Int. J. Engng Ed. Vol. 23, No. 4, pp. 650–660, 2007
Printed in Great Britain.

0949-149X/91 $3.00+0.00

Adapting Pervasive Learning Technologies to Mixed Local/Distance Agricultural and Biological Engineering Education*

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A hardware and software architecture suitable for active-learning approaches is described, using gigabit network, video conferencing equipment, network control and collaborative learning software. This system supports interaction and collaboration features in the lecture delivery task, between teacher and students, as well as between students, within and also outside of the classroom. This report documented the integration of two software packages 'NetSupport Manager' and 'Silicon Chalk' in the delivery of an Applied Machine Vision course whereas lecture, demonstration and laboratory activities are merged seamlessly. This system was used to teach synchronously to graduate students at Kagoshima University in Spring 2004.

Keywords: synchronous learning; distance education; USA; Japan; collaborative learning

INTRODUCTION

SEVERAL NRC REPORTS [1,2] advocated the adoption of Information Technology (IT) to improve student learning at high school and university levels, but IT is changing at a breathtaking pace, making it virtually impossible to accurately predict its future impact on teaching and learning in undergraduate science, mathematics, engineering and technology education [2]. A survey [3] showed that 'A Classroom of One' is just around the corner, and the University, as we know it, could be 'deconstructed' in the near future as learning shifts from a teacher-initiated orientation to a more active role from the student [4]. For this purpose, the National Science Foundation has been funding for more than a decade seven Engineering Coalitions (Academy, ECSEL, Foundation, Gateway, Greenfield, SUCCEED, Synthesis) for researching and disseminating better methodologies for engineering education (http://www.foundationcoalition.org/home/foundationcoalition/engineering_coalitions.html). Recently, we also have Project Catalyst from Bucknell University to train engineering faculty for problem-based learning (http://www.departments.bucknell.edu/projectcatalyst/). Innovative computing concepts and technologies better suited for human needs are being developed especially in science and engineering education [5,6], and Shneiderman's active learning approach goes beyond the academic realm to extend to the corporate community or civic network as the ultimate realm for application of any education process, considered as a human activity. The most surprising finding is that all these concepts and projects have a common paradigm in the Constructivist view of learning [7] which has one basic tenet that the learner constructs his or her own knowledge. However, in a recent study, almost 25 per cent of first-year engineering students reportedly study less than 10 hours per week outside class, with only 12 per cent saying that they spend more than 25 hours on school work [8], showing rather clearly that students are not yet ready to be responsible for their own education. Furthermore, most of current engineering faculty were exposed to or trained (if at all) in the standard lecture format of information delivery, so most of them were also not ready for active learning methodologies.

Over the past three years, the Biological and Agricultural Engineering Department at the University of Georgia had been engaged in developing and adopting pervasive learning technologies with the goal of engaging our students into an active learning mode inside and outside the classroom.

One of the thrusts for our department curriculum was to enhance the experiential learning aspects for our engineering students during class lectures, because it was usually difficult or sometimes impossible to bring in 'equipment' from the 'lab' into the 'lecture hall' due to equipment size or its location off building or campus. Since Summer 2001, we had spent considerable efforts in first creating a web-enabled Machine Vision Labora-

* Accepted 20 June 2007.

tory that allowed students to access the test stations from anywhere in the Web to perform their laboratory assignments in spectrometry and machine vision without having to be physically present in the laboratory, but without losing the touch and feel of actual hands-on experimentation [9]. In the summer 2003, the Collaborative Distance Education (CDE) Laboratory was made operational to provide a facility that allowed synchronous collaborative interactions between teacher-students and student-student for in-class projects, as well as for receiving classroom instructions from experts located outside the Athens campus via videoconferencing technologies [10]. Naturally, in the next phase of development and using the ENGR-4540/6540 'Applied Machine Vision' course as the demonstration platform, we seeked to combine the two existing resources to create a state-of-the-art Collaborative Distance Engineering Education facility that could serve on-campus students, as well as off-campus students who could be in industry for continual education purposes or in other universities pursuing standard academic goals. Thus we proposed to create a Distance Education programme between The University of Georgia and Kagoshima University (UGA sister University in Japan) using the Applied Machine Vision course as a demonstration vehicle for Spring 2004 semester. This project answered the call for internationalization at UGA and would be among the firsts of such facilities. Future expansions of this concept to other UGA strength areas would garner interests from industry for just-in-time training of its employees and also funds from public or private educational organizations overseas.

