Polymorphism for State Machines

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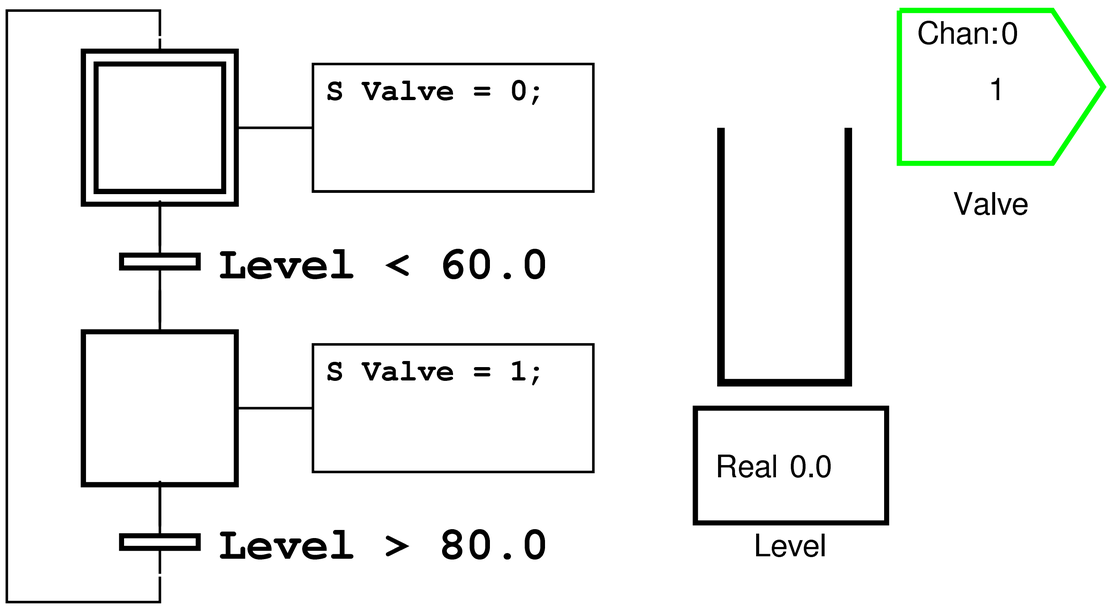
Motivation

Much engineering time is needed to develop control applications, partly since the automation languages are relatively primitive.

Goal: More efficient engineering by extending Grafcet/SFC.

Grafchart



Grafchart is a graphical programming language for sequential control applications based on Grafcet/SFC. Previous extensions make development more efficient, convenient, and scalable:

- Hierarchical structuring
- Reusable sub-sequences
- Rudimentary object orientation
- Various means for exception handling

Proposed Idea

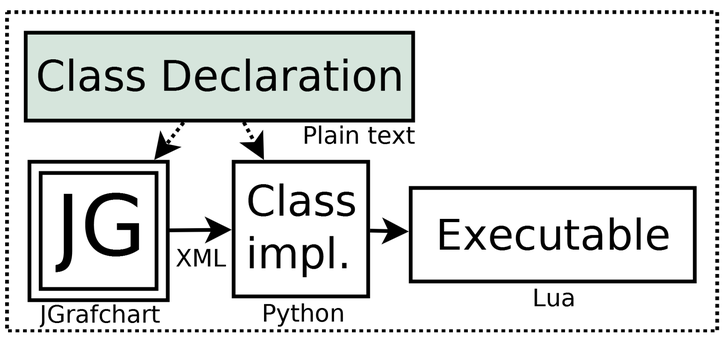
Extending Grafchart with polymorphism similar to Java

This has the following advantages:

- Classes are reusable in various control applications
- Control applications are reusable in various contexts
- Enables encapsulation in Grafchart

