Computer Vision:

Object detection, tracking and recognition

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New applications

Computer vision has now found a place in consumer products

- Mobile phones and digital cameras
- Games
- Cars
- Image and video search
Overview

- Local appearance: 2D target detection and image registration
- Shape: 3D object detection
- Motion: looking at people in crowds
- Event and action recognition
1. Image matching with interest points:

2D target detection and registration
Image matching
Where am I?
What am I looking at?

Johansson and Cipolla 2002
Cipolla, Tordoff and Robertson 2004
Where I am?

Determine pose from single image by matching
Register database view

First align database view to map
Localisation of query view
2. Using 2D and 3D Shape:

Human hand and body detection

Stenger, Thayananthan, Torr and Cipolla 2003
Williams, Blake and Cipolla 2003 and 2005
Ramanan et al 2006
Matching shape templates
Matching shape templates
Hand detection system
Tracking - 3D mouse
Tracking - 3D mouse
People and pose detection
People and pose detection
3. Object category detection and machine learning

Shotton, Blake and Cipolla 2005
Supervised learning

- Learn to recognise images of a particular class, localised in space and scale
- i.e. find the horse/cow/car etc!

Desired Results
Learning and Adaptability

Training Data

Class
Segmented: $D_S$

Unsegmented: $D_U$

Background: $D_B$
Object Model

\[ F = (T, p, \sigma, \lambda, \theta, a, b) \]
Visual Object Categorisation
Pedestrian detection
4. Motion Analysis

Detection and tracking people in crowds

Brostow and Cipolla 2006
Input Images
Recovery of camera motion

Input images  Feature extraction  Feature matching  Bundle adjustment
Image motion
Tracking people in crowds

Detecting People in Crowds by Bayesian Clustering

Brostow & Cipolla, 2005
5. Detection and recognition in video

Arandjelovic and Cipolla 2004-2006
Kim, Wong and Cipolla 2005-2006
Face recognition

Appearance variations due to:

Lighting condition

Scale, pose, motion pattern
Face recognition

Face recognition from video for access control

Reference sequence

Input sequence
Automatic cast listing

Problem difficulties

- Illumination
- Motion blur
- Pose
- Occlusion
- Low resolution
- Facial expression
Automatic cast listing

“Simple clustering” results

Sir Hacker:
Miss Hacker:
Humphrey:
Secretary:
Bernard:
Frank:
Action recognition
Action recognition

- Boxing
- Hand clapping
- Hand waving
- Jogging
- Running
- Walking
Overview

• Object detection – local appearance and shape

• Motion analysis – people in crowds

• Face, event and action recognition