Semantic-Based Workflow Composition for Video Processing in the Grid

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Introduction – Ecological Motivation

- Collaboration between National Centre for High-Performance Computing (NCHC), Taiwan and AIAI, Edinburgh on workflow enactment for EcoGrid.

- Problem:
  - Valuable and continuous real-time data collected over 3 years, unanalysed.
  - Manual processing is time-consuming.
  1 minute’s clip will take 15 minutes to analyse, thus 1 year’s recording will cost human experts 15 years’ effort x 3 under water cameras = 45 years.

- Impractical situation and more appropriate automation methods must be deployed.

- Semi-automated and automated way to speed up this process.
The Semantic Grid

- The Grid is aimed at enabling resource sharing and coordinated problem-solving between computers and people in a distributed and heterogeneous manner.

- The Semantic Grid is an extension of current Grid whereby information and services are given well-defined and explicitly represented meaning.

- Requires means for composing and executing complex workflows.

- Improvement of Grid workflow systems with the incorporation of semantic capabilities.
Requirements

- Video Annotation example:

  Key frame detection → Segmentation → Recognition → Annotation

- Performance-Based Selection.
- Iterative Processing.
- Adaptive, Flexible and Generic Architecture.
- Semantic-Based Compatibility.
Related Work

- Existing Grid workflow systems:
  - Pegasus
  - Triana
  - Taverna
  - Kepler

- Limitations of current solutions
Proposed Framework – Hybrid Method

- Modeller
  - Tool/Capability Ontology
  - Domain Ontology
  - Goal Ontology
  - Process Library
  - Case Library
  - Process Manager

- Domain Expert
  - Advice + Review + Request
  - Result
  - Workflow Tool

- Data Storage
  - Videos
  - Image processing toolset
    - Keyframe detection
    - Classification by characteristics
    - Annotation
Proposed Framework – Design Layer

- Process Manager is responsible for composing sequence of processes to be executed based on available tools.
  - Planning component
  - CBR component

- Ontologies give meaning to process and keep goals separate from capabilities.
  - Goal
  - Domain
  - Tool/Capability
Proposed Framework – Workflow Layer

- Main interface between design and processing layers.
- Workflow enactor acts as interpreter of events that occur within system.
- Scenario.
Proposed Framework – Processing Layer

- Consists of a set of image and video processing tools.
- Functions of tools represented in capability ontology in Design Layer.
- Once a workflow has been established, tools may work directly on videos.
- Depending on quality of video and task at hand, each tool will work on varying level of accuracy.
- Feedback from domain expert would be useful.
- Use of ML techniques to assist with performance measure predictions for image and video processing tools.
Discussion

- Work in progress
  - Understand image processing tools available.
  - How to utilise workflow technology to best use image processing tools in accordance with the requirements for the EcoGrid problem domain.

- Implementation issues
  - develop a video processing layer on top of an existing Grid workflow system.
  - deploy a workflow enactor on existing process modelling tool.
Tools

- Open Computer Vision Library (OpenCV)
  - Library of programming functions mainly aimed at real time computer vision.
  - Applications include Object Identification, Segmentation and Recognition, Motion Tracking.

- Process model for annotation

Key frame detection → Segmentation → Recognition → Annotation

- Other tools?
End of Slides
Thank you!
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References

- OpenCV. http://sourceforge.net/projects/opencvlibrary