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David W. Forslund*, James E. George and Eugene M. Gavrilov

Abstract

This is the final report of a one-year, Laboratory Directed Research and Development (LDRD) project at the Los Alamos National Laboratory (LANL). The objective of this project was to develop a Java-based, electronic, medical-record system that can handle multimedia data and work over a wide-area network based on open standards, and that can utilize an existing database back end. The physician is to be totally unaware that there is a database behind the scenes and is only aware that he/she can access and manage the relevant information to treat the patient.

Background and Research Objectives

A distributed electronic medical record is of fundamental importance to the improvement of health care in this nation. Our goal is to develop a database access system, called TeleMed, that allows access to electronic medical records at almost any location in the world, even at low-bandwidth, something that was considered impossible in the past. In this project we developed distributed-object interfaces to, and implementations of, the primary components of the Essential Medical Data Set (developed by the National Information Infrastructure - Health Information Network sponsored by DARPA) to allow physicians to simultaneously access and interact with object or relational databases in an intuitive manner. We also included support for multimedia data, such as images, in a scalable way, with minimal impact on the server databases.

Importance to LANL's Science and Technology Base and National R&D Needs

Much of current computational efforts at the Laboratory require innovative ways of managing and analyzing the large amount of information that is produced. Simply utilizing files systems is not adequate, nor is it scalable. New methods of managing information over wide areas, along with the ability to collaborate on research based on the information,

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is needed. In addition, the rapid change in computer technology requires a highly portable means of managing applications. Thus the distributed object model, based on Java and the Common Object Request Broker Architecture (CORBA), has wide applicability for many projects within the Laboratory. Of utility far beyond business applications, Java and CORBA have great value for managing complex scientific applications. In fact, the rapid evolution in high performance computing platforms is resulting in a convergence in tools used for business and scientific applications. It is crucial to the future success of the Laboratory that we maintain a state-of-the-art capability in this area.

By working on a scientific problem of national and international value such as securely and reliably making available multimedia, electronic medical records over a wide area, we can develop a very important capability while making an impact on the national and international level. In fact, this ability to create a virtual patient record immediately accessible anywhere on the planet is recognized as one of the major grand challenges to medicine in the next decade.

Scientific Approach and Accomplishments

We developed the TeleMed system entirely in Java; it uses CORBA from the Object Management Group (OMG) for communicating among the clients and servers. The patient identification process conforms to the evolving specification being defined by the OMG. We have participated in the process of defining this standard and expect there to be a national and international standard in this area by the first quarter of 1998. Our work has been a seminal contribution to this effort by providing working implementations and critiquing the models as they were developed. While we had used CORBA itself in earlier work, this isn't sufficient for interoperability because the Interface Definition Language (IDL) had not been standardized. The effort continues to standardize the IDL interfaces so that very different implementations of components can be made to work together without any prior arrangements.

Our research has had substantial impact on the design of TeleMed by making it enormously more scalable and portable. We have outlined the basic elements of the required security and have devised a mechanism for handling immunization records over a wide area, but have not yet implemented them. The immunization design builds on the existing graphical patient record by simply overlaying the immunization history of the patient along with recommendations from the state or county health department. The system would provide immediate information as to the need for immunizations and visually show when the next immunizations would be required.

The efforts involved designing and implementing novel mechanisms for managing the image data simultaneously with the other clinical information and developing highly portable interfaces to both relational databases and object databases with no impact of any kind to the Java client. In addition, the server is highly portable between various relational databases and object databases because of its use of standardized (but previously untested) Object Database Management Group (ODMG) Java bindings. As a result of this work, we were invited to present our research at the annual Radiological Society of North America, attended by about 60,000 people from around the world. The purpose was to demonstrate the value and importance of integrating imaging data with clinical information, a pioneering result of the TeleMed research. The value of using the electronic medical record as an international collaboratory was described in detail in an article in the Communications of the ACM in August, 1997 (Publication #2).

Publications

1. Forslund, D.W., and J.L. Cook, "The Importance of Java and CORBA in Medicine," in *Journal of the American Medical Informatics Association 1997 Annual Fall Symposium*, D.R. Maysis, Ed. (Hanley and Belfus, Inc., Philadelpha, 1997), p. 364.

