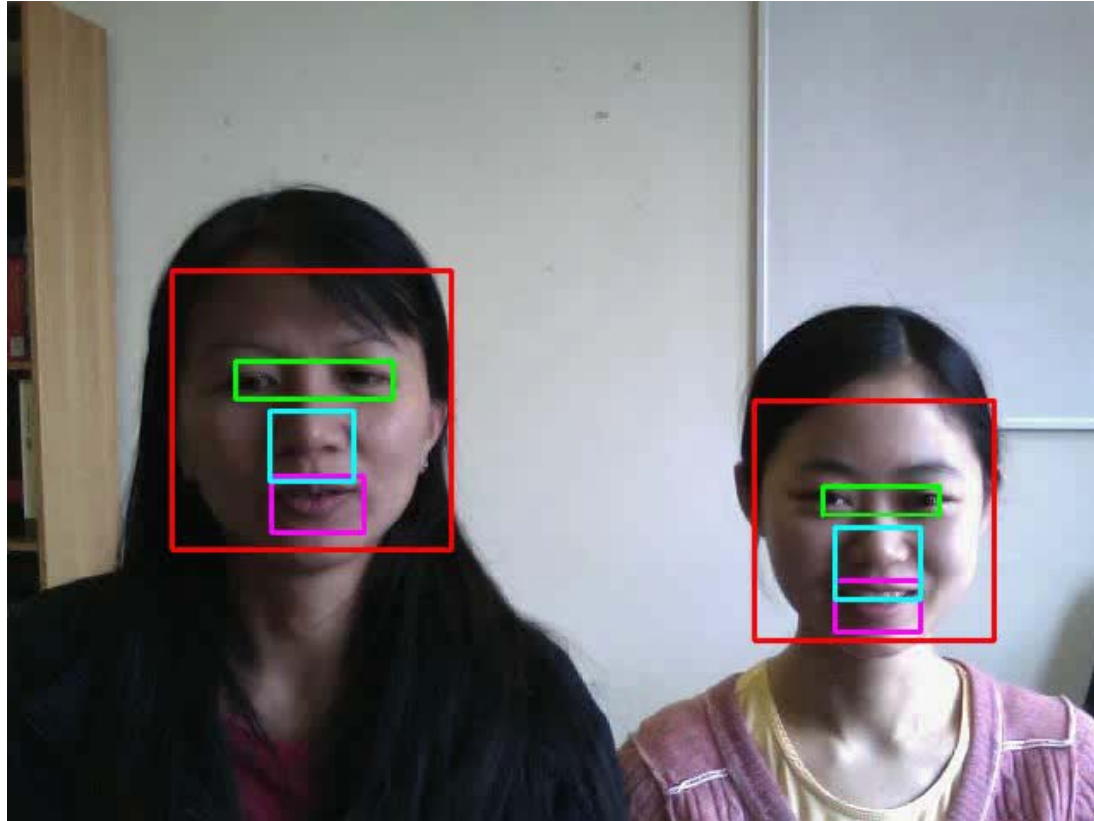
Improvement in Face Detection

- ❑ Improved the algorithm by a pre-processing stage (Colour Segmentation)