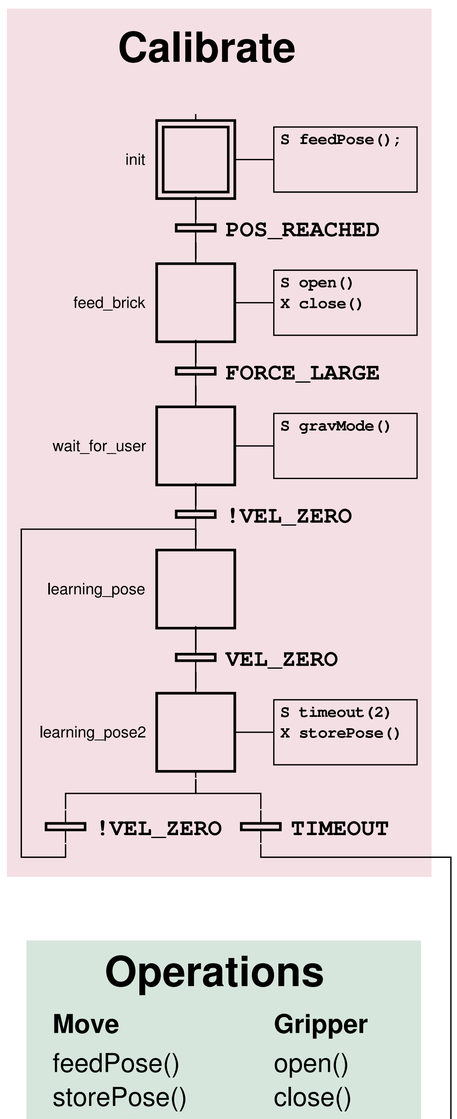
The BRICS Challenge

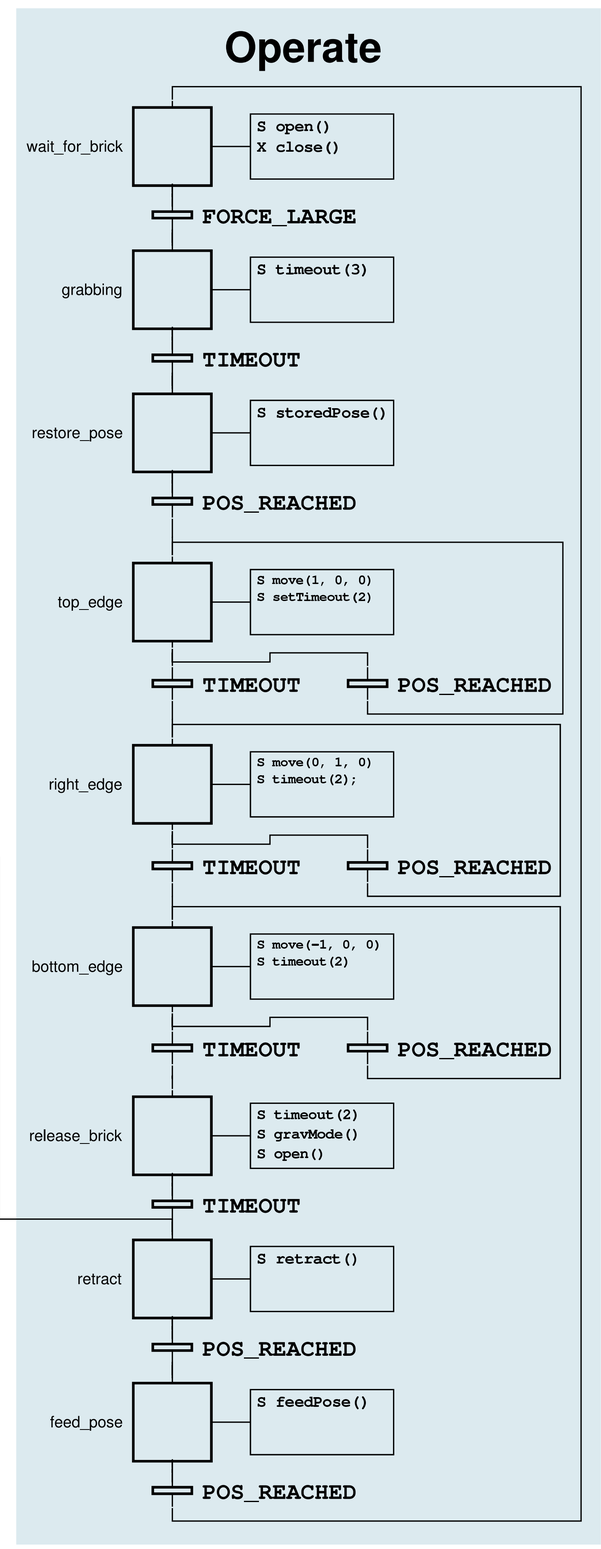
The task at the BRICS 3rd research camp was to use a KUKA youBot, a mobile robot with a gripper, to fill a box with bricks.



Overview for prototyping of the proposed idea.

Prototyping





Operations

Move	Gripper
feedPose()	open()
storePose()	close()
storedPose()	**Misc.**
move(dx,dy,dz)	gravMode()
retract()	timeout(t)

Events

TIMEOUT
POS_REACHED
VEL_ZERO
!VEL_ZERO
FORCE_LARGE

Calibrate The location of the box is taught.
Operate A brick is grabbed when pushed against the gripper. It is then automatically placed properly in the box.

Conclusions

Polymorphism for state machines was prototyped for a robotics task and resulted in an implementation that is reusable for any device for which the class can be implemented.

Future Work

- Implement polymorphism in the free tool JGrafchart
- Evaluate in other domains
- Evaluate scalability – How much is gained in a realistic setup?

Acknowledgements

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