1996

Creating Web Explorations In Science And Engineering

Lawrence Genalo
Iowa State University, genalo@iastate.edu

Christine Collier
Ames High School

Michelle Roberts
Graettinger High School

Julie Sandberg
Graettinger High School

Creating Web Explorations In Science And Engineering

Abstract
A summer internship program is held at Iowa State University each year for undergraduate and high school women in science and engineering fields. In the summer of 1995 two high school women in this program, co-authors Roberts and Sandberg, created world-wide-web based multimedia explorations into topics in science and engineering which are common in our daily lives. The prototype documents placed on the web were well researched and scientific explanations of the phenomena at hand, but explained so that the average 6th or 7th grader (the target audience) could understand them. These two students were directly supervised by an undergraduate woman, co-author Collier, herself a former intern in this program.

The purpose of the internship program is to give young women experience in research laboratories under the mentorship of an Iowa State professor, thereby solidifying their interest in SEM (Science, Engineering, and Mathematics) careers. This particular research project not only provided such a research experience for the two high school women but it also provided an internship in supervising researchers for the undergraduate student as well as allowing a mentoring relationship for all three students with a professor, co-author Genalo.

Disciplines
Curriculum and Instruction | Engineering Education | Online and Distance Education | Science and Mathematics Education

Comments
This is a conference proceeding from *Proceedings of the ASEE Annual Conference* (1996): 1. Posted with permission.

Creating Web Explorations in Science and Engineering

Lawrence J. Genalo, Christine Collier /Michelle Roberts/Julie Sandberg
Iowa State University / Ames High School/ Graettinger High School

A summer internship program is held at Iowa State University each year for undergraduate and high school women in science and engineering fields. In the summer of 1995 two high school women in this program, co-authors Roberts and Sandberg, created world-wide-web based multimedia explorations into topics in science and engineering which are common in our daily lives. The prototype documents placed on the web were well researched and scientific explanations of the phenomena at hand, but explained so that the average 6th or 7th grader (the target audience) could understand them. These two students were directly supervised by an undergraduate woman, co-author Collier, herself a former intern in this program.

The purpose of the internship program is to give young women experience in research laboratories under the mentorship of an Iowa State professor, thereby solidifying their interest in SEM (Science, Engineering, and Mathematics) careers. This particular research project not only provided such a research experience for the two high school women but it also provided an internship in supervising researchers for the undergraduate student as well as allowing a mentoring relationship for all three students with a professor, co-author Genalo.

Two specific web based multimedia documents were created. The first of these explains how airplanes fly. It includes graphic and verbal explanations as well as fill-motion video and numerous links to related documents. The second exploration is into the world of special effects in movies and how computers are used to create these images. An auxiliary product of this internship was a home page for the Program for Women in Science and Engineering (PWSE) at Iowa State, which was produced by the interns and linked to their documents.

Program for Women in Science and Engineering Summer Internship Program

The PWSE Summer Internship Program began offering paid research internships to both high school and undergraduate female students in 1987. The program allows talented high school women to explore research opportunities in science and engineering and to build their confidence in SEM related fields [1-3]. The students work independently on a research project with an ISU faculty member. The students complete a hands-on research project and present a formal paper and poster at the completion of the session. The high school students also agree to do a presentation for their home schools during their senior years.

The PWSE office administers pre and post event surveys of the interns and tracks their progress and attitudes [2,3]. A survey done by the PWSE office in 1993 reported that 68% of the respondents felt that the internship had furthered their interests in a career with science and engineering [3]. These findings demonstrate the success the program is having in promoting SEM career paths.

The Division of Engineering Fundamentals and Multidisciplinary Design (EFMD), under the mentorship of Dr. Genalo, had two high school interns create courseware for a local high school [2]. These interns were involved in creating interactive multimedia courseware for other high school students, thus adding another level to EFMD's outreach effort: students creating courseware for other students. EFMD continues to improve its recruiting programs for K-12 students by direct involvement in these programs. This program has helped to open new paths for bright students and has enlightened them, and those they touch, about the obstacles placed before women who embark on SEM careers. The following excerpt is from Julie Sandberg's final project report [4].