Improvement in Face Detection

- ❑ Extended the real-time analysis to multiple faces detection



FACS and MPEG-4 Standard

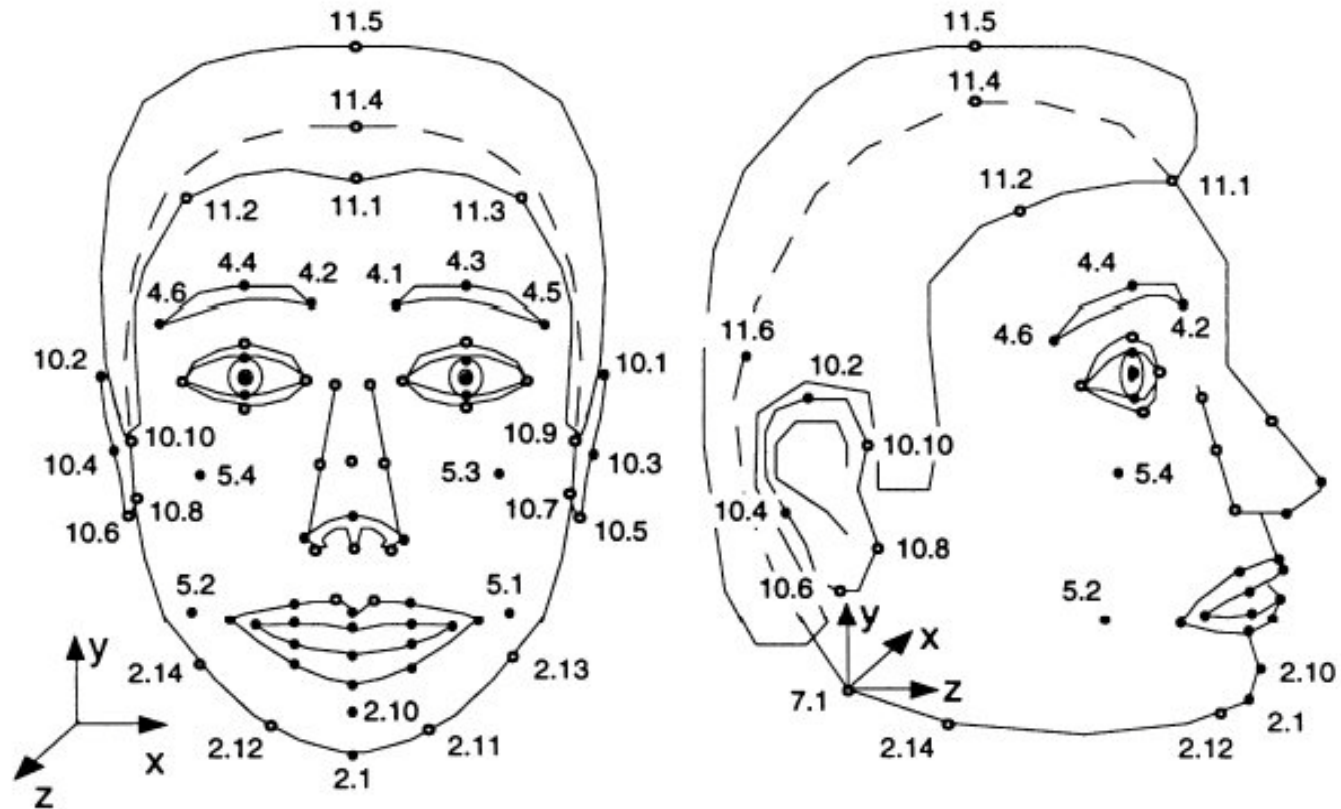
❑ FACS (Facial Action Coding System)

- ❑ The human-observer-based system designed to detect subtle changes in facial features
- ❑ A method to measure Facial expressions by identifying the muscular activity underlying transient changes in facial appearance

❑ MPEG-4 standard

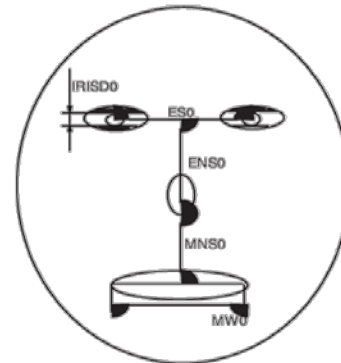
- ❑ Inspired by FACS
- ❑ Contains a comprehensive set of tools for representing and compressing content objects and the animation of those objects
- ❑ FDP (Face Definition Parameters): define different feature points on the face

MPEG-4 Face Definition Parameters



MPEG-4 Face Animation Parameters

- ❑ FAP (Face Animation Parameters): define the movement of different parts of the face. FAPs are the displacements of the feature points from the neutral face definition.



- ❑ With the advent of MPEG-4, there has been a move from FACS to MPEG-4 in the computer vision community.
- ❑ The definition is not based on the specific movement of muscles or directly related to emotions, but is a standard which is more convenient for facial animation.

