Science Projects Seeking Dissemination Sites

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THE IMAGE PROCESSING FOR TEACHING PROJECT (IPT)

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Many students, perhaps most, are visual learners. For these people, manipulation of images provides a more attractive entree into science and mathematics than traditional language-based teaching. This is especially important for students from diverse linguistic or cultural backgrounds. Certainly, images convey information to the brain much faster than words or other "codes". Learning through image manipulation complements and enhances language-based instruction for all students.

What is Image Processing?

Image processing allows pictures of photographic quality to be manipulated through a computer. This new technology has been driven to a great extent by spacecraft exploration of the solar system and by biomedicine, and has advanced to the point where sophisticated systems are available for microcomputers.

The IPT Project

The Image Processing for Teaching project at the University of Arizona Department of Planetary Sciences is educating teachers in the technique and technology of image processing, and in the scientific content of a variety of data sets. Teachers are developing classroom activities for children in a wide range of grade and subject areas. Teachers and their students work with systems consisting of a Macintosh computer with a CD-ROM drive, the software "Image" developed by the National Institutes of Health, and extensive data sets of imagery.

During the pilot phase of the IPT project, funded by the National Science Foundation and Apple Computer, children have done digital image processing in over fifty schools, spanning a diversity of student bodies, types of schools, and geographical settings. Experiences at these test sites show that we have discovered an extremely effective way to excite children about science and mathematics. IPT may have the potential to revolutionize the way these subjects are taught.

We are now beginning the dissemination stage of the program in which we plan to begin nationwide teacher training and materials distribution. In order to meet the widespread demand from schools, teachers, and scientists for national dis-

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THE REMOTE ACCESS ASTRONOMY PROJECT

Philip Lubin, Physics Department, UCSB, Janet van der Veen, Physics Department, Adolfo Camarillo High School.

The UCSB Remote Access Astronomy Project (RAAP) grew out of experiences in teaching undergraduate astronomy. Students were generally very disappointed in their ability to "see" anything through the small telescopes used on the roof at night. Yet astronomy is one of the few sciences where everyone can participate with only a modest investment in modem technology. By coupling a large dynamic database of images to high speed dial up access and powerful, low cost microcomputers in the classroom with a small automated telescope and a state-of-the-art electronic imaging unit (cooled CCD camera), a qualitatively different way of teaching astronomy and physical principles was begun. In addition, by doing astronomy in the daytime and having a telescope take requests the next night automatically and returning images the next day, students can incorporate astronomy into a regular physics curricula.

Started in early 1988 and on-line since July 1990, the RAAP can be used in secondary schools in various ways. As part of a regular senior level physics class, the images and curricula work with a variety of physical concepts. Since very few schools dedicate a class to astronomy exclusively, the curricula are designed to fit into more general physics and other science classes. There are even biological related images and atomic force microscope images of DNA, atomic structure, etc. Geography is another area of potential interest desertification, annual foliage changes, etc.

A computer and modem were installed in the physics classroom at Adolfo Camarillo High School starting in the spring of 1991. It is now apparent that the combination of computer, modem, and high-quality images can be a very powerful motivator and pedagogical tool. Several students communicated with research staff at the university asking for help with their projects (which ranged from orbital mechanics to imaging techniques in medicine). In addition to the image processing program. A variety of other programs were also available, such as a stellar mapping program which uses the Yale Bright Star Catalog as its database, and a program to track positions of stars and planets. The students' responses to the new equipment were extremely positive.

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Remote Access Astronomy

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This year the computer and modem will form an integral part of the physics classes at Camarillo High. Plans for the computer include the use of a spreadsheet to graph data obtained with the more traditional labs from classical physics, as well as using the image processing program to incorporate astronomical images into the regular curriculum wherever possible. In addition, students will have the opportunity to design their own research projects which will include using the remote access telescope at U.C.S.B.

