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E-LEARNING ARCHITECTS

Biographix Integrated Simulated Learning Environments (ISLE)

A White Paper

Abstract

The Biographix Corporation has developed an innovative Internet-based e-Learning technology with real-time simulation for high fidelity training applications. Principal applications are for training centers that must provide fully trained graduates of complex systems, but who also need to keep their student course costs under strict control.

Example applications of the technology includes courseware for automotive electronics servicing, industrial plant operations, equipment training for Health sciences and for maintenance professionals.

This White Paper discusses the architecture of the ISLE technology and how it supports training environments requiring real-time environmental simulation.

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September 2002

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The ISLE Platform

Developed by Biographix, Interactive Simulated Learning Environments (ISLE) is a software framework and component suite designed specifically for the construction of highly-interactive, simulation-based training systems.

System Overview

An ISLE-based e-learning application uses a layered architecture with each layer belonging to one of two main categories: elements that are common to all e-learning applications, and those that are customized for a specific application.

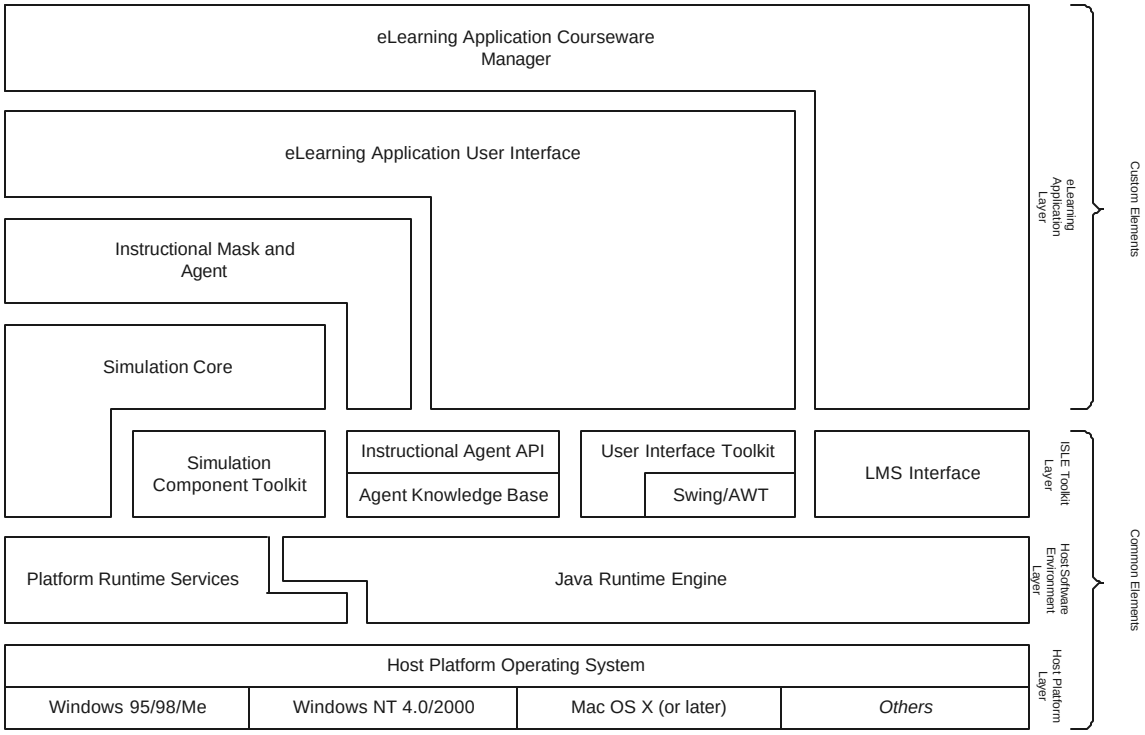

Figure 1: ISLE-based e-Learning Application Layered Architecture

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Common Elements

At the base of the e-learning application is the Host Platform Layer, consisting of the host computer operating system. This defines the computing environment in which the application runs. Closely tied to this is the Host Software Environment Layer, which provides a Java 2 compliant virtual machine, as well as any software services that are optimized for a specific platform (such as, for example, multimedia presentation services). Only these two layers are unique to the specific type of computer and operating system upon which the application is running.