Image Processing Algorithms

- ❑ Colour Segmentation on eye areas

- ❑ Problems:

- different database, different parameters.
- make-up and accessories

- ❑ Next:

- ❑ repeat experiment on high resolution images

Source A



Source B

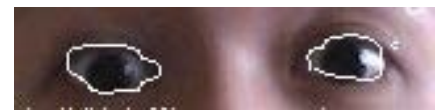
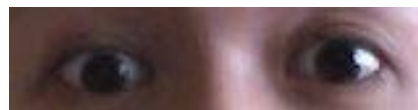
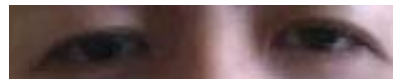


Image Processing Algorithms

- ❑ Iris Detection by using Hough transform
- ❑ Problems:
 - Only work on Open eyes

Source A



Source B

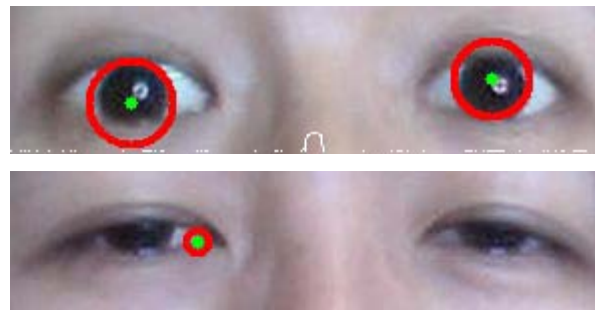
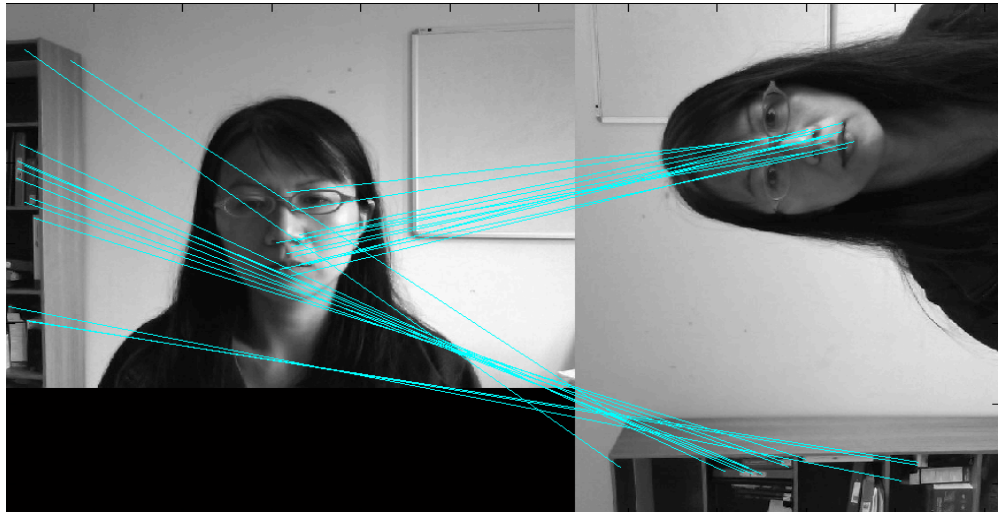


Image Processing Algorithms

- ❑ Scale Invariance (SIFT)
- ❑ Problem:
 - Did not work for different expressions