In addition to the large number of images available including Voyager planetary images, radio, infrared, optical and X-ray images, earth resource, Hubble and Keck telescope images, there are daily (more or less) updates of high resolution solar images allowing students to track sun spots and flares as well as study solar differential rotation. As new astronomical discoveries are made (eclipses, supernova, Hubble, Keck, etc.), new images are posted. In this way, the system is very dynamic and not just a dead archived dataset. It literally changes daily. For example, there are infrared images of the July 1991 eclipse taken from Mauna Kea, Hawaii allowing students to search for evidence of (still) hypothetical dust rings in close orbit near the sun. This type of data is very fresh (very few professional astronomers even have such data) allowing students a true sense of potential for discovery. In addition, curricula is available for downloading allowing teachers to immediately incorporate the RAAP into a physics curricula.

Perhaps the most important aspect of the system is that it allows the traditional classroom boundaries to be substantially expanded through the use of electronic mail which is integral. Teachers are not isolated on the system but can discuss problems and ideas with other teachers both of secondary schools and universities. Students also can (and do) take advantage of this aspect by communicating with other students sharing ideas, discoveries, etc.

As of January 92, six California schools are participating in the RAAP. The schools are Lick High in San Francisco, Santa Barbara and San Marcos High in Santa Barbara, the Santa Barbara Middle School (junior high), Camarillo High in Camarillo and Crossroads High in Santa Monica. We hope that as more schools join the bulletin board, students and teachers from all over the country, and perhaps overseas, will communicate with each other over the network.

The power of a system such as ours lies not only in the introduction of new data and technology into the classroom, but in changing the focus from the traditional lecture-lab-test method, in which all the answers are known ahead of time by the teacher, to a more student-directed and spontaneous approach, in which the classroom teacher is not the sole source of information, and often does not know the answers. With the modem and bulletin board, students' resources are extended to professors and graduate students at the university, and students and teachers at other high schools. The classroom is no longer an isolated entity, but part of a dynamic educational network - a classroom without walls in the electronic sense.

To utilize this technology effectively, the role of the teacher has to shift from being a controller to being a manager, with groups of students working cooperatively, perhaps even at different ability levels within the same classroom. There also needs to be flexibility on the part of school administrators not to pressure teachers into covering too much material too quickly, in order to allow time for extra activities.

We invite interested teachers who want more information or want to join the RAAP to contact:
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Requirements at the school are divided into two categories: low and high resolution. The recommended system is a 386 SX, 386, 486 SX or 486 IBM-PC or clone with math coprocessor, 4-8 MB of memory, mouse, SVGA display and a V.32/V.42 class modem. Such a system is currently about $1500 with 386 SX and $2500 with 486. A standard non-dedicated phone line is also needed. A minimum system would be a 286 IBM-AT or clone with math coprocessor, 640 KB memory, VGA display and 2400 baud modem (V.32/V.42 modem definitely recommended). The display resolution and student interface if far superior with the recommended system versus the minimum system. All the currently participating California schools use the recommended system. Display software is available from external sources.

Image Processing

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semination of IPT, we have established the Center for Image Processing in Education. This non-profit center is coordinating the efforts of participating scientists and expert teachers to support your science and mathematics education programs in several ways:

1. The Center provides in-service teacher training in image processing for use in the classroom.

A typical course arrangement for 12 to 16 teachers is a five-day workshop, with a team of two instructors and one assistant provided through the Center. The instructional staff are both technically expert and experienced in classroom curriculum design and implementation of IPT. Ordinarily the school district or sponsoring agency provides the workshop site, hardware and set-up. The workshop can be customized to emphasize any school subjects, grade levels, student interests, or special needs.

2. The Center provides image processing software, thousands of digital images from a variety of disciplines, and can provide activity units and curriculum materials in a range of subject areas.

It also has the expertise to develop custom materials to make particular scientific data sets accessible to schoolchildren, or to meet specialized curriculum needs.

3. The Center provides technical support and consulting services for educational program development and for developing special training courses or applications in image processing.

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