Relatório Técnico

Núcleo de Computação Eletrônica

Design and Implementation of a Distance Education System Aimed to the Teaching of Object-Oriented Technologies

C. Lima
C. E. Tolla de Oliveira
H. Lima Benício

NCE - 05/02

Universidade Federal do Rio de Janeiro

Design and implementation of a distance education system aimed to the teaching of object-oriented technologies

Cabral LIMA
DCC/IM/UFRJ
Av. Brigadeiro Trompowsky, s/n
CP 2324
Cidade Universitária / Ilha do Fundão
20001-970 Rio de Janeiro RJ Brasil
T: 55 21 2278-3906 F: 55 21 2587-7451
T: 55 21 2598-3168 F: 55 21 2598-3156
clima@dcc.ufrj.br

Carlo Emmanoel TOLLA de OLIVEIRA
DCC/IM/UFRJ
Av. Brigadeiro Trompowsky, s/n
CP 2324
Cidade Universitária / Ilha do Fundão
20001-970 Rio de Janeiro RJ Brasil
T: 55 21 2598-3173 F: 55 21 2598-3156
carlo@nce.ufrj.br

Haroldo LIMA BENÍCIO
Military Institute of Engineering
Engineering System Department (DE9)
Praça General Tibúrcio, 80
Praia Vermelha / Urca
22290-270 Rio de Janeiro RJ Brazil
T: 55 21 2546 7080 F: 55 21 2546 7099
haroldo@qw.com.br

Abstract

In the new connected and distributed electronic world, the object-orientation (OO) paradigm has been recognized as a strategy for software development, based on the idea of producing systems starting from reusable components. Problems of the real world are easier to be dealt with when OO development approach is used than when the structured and traditional one is applied. In the software engineering community, the question of managing changes has been a permanent concern among the developers who look forward to flexible and reusable systems. In this paper, we present a description of a flexible framework, aimed to peer-to-peer applications, that can be plugged-in a distance education platform. This framework is the hosting of a remote computer-based learning system (called TOOHELP). TOOHELP aims the learning of object-oriented techniques: it focuses on a faster development of complex software of high quality. Basically, the TOOHELP utilizes a simplified *OO meta model* and it follows a *process pattern* that unifies the most known patterns of process in use today.

Keywords

Software engineering, object-oriented technology, distance-learning platforms.

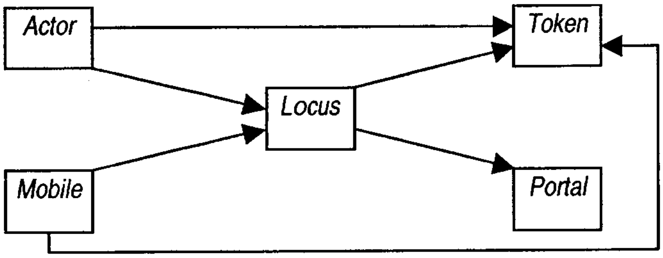
1. Introduction

The object-orientation paradigm has been seen by the software engineering community as "*a software development strategy based on the idea of building systems from reusable components called objects*" (IBM, 2002). (Rumbaugh, 2002) affirms that "*the brave new electronic world is now distributed, concurrent and connected*". It is *distributed,* for the information is all over the world, in many different places at the same time; it is *concurrent* because the activity is decentralized and simultaneous, and the reason why it is *connected* is in the fact that a localized action may result serious consequences elsewhere. Effectively, the advent of the world-wide network of computers sped up the continuous process of changes in corporate software systems and has demanded significant efforts from the community of developers and from the support and operation staff. The object-oriented technology is changing the way things are being done and the concerned scientific community acknowledges that the object-orientation paradigm is essential to the development of complex software, scalable and fundamental for distributed computing (SDC, 2002).

A growing demand for specialized professionals in object-oriented technology has been noticed. In this paper we present an overview of a Java-based framework (called DEDALUS) that when joined with an application program (called ACADIA) may be used as a collaborative and distributed distance education platform (EAD). DEDALUS is aimed to peer-to-peer applications and also is used as the hosting of a remote computer-based learning system, as the TOOHELP. TOOHELP adopts an *application metaprocess, it* utilizes a simplified *OO meta model* and it follows a *software process pattern* that unifies the most known patterns of process in use nowadays. TOOHELP environment sets out to the learning of the paradigm's concepts and object-oriented technologies applied in diverse steps and activities of a software's complete life cycle (EUP, 2002), whose implementation allows its use in a remote or presence learning. It supports the object-oriented paradigm process of teaching and learning, making use of contextual diagnoses (Romanczuck-Requile, A. et al, 1998).