Eye Movement Detection



Eye Movement Detection



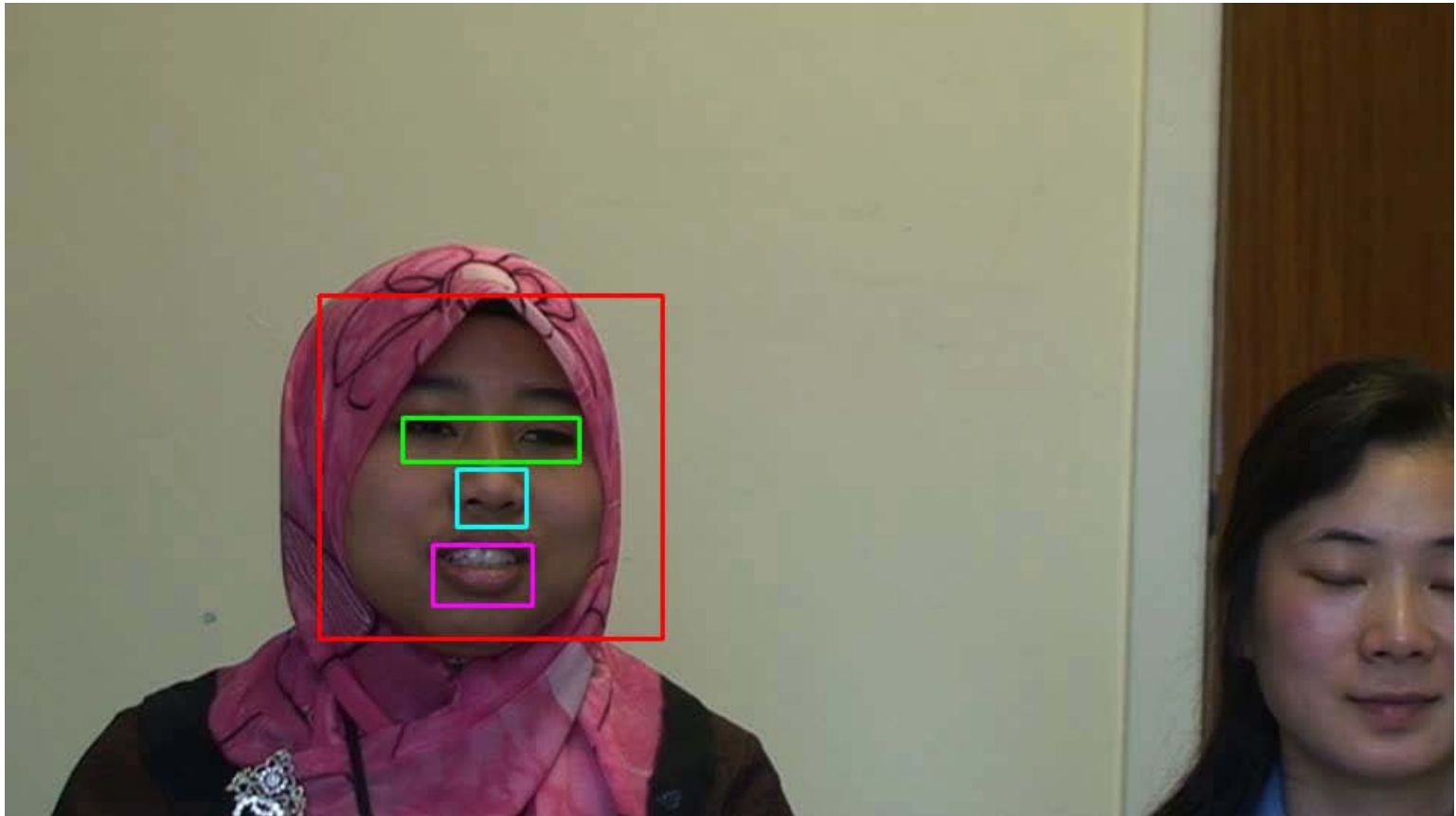
New Equipment Setup

- High resolution and portable



Performance

- Input type: Firewire



Summary - Visual domain

❑ Research output:

- ❑ Improved and understand the image processing algorithms on face images
- ❑ Prototype in Eye Movement Detection
- ❑ Presented our work in Cyberworlds 2009, Bradford.

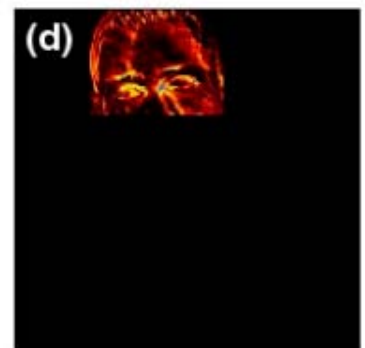
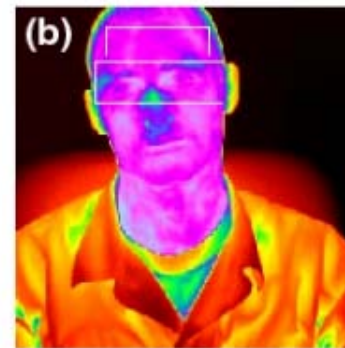
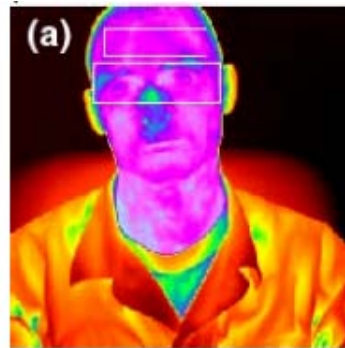
Moi Hoon Yap, Hassan Ugail, Reyer Zwiggelaar, Bashar Rajoub, Victoria Doherty, Stephanie Appleyard, Gemma Huddy, "A Short Review of Methods for Face Detection and Multifractal Analysis", *2009 International Conference on Cyberworlds, 7-11 September 2009, University of Bradford, UK, IEEE Computer Society.*

