Framework for the Development of Educational Software

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Abstract: - The use of computer networks and information technology are becoming an important part of the everyday work in almost all professions, especially in scientific areas, and facing new education concepts, many universities and education organizations decided to plan new strategies concerning computer based technologies. As a result of these developments Computer Aided Education (CAE) methods came out. These methods have been used and developed for more than fifteen years in many universities and organizations. The goal of CAE is to develop the learning capacity of students and to increase the teaching productivity and effectiveness of instructors with the help of advanced computer based technology. It is in this context that the work proposes a framework for the development of educational software. This framework is in development and will have CASE (Computer Aided Software Engineering) features, because it will be supported by X-TEC model (Techno-Didactical Extension for Instruction/Learning Based on the Computer). With the specifications of this model we can create and reuse the learning objects in order to reach a one specific audience.
The architecture is composed by three tiers: User interface, rules and persistence. In the first tier we have three components: graphic editor, RAD editor and code generation. The graphic editor makes possible the edition of the diagrams of model X-TEC, which are stored in a data repository. The RAD editor allows creating educational software (e.g. tutorials, drills) through pre-defined templates. The code generation component will be responsible for the automatic creation of educative software for the web environment, since, the generated code is HTML language. The software is based in the specifications of the domain of the problem, internal specifications of the X-TEC model and in a set of templates.
The system encourages the style of incremental development, iteractive and based on a prototype, so that in each/every phase models are built or enriched.

Key-Words: - X-TEC model, Instructional Strategies, Software Architecture, Data Repository, Code Generation, Windev Software.

1 Introduction

With the development of information and communication technologies and the growth of the information society by the use of the Internet, institutions, corporate and academic, are increasingly adopting different multimedia resources and educational software.
To be able to create an education that always accompanies students, in school and out of school, the number of institutions which adopt a LMS (Learning Management System) [9] is increasing. They use it as support to the lessons, through the availability of educational resources, chats, etc.
However, the majority of teachers/instructors/mentors offer students the resources as simple documents of text. These educational resources should not be made available in this way, but, where possible, be accompanied with other "media" becoming more effective and appealing - Guaranteeing a quality education with that, allows the teacher to choose the best strategies both at the level of methodology of teaching-learning and at the level of iteraction and students' motivation.

One of the difficulties faced by the tutors is that the author tools available in the markets, e.g. director [10], Flash [11] and Toolbook [12], require some knowledge of computers and are not easy to work.

This study aims to offer a tool that allows the construction of educational software easily and efficiently to:

- ✓ help the designer to avoid the problems about conception;
- ✓ facilitate context based learning with demonstrations of real life scenarios;
- ✓ create a dynamic and stimulating learning environment
- ✓ follow good software design and development practices

This paper is structured as follows: section two presents the methodology for developing the framework; the third section is focused on the system architecture, where its components will be explained; the system implementation is described in the fourth section; Finally, some conclusions are drawn;

2 Methodology for developing the framework

The framework to be proposed is a CASE tool that aims to provide support to the creation of objects of learning, increasing the productivity of the software development process, with less cost and time and greater flexibility for maintenance. The framework integrates the technologies of software engineering in its specification and implementation. Studies will be used to test the application and deliver "feed-back" to correct any errors in the differences phases of the lifecycle of the framework.

In this draft development will adopt the Evolutionary Prototyping model [1].

Figure 1 presents the activities for the construction of the framework: identification of requirements of the domain system; specification of components, design components and implementation and testing components. These activities repeat itself throughout the lifecycle from its conception to implementation.

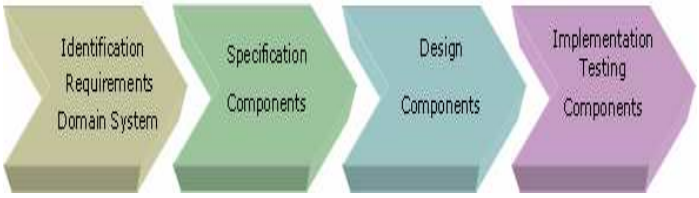

Fig.1. Activities for the construction of the framework

In activity "**Identifying the Requirements of the Domain Problem**" it is given emphasis in the identification of the requirements of the system, specifying "What" the system does to resolve the problem. In this study the activity was based on a survey of the framework requirements and following examples of frameworks in the market.