An Intern's Perspective

> In recent years, women have accomplished many things. They have gained acceptance into society, and are now welcome in almost every field of study. For some reason, however, women tend to avoid careers that depend on math, science, and technology. Women seem to feel incapable of performing the tasks involved with these jobs. Society must discover what is causing women to avoid choosing careers in science and engineering.
>
> There are many different theories about why women seem to avoid technological careers. One such theory is that women are discouraged from these careers in early grade school. It is thought that women leave high school feeling that they are incapable of participating in difficult math and science careers. This is a problem society needs to address. Many people believe the education system needs to be reformed. Some think segregated classes would be the answer. Since boys and girls learn differently, they believe the best way to encourage girls interested in science is to individualize the study between the sexes. The girls would learn more of the sciences, and the boys would work on communication skills. This, however, is a very questionable solution. Another possible solution, perhaps an even easier one to accomplish, is to encourage girls in science through early education [5]. An example of this is the SEER Project (Science Education for Equity Reform). This program is trying to teach science in school to elementary age children. By teaching them early in their school career, it is hoped that more children will become interested in science. According to John Rigden of the American Institute of Physics: "By high school, kids' attitudes about science are already set" [6, p 54]. Therefore, children may continue to be interested in science if they have been introduced to it at an early age. In a similar case, a school in Minneapolis has created a program in which fourth through sixth grade boys and girls were matched with women in science and math careers [7]. In the words of Suzette Hunt, career facilitator of Project Link: "Girls will be interested in science if they see people like them involved in it" [7, p58]. This program has two effects. Girls are inspired by having women role models in science, and boys become more aware of women in science [7]. These programs are trying to influence young girls into becoming interested in science and technology.

Other programs have different, yet corresponding, goals. These programs not only try to educate young girls, but they also encourage college age students, as well. The Program for Women in Science and Engineering (PWSE) at Iowa State University and other similar programs are trying to create opportunities for young women interested in science and engineering. The Program for Women in Science and Engineering accomplishes its goals through career conferences, scientific internships, and scholarships. PWSE also provides support for women in science and engineering (PWSE pamphlet). This as well as many other programs try to make women aware of the career possibilities for them in technological careers.

This World Wide Web project is very similar to all of these programs. Its goal is to encourage girls the age of eight and up to become involved in science and engineering. This project uses the World Wide Web to educate young girls about science and technology in a fun and interesting way. It introduces young people to computers and the intemet, while answering questions they may ask about the technological world. The World Wide Web pages that were created will educate girls about science subjects and will hopefully increase their interest in scientific topics. Through these Web pages, young girls will have the opportunity to explore their interests in science and engineering.

Summer 1995 Project

In June of 1995, two PWSE high school interns began developing a web exploration aimed at 7th grade girls entitled Airplanes for Kids under the direction of Dr. Lawrence Genalo and the supervision of Christine Collier. In order to gain familiarity with the Internet and HTML (Hyper-text Markup Language), a homepage for PWSE was created. The PWSE and Airplane page work went so well that another web document on Computers and Special Effects was created. The interns began their work with a general orientation to the computer facilities and an introduction to the web and html programming. Both interns received an account on the EFMD computer system so that they would have access to network resources. A description of the creative process, taken from Michelle Roberts final project report, follows [8].

Procedure

Creating documents for the WWW first requires an understanding of HTML(Hyper-text Markup Language). To begin this project it was necessary to read several manuals and help guides attained from a book store and the WWW. While HTML is not complex, it seems does seem confusing at first. The most helpful guides were Creating Cool Web Pages by Dave Taylor [9] and A Beginner's Guide to HTML [10]. Although the books were a tremendous asset, the best way to learn to write HTML documents is through experimentation. Before the actual project was attempted, several sample documents and a personal homepage were created. After this preliminary work was completed, the actual project began. The first step toward the creation of the page was to select and research a topic. The topic of how airplanes fly was selected and research was conducted based on what aspects of the science of flight would most likely interest children.

The first part of creating the actual page involved organizing the information in the most effective manner. A skeleton of what the page would later become was created by making headings of each of the main areas of emphasis. These headings made it simple to organize the

information by entering it in the correct section. During the construction of the text it became clear that graphics were needed to add more interest to the page. Graphics were downloaded from sites found on the WWW through searches, created using CorelDraw, or scanned in and then converted into the appropriate format. These graphics were used in conjunction with the text to create both an informative and attractive page.