❑ Current and Future work

- ❑ Test new equipment (Camcorder) to replace webcam
- ❑ Investigate the algorithms on high resolution images
- ❑ Data collection and experiment on subjects
- ❑ Further development in prototype
- ❑ Prepare a conference paper to ICPR 2010 (deadline: 15th January, 2010)

Thermal Work by Others

- ❑ Bio-heat modelling vs direct thermal data
- ❑ Periorbital temperature vs. left, right {min,max} periorbital temperature
- ❑ Advanced tracking
- ❑ FFT filtering



Thermal Work by Others

2001	kNN	300 frames	19	CC=78%	MD=17%	FA=5%
2002	Thresholding	Slope information	19 - 2 training subjects	CC=84%	MD=11%	FA=5%
2006	Regression	L,R, min,max	24 subjects	CC=91%	MD=4%	FP=4%
2006	thresholding	Global slope	39 subjects	CC=87%	MD=7.6%	FP=5%

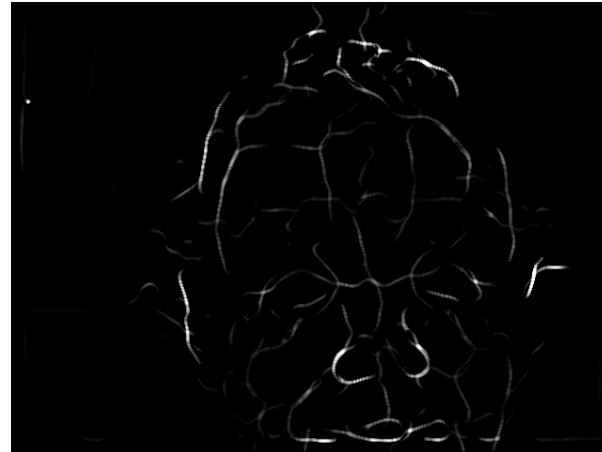
Our Objectives and Methodology

- ❑ Objectives
 - ❑ Increase correct classification accuracy
 - ❑ Decrease false positives
 - ❑ Operational evaluation – not just lab
- ❑ Methodology
 - ❑ Obtain additional information in visual and thermal domain
 - ❑ Advanced modelling and classification techniques

