3rd International Conference on Applications of Holonic and Multi-Agent Systems HoloMAS 2007

Information Agents Handling Semantic Data as an Extension to Process Monitoring Systems

Teppo Pirttioja, Ilkka Seilonen, Antti Pakonen, Aarne Halme, Kari Koskinen

Automation Technology Laboratory
Helsinki University of Technology
FINLAND

Contents

- Process monitoring and its requirements
- Possible role of information agents and ontologies in monitoring
- Proposed system architecture
- Example functionalities
- Conclusions

Process Monitoring

- Monitoring process is one of the most important tasks of process operators
- The amount of available measurement data has been increasing considerably
- There is a need to observe the process in a larger scope
- The large amount and low abstraction level of measurement data combined with limited human perception makes monitoring an error-prone task.
- Monitoring systems could be developed with capabilities to assist the data selection and interpretation sub-tasks of monitoring through so-called <u>indirect management</u>
- An essential idea in this approach is configure a part of the operator's monitoring expertise to the system and automate it

Requirements of Process Monitoring

1. Offer integrated patterns of the total process
2. **Raise the abstraction level of information** ⇐
3. **Open a multitude of views to the process** ⇐
4. Highlight exceptions
5. **Automate monitoring (perform it for a user)** ⇐
6. **Guide to extract relevant information** ⇐
7. **Guide the operator to use extra information beyond the present hypothesis** ⇐
8. Teach the operator about process interdependencies
9. **Activate the operator to monitor** ⇐
10. Support long-term performance analysis, reveal opportunities to improve operation.
⇒ Information agents might be useful for some of the requirements