The objectives of this manuscript were:

(1) To describe an approach to the design of a computer hardware and software system suitable for teaching local and remote students synchronously, with interaction and collaboration features supported in the lecture delivery task, remote equipment operation and class activities recording.
(2) To report on the system performance and feedback from Kagoshima University students during the delivery of an Applied Machine Vision course in Spring 2004 from the University of Georgia to Kagoshima University.

RATIONALE FOR SELECTED APPROACH

About half of the BAE teaching faculty used PowerPoint slides regularly as the information delivery tool, while the other half found the standard chalkboard adequate for their needs. Our students were also not ready for a full-blown student-centred problem-based learning approach, thus the author's goal was not to design a solution that was too far from the possible adoption reach of the majority of the faculty and students, and also to implement it in incremental steps. The adopted solution was then 'teacher-centred' with some elements of 'interaction' and 'collaboration' between teacher/student and student/student.

Description of instructional facilities

In the summer of 2001, when we embarked on this long-term project for effective engineering instruction with technology, there were lots of information available but still there were no concise texts for a systematic approach in this area, so we had to formulate our own approach suitable for our academic environment through several attempts. However, since March-April 2004 we had found two very useful books for anyone wanting to start on a system approach for such a project [11,12].

Communication protocols and system architecture

To be compatible with KU campus, we used TCP/IP protocols for all computer communications including technical content delivery and videoconferencing for 'people' contact. This method was most flexible as it used the existing GigaBits Ethernet in Athens' campus, however, KU had only a 100 Mbps Ethernet facility. Our approach was to offer this class MWF from 8 to 9 am (GA time), which translated into 10 to 11 pm Kagoshima time. Of course, we were concerned about the lateness of the hour but the KU students' response was that 'The night is still young at 11 pm so we often go out for a beer after class any way'. This indicated a high level of motivation from the KU students that turned out to be important at later stages.

Teaching was planned to be done from the CDE Lab of Driftmier Centre (UGA) to local Athens students, while the KU students would be joining in from Kagoshima via the Internet, consequently we needed to coordinate the information flow between three physical facilities:

- The UGA Collaborative Distance Education (CDE) Laboratory, equipped with 30 PCs for students and a teacher station connected to an isolated 1.0 Gbps LAN;
- The UGA Web-enabled Spectral Imaging (WSI) Laboratory consisted of a Web/FTP server and two completely equipped Machine Vision stations;
- The KU Food Safety Education (FSE) Laboratory with a total of 10 Notebook PCs connected via a 100 Mbps Ethernet network.

Other design criteria for the IT system architecture between UGA and KU were:

- Symmetry, so that either UGA or KU can be the originating instruction site for local as well as remote students in the future;
- Bandwidth minimization of all overseas Internet communication lines.

