TELE PRESENCE MICROSCOPY/LABSPACE: AN INTERACTIVE COLLABORATORY FOR USE IN EDUCATION AND RESEARCH

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Computerized control of scientific instrumentation has been successfully implemented in recent years to facilitate the indirect operation or remote observation of a wide variety of equipment including the full range of electron microscopesl~4. The concept is, however, usually applied in it's simplest sense, namelythe direct one-to-one functional replacement of "local operation" of equipment by a remote workstation. While the microscope is clearly central to the our research, real collaboration will not be achieved simply by creating a networked interface to a microscope for remote scientists. This is merely a simple exercise in computer programming and digital control. For true distributed collaboration (either in research and/or teaching) to be successful, all of the aspects of the research/teaching environment must be considered. For example, the investigators must be able to talk to and see each other while running an instrument, and they should be able to do everything else they would normally do if they were in the same laboratory. This includes sharing experimental data, review previous experiments, write papers, talk over coffee and even visiting each other in their office to plan current and/or future work. The TelePresence Microscopy (TPM) /LabSpacel project attempts to bridge the gap between simple "remote microscopy" and true collaboration, by integrating protocols, tools, and interactive links to instrumentation, data (real-time as well as archived), and audio-visual communications. The initial goal of this project has been to create a virtual space, accessible via the Internet, where microscopists and their colleagues, who are distributed across the nation or the world, can meet, talk, plan their research, and also run their experiments.

After the first year of development, we have interfaced the control functions of the ANL Advanced Analytical Electron Microscope to TelePresence operation. Figure 1 illustrates the various data streams which include: instrument control, data archiving, and teleconferencing which have been implemented on the AAEM. The remote collaborator has control of all lenses, specimen position (shift/tilt), and imaging modes and can control these functions using secure (password protected) remote login using either direct command entry (text) or via a GUI. Figure 2 shows examples of typical data fields which correspond to laboratory views, instrument / experimental data and multicast teleconferencing windows. Choice of fast frame low resolution or slow frame high resolution windows for image transfer is an option for imaging. This allows optimal configuration of the telepresence interface, particularly over slow network lines. The generic TPM system is composed of both software and hardware, which operate in a client/server relationship and is based upon customized software, with a minimum of commercial products. This was chosen to provide maximum versatility, and minimum cost to the user. All source code and platform independent Internet browsers will be distributed free of charge as it is completed. While it may be argued that this creates one-of-a- kind software tool, the interface is generic enough that it may be applied to a wide range of instruments and includes the possibility of plug-in modules which can be customized for different equipment. In addition, to enhance the concept of collaboration, an intera'&~~on space is being experimented with which attempts to add video and audio support to a MOO server, which is usually a simple text based communications medium. When fully implemented this will allow a researcher to walk into a virtual electronic laboratory and be able to see and hear their colleagues who are present in the eLab. The current status of the TPM project can be checked by accessing the Microscopy and Microanalysis WWW Site (URL= *http://www.amc.anl.gov).* This site provides a demonstration of some of the capabilities of a passive link using conventional WWW browsing tools and provides update on the project.

References:

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6) Supported by US. DoE under contracts BES-MS W-31-109-Eng-38, and DE-AC03-76SF00098.