Information Agents and Ontologies in Monitoring

- BDI-model based information agents are proposed for implementation of proactive indirect management in monitoring
  - B = what is known
  - D = what should be known
  - I = what needs to be done
- Ontologies are proposed for integration mechanism
  - Should reflect operator's concepts of the monitored process
- Information agents in monitoring are mainly for awareness, not so much for intelligence
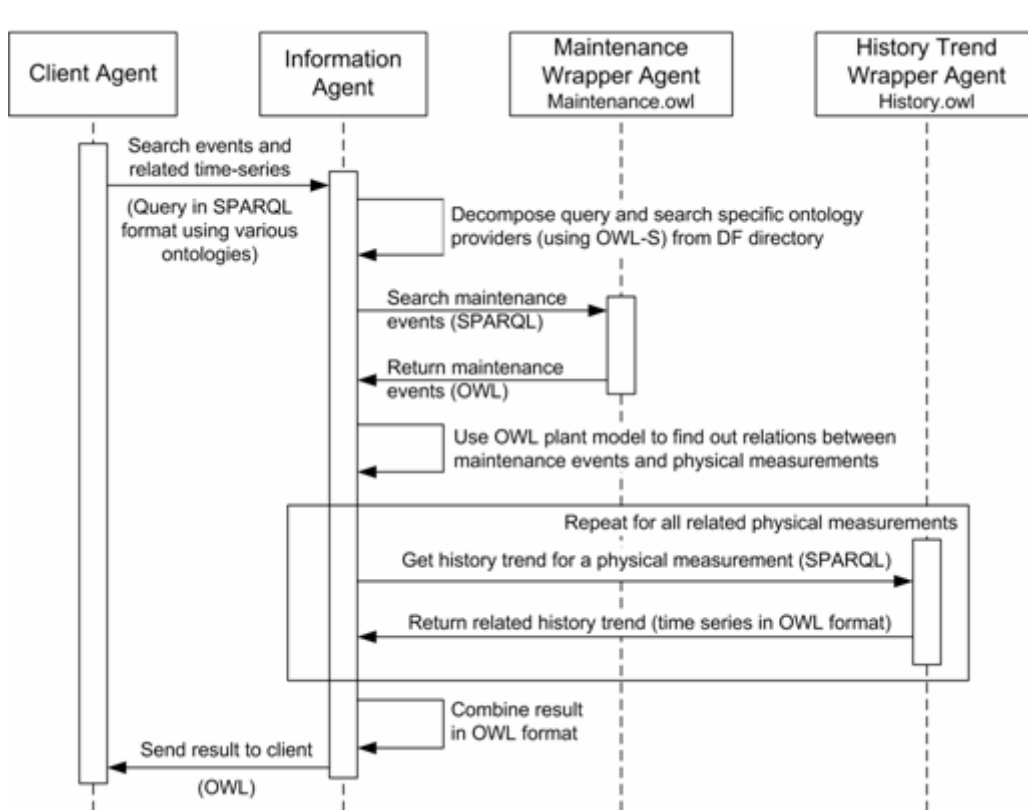
Information Agents in Monitoring
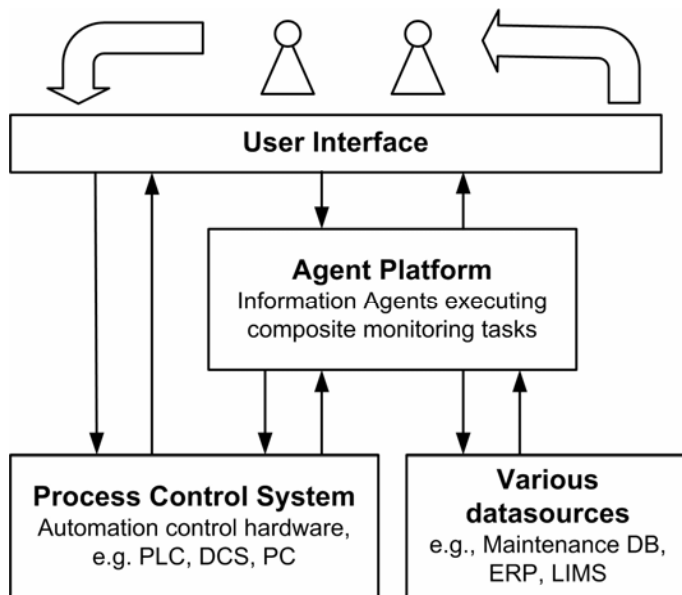
Architecture of a monitoring system extended with IAs
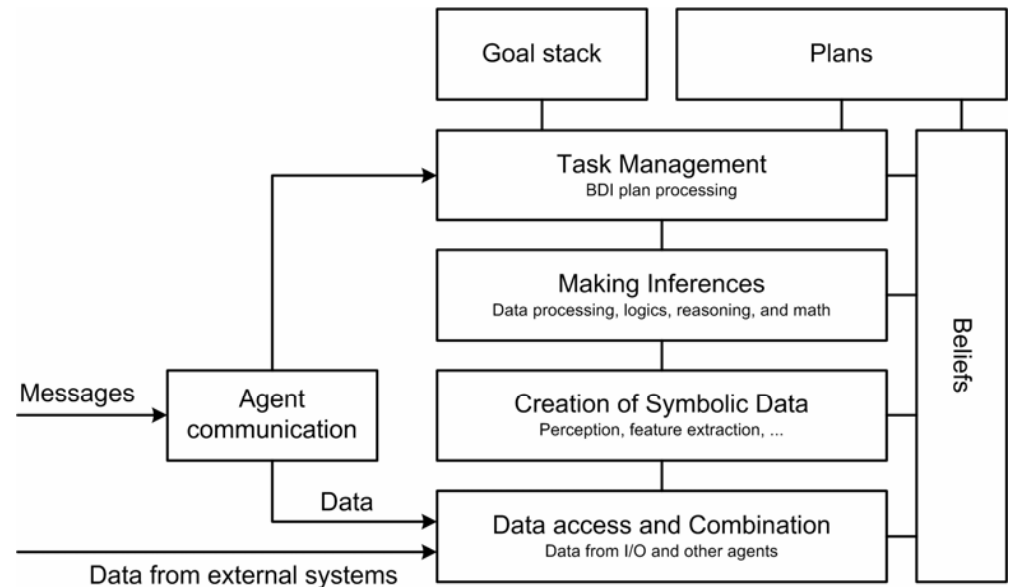
Architecture of an IA.

Example of Data Access and Combination

- Monitoring the effects of maintenance events
- There is useful information outside of automation, e.g. in maintenance systems, that is not fully utilized
- Model the association between maintenance events and measurements in a plant model