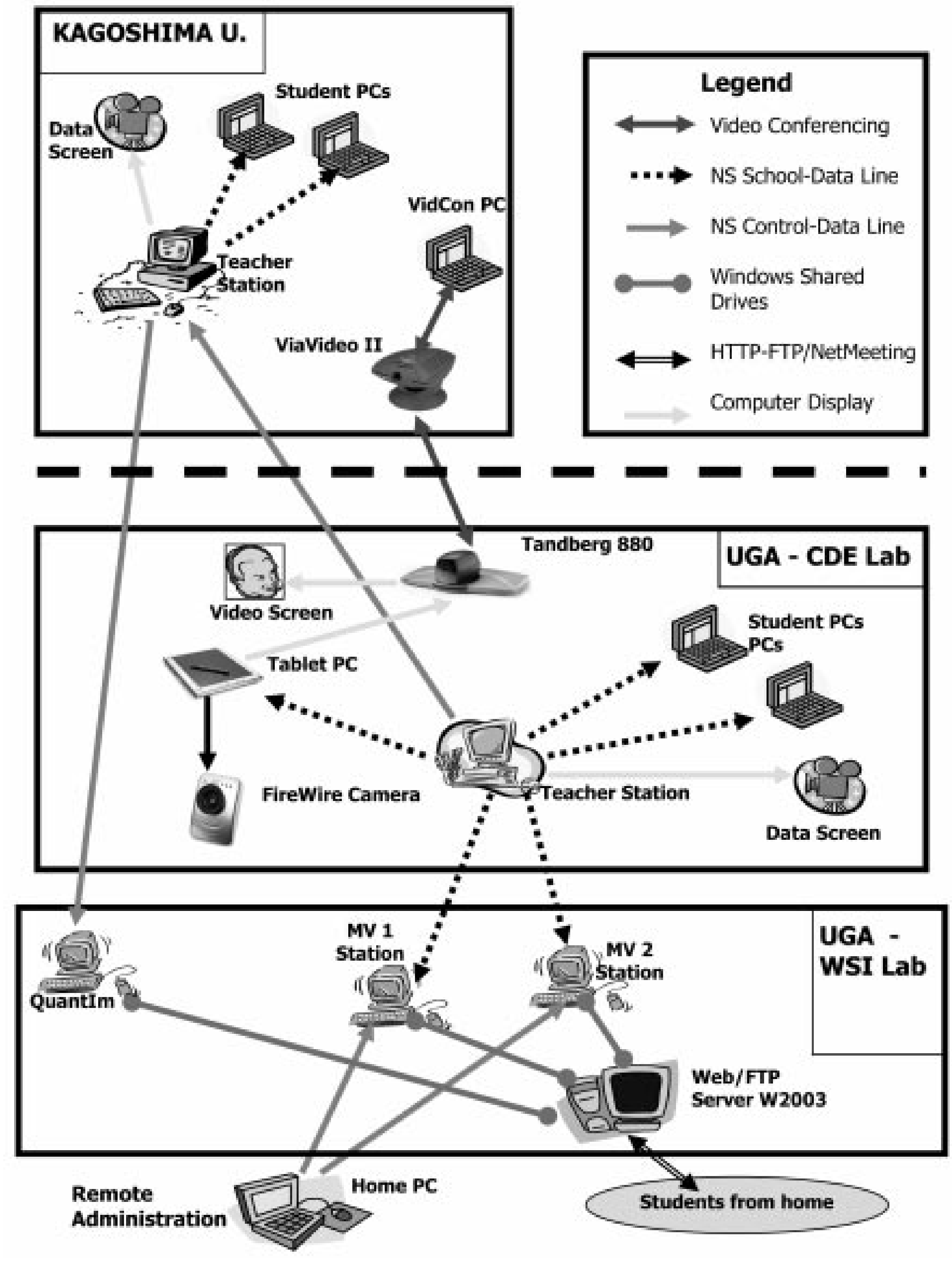

Fig. 1. 'Planned' information flow between UGA and Kagoshima U.

After some iterations, the final system architecture chosen for our project is described in Fig. 1 where one can recognize readily the three physical labs.

In Fig. 1, let us first consider the CDE Lab, wherein the UGA Teacher Station was in full interaction with the local UGA student PCs by way of the 'NetSupport School' software. The UGA Teacher Station was also connected to the KU Teacher Station via the 'NetSupport Control' software which allowed either the UGA Teacher Station to remotely 'CONTROL' the KU Teacher Station or to 'SHOW' its UGA Windows Desktop to the KU Teacher Station which was itself connected to the KU screen projector, therefore allowing KU students to see all instructional materials being presented to the UGA students, albeit with a little time delay. Ordinarily, there was no need to have an operator at the KU Teacher Station, as the 'instructing' was done by the UGA Teacher.

At the UGA site, other tools needed for instruction were: a data screen projector to let local students view the Teacher Station desktop, a Tablet PC for hand-written notes and equipped with a FireWire camera for props or equipment demonstration. The video conferencing functions were performed by the Tandberg 880 unit on the UGA side and by the Polycom ViaVideo II unit on the KU side (the Polycom unit was connected to the KU VidCon PC via a USB port and its sound card). Thus the video screens on both sites had dual purposes as the instructor could choose either to display the 'talking heads' for video conferencing to satisfy the 'human presence' need, or to push out handwritten notes or props demos to UGA and KU students.

The Athens Teacher Station (through its Windows desktop) used 'NetSupport School' to remotely control the Machine Vision Stations of the WSI Lab (located in a different part of the BAE building) to have a laboratory session using available spectrometry and machine vision equipment. UGA students could watch this lab session via the local UGA data screen projector, while the KU students could also do likewise thanks to the use of the 'NetSupport Control' software which continuously sent the UGA Teacher Desktop to the KU Teacher Desktop (as described in a previous paragraph). During a typical laboratory activity, any UGA or KU student could be allowed by the UGA Teacher to access and control the WSI Lab equipment on their own using a procedure to be described in more detail in the following Section on 'Teaching Modalities and Software Operations'.

Thus lecture, demonstration and laboratory activities were merged seamlessly through the Athens Teacher Station which data screens could also be sent to the Kagoshima Teacher Station, which in turn relayed these data screens to the local KU student Notebooks or via its own screen projector for the KU students to observe. This daisy-chain scheme was used to satisfy the 'symmetry' and 'bandwidth minimization' criteria mentioned above. The human presence and interaction aspects between both sites were fulfilled using video conferencing equipment such as the Tandberg 880 system on the UGA side and the ViaVideo II for the Kagoshima side. Thus we used only two long-distance Internet lines during a typical class period. Furthermore, the class instructor could remotely administer the Machine Vision PCs from home during off-business hours, while the students could log in from home into the Web/FTP Server via a private web site (http://weblabs.engr.uga.edu/) to perform their lab assignments and transfer lab data to their home computers for further analysis [9]. Lastly, arrangement for remote access from KU into a UGA PC named QuantIm was also necessary, because our departmental software site licence did not allow us to instal a copy of the image processing software called QuantIm on a PC outside the BAE department.

