Object Technology Toolsets for LabVIEW *OTT*

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Products used:

National Instruments LabVIEW™ 6i

Abstract

Since the eighties NIs LabVIEW proofed to be a powerful and versatile platform for developing test applications and automation systems. The use of the graphical dataflow paradigm enables engineers to design applications in a shorter period of time. With the growth of LabVIEW applications however, devolopers face a lot of difficulties including performance and maintennance drawbacks.

Vogel GmbH developed four toolsets as add on to LabVIEW to handle those problems. The Object Technology Toolsets (OTT) break all frontiers for LabVIEW enthusiasts using a unique event driven object technology with multiple inheritance. With this toolsets LabVIEW developers are free to choose their own approach for their application.

The Challenge

- Developing a set of “G++” toolsets that overcome the limitations of LabVIEWs Graphical Dataflow paradigm.
- Adding revolutionary new technologies and abstraction mechanisms to implement multiple inheritance and sophisticated modelling and abstraction methods.
- Enabling LabVIEW to become a general purpose development system that is able get market shares in all information technology areas.

The Solution

- Using LabVIEW 6i, with 100% pure “G” code, including queues, notifications, semaphores, occurencies and creating class libraries with inheritance capabilities.
- Developing toolsets that implement different abstraction mechanisms, event management, object technologies, and all relevant communication technologies like ActiveX, DataSocket, TCP/IP, OPC, XML.

The Technology

The toolsets represent a synthesis of different concepts including LabVIEWs inherent Graphical Dataflow Concept, object oriented approaches including classes and inheritance, event/signal/message management capabilities, concurrent intelligent distributed objects, concurrency in objects, aggregation, ports, etc..

Implementing those technologies lead to applications with distributed, easy reusable, extremely scalable, robust, highly maintainable, redundant, and reliable intelligent objects.

Objects can be distributed in LAN and WAN environments including the Internet.

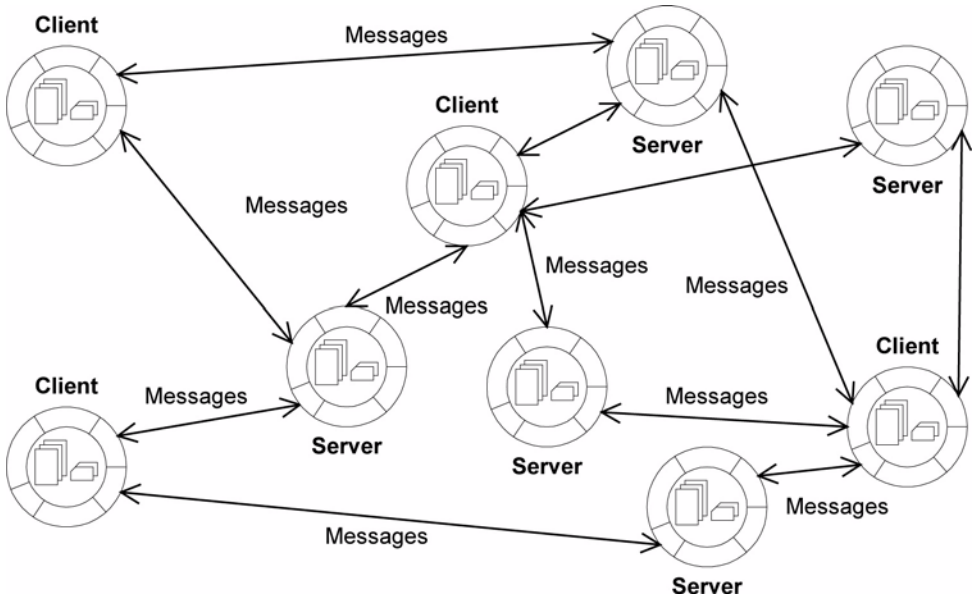

Bild 1: Objects sending messages in a Client Server environment

Figure 1 shows a client server architecture that can be spreaded in the internet. This enables highly scalable systems. The objects encapsulate data and procedures with different methods. Figure 2 illustrates the encapsulation of objects.

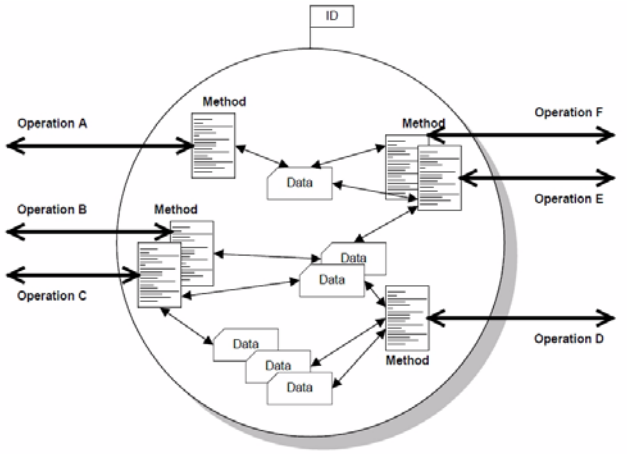

***Bild 2:** Encapsulation of Objects*

Objects deal directly with the problem domain and can be derived from parent classes. There are no limitations concerning the class hierarchy depth.

