INTERNET OFFERING TO FOSTER NDE/NDT TECHNOLOGICAL EDUCATION IN COMMUNITY AND TECHNICAL COLLEGES

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INTRODUCTION

Iowa State University, specifically the Center for Nondestructive Evaluation (CNDE) and the Department of Engineering, Cowley County Community College (Arkansas City, Kansas), Ridgewater College - Hutchinson Campus (Hutchinson, Minnesota), Northeast Iowa Community College (Peosta, Iowa), and Southeast Community College (Milford, Nebraska) make up the NSF funded North Central Collaboration For Education in NDE/NDT. The Collaboration has many goals to improve the NDE/NDT education [1].

OBJECTIVES

Development of new course materials and instructional modules for use in NDE/NDT technician programs at community and technical colleges. According to the ASNT there are currently 65 technology or engineering technology programs, 45 of them at technical and community colleges, that include NDE/NDT courses. Two or three distinct course modules will be developed, beta tested and disseminated with this group of programs as the primary audience. Emphasis will be placed on active student involvement in the learning process, collaborative learning approaches, appropriate use of computational and educational technology, and on developing materials that are easily transportable among institutions. All materials developed as part of the proposed project will be widely shared with the technological education sector across the U.S.

Curriculum redevelopment and innovation in NDE/NDT technological education in community and technical colleges with an emphasis on upgrading the math, science and engineering base of technician education. This component will target curriculum development for both NDE/NDT specific programs and for the development of appropriate NDE/NDT components for related technology programs such as manufacturing, mechanical and aerospace technology. Significant involvement by industrial partners, as well as involvement by K-12 teachers, is expected in this component of the project.

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Development and adaptation of NDE/NDT course materials and modules for use in non- NDE/NDT technology education programs at community and technical colleges. Courses and modules for use in mechanical, manufacturing, welding and aviation technology programs are anticipated. There are estimated to be more than 700 such programs at two year institutions in the U.S. (NSF HES Survey Number 17, 1995), some of which already include a course or courses in NDE/NDT. One or two distinct course modules for use in non-NDE/NDT technology programs will be developed, beta tested, and disseminated.

Educational technology transfer of NDE simulation models that have been developed at the ISU CNDE for design and research purposes by porting them to personal computers for use as learning tools by students. The simulations are physically accurate models of ultrasonic, radiography and eddy current NDE techniques that will allow students to develop a physical feel for how measurement parameters, instrumentation or part geometry influence inspection results. The radiography (X-ray) simulation model will be ported first, and depending upon difficulties encountered and beta testing results, the porting of the ultrasonic simulation model will begin in year two or three of the project. The partner two-year colleges will participate in the development and beta testing of educational versions of the simulation models.

Faculty development for community and technical college instructors to enable them to better implement new industrial and research developments in NDE into their educational programs. Faculty development and dissemination will be coupled via the workshops that comprise the sixth project component described below. This component will be leveraged by related efforts that are part of a previously funded project.

An annual workshop with a specific focus on one of the project components. The first workshop will focus on developing a framework for the project and will involve industry and the project evaluator, along with faculty, in developing measurable expected outcomes, assessment and feedback mechanisms, and further specific plans for dissemination of results. The second workshop will be on instructional module development and use of the NDE simulation models as learning tools. The third workshop will be on upgrading the math, science and engineering base of technological education in NDT/NDE. The first workshop will be primarily for the collaborating institutions and selected industrial advisors. Subsequent workshops will seek and encourage wide participation across the technology education community. Workshops will be advertised to the community and technical college sector of education across the country and will be offered at minimal cost to all interested instructors from technology programs.

PROJECTS

Five specific component projects focus on the theme of improving technological education in NDE/NDT at community and technical colleges. All components involve significant collaboration among the four participating two-year colleges, ISU and industry with appropriate input from the K-12 educational sector. Early involvement of industry in planning the appropriate content, desired outcomes and assessment and dissemination mechanisms is a critical element in all components.

INTERNET OFFERING

One of the projects seeks to create a multi-level Internet offering of NDE/NDT technology and applications will serve to attract middle and high school students into

technical and engineering professions related to NDE/NDT, to supplement educational materials for community college and university engineering students, and to make basic and advance NDE/NDT information available to technicians, engineers and managers working in American Industry [2].