Teaching modalities and software operations

The previous section showed that a daisy-chain remote control scheme, via the teacher stations, was required to achieve the data sharing and remote control features needed in this project. This was achieved using a software suite called NetSupport Manager (NSM—V.8.1) which has two components: NetSupport Control (NSC) and NetSupport School (NSS). NSC was deployed on the Teacher Stations of both sites and these implementations were differentiated as NSC-UGA and NSC-KU. NSS was deployed on Local Student PCs at each site such that the Control Agent was on the Local Teacher Station, while the Clients were deployed on the Local Student PCs (these implementations were also differentiated as 'NSS-UGA' and 'NSS-KU' to distinguish their actions in this report).

Some of the main features of the NSS component were as follows:

(1) Each Local Teacher Station could 'SHARE', 'WATCH' and 'CONTROL' its own Local Student PCs on a one-on-one basis. This was used for quick response to student difficulties.
(2) The teacher could 'SHOW' his or her PC application to all or selected Local Student PCs, and could also select ONE 'SHOW LEADER' among the students, who could then share into the control of the Local Teacher Desktop.
(3) The teacher could 'EXHIBIT' a selected student work to the rest of the class, or organize the class into sub-groups with assigned GROUP LEADERS.
(4) The teacher could send out instant SURVEYS (polling questions) to check on the class understanding of concepts being presented. Currently only percentages of Yes/No answers to the given question could be reported back to the Teacher Station.
(5) Facilities for File Transfer, Distribution and Retrieval and Video Playing were also available.

During a typical lecture session, the UGA Teacher Station interacted with the UGA students using NSS-UGA, it also connected to the KU Teacher Station using NSC-UGA, and via the KU Teacher Station it could interact with a chosen KU student PC using the local NSS-KU implementation. The NSC component could also 'SHARE', 'WATCH' and 'CONTROL' the remote PCs that it connected to. Therefore, the UGA Teacher could interact with any student PC whether located in Athens or Kagoshima and, most importantly, change that student PC desktop content via the teacher's own mouse and keyboard. Typically, a PowerPoint slide could be shared with all students via the screen projectors on both sites.

As described above, the UGA teacher could access any Machine Vision Station of the WSI Lab and start a laboratory session, with the UGA and KU students watching the unfolding experiment via their own local Data Screen projections. To make the lab session more interactive, any UGA or KU student could be allowed to interact with the WSI lab equipment using a more complex procedure:

(1) *Granting lab equipment access to ONE selected UGA student while KU students could only observe (see Fig. 2).* First, using NSC-UGA, the UGA Teacher would 'CONTROL' the KU Teacher Station, then started its NSC-KU to 'WATCH' the chosen Machine Vision (MV) Station back at UGA: this allowed all KU students to observe the experiment via their own Data Screen projection. Second, using NSS-UGA, the UGA Teacher started a 'CONTROL' session of the same chosen MV Station as a separate Window, next 'SHOWed' the UGA Teacher Desktop to a selected UGA Student PC and also granted this UGA student 'SHOW-LEADER' privileges: this allowed the selected UGA Student PC to 'SHARE' in the 'CONTROL' of the chosen MV Station equipment, but by way of the UGA Teacher Station.

(2) *Granting lab equipment access to ONE selected KU student while UGA students could only observe (see Fig. 3)* In this case, the simplest procedure was to first ask the selected KU student to step up and operate the KU Teacher Station directly as usually there was no one manning the KU Teacher Station. Second, using NSC-UGA, the UGA Teacher accessed the KU Teacher Station in a 'SHARE' mode and started its NSC-KU to 'CONTROL' the chosen MV Station back at UGA as a separate Window. This allowed the selected KU student to 'CONTROL' the MV Station equipment at UGA and also allowed the UGA Teacher to coach the KU student in performing the lab experiment as needed. The UGA students could all simply watch the lab experiment via the UGA Data Screen projector in this case.

All course experimentation work was done via the Web requiring only the software 'Internet Explorer' and 'NetMeeting' from any student PC regardless of location. The experimental procedures and tutorials were available at the Weblabs site as well (please see this link for an example: http://www.engr.uga.edu/~thai/KUProject/exp1/MSIL_Exp1.htm).