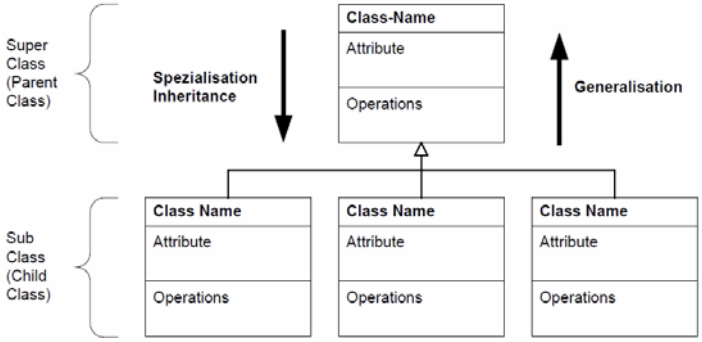

***Bild 3:** Basic class hierarchy structure*

Using OOT offers the developer abstraction mechanisms that exceed the G paradigm. One of the implementations if those mechanisms is a bundle of Petri Nets concepts. Petri Nets are ideal for implementing concurrent inpredictable processes rapidly. The Petri Net concepts with their visual representations enable the users to express their ideas in a very comprehensive manner.

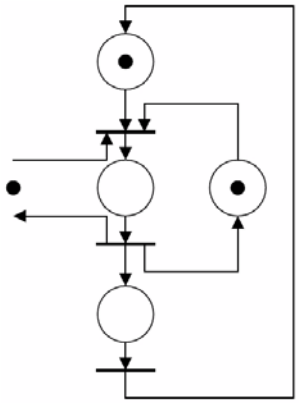

Bild 4: Simple Petri Net notation (State Transition Net)

Figure 5 and 6 show the front panel and the block diagram of a LabVIEW/OOT based Petri Net demo.

Bild 5: Dining philosophers front panel

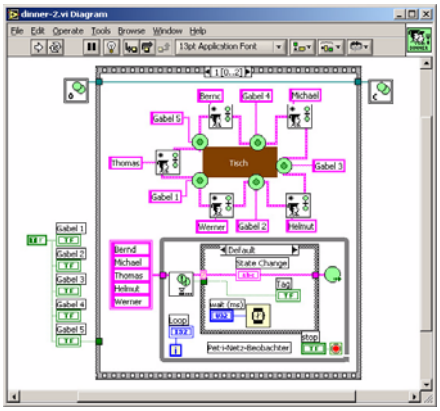

Bild 6: Dining philosophers block diagram

Petri Nets allow the implementation of intelligent, dynamic distributed systems dealing with concurrent processes and non deterministic behaviour of processes in those objects. The developer is able to directly draw his solutions using the toolset VIs mixing an matching all types of object net technologies. There is no limit in the number of object net hierarchies.

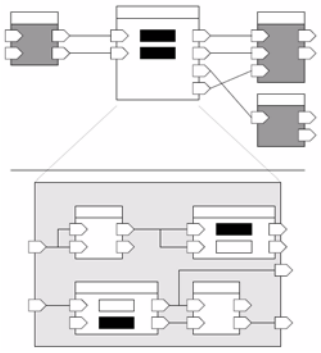

Bild 7: Hierarchical Object Nets

The Toolsets - Overview

Vogel developed four versions of toolsets. The Basic Version (Object Event Toolset *OET*) supports active objects and event management using asynchronous messages (via queues), signalling (via notifications), and communication technologies like DataSocket/OPC and ActiveX. The Professional Toolset (Object Inheritance Toolset *OIT*) feature Basic Toolset functionalities plus passive objects, class libraries, class library management, inheritance, methods, method calls, flat state machines. The Developer Toolset (Object Network Toolset, *ONT*) extends the Professional Toolset capabilities with Harel State Machines, Petri Nets (Place Transition Nets, Coloured Petri Nets, Predicate Transition Nets, Hierarchical Nets, Object Petri Nets, Ports).

The Universal Toolset (Application Framework Toolset, *AFT*) is a superset of all toolsets and provides different class libraries (Client Server, Node Communication, Message, Trend, Error Management, Facility Management, ERP, MES).

The Applications

The toolsets are used to develop complex applications in a minimum of time. Vogel and SYSTEC offer a broad range of solutions for different industries. One of the most complex applications is an MES (Manufacturing Execution System) that controls the automating shipping in a cement works developed by VOGEL GmbH. Various interfaces in this multi thousand tag OOT based system are implemented, including SAP R3™ ERP (Enterprise Ressource Planning) interconnects. The system was developed in a minimum of time compared with traditional methods.

SYSTEC developed a number of test&automation systems for strategic customers like Lucent Technologies/Bell Labs, Siemens, Bosch and others taking advantage of the numerous benefits of LabVIEW in conjunction with OT Toolset technology. SYSTEC offers a superior Universal Test- and Automation System using the OOT based event driven object oriented LabVIEW approach (UTAS).

Conclusion

The Object Technology Toolsets for LabVIEW strengthens NIs efforts to place "LabVIEW everywhere" featuring extremely powerful and easy to implement technologies. The use of OTT allow the development of solutions based on distributed, easy reusable, extremely scalable, robust, highly maintainable, redundant, and reliable intelligent objects. This marks the advent of a new chapter in the history of LabVIEW programming.

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