One approach that works well for high school students is an offering that gets their attention, entertains them, and at the same time facilitates the LEARNING of the basic science of nondestructive testing and evaluation. It is important that the link is made between things and events in the student's life and environment that are effected by NDE/NDT inspections, such as pop cans, automobiles, and airplane safety. Community and technical college students will be able to re-enforce fundamental ideas of NDE/NDT technology and applications ranging from basic NDE/NDT technology such as laboratory experiments developed in NDE overview courses to real application of technologies being applied in American Industry. Similarly undergraduate and graduate engineering and science students could access basic NDE/NDT technology as well as relevant state-of-the-art research driven by our industrial partners. The industrial technician and engineer would find material that would provide background for inspection using various NDE/NDT technologies and would enable technicians and engineers to better assess a given technology's application to their particular inspection problem.

Figure 1 shows one of many beginning web pages currently in development that must be considered as part of a phase I implementation. These pages consist of an integrated sets of texts, images, and hypertext links to URLs, providing information about NDE/NDT technologies, standards, applications, and research results. Pages are being developed to specifically address the four audiences of middle and high school students, community college and university engineering students, and the working professionals in the NDE/NDT community.

A phase II implementation will attempt to apply the Internet technology as a tool for constructivist classroom environments, with the learners being the central focus of the offering. The constructivist approach assumes that the learner is not a vessel to be filled with knowledge from a lecture, book, or a set of passive web pages, but a learner who constructs knowledge by making connections,tests theories, and is an active participant in the process. Web pages developed in this constructivist classroom context must interactively engage the learner remotely.

AVAILABLE TOOLS

Authorware is a powerful multimedia authoring software that allows the creation of multimedia learning and training materials that can be used for individual instruction or in a classroom setting [3]. Combined with appropriate principles of instructional design, Authorware can help teachers, trainers and educators create rich learning tools that incorporate graphics, sound, animation, and a wide range of possibilities for interactivity on the part of the student user. File compression capabilities allow instructional materials created with Authorware to be delivered over the Internet for affective distance learning. With the installation of the appropriate plug-in, obtained free of charge over the Internet, students can have access to quality learning materials right from their home or office. Learning materials created with Authorware enable the student user to do much more than read, listen, or watch passively. They can experience simulations, participate in demonstrations, answer questions, receive feedback on performance, watch animation of complex procedures, connect with other Web sites, which makes Authorware particularly well suited to constructivist classroom approach to web page development.

