

# The remote access astronomy project: an example of a university/high school cooperative effort \*

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## *Abstract*

Lubin, P. and J. van der Veen, The remote access astronomy project: an example of a university/high school cooperative effort, *Education & Computing* 8 (1992) 79–82.

The Remote Access Astronomy Project is a unique computerized telescope and data distribution system that has the potential to change the way astronomical, earth science and physics concepts are taught to high school and undergraduate students. The project uses high resolution astronomical and earth resource images and image processing techniques that appeal to the natural curiosity young people have about space and astronomy as well as taking advantage of the familiarity of video imagery. In addition, particularly at the secondary school level, it serves as a forum for low cost and rapid distribution of curriculum materials among teachers and as an educational network between high schools and between high schools and universities.

By using a combination of high performance, low cost microcomputers, high resolution interactive graphics, high speed modem technology and data compression techniques, the project can break down the traditional learning boundaries in a classroom and allow students and teachers access to a much richer environment that is, in a sense, a classroom without walls. The graphics resolution achieved is near photographic at  $1024 \times 768$  pixels allowing us to have in the classroom a system that only five years ago would have cost roughly 25–50 K\$ but can be utilized for less than \$2500 today.

The system is currently undergoing testing at the undergraduate level at UCSB, at a number of California high schools and a junior high. The project is supported by the University of California, The National Science Foundation's Center for Particle Astrophysics and the National Aeronautics and Space Administration.

## Rationale behind the project

The Remote Access Astronomy Project at the University of California Santa Barbara originally developed out of a desire to improve astronomy education at the undergraduate level. Students were disappointed when they observed celestial objects with the small portable telescopes used in the astronomy labs. These objects appeared only

slightly better through small telescopes than with the naked eye, and looked nothing like the spectacular photographs taken with the large ground-based telescopes, that appear in astronomy text books. By mounting a very sensitive digital camera on the back of a 14-inch telescope, students could study stars, galaxies, planets, moons, nebulæ, and other interesting items in a more meaningful way. Moreover, by automating the telescope and installing it at a remote site away from parking-lot lights on the campus, students would not need to gather on the roof of the physics building late at night to do their observing.

\* This project was presented in the first session of the working conference. The following is a summary of the presentation.