The activity "**Specifying Components**" was based on the requirements of the domain problem, specifying the types, grouping them into packages and finally defining the components of the framework.

The third activity "**Design Components**" was based on the components specified in the previous activity, where specified the iteractions of components. This activity will be held with greater emphasis on the construction phase of the framework, because it will define the system architecture. Finally, "**Implement**ing **and Testing Components**" is the implementation of the framework using WinDev [2] and through tests it will validate the functionality according to the survey of requirements.

3 System Architecture

The framework presents a multi-tiered architecture [3]. The multi-tiered architecture is used to ensure a separation and reuse of its functionality and facilitate maintenance. A multi-tiered architecture is composed of three tiers: User interface, rules and persistence.

In the first tier we have the Client, which may be an application or any storage device. In the second tier we have the Middle-tier server that provides services to clients, accessing to data of the system, available in the third tier, and returning them to the client that requested them. The third tier stores data using Database.

The figure 2 shows the multi-tiered architecture of the framework

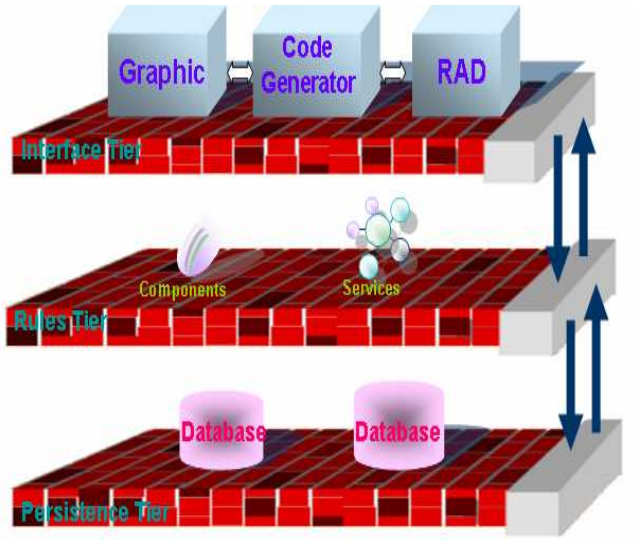

Fig. 2 the multi-tiered architecture of the framework

As you can observe in figure 2, in the user interface (1st tier) we find the graphic, RAD (Rapid Application Development) [4] and code generation tools.

The Rules (2nd tier) have the Instruction/Learning Management Systems(ILMS) that supplies the service to the designers, which is available in the persistence tier. Finally, the persistence (3rd tier) contains the data repository that is the base of the development system; all the information that is

defined through the different phases of the development cycle meet stored here.

The different tiers are related, because:

✓ In the repository all the contents, rules and interface specifications are stored;

✓ The graphic tool opens appropriate forms, when specific information cannot be included in our diagrams. With these forms we can include more information.

✓ The code generation uses the information stored in the data repository to develop the prototype.

✓ Provide an increase in its performance, flexibility, maintenance and reusability while hiding the complexity of distributed processing and future upgrades of the application. This ensures higher security because database access is only authorized via the process tier. It also helps to optimize teamwork and multi-target development.

4 Main Components

The framework has an environment authoring that provides resources and services for the construction of education software. It is specific for experts and teachers who have no experience in design. There are two components: Graphic editor, RAD editor.

The following sections will describe with some details each of the two components.

4.1 Graphic Editor

This graphic tool contains some graphic publishers who support the different diagrams that compose X-TEC (Techno-Didactical extension for Instruction/Learning Based on the Computer) model [5].

The diagrams created depend on the definition of requirements of the system: the instruction strategy and the environment of learning [6].

With graphic editor we can create the diagrams which have constructors and stereotype suggested by X-TEC model. These diagrams are: use case diagram, action table, functional diagram, interaction diagram. All the specification of the diagrams will be stored in a data repository, in the so called metamodel [7].

