Software for Beamline Automation - VMXi Use-Case

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I02 Selected
Phase III Upgrade
VMXi – Versatile MX: \textit{in situ}
VMXi Endstation Schematic

- Data Collection Environment
- Storage Units
- Local Storage
Beamline Automation

GDA
software for science

ISPyB

User

User

User
Automation Requirements

Continual processing of plates…

• Repeatedly
• Indefinitely
• Robust to faults

GDA to become a Plate Processing Machine
Software Design for Automation

This is the domain of AI.
AI Models – Sense, Plan, Act.

**Sense**
- Excitation of a sensor attuned to sense the state of some artefact in the environment. Feed sensed state data in to an agent.

**Plan**
- Updating global plan with the sensed data, and use plan to generate a control action.

**Act**
- Present the control action to the agent actuators and do the action.
Plan

**Planning and Decision Making**

**Data Collection:**
- User experiment parameters fully express what state beamline hardware is required to be in to collect data.

**Sample Handling:**
- What to load next from storage can be derived by dynamic criterion, a **Load Plan**
Reactive Controller

- A tight coupling between what is sensed and the action generated.
- It is stateless.
- It should not execute any computationally difficult or intensive task.
Reactive Controllers

- Sample Handling Agent
- Data Collection Agent
Agent Communication and Co-ordination

Data Collection Triggered
Sample Handling

External Storage

Local Storage

Goniometer

PVs

- External Storage->Local Storage
- Local Storage->Goniometer
- Goniometer->Local Storage
- Local Storage->External Storage
Brooks’s Subsumption Architecture
Sample Handling Reactive Controller

Sense

Sample Handling Behaviour Layers

Act

EPICs: Robot Fault

Robustness

Load Plan: Plate Barcode

Sample Conveyance

ISPYb: Plate State

Action Executor
Data Collection Environment

- Fast Shutter
- OAV, Goniometer
- Detector
Summary

- Automation is possible with standard software tools
- AI is the domain for design solution
- Planning and decision making tasks are external
- Computational intensive tasks are external
- Hardware synchronisation in controls layer
- Reactive Agents initiate and monitor actions only
Thank you to…..

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GDA: Paul Hathaway.

And to all the mechanical, electronical engineers and technicians who built VMXi.
Thank you for your attention...Questions