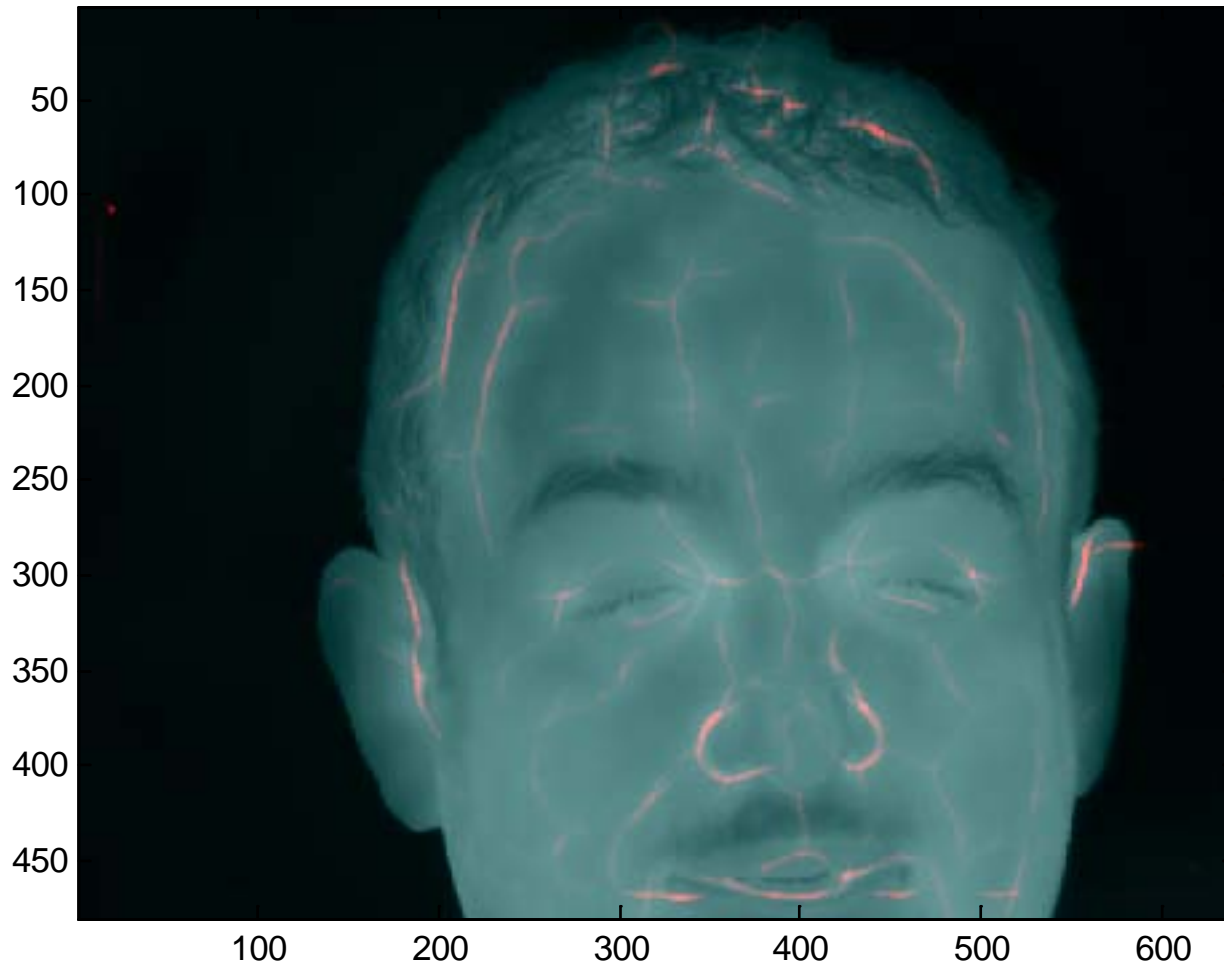
Some Results

- ❑ Enhancing thermal information
 - ❑ Image equalisation
 - ❑ Bio-heat modelling
- ❑ Segmentation
 - ❑ Least-invariant thermal features
 - ❑ Face detection

