Previous and ongoing activities in the “EC” Cognition

Friday April 23, 2004
Luxembourg
Outline

- Cognitive Vision Initiative in FP5
- Strategic Objective “Multimodal Interfaces”
- FET - Future & Emerging Technologies
- Cognitive Systems call results
Cognitive Vision Initiative in FP5: Rationale

Limitation of computer vision systems:
- 2D / recognition of identity rather than category / focus on single image cues / dependence of “built-in” knowledge/task information / mainly static scene analysis / insufficient self-learning and self diagnosis

Cognitive vision
- combine state-of-the-art image analysis with cognitive reasoning. (self-adaptivity, abstract representation, categorisation, memory organisation, contextual knowledge, behavioural interpretation)
- robustness, speed, versatility and cost
Cognitive Vision in FP5 (1/5)

- EC-VISION - http://www.ecvision.org

The "European Research Network for Cognitive AI Enabled Computer Vision Systems"
Provides a forum addressing AI-oriented and systems-oriented areas of cognitive computer vision and promotes research and development amongst the academic and the industrial communities.
- research planning / Edu./training / Dissemination / Industrial liaison

- ACTIPRET – http://actipret.infa.tuwien.ac.at
Interpreting and Understanding Activities of Expert Operators for Teaching and Education
Focuses on active observation, interpretation and translation in natural language expression of activities
- Activity plan (manual of 3D reconstructed scenes)
- Feedback for user
Cognitive Vision in FP5 (2/5)

  Context Aware Vision using Image-based Active Recognition
  Investigates image-based recognition processes exploiting foveal-like image sensors (biolo.), hierarchical visual attention process (top-down) and contextual knowledge (learning Apparences of objects).

- **COGVIS** - [http://cogvis.nada.kth.se/cogvis-home.html](http://cogvis.nada.kth.se/cogvis-home.html)
  Computational Vision and Active Perception
  Develops vision systems that can perform task oriented categorisation (set of objects), scene interpretation (rich semantic models -> robustness) and learning in the context of an embodied agent to demonstrate the basic functionalities of cognitive vision in the context of realistic problems (fetch / deliver objects).
Cognitive Vision in FP5 (3/5)

- COGVISYS - http://cogvisys.iaks.uni-karlsruhe.de
  **Cognitive Vision Systems**
  Build re-usable vision system with self-adaptive perception (improve cue extraction/integration), categorisation capabilities, and explicit knowledge base at the level of reasoning.
  - virtual commentator (visual info -> text)
  - traffic surveillance / sign language

- DETECT - http://www.detect.tv.com
  **Real Time Detection of Motion Picture Content in Live Broadcasts**
  Implements a general platform for detection of semantic blocks (i.e. commercial blocs) and regions (i.e. brand detection) within digital video streams for automatic broadcast analysis by means of cognitive vision.(concentrating on regions of interest/ receptive fields) - industry/research
Cognitive Vision in FP5 (4/5)

- **LAVA** - [http://www.l.a.v.a.org](http://www.l.a.v.a.org)
  Learning for Adaptable Visual Assistant
  Device machine learning technologies, for the robust, efficient and learnable categorisation of generic object classes in real-world images and for the interpretation of events in video data
  - improve robustness / generalisation / speed

- **VAMPIRE** –  
  [http://www.techfak.uni-bielefeld.de/ags/ai/projects/vampire](http://www.techfak.uni-bielefeld.de/ags/ai/projects/vampire)
  Visual Active Memory Processes and Interactive Retrieval
  Investigates categorisation of unknown objects and events with regard to the situational context and background knowledge ("stored" in the Visual Active Memory)
  Interactive retrieval -> association between perceived vs stored information
Cognitive Vision in FP5 (5/5)

- VISATEC - http://www.ks.informatik.uni-kiel.de/~visatec

Vision-based Integrated Systems Adaptive to Task and Environment with Cognitive Abilities
Develops a generic, automatically adaptable, cognitive vision architecture including image and shape representation, multi-cue integration, dynamic adaptation and learning mechanisms for the detection of 3D objects in images and attentive object/situation analysis
- robot arm able to remove objects from a bin
• Strategic Objective launched in early 2004
• 3 projects strongly related to cognitive systems

- Humaine:
  Human-Machine Interaction Network on Emotion. Study of systems that can register, model and/or influence human emotional and emotion-related states.
  http://emotion-research.net
Enactive

Enactive Interfaces - study of interfaces and interaction paradigms base on Enactive Knowledge, i.e. knowledge stored in the form of motor responses and acquired by the act of “doing” - a form of cognition inherently tied to actions. http://www.enactivenetwork.org

Pascal

Pattern analysis, statistical modeling and computational learning - study core enabling technology for discovering, structuring and presenting complex information, or for processing of complex sensory data. http://www.pascal-network.org
- **Neuroinformatics**
  enable the construction of hardware or software artifact that live and grow

- **Life-like perception systems**
  develop integrated perception-response systems that are inspired by the sophistication of solutions adopted by living systems

- **Presence research**
  explore the cognitive and affective roots of sensory perception.

- **Beyond Robotics**
  develop physical mobile artifacts that could serve as companions to humans, function as bionic parts augmenting human capabilities, or act as autonomous microrobot groups.
Cognitive Systems call overview

Construct physically instantiated or embodied systems that can **perceive** (‘see’, ‘hear’, ‘smell’), **understand** the semantics of information conveyed through their perceptual input (‘recognise’, ‘categorise’) and **interact** with their environment (‘decide’, ‘act’), and evolve in order to achieve human-like performance in activities requiring context specific knowledge.

- Artificial systems that combine perception, action reasoning, learning and communication
- Provide enabling technologies for robotics, natural language understanding, man-machine interaction, complex real world systems

**Results**
- 8 projects under negotiation
- Start of the project: September 2004

**Funding**
- Preallocated 25 Meuro (80%)
Cognitive architectures and open platforms
Integration of perception, representation, learning, reasoning, action and communication

- **cognitive systems for cognitive assistants**
  - exploring and modelling space and objects.
  - architectures, forms of representation and perceptual mechanisms for learning, planning, reasoning, motivation, action and communication

- **open-system, physical platform for cognitive systems R&D**
  - Perceptual, motor and communication capabilities for goal directed manipulation tasks.

- **architecture for perception-action learning**
  - model to integrate symbolic and associative (numerical) representations
  - robotic manipulation experiments

- **architecture incorporating cognitive competences**
  - perception, attentional control, goal and action generation,
  - abstraction, categorisation and conceptualisation, learning
  - robotic platform that has sensing and actuation capacities

**architecture for affordance-based robot perception and control**
- grounding representations/symbols in affordances and real-world interaction
Cognitive Systems call results: Focussed efforts

cooperation, living systems vs. computing architectures, anticipation

- **Joint action**
  - cooperation between autonomous robots, or between robots and humans

- **Research inspired by the basic principles of living systems**
  - new models, methodologies and theories based on self-organisation
  - new types of computing architectures

- **Systems with anticipatory cognitive capabilities.**
  - goal-governed with a model of future events
  - simulated scenarios and real robot experiments.
Cognitive Systems call results

• Common characteristics:

1) they all rely on “physical instantiations” (robots or robotic devices)
2) they mostly propose to construct systems architectures and/or platforms for use by developers
3) they all draw heavily on a body of knowledge know as “Neuro-Informatics”