COMPSCI 773

- Lecturers: Dr Patrice Delmas (303.389)
  A. Prof. Georgy Gimel'farb (303.391)
- Lecture time: Tues 2pm-4pm Wed 3pm-4pm
- Tutorial: Fri 11-12
- Marking:
  - 40% Final exam
  - 60% Lab work (30% group work, 20% individual assessment, 10% oral assessment)
- 3 assignments

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1st assignment: image features, image segmentation, image matching – 01.04.2011

1st assignment: camera calibration, image pairs rectifications

2nd assignment: stereo matching algorithms implementation, depth map construction, 3D visualisation (OpenGL/CUDA, optional) – 01.05.2011

3rd assignment: -03.06.2011

- 2+3D Face recognition (tentative)
- Whole system testing (live demo)

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- Individual assessment: (either or both)
  - Oral interview (with Patrice)
  - Research paper presentation during final 3 lectures (time permitting)
  - Overall involvement in group work
- Assignment reports (what's in):
  - A group report:
    - Who did what
    - Detailing parts each student did (individual report)
    - What solution has been chosen and why
  - An individual report
    - Presenting OWN solution and results (if any)

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- The report should look like a research report with references
  - Justified explanations on the chosen solutions, graphs, results and
  - Critical assessment of the outcomes
- Programming
  - Windows C, C++, Java
  - OpenGl, CUDA, Gtk, OpenCv
  - You are allowed to use external libraries but you have to make sure we are aware of it (in your report write down which programs are yours and which ones are not)
  - You may be asked to pass your code to other groups for the next assignment
  - If you use another group's codes you MUST state it in your report

The project: (advanced biometrics:) 2D/3D face (expressions) recognition using stereo vision

- Part 1:
  - Image features, image segmentation
  - Calibration
  - Rectification
- Part 2:
  - Improve calibration accuracy/rectification
  - Matching/stereo matching
  - Database acquisition
  - 2D face (expression) recognition
- Part 3: Face authentication or face expression recognition
  - Goal: Identify faces from images using 2/3D data
  - 2D/3D Statistical analysis
  - Live face recognition
- Each group will have to do BOTH parts

What is available and what you will have to do

US: 3D USB 2.0 web-cameras
- Calibration object

YOU:
- Code in C, C++, Java (real-time)
- A very strong team/personal effort
- Good planning
- Fast-tracking learning ➡ application

OUTCOME
- You will undertake work at the top-edge of today's research
- You will gain a unique experience of Applied Computer Vision

What is expected

Projects at the edge of research development: neither easy nor simple

- A great deal of work is required but: (1) you will learn a lot; (2) this could count as work experience in an expending IT area; (3) you can show what you are worth without having to fear too much about the final exam
  - Still 2 students failed because of exam in 2005, none since but some ended up with B-/C+ final grade
- The exam will encompass all that will be lectured + project-related questions
- It is not a good idea to concentrate on a very restricted part of the project as this will penalise you by the end
- If you like the projects you can continue towards the same directions for COMPSCI 780 / MSc studies
- If you think COMPSCI 773 is too hard for you we can offer a COMPSCI 780 project along the same directions

What you should know or learn very quickly

- C, C++, Java programming
- Confidence in mathematical skills (linear algebra)
- Basics of Image Processing
- To learn quickly (by yourself)
- GUI design (just the basics) --optional
- A bit of CUDA for matching computation → to be taught
- Camera control
- The rest we will teach you…

Course contents (ideally)

- Introductory lecture
- Segmenting binary images
- Feature extraction
- Image matching
- Stereo image matching
- 2D and 3D vision geometry (self taught)
- Camera calibration
- Stereo calibration
- 3D scene description / understanding
- Real-time image processing
- Rectification of stereo pairs
- Colour discrimination
- Features classification: PCA-LDA
- Higher level statistical approaches
- Course overview and final demo

Project details: Part 1

- Acquire synchronised still images from 3D webcams
  - Acquisition of face images
- Calibration
- Implement Image features and image segmentation algorithms
- Rectification
- Demo
- Report

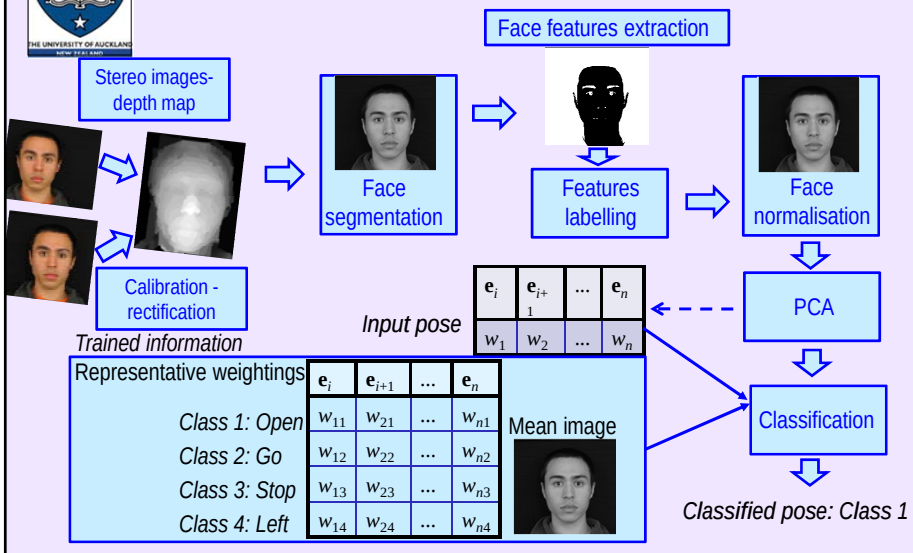
Project details: Part 2

- Improve calibration/rectification accuracy
- Matching / stereo matching
  - Implement a simple window-based correlation-based matching algorithm
  - Improve the algorithm accuracy by taking into account edges, features and regions.
- Database construction
  - Acquire 2D face database with 3D webcam
  - Extract faces from images
  - Normalize database images
- Analyse 2D face database
- Demo
- Report

Project details: Part 3

- Database construction
  - Acquire 2/3D face database with 3D webcam
  - Extract faces from images
  - Normalize database images
- Analyse 2D face database
- Analyse 3D database images
  - Compare new faces versus faces within database
- Perform a real-time demo
- Write a conference submission-like report

A Possible Tentative Framework



Questions ?

- First thing first
  - Create groups
- Next
  - I will do the first 4 weeks of the semester; Georgy - the 4 weeks following, Patrice and Georgy will do the last 4 weeks
  - I am very keen to help and answer questions:
    - Better ask after lectures and during tutorial hour any.
    - This is a research-based project: I am keen to learn from you.
    - *My advice*: read research articles, self-learn, respect assignments requirements, but you are very welcome to explore alternative solutions.

Slide 14

CD1 celine, 23/02/2009