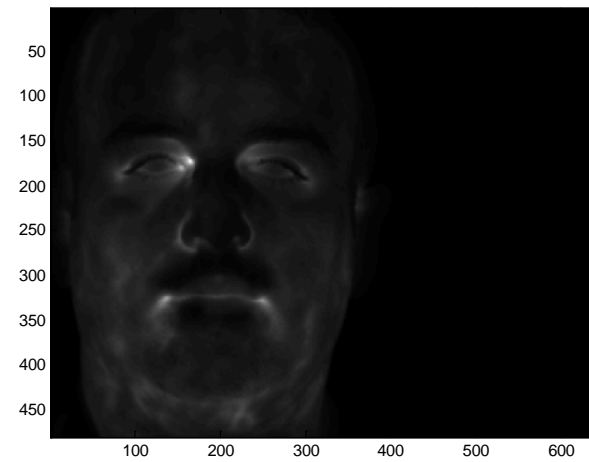
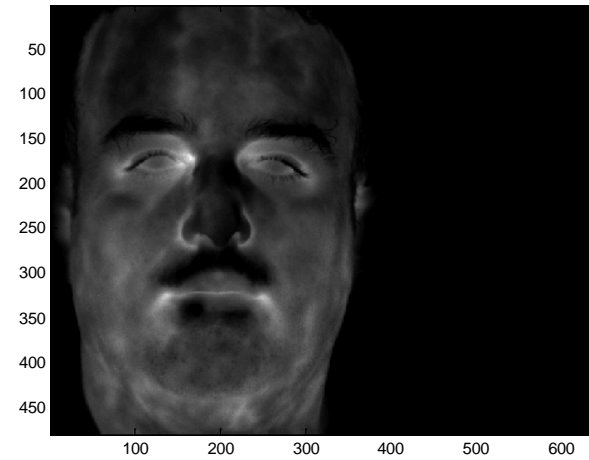
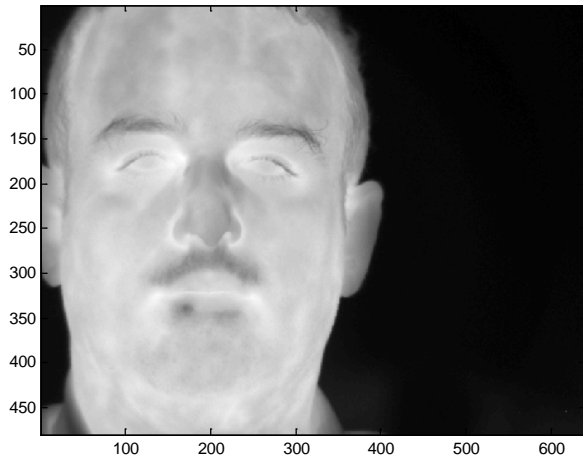
Histogram Equalisation



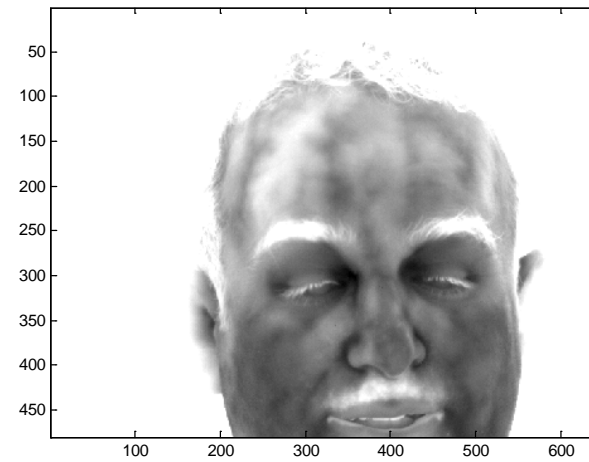
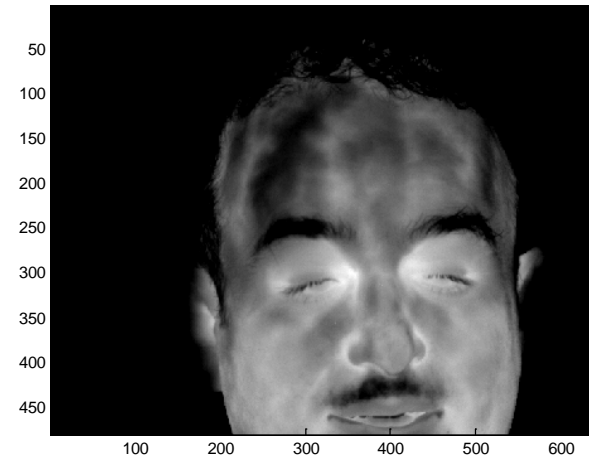
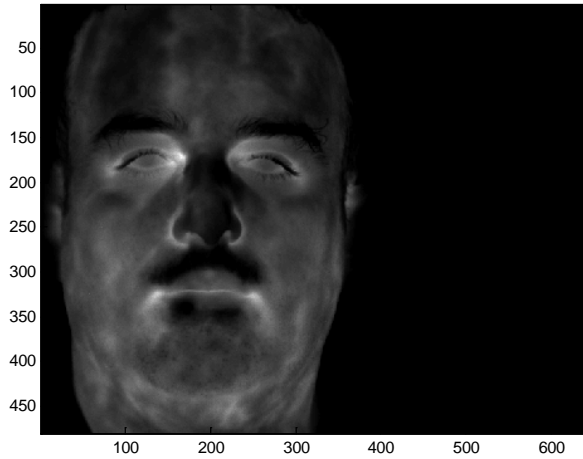
Invariant Structures