Ontologies Needed in the Monitoring of Maintenance Events
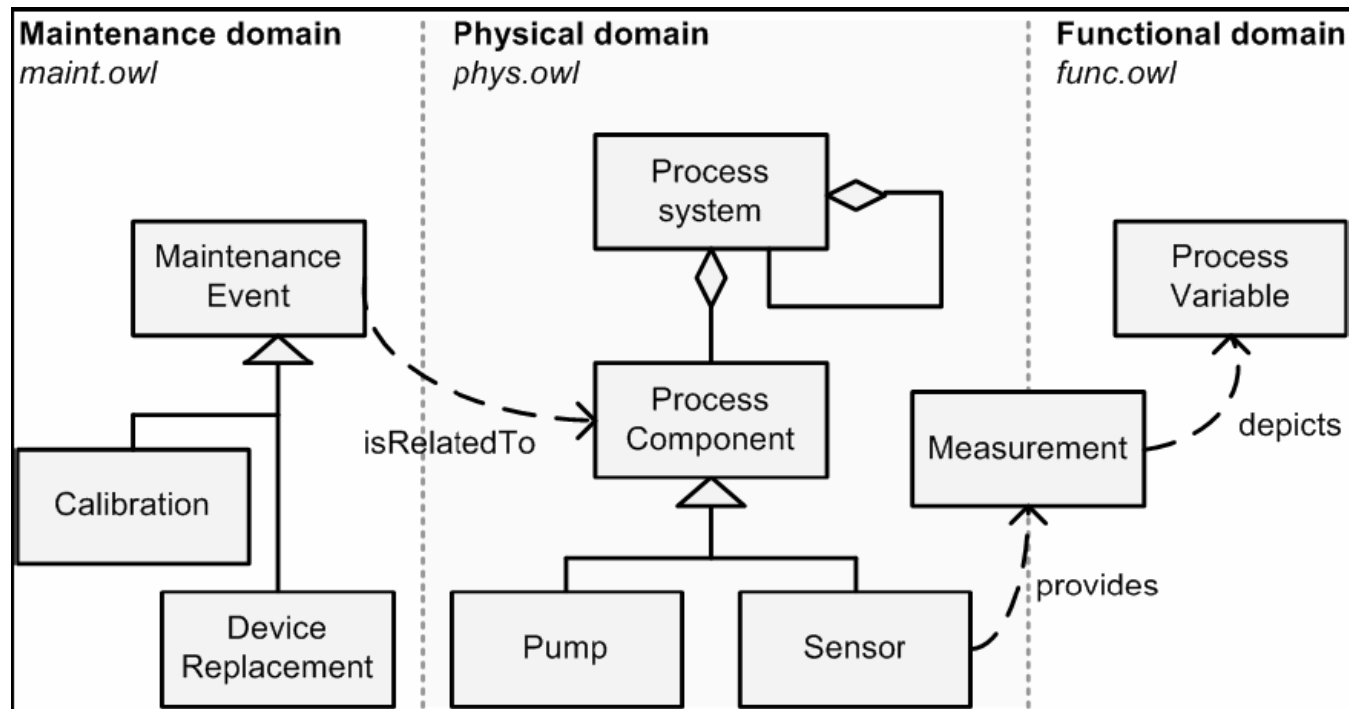
The concepts in different subontologies are linked via the base ontology of the physical domain

User's view Measurements and Events
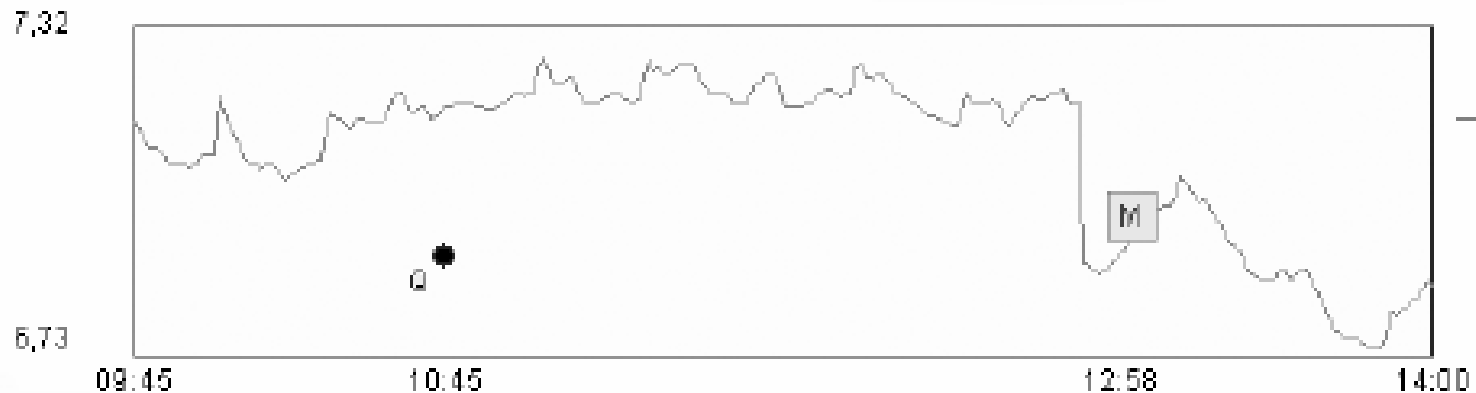
Calibration 12:58:22 28.04.2006
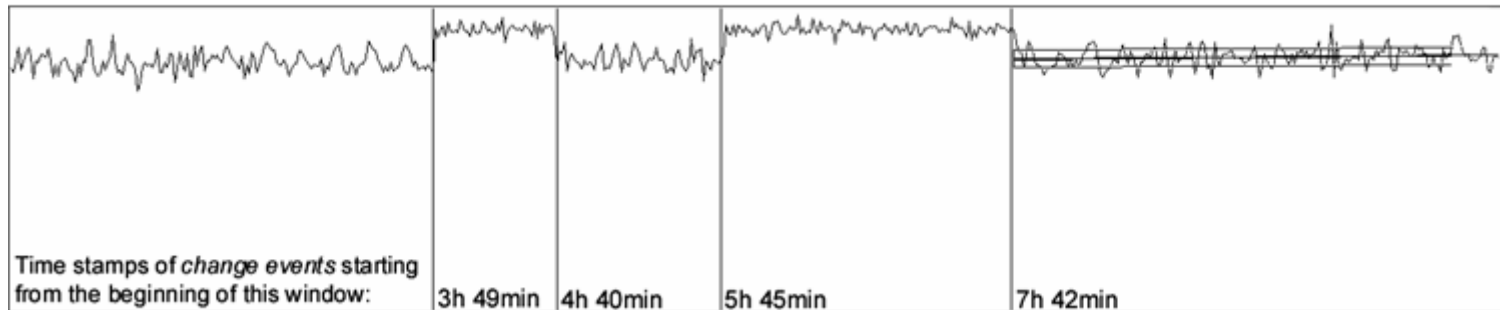Process Component: pHOfBleachedPulpSensor2
Description:
pH:n_kalibrointia.
Kasinaytteen perusteella laskettu nayttoa 7.2:sta 6.9:aan.