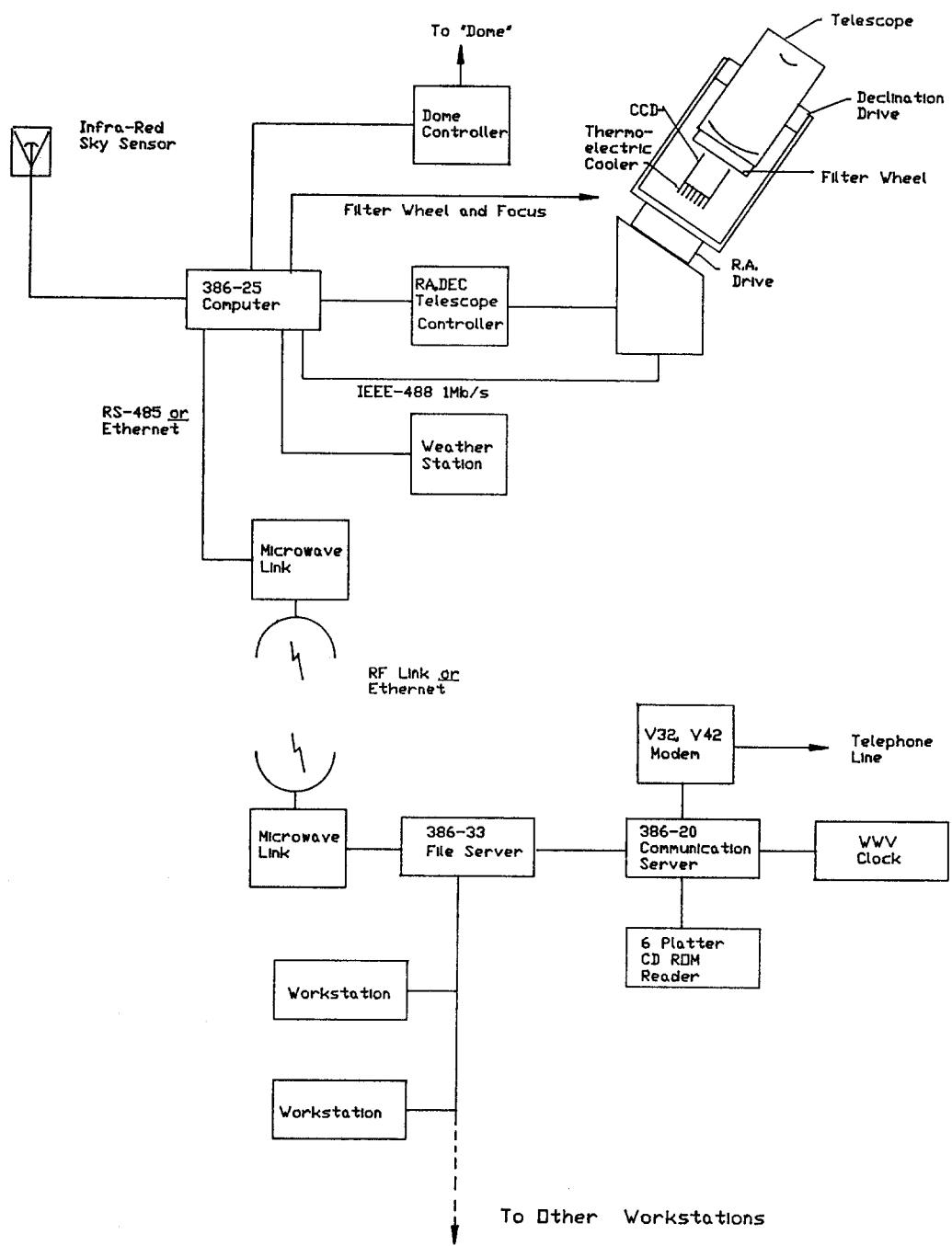


Fig. 1.

The project began three years ago, with a team of undergraduate students from the physics department at U.C.S.B with the aid of a staff tech-

nician, constructing the filters, weather station, and weather-proof dome for the telescope. A schematic of the system is shown in Fig. 1.

## Use of communication technology

Within the last decade, computer networks and electronic bulletin boards have become very popular. The technology already exists to extend access to our computer-controlled telescope to high schools, via a modem and telephone line connected to a computer at the university. In addition, a tremendous volume of high-quality images has recently become available through the NASA space missions (Voyager I and II, Magellan, Viking) and Earth-orbiting satellites (IRAS, Cires, the Hubble Space Telescope), and other sources. At the university, we have access to a wealth of data that are not generally accessible by high schools, but which could be used effectively by creative teachers in a variety of high school science classes. In July, 1990, we opened the ASTRO-RAAP bulletin board, with the goal of allowing high schools to access our astronomical database, issue observing requests to the telescope, and communicate with the university and with other high schools.

## Plans for the future

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 from 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, but not be limited to, using the remote access telescope at U.C.S.B.

As of August, 1991, three other California high schools have joined our bulletin board and have indicated their intent to use the system with physics and astronomy classes this fall. These schools are located in Santa Monica (near Los Angeles), San Francisco, and Santa Barbara. 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.

## Group research projects

A computer and modem were installed in the physics classroom at Adolfo Camarillo High School for the last three weeks of the 1991 school year. In this short time period, the students used it primarily to do group research projects, rather than as an integrated part of the normal curriculum. Even so, it was 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). Some students learned to manipulate images stored on disk with the image processing program. A variety of other programs were also available, such as a stellar mapping program which uses the Yale Bright Star Catalogue as its database, and a program to track positions of stars and planets. The students' responses to the new equipment were extremely positive.

## Co-operative education

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 co-operatively, 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 cover-

ing too much material too quickly, in order to allow time for extra activities.

Our high school physics course places a great deal of emphasis on weekly laboratory activities, with several construction projects and contests throughout the year, and a final research project—all of which are done in groups. The use of the computer and bulletin board within the existing structure will effectively make the role of the students even more active in the learning process.

The goal for the coming year is to have only one day per week in which the class is dominated by a teacher-centred lecture/ demonstration. Tuesday through Thursday students will work in groups to solve problems, the weekly lab assignment, and work on the computer. The teacher will make only short introductory presentations. Most of the time the teacher will circulate, helping small groups of students. On Friday students will present their solutions, data, and lab results to the rest of the class, with the teacher acting as a facilitator. Testing will be a necessary part of the program, but within this framework, students need not all take the same test, nor all be tested on the same day. Students with more advanced math skills may elect to use a college text instead of the high school one, studying chapters that cover the same material, but in more detail, and with the use of calculus.

There is necessarily quite a bit more preparation time for the teacher in planning curricular activities within such a structure, but the daily classroom routine becomes much more pleasant. Students retain more of the material because they are given the responsibility of acquiring knowledge, rather than being passively fed information. In a traditional lecture-based classroom,

a teacher often finds out too late that a student who has appeared attentive in fact has no grasp of the material. In a classroom where the teacher spends less time in front of the students, and more time among them, students who are having trouble are much more quickly discovered. Moreover, such students are much less intimidated to ask for help from their peers, or from the teacher if it is not done in front of the whole class.

Certainly we have seen that the rate at which we are acquiring knowledge increases far faster than textbooks can be updated. In the future, the emphases of our entire educational system may need to shift from the teacher-dominated, isolated classroom to more of an educational network in which students and teachers at all levels can communicate with and help each other.



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