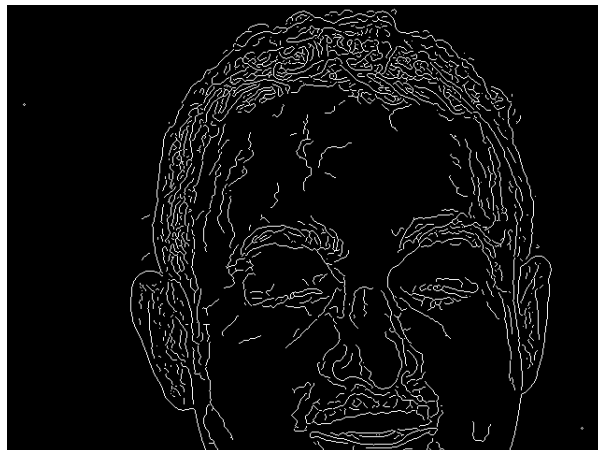
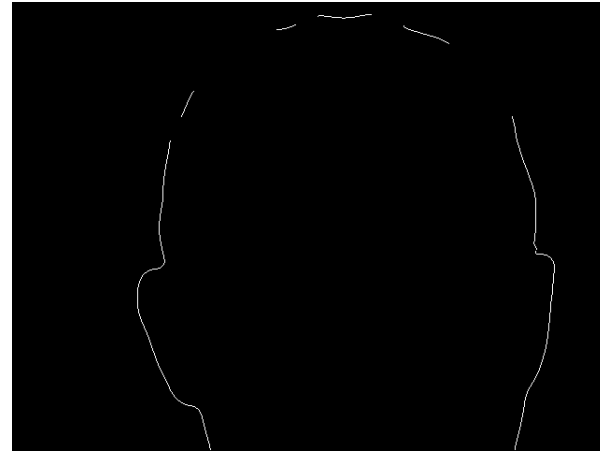
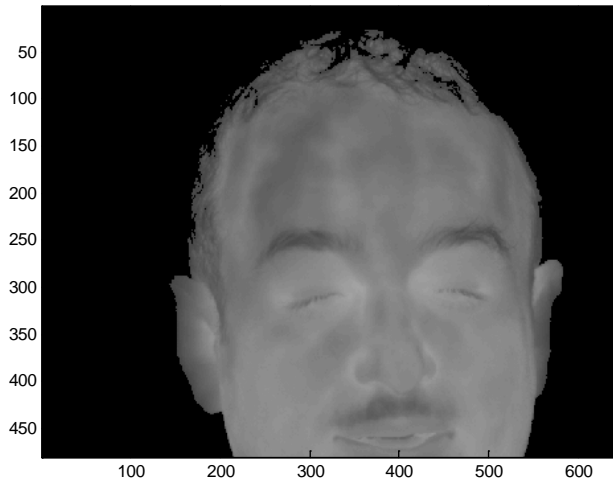
Bio-heat Models



Bio-heat Models



Segmentation



Summary – Thermal Domain

- ❑ Modelling done
 - ❑ Segmentation
 - ❑ Tracking (no details shown)
 - ❑ Bio-heat and related

Pilot Study

- ❑ The pilot study should look at as many cues as possible with the aim of identifying the variances and correlations
- ❑ Use a more challenging pilot study
 - ❑ Narrative approach instead of simple “yes” and “no” answers
 - ❑ Use a number of different examination scenarios
 - ❑ Use more subjects, various ethnic groups, ages, etc.,
- ❑ Details
 - ❑ Lying based on learnt story
 - ❑ Lying requiring extension to learnt story
 - ❑ 12 character profiles: there will be two topics that the Examiner will ask about
 - ❑ Topic A: hobbies, personality, etc
 - ❑ Topic B: university, study and career
 - ❑ The Participant should not be told which order to expect the topics in
 - ❑ Trained professional examiners (blind to subject category) who will look formal to induce impression of authority