Before the graphic edition we have an interface, shown in figure 4, where the designer answers a set of questions about problem domain specifications.

The specifications are:

✓ Instructional strategies defined by Alessi and Trollip [8]. The instructional strategies are tutorials, drills, test, simulation, and educational games.

✓ Learning Environment: learning activities and learning profiles [6].

Fig.4. Requirements of the system

Graphic palettes on the basis of these specifications, which contain the constructors of the X-TEC model, related with the previous points will to be presented;

All the specification of the diagrams will be stored in a data repository, in the so called metamodel [7].

4.2 RAD Editor

The objective of this component is to develop easier and, at the same time, educational software with quality. Since this editor has the characteristics of a RAD tool, this software will be created in very short time period, using the forms and templates. We will be able to build the education software without having to perform any HTML coding using templates. We can edit the final product in any text editor if we are familiar with HTML language.

During the implementation process templates that allow the personalization of the product that will be generated are presented, as shown in the figure 5.

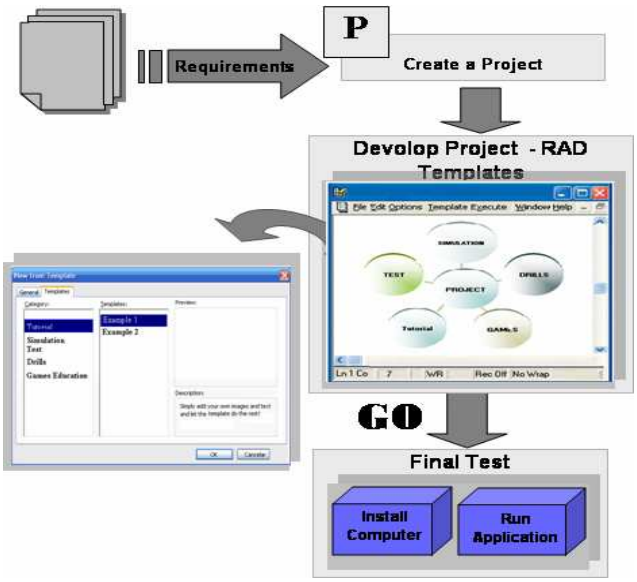

Fig.5. Process generation of SE

5 Code Generator

The code generator makes the process automatic, using the information stored in the repository.
Here we can publish an author's guide and generate a prototype education system. It's based in the internal specifications that had been stored in the persistence tier during the different phases of development cycle and in the association of templates.

The code generation is based on a software model process. A new specification can be obtained through the transformation rules application that can be mapped in description of the code in the Html language or specifications in SQL for creation of the database system.

With a code generation we can:

✓ Create a prototype Education Software (can be a final product).

✓ Publish our work by extracting information from our model and creating the necessary HTML to view it in browser (it's a author's guide)

The code generation process is shown in fig.6.

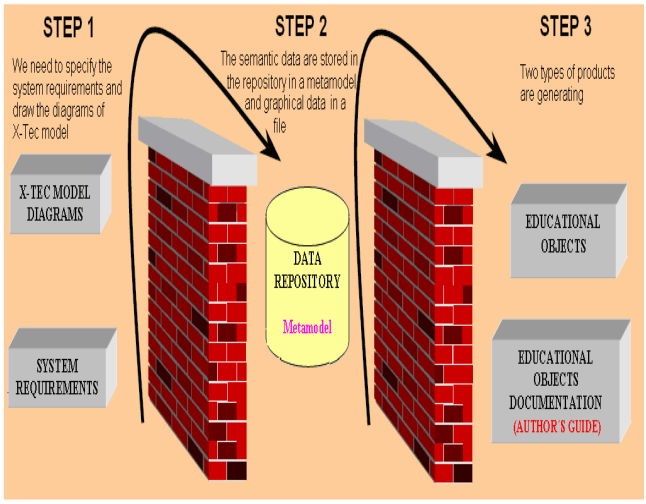

Fig.6. Code Generation process

The developers can create the prototype education software independently from the author's guide or both working together.

If the developer wants to create the author's guide alone, it must specify the system requirements and draw the diagrams of the model X-TEC. Otherwise, go directly to the RAD tool that contains all the forms and templates described above.