Outside-of-class mobility and connectivity features

Although the previous section clearly demonstrated that the NetSupport Manager suite could provide high levels of Interaction and Collaboration within the classroom, we readily recognized that, for students, the 'learning' time in-class was very small compared to that spent outside during which we wanted to motivate students to achieve their own learning goals. We also noticed that although, in-class, students could follow with the teacher complex procedures involving keyboard and mouse inputs, shortly afterwards and outside class, students had difficulty remembering them. To alleviate this problem, we had used packages such as RoboDemo (http://www.ehelp.com/) and Camtasia (http://www.techsmith.com/) to create narrated tutorials that are publishable on the web such as this one (http://www.engr.uga.edu/~thai/KUProject/exp1/Tutorial_2/Tutorial2.htm), showing students how to perform a spectrometry experiment. RoboDemo yielded a good final

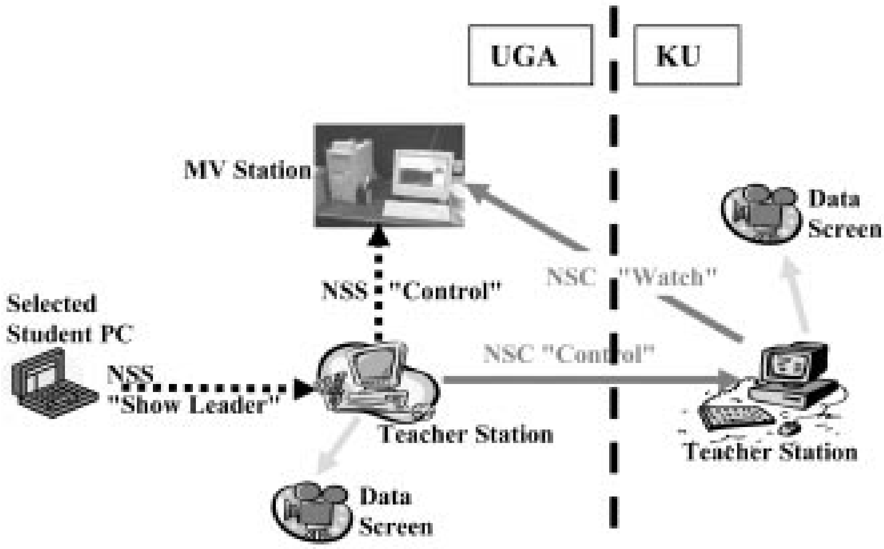

Fig. 2. Granting lab equipment access to selected UGA student

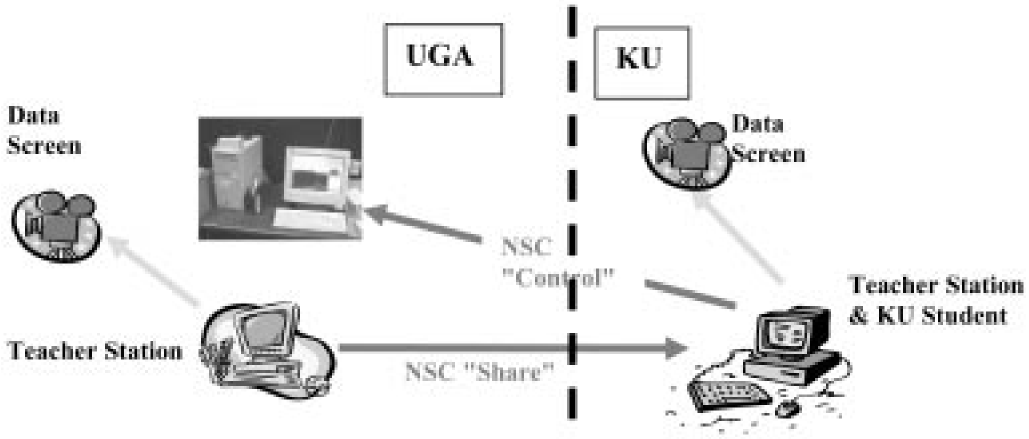

Fig. 3. Granting lab equipment access to selected KU student

product but a fair amount of time was required to prepare one tutorial and Camtasia sped this process substantially; however, both of them yielded static products that students could not modify for personal needs. The book *Persuasive Technology* [13] recommended using Customization, Mobility and Connectivity (among other technologies) to increase 'Persuasion' for computer users (students in our case), to motivate users to achieve their own goals. Currently, the only product on the market that is designed specifically with this approach in mind is Silicon Chalk (http://www.siliconchalk.com/features.htm). Coatta narrated the flow of different learning activities in a typical day for a student using Silicon Chalk from in-class notes taking, to working cooperatively with fellow students on a common web-based project, to updating one's own personal notes and so on [14]. For our needs, we used a lab-based installation with extra student licences for home use bought by the department for them, as the number of students was usually small for this class (around 15), and also because Silicon Chalk has not yet finalized their financial model for various licensing modes at that time (Spring 2004). The cost was $33 (£16 approx.) per PC installation and licences needed to be renewed every year.