At the topmost layer of the common application elements is the ISLE toolkit itself. This layer consists of four major components:

- The Simulation Component Toolkit is a collection of software objects that become the "building blocks" of the simulated system or process. The toolkit consists of basic simulation components, as well as a standard set of interfaces for interconnecting the components to form a system. By extending or modifying these components and interconnection interfaces, specific systems, processes and test equipment may be emulated.
- The Instructional Agent Application Program Interface (API) and Knowledge Base form the foundation upon which a trainer-specific knowledge database and intelligent query engine may be built. By extending these foundation components, an effective and highly interactive instructional agent can be assembled.
- The User Interface Toolkit is a collection of software objects that construct the interface through which the student interacts with the simulated system, and with the instructional agent. Based upon the Java Swing window toolkit, it includes more application-specific elements that allow the construction of navigation windows, test equipment, and the instructional agent's presentation facilities.
- The LMS Interface provides mechanisms to support interaction with standard learning management systems, allowing the e-learning application to reside within standard on-line learning environments.

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Custom Elements

The custom elements of the typical e-learning application make it unique to a specific learning application, and include the following:

- Simulation Core
- Instructional Mask/Interface Agent
- User Interface
- Courseware Manager

Simulation Core

An integral component of any ISLE-based e-learning application is the ability for students to practice diagnostics techniques within an environment that emulates reality. To this end, the program incorporates a customizable simulation of a system or process – the *simulation core*. The simulation core models the components, operational characteristics, and responses displayed by the actual system. The simulation provides the "workbench" upon which students learn and then practice fault isolation and diagnostics techniques.

The simulation core is what makes an ISLE-based system an effective trainer. Using an Object Oriented Design (OOD), it consists of mathematical computer models of specific system components and test equipment. Simulated models take input from other modeled components, process the data stream according to their function and pass the data on to other components. Each component model operates as an individual functioning unit. This type of design makes it easy to introduce malfunctions to the system or other departures from normal operations to exercise students and aid their understanding. Change the way a model works, and the system operation changes.

Instructional Mask and Agent

The *instructional mask* provides the mechanism to passively or actively monitor a student's actions on the simulated system.

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An instructional mask is a high level "expert system" which incorporates the correct procedures for each type of maintenance activity. As a student performs the steps of a specific procedure, the instructional mask monitors each student action and compares it with what should have been done (the rule base). Since the instructional mask incorporates the correct procedures to perform each specific operation, it can:

- provide a demonstration of the correct procedures to follow to perform a maintenance action,
- actively monitor a student's action and provide remediation, in real-time, if a step is performed incorrectly,
- passively monitor a student's actions for testing purposes and provide a post training debrief.

User Interface

The *user interface* is the means by which the student interacts with the simulation core and the instructional agent. Using photographic or schematic representations of the actual system, the student can take measurements of the system using virtual test equipment and carry out diagnostic and maintenance procedures by examining and replacing faulty components. The instructional agent interacts with the student through an on-screen "virtual advisor." The "virtual advisor" presents instructional material, identifies hazardous actions and provides lesson debriefs through alternate media channels (for example, audio, *avi* file) as an alternative to the student reading original material.

Courseware Manager

The *courseware manager* is concerned with the execution and presentation of courseware. Such courseware supports the system theory of operation and the context sensitive help facility. This layer integrates closesly with the specific applications' chosen LMS.

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System Theory of Operation

The training objective of the "system theory of operation" mode is to aid a student in learning the theoretical and practical operation of a complex system. The fundamental premise to training in simulated environments is: if the student can understand how a system operates from a theoretical point of view, he or she will better troubleshoot real life malfunctions or other unexpected behaviors in a more effective and efficient manner. With the simulation and appropriate graphics, a student learns the practical functioning of a system without being risking a hazardous live environment, or requiring the use of real equipment in an expensive training environment.

In a typical environment, a student sees system schematics which can be represented by simple block diagrams and/or detailed computer graphic drawings and images. The student can select and display schematics of specific systems and sub-systems along with a graphic display of diagnostic tools. The schematic displays draw values from the simulation and display the system status in response to student inputs and actions.

A trainer can select specific malfunctions in the simulation and view an associated "ripple" effect on a system schematic display. The student uses simulated tools to make measurements from system schematic test points, and view the associated readings under normal and malfunction conditions.

Summary

Biographix ISLE is an innovative technology for taking e-Learning to new successes. By combining the ten years of practical CBT experience and the new ISLE technology, Biographix delivers effective and affordable simulation-based e-Learning. Training managers benefit by delivering advanced courseware significantly faster and deliver better qualified students for much lower cost per student course.

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