2. DEDALUS Framework and ACADIA Application Program Overview

The DEDALUS (Faissal and Paiva, 2002) is a flexible framework implemented in Java language and concerned with *peer-to-peer* applications. In its implementation, some metaphors have been used and associated interfaces created, describing the behavior of each element that composes the environment, as figure 2.1 illustrates.



PIC. 2.1 – Interfaces and its Relationships

The representative interfaces of these elements are as following: ***Actor*** – the users are the actors of the applications; they are those who carry out and undergo actions, they implement an *Actor* interface; ***Mobile*** – the *Mobile* interface represents the objects which can go from one place to another; in other way, as its name says, they are mobile; ***Locus*** - *Actors* and *Mobiles* should be in any place characterized by the *Locus* interface, which represents where the DEDALUS elements can be found; ***Portal*** - so that an user/actor can go from one *Locus* to another, he needs an structure which gives him access. It is like going from one room to another in a house, an access door is needed. They are the doorways or the *Portal* interface; ***Token*** – all the elements may take or experience actions which will represent states or indicators for other actions. Such actions, being too complex, will be represented by objects with its general characteristics typified by the *Token* interface. The DEDALUS framework deals not only with the communication and exchange of information issue, but also, and mainly, with the issue of a friendly interaction environment and an easy access amongst users. It is a structure supporting applications on the web, which allows the building of interconnected sites, in which users from other sites can access available resources in one site.

The system ACADIA (Correa and Martins, 2002) has as objective to work the graphic communication in a simultaneous association with its content. ACADIA makes use of resources from DEDALUS, implementing its interfaces and configuring a distance education platform, which represents a teaching-learning environment: a virtual school projected to promote the cooperation, the creativity and the effective and interactive participation of teachers and students. The ACADIA allows the creation of *mobile* objects that represent diverse learning environments of specific subjects. These environments, once incorporated in the distance-learning platform (based on DEDALUS and ACADIA), begin to be distributed and offered remotely, besides benefiting from *peer-to-peer* technology. The increase of interaction between the teacher and the student, and among the students as well, opening space for the discussion, suggestions and criticism is also intended: the use of multimedia (image, video, sound, text) stimulates the participants' creativity and learning.

3. TOOHELP General Description

In the software engineering community, the issue of changes has been a constant concern among software developers who look for *flexible* and *reusable* systems, in part or in whole. Object-oriented systems have consolidated its role in the software industry market as a result of their built-in concepts and principles, specially the characteristics of *inheritance, encapsulation* and *polymorphism,* which allow the progressive development of systems. Crucial characteristics of these systems concern also their capability in representing in a good way various real world situations like, for example, grouping appropriate *objects* in *classes*, defining *interfaces* and *inheritances hierarchy*, creating *polymorph behaviors* and setting up *relationships* between these elements.

TOOHELP adopts an *application metaprocess*, a simplified *OO meta model* derived from the UML and a unified *software process pattern*: its *application metaprocess* is based on learning through development and approaches the *conversational development* of extreme programming (XP Extreme Programming) (XP, 2002) starting from a *User Story. A User Story* is an informal description of a small localized problem, specific of the real world, used to model and catch accurately what the user needs and, subsequently, implement the program's *code* passages. This metaprocess illustrated on figure 3.1 defines the three phases and the four basic activities of the

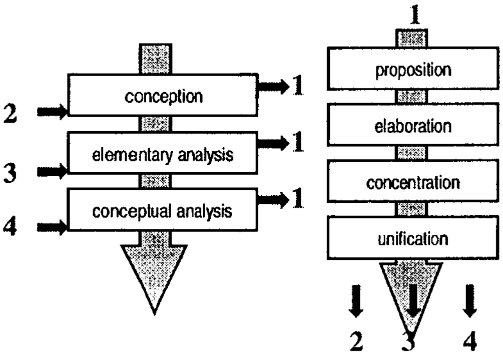


FIG. 3.1 Application Metaprocess

TOOHELP processes of use. The simplified *OO meta model* allows a visual modeling of the software systems through the UML diagrams. The current prototype models and implements the *class* elements and their relationships, which when combined result in a *diagram of classes.*

The development-process pattern of the TOOHELP makes use of a development approach that puts together concepts: *incremental* on the high level of abstraction (macro), *iterative* on the operating level (micro) and a *interactive* on all levels, based on the Corporate Unified Process (EUP, 2002), as it is illustrated on figure 3.2. These elements, shown on figures 3.1, 3.2 and 3.3, when integrated into the graphic interface with the user, represent the backbone of TOOHELP.