As we planned to use Silicon Chalk (peer-to-peer and using UDP protocols) together with NetSupport Manager (client-server and using TCP/IP protocols), we had some initial concerns whether they were compatible with each other, but we found that they worked together seamlessly.

During a typical class meeting, the teacher would wear a wireless microphone interfaced with the teacher station sound card and started NSS to link the teacher station to all student PCs along with other 'instruction' PCs as needed (Tablet PCs and machine vision stations located in the Spectral Imaging Lab) (see Fig. 4 for a view of the NSS main window). Next teacher and

Fig. 4. Main window of NetSupport school software

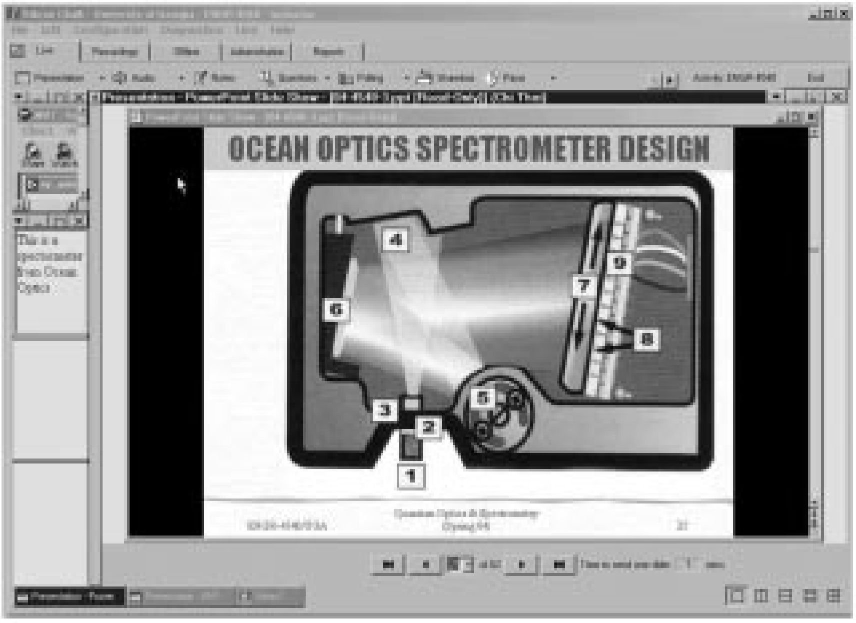

Fig. 5. Typical live screen record of a Silicon Chalk session for PowerPoint

students would start their own version of Silicon Chalk, then students waited for the teacher to start the recording session. At this point, the teacher started PowerPoint to show the lecture slides of the day, and any other Windows applications as needed for instruction. The teacher was then ready to start his/her own recording process and the teacher station would send messages to student PCs signalling that they could join in the class (i.e. start their own recording process on their local PCs, if they wanted to). At any one time, Silicon Chalk (V.2.5) could only record up to two live Windows applications and one notepad (along with the teacher narrations). Figures 5 and 6 were typical live-shots of a Silicon Chalk session showing two Windows applications: a PowerPoint slide show about 'Spectrometer Design' and an NSS session showing how to perform a spectrometry experiment 'live' on a selected machine vision station located in the WSI Lab and also a little Notepad for personal notes.