The figure 7 shows the process of creating the author's guide.

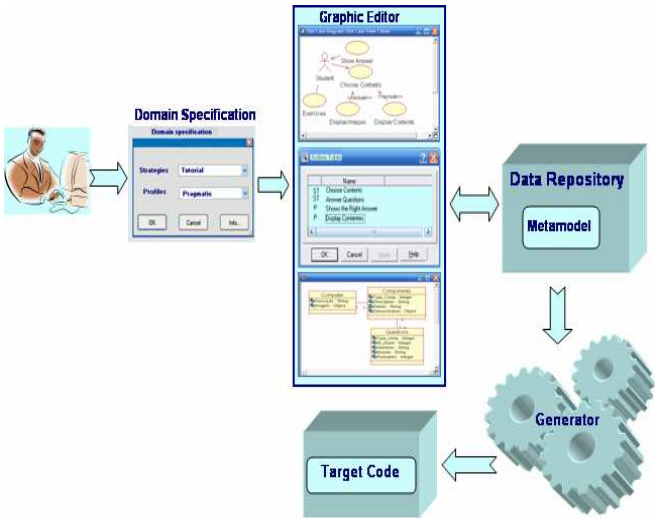

Fig.7 Process for create the author's guide

Figure 7 illustrates the four modules that are required for the product:

✓ **Domain specification** allows the developer to identify the type of educational software and the desired learning profile of the student, for example a tutorial and pragmatic learning profile.

✓ **Graphic editor** makes it possible to design the diagrams of the X-Tec Model. They are displayed according to the type of educational software chosen.

✓ **Data Repository**: once described the specifications of the domain and the diagrams of the X-TEC model, these are stored in a database, in which we have a metamodel.

✓ **Generator** allows the transformation of the conceptual scheme stored in the data repository into a logical scheme.

✓ **Target Code** is a program described in HTML language that can be accessed by a browser.

6 Data Repository

The repository contains the project of data created by designer and teachers. A project has two types of data, the graphical data (drawing) and the semantic data. The semantic data are stored in the repository in a metamodel and the graphical data in a file.

The designer is able, at any time, to recover the diagrams and reuse them in others systems.

The data repository will be supported by a SGBD relational and presents a complex model of data to support, in a flexible form, the storage and management of a variety of elements, namely: (1) the constituent elements of the metamodel; e (2) the elements to support the proper process of generation.

7 System Implementation

The framework environment prototype will be developed in Windev [6], which provides a reliable way to implement the required Web applications.
Windev is an integrated development environment, which allows programmers to create application based on a run time engine.

Windev uses its own fourth-generation programming language, W-Language. W-Language consists of simple orders, similar to everyday language for intuitive programming. We can use it to easily program all the Internet processes you need without having to know HTML, JavaScript or PHP.

The tool enables you to predetermine a set of your standard forms and algorithms that can be used in an automatic fashion to quickly generate applications (RAD). The core of the project will be development in W-Language and supporting database management system will be used is SQL server.

8 Conclusion

The presented work proposes a new framework to support the development of the educative software. Using this framework in the process of developing educational applications makes the time of creation of the project reduced, allowing a consequent reduction of costs and increase in the quality of teaching-learning .

This framework was developed to help, namely: (1) the designer to develop his applications with more quality, following one design methodology, which is based on a conceptual model; (2) the teacher in the drafting and management of contents.

The documentation we can have during the project, allows subsequent queries and views, which make possible a future maintenance of system and immediate generation of new versions of applications with updates.

The framework is going to give support to the construction of the author's guide and conception of prototypes that will be able to evolve successive alterations for a final product. That will serve as support to the education learning process of any tutor with or without great knowledge of computer science.

This is an interactive system that, allows the generated product to be used in several contexts. It makes possible for teachers to create environments that support educational activities and planned learning situations through the use of the resources of contained work in the environment.

Through interfaces the system makes it possible for teachers to access the tools of work that support specific activities of the educational trial (educational process), such as: the construction of educational software and the educational planning.

The system is presently in the phase of conception and analysis and, as future work, intends to develop a prototype

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