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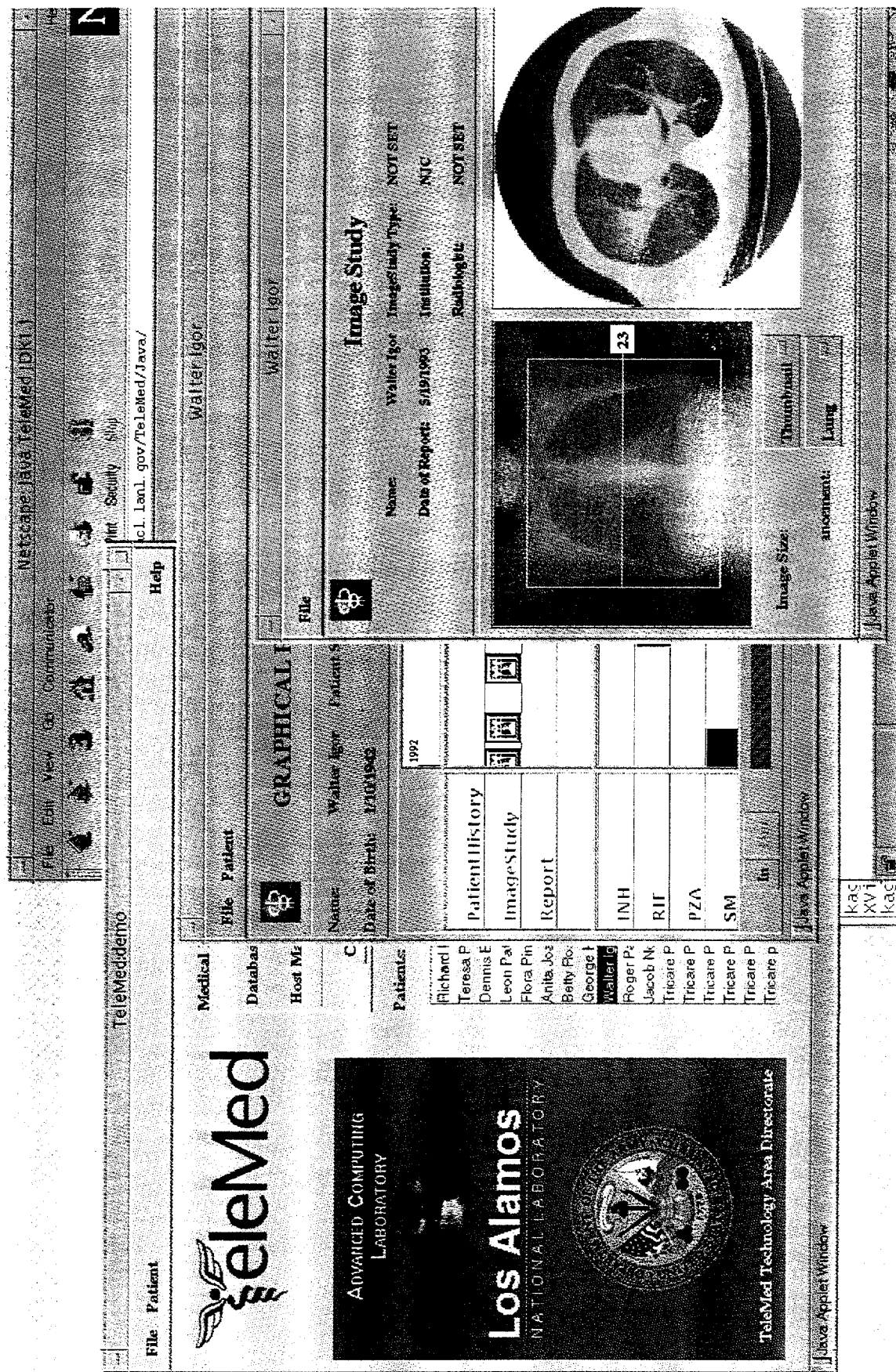
Figure. 1. The Netscape Communicator 4.0 browser can be used to view the entire TeleMed client showing the graphical patient record and the management of computed tomography images.