During a Silicon Chalk session, each student was

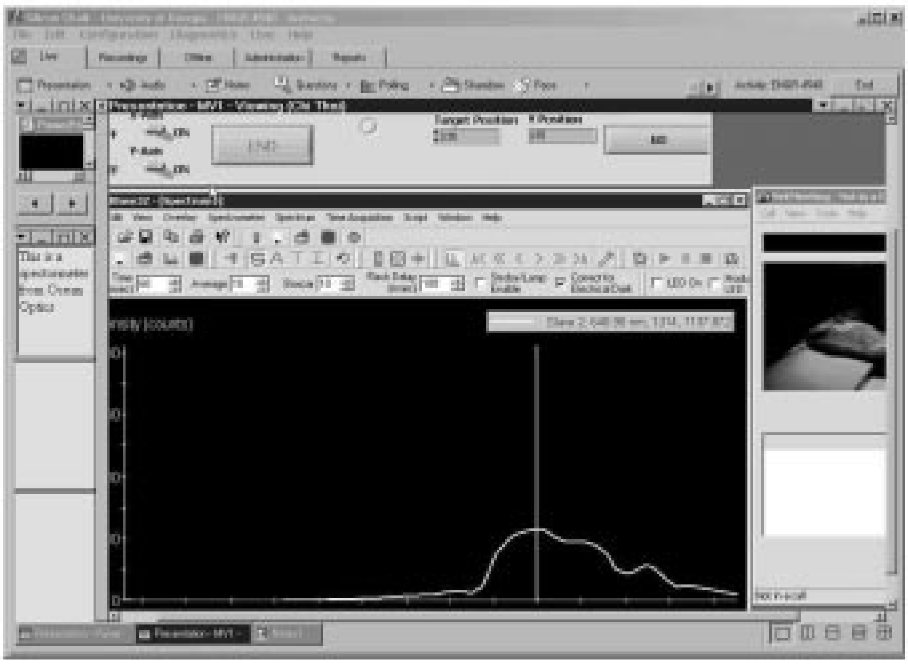

Fig. 6. Typical live screen record of a Silicon Chalk session for NetSupport School

free to add personal notes as needed on their PCs or leave the session at any time. After classes, students needed to copy their recordings (MP3 files) to a CD-R or Zip disk to bring home (typically an 18 minute long recording requires 57 MB). When students reviewed their personal recordings outside class, they could add new notes into the previously recorded session. Both Silicon Chalk and NetSupport Manager offered many other online tools, such as for surveying/polling, chatting/questioning, quiz distribution and evaluation, which will be evaluated for their performances in the near future. We did not plan to offer the live services of Silicon Chalk to the KU students due to the great distance involved, but planned to share with them the teacher's recordings.

PROJECT IMPLEMENTATION

This Machine Vision class was scheduled for Spring 2004 semester, but unfortunately no UGA students enrolled for this class, thus we could not report on UGA student feedback about the effectiveness of this instructional approach, but we did test our system on a medium-sized classroom with one teacher station and 12 student PCs. All PCs were identical and had a plain Pentium IV CPU at 2.53 GHz with 512 MB of RAM and a network card working at 100 Mbps. They were all connected to a 100 Mbps Ethernet switch that also connected to a remote computer, controlling machine vision equipment, on a 10 Mbps line. The student PCs were on Windows 2000, while the teacher station was on Windows 2003 Server Standard Edition. Our full operational condition was such that Silicon Chalk was broadcasting simultaneously to all 12 student PCs, two Windows sessions (one with PowerPoint slides and the other remotely controlling machine vision equipment via NetSupport Manager), along with an audio stream containing the instructor narrations, and all 12 student PCs were under the control of NetSupport School software. At this point, Windows Task Manager reported that 439 MB of RAM were used and that the CPU usage was about 38–40%. Whenever we switched to a new PowerPoint slide, the CPU usage would momentarily jumped to 52% then settled down back to 38–40%.

On the KU side, we also encountered implementation difficulties. By September 2003, the IT architecture as described in Fig. 1 was checked within the University of Georgia network and we ascertained that the proposed system was operational. In October 2003, Dr Kazuo Morita, Head of the KU cooperating Department of Environmental Science and Technology bought 10 networked laptops for KU students, and the project had also received acceptance from the KU International Committee. The next step was to request the KU Network Administration to open up several IP ports needed for the video conferencing and NetSupport software to work properly. The KU Network Administration response was that they needed to hire consultants to study the security risk of opening the KU firewall for the requested ports, and that we could expect their final response by mid-January 2004. However, the first day of class was already scheduled for 9 January 2004. At that point, the entire project was in jeopardy, but the KU students were still very enthusiastic about it. Consequently, the goal of the project drastically changed from the extensive system described in Fig. 1 to finding a way to do synchronous distance education from UGA to KU with minimal IT resources. By the end of October 2004, we had come up with a possible solution that was to teach into a desktop PC at one student apartment that had commercial cable modem services at a rate about 1 Mbps. But in early November 2004, author Thai had health problems and could not go to work until January 2, 2005, so we could not verify the feasibility of this solution until a few days before classes started on January 9. With a cable modem rate of 1 Mbps, we found out that we could not maintain video conferencing and NetSupport Manager at the same time. Fortunately, the NetSupport Manager suite had full-duplex audio support, thus the final solution was for author Thai to don an audio headset and to use NetSupport Control (NSC) software to transmit instructional materials to the student PC in Kagoshima, and to deliver lectures as normal, except that students and teacher could only hear each other. We also used the second software component NetSupport School (NSS) to exhibit to Kagoshima the desktop of a Tablet PC for those occasions that needed ad-hoc handwritten notes or the desktop of another remote networked computer when we wished to demonstrate our spectrometer or machine vision equipment. The following photographs should give the reader an idea of a typical class session. Figure 7 depicted the instructor station showing the Tablet