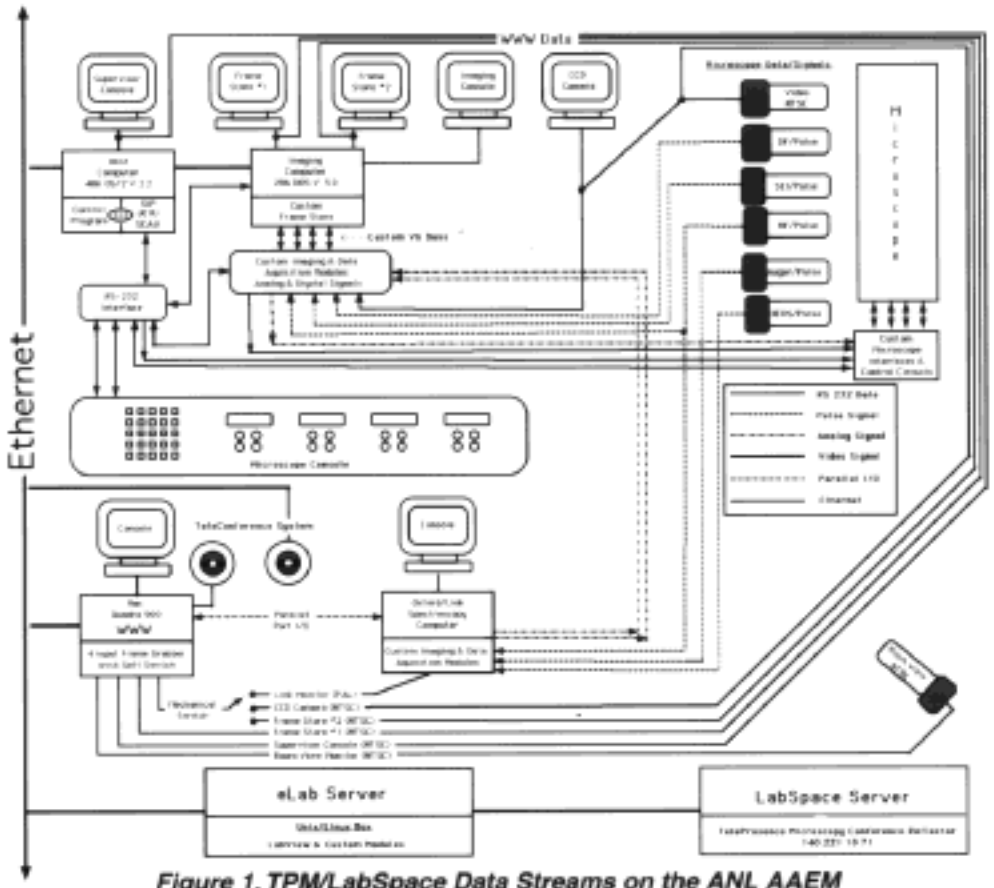

Figure 1. TPM/LabSpace Data Streams on the ANL AAEM

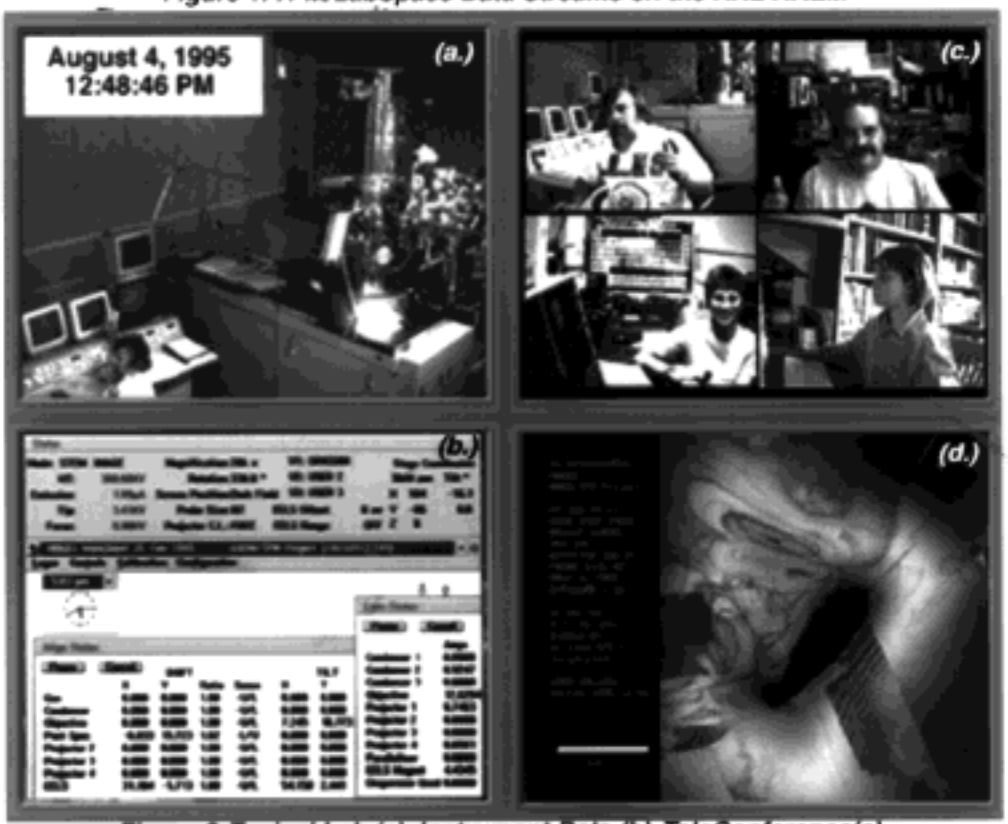

Figure 2. Typical Lab (a), Instrument Data (b), TeleConference(c) and Experimental Image (d) Information Screens