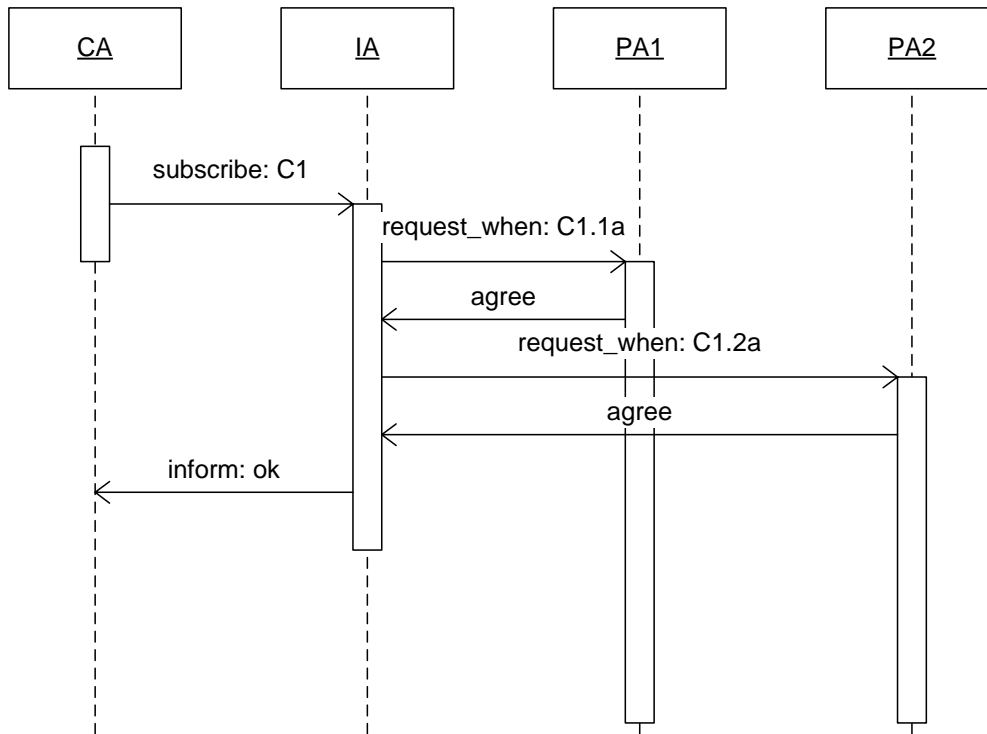Laboratory Measurement 10:45:22 28.04.2006

Example of the Creation of Symbolic Data

- Monitoring of process events
- Operators have expertise to assess the condition of the process based on symbolic information about events
- Events can be recognized with numerical methods and be given to information agents as an input for inferences

| Time stamps of *change events* starting from the beginning of this window: | 3h 49min | 4h 40min | 5h 45min | 7h 42min |

Example of Inferences with Constraint Type of Rules

- Monitoring of measurement consistency
- Monitoring relationships between separate pieces of information is difficult
- Operator's expertise about the acceptable relations among measurements in different situations
- Configurable network of constraints between measurements and symbolic information

User's View to Rule Configuration

Conclusions and Future Work

- Conclusions
  - The presented approach may be seen as a platform for extended monitoring applications with indirect management functionality
  - It could have been implemented without agents or ontologies
    - Basically one needs a common data model which can integrate separate data sources
    - However, the BDI-model seems to simulate operator's information access tasks

- Future Work
  - An essential questions is if the approach can be extended to large enough set of other use cases so that is useful
  - Another essential question is if the operators would accept this kind of a monitoring system so that they would actually use it
    - do not disturb unless it is necessary

Thank You!

Questions?