Fig. 7. Instructor station at UGA

Fig. 8. PC at student apartment (KU)

PC being used, with the main desktop in the back displaying the remote spectrometer in operation, while Fig. 8 depicted the student PC in Kagoshima displaying live hand-written notes from the instructor at UGA.

Figure 9 shows how students typically gathered around the PC for lectures; please note the positions of the keyboard in Figs 8 and 9 (bottom right), as they would give the reader an estimate of the size of the room.

As no local UGA students were enrolled for this class, there were only the seven graduate students from KU in this project as it was implemented. The biggest issue was the language problem as the live lecture was delivered in English; fortunately there were among the Kagoshima group two Tanzanian students who were fluent in English and they could explain back in Japanese difficult sections to their Japanese colleagues. By 20 February 2004, we'd had seven weeks of classes and finished the spectrometry part: the KU students then began their spring vacations. When they got back in April, we continued with the spectrometry web lab and got further along into the machine vision part of the course throughout the months of April and May.

Below are the results of various assessments and surveys done via WebCT for the first seven weeks of instruction. The WebCT pre-course survey showed both expected and unexpected results, and some are reported here:

(1) Most Japanese students were more comfortable with written English than with spoken English, consequently more hand-written notes were generated to explain more complex sections such as the 'Grating Equation' and 'Overlapping Diffraction Orders'.
(2) Most students agreed that they had good understanding of chemical concepts like atoms, electrons and molecules, and this turned out to be true as the class progressed.
(3) Regarding their understanding of multivariate integral and differential calculus, half agreed that they had a good understanding, while the other half disagreed, and it turned out that all of them had problems knowing when to apply properly the differential or integral approaches in solving a homework problem about Beer-Lambert Law (light absorption in optical materials).
(4) Most claimed that they did not have a good understanding of matrix algebra which would be important when we got into Image Processing, so students were told to review linear algebra during their spring vacations.

Fig. 9. KU student group attending lecture session

(5) The majority claimed poor understanding of trigonometry and geometry, but only one struggled through the homework about reflection and refraction laws. This also warned us to go through the Lens Theory section much more carefully in the future.

A formative course survey was given at the end of the first seven week-period; so far only two students completed the survey, making us wonder about how many would come back for class in April. However, the responses from these two students were encouraging:

(1) Class lengths were just right or a little short.
(2) The difficulty level and pace were just right.
(3) One 'strongly agreed' and the other 'agreed' that what they were learning in this class was relevant to their future careers as engineers.
(4) Group work and doing homework with a partner were found to be useful.
(5) The activities that help them learn best were the lectures and homework assignments.

CONCLUSIONS

Through the use of pervasive information technologies, we had shown that everyone could build an engineering instructional system merging seamlessly different functions such as lecture, software demonstration, remote operation of laboratory equipment, interactions among participants and recording of classroom activities. This system allowed learning to happen at different times and in different contexts and that, in a way, made the teacher available 24/7 at the students beckoning. There were some interesting and new issues like copyrights of the recordings: did they belong to UGA, the teacher or the students as everyone involved had some parts, great or small, in the recording itself? In effect, practically all barriers can be removed for the students in the mechanics of the delivery of the lecture/lab session, then would the students spend more time studying and learning or would they just let the recordings gather dust and just review them the night before a test?

We also had shown that the instructional technology model described in Fig. 1, which required extensive computer and Internet resources, could be adapted to an unplanned situation with minimal IT resources (e.g. minimum network rate of 1 Mbps) and still deliver the instructional contents needed. Recently, we found that we could extend the use of Silicon Chalk to overseas students as needed [15].

We found that synchronous and asynchronous (WebCT) facilities complemented each other in this distance education project.

Overall and so far, the KU students seemed to go through the materials at a slower rate as compared to their US counterparts from the Spring 2004 class. Thus we do not think that we can maintain a parallel pace between the UGA and KU classes in the future, unless only KU students fluent in English are allowed to take this class.

Acknowledgement—We wish to acknowledge the financial support from the UGA Learning Grant Programme and the help from the following staff of the UGA Office of Instructional Support and Development, Michele Estes, Frankie Jones and Li Zhu for the successful completion of this project.

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