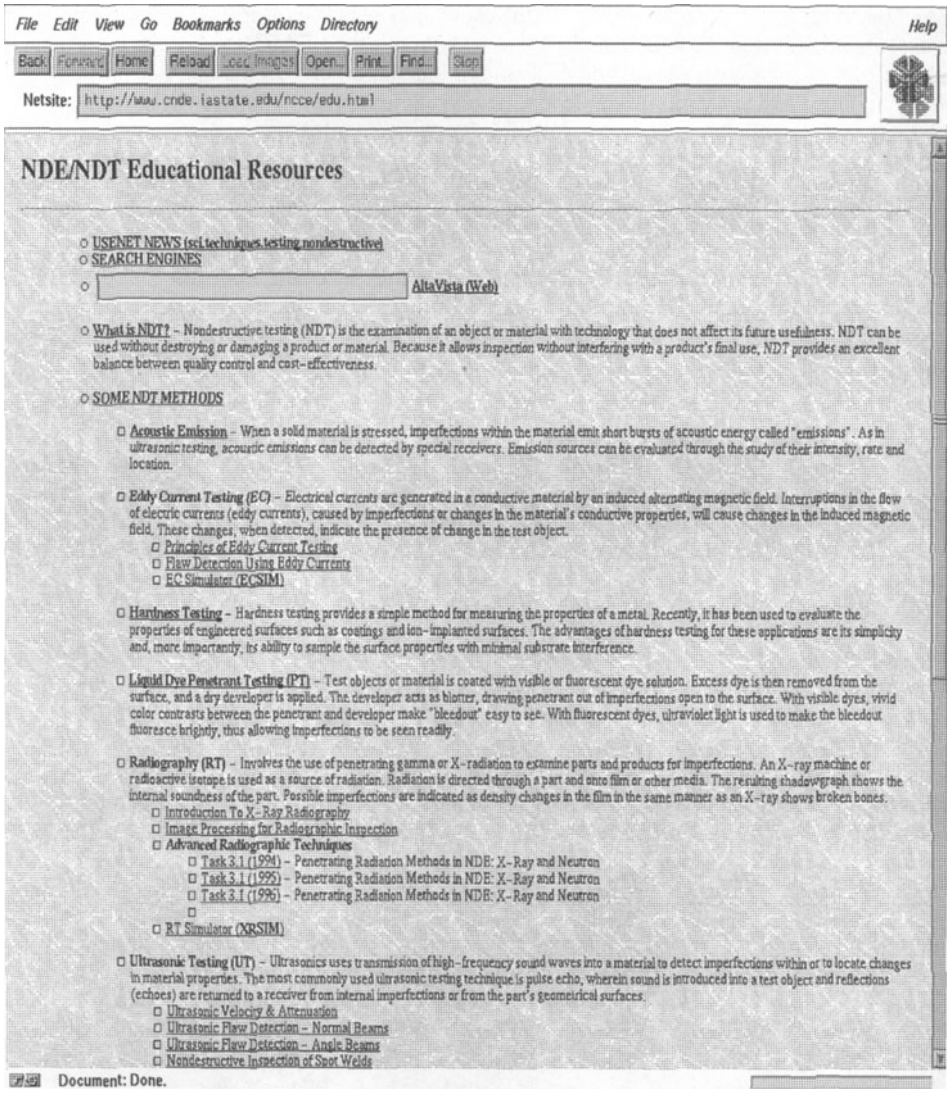

Figure 1. Web page - NDE/NDT Educational Resources

Java is also suited to the constructivist classroom approach to web page development. The Java language originated as part of a research project to develop advanced software for a wide variety of networked devices and embedded systems [4,5]. The goal was to develop a small, reliable, portable, distributed, real-time operating environment. When the project was started, C++ was the language of choice. But over time the difficulties encountered with C++ grew to the point where the problems could best be addressed by creating an entirely new language environment. Design and architecture decisions drew from a variety of languages such as Eiffel, SmallTalk, Objective C, and Cedar/Mesa. The result was a language environment that has proven ideal for development of secure, distributed, network-based end-user applications in environments ranging from networked embedded devices to the World-Wide Web and the desktop.

A primary goal of the Java language was a simple language that could be programmed without extensive programmer training and which would be roughly attuned to current software practice. The Java language was designed as an object-oriented language from the ground up. Object-oriented design, simply stated, is a technique that focuses design on the data, i.e. objects and in the interfaces to it. The needs of distributed, client-server based systems coincide with the packaged, message-passing paradigms of object-based software. To function within increasingly complex, network-based environments, programming systems must adopt object-oriented concepts. The Java language provides a clean and efficient object-based development environment.

Java was designed to support applications on networks [6,7]. In general, networks are composed of a variety of systems with a variety of CPU and operating system architectures. To enable a Java application to execute anywhere on the network, the compiler generates an architecture neutral object file format -- the compiled code is executable on many processors, given the presence of the Java runtime system. This is useful not only for networks but also for single system software distribution. In the present personal computer market, application writers have to produce versions of their application that are compatible with the IBM PC and with the Apple Macintosh. With the PC market (through Windows/NT) diversifying into many CPU architectures, and Apple moving off the 68000 towards the PowerPC, this makes the production of software that runs on all platforms almost impossible. With Java, the same version of the application runs on all platforms. The Java compiler does this by generating bytecode instructions which have nothing to do with a particular computer architecture. Rather, they are designed to be both easy to interpret on any machine and easily translated into native machine code on the fly.

The Java interpreter can execute Java bytecodes directly on any machine to which the interpreter has been ported. And since linking is a more incremental and lightweight process, the development process can be much more rapid and exploratory. As a part of the bytecode stream, more compile-time information is carried over and available at runtime.

RESOURCE MATERIALS

Sources of material to include in a multi-level Internet offering come from new course materials and instructional modules developed by the North Central Collaboration for NDE Education, relevant research and course materials from the Engineering College and Center for Nondestructive Evaluation of Iowa State University, and from other

sources of educational materials applicable to NDE/NDT. These additional sources include links to material available on the Internet.

Along the lines of interactive tools, three interactive inspection simulation packages (UTSIM, XRSIM, ECSIM) developed at the Center for Nondestructive Evaluation at Iowa State University are being integrated into the classroom environment by our community college partners. These are powerful predictive tools that are conceptually and physically correct, accurately predicting results of NDE/NDT inspections with ultrasound (UT), x-ray radiography (XR), and eddy currents (EC). Interactive web pages could include subsections of these simulators as tutorials, for example, a interactive page for correct film exposure, or an interactive page for the effects of ultrasonic transducer focusing on inspectability. The possibilities are enormous.

SUMMARY

We are developing a multi-level Internet offering of NDE/NDT technology and applications to enhance compliment several levels of NDE/NDT education and to make basic and advance NDE/NDT professionals. To date pages consist of an integrated sets of texts, images, and hypertext links to URLs, providing information about NDE/NDT technologies, standards, applications, and research results. Our longer term goal is to apply the Internet technology as a tool for constructivist classroom environments, with the learners as active participant in the process. Technologies such as Authorware, Java, and NDE inspection simulators developed at Iowa State University are tools that will help engage the learners.

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