4. Final Considerations

Knowledge about OO paradigm is, in fact, indispensable to solving emerging questions in software development, focused on the improvement of software quality. The DEDALUS framework and the ACADIA system are configured together in order to generate a distance-learning platform, important in the leverage of remote learning processes, based on a high degree of cooperation and interaction between teachers and students. The use of well-designed distance-learning platform is our main focus of interest. The TOOHELP is an environment for the learning of OO techniques, used in of presence or remote education. The TOOHELP is context sensitive and it is easily adapted to requirements of educational processes.

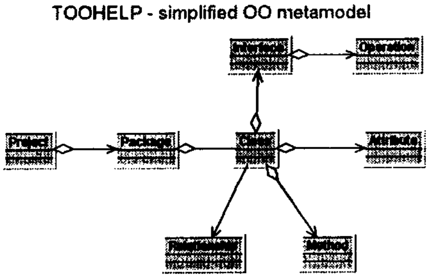


FIG. 3.2 Simplified OO metamodel

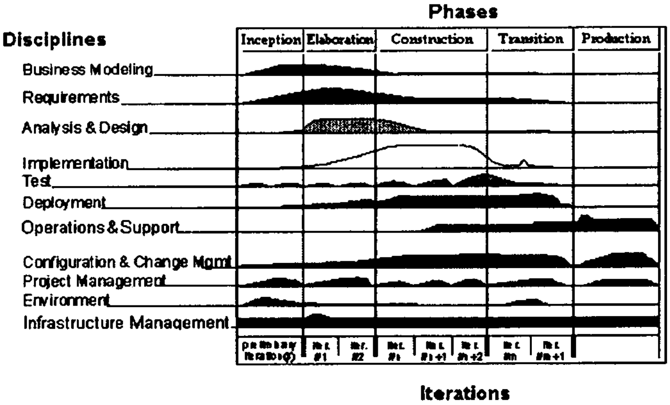


FIG. 3.3 Software Process Pattern (apud EUP, 2002)

The integration of the DEDALUS framework and the ACADIA system is very important to the establishment of interface patterns, which may make possible the coupling of different environments. TOOHELP development encloses the conception of modules, which simulate and put into practice the software's life cycle. Developing teams are leant over these issues, carrying out works and researches which are already on the way in the *opensource* mode in (SFNet, 2002). Our next step is to study deeply the *meta models* conceived in section 3 and implement them in the TOOHELP environment.

Bibliography

Correa, B. O. B. and Martins C. G. (2002); ACADIA - Ambiente de ensino-aprendizagem com ênfase em comunicação gráfica, desenvolvido em plataforma distribuída; NCE/UFRJ Brasil.

Faissal, G. M. and Paiva, D. M. (2002), DEDALUS - Uma Plataforma Java para Aplicações Peer-to-Peer. NCE/UFRJ – Brasil.

EUP Enterprise Unified Process. (http://www.ronin-intl.com/publications/unifiedProcess.htm)

IBM, AMBLER, Scott W. The Object Prime. Using object-oriented techniques to develop software. (http://www.-4.ibm.com/software/developer/library/using-oo/index.html)

Romanczuck-Requile, A., Lima, C., Kaestner, C., and Scalabrin, E. (1998); A contextual help system based on intelligent diagnosis processing aiming to design and maintain object-oriented package; Lecture Notes in Computer Science; issn 0302-9743; Springer-Verlag, pp. 64-65.

Rumbaugh, J.; Trends in UML and e-Development. The Rational Edge.
(http://www.therationaledge.com/content/dec_00/f_uml.html)

SFNet Source Forge Net, Plataforma de Gerenciamento de Projetos OpenSource ONLINE (http://jhotdraw.sourceforge.net)

XP, Extreme Programming. (http://www.extremeprogramming.org/index.html)