This project moved much more swiftly than was originally anticipated, so the decision was made to create another similar page on computer-generated special effects. The same procedure as for the first page was repeated to create this page.

The PWSE homepage (figure 1) can be found at:
http: //www.public.iastate. edu/-pwse_info/homepage. htnd .

Airplane for Kids is an informative page instructing on how an airplane flies (figure 2), the parts of an airplane, the history of an airplane, pictures (figure 3), and a section on ornithopters. Most of the information is presented as text with pictures. One section, however, is presented in the form of an imagemap. In this section the viewer can click on the various parts of the airplane to see a description of that part (figure 4). This allows more text to be included while still appearing easy to read. *Airplanes for Kids can* be found at:
http: //www.public.iastate. edu/~pwse_info/airplane. html .

Computers and Special Effects is a similar page containing: what animation is, ways animation is used, how computer animation is created, and other ways of creating animation (figure 5). This page turned out to be very similar to *Airplane for Kids*, but was written at a slightly higher reading level. This Web page can be found at:
http: //www.public.iastate. edu/~pwse_info/effects. html .

Conclusions

The 1995 Summer Intern Project was a great success. The students involved worked independently and created well researched, interesting, multimedia web documents, These have been permanently placed on an Iowa State web server. The success of this prototype program has lead us to conclude that the effort should be expanded. The extension to other fields and topics in science and engineering is being planned. Funds are being sought to bring 20 more high school students to this program and to test the modules with the targeted audience.

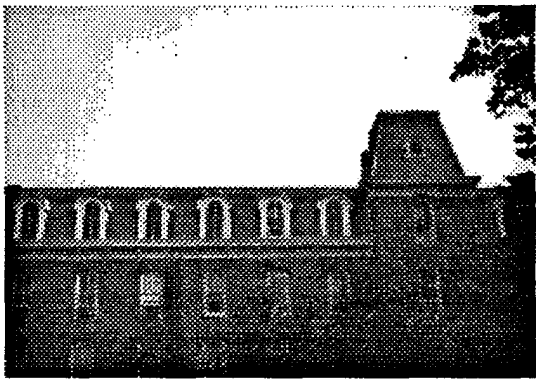
Acknowledgements

The authors wish to thank the Program for Women in Science and Engineering, the National Science Foundation, the Synthesis Coalition, ISU's College of Engineering, and the Division of Engineering Fundamentals for their support of this project.

IOWA STATE UNIVERSITY

PROGRAM FOR WOMEN IN SCIENCE AND ENGINEERING

About PWSE



The Program for Women in Science and Engineering is an administrative unit within the Provost's office at Iowa State University, dedicated to promoting participation of women and girls in science and technology related fields. On campus, PWSE organizes networking opportunities through social events, serve as a resource for information on educational and finding opportunities, arrange for mentoring by women students, faculty and staff, organize community outreach events to nurture girls' interest in science and math, sponsor seminars and speakers to enrich students' educational experience. The PWSE office is located in the historic Lab of Mechanics on the left.

Program Components

- **Career Conferences**
- **Role Model Visits by ISU Students and Professional Women in Iowa**
- **College Scholarships**
- **Paid Summer Research Internships**
- **On Campus Retention Activities**

Figure 1: The PWSE Homepage

What makes an airplane fly?

Created by Julie Sandberg and Michelle Roberts, two high school interns at Iowa State University in the Program for Women in Science and Engineering summer internship program.

Avery complicated question you've asked us, so we'll divide it into parts.

- **What does an airplane look like exactly?**
  (We know you know, but we wanted to show you some pictures)
- **How did airplanes become what they are today?**
- **What are the main parts of an airplane?**
- **How does something so heavy get into the air?**
- **Why** don't airplanes flap their wings?
- How could I build an airplane?
- A video of an airplane taking off!
  You need an AVI viewer to see it, and it will take a few minutes to load.
  Thanks to Jerohn Anderson and DeAntrious Mitchell for the footage of the airplane.

To get started, how about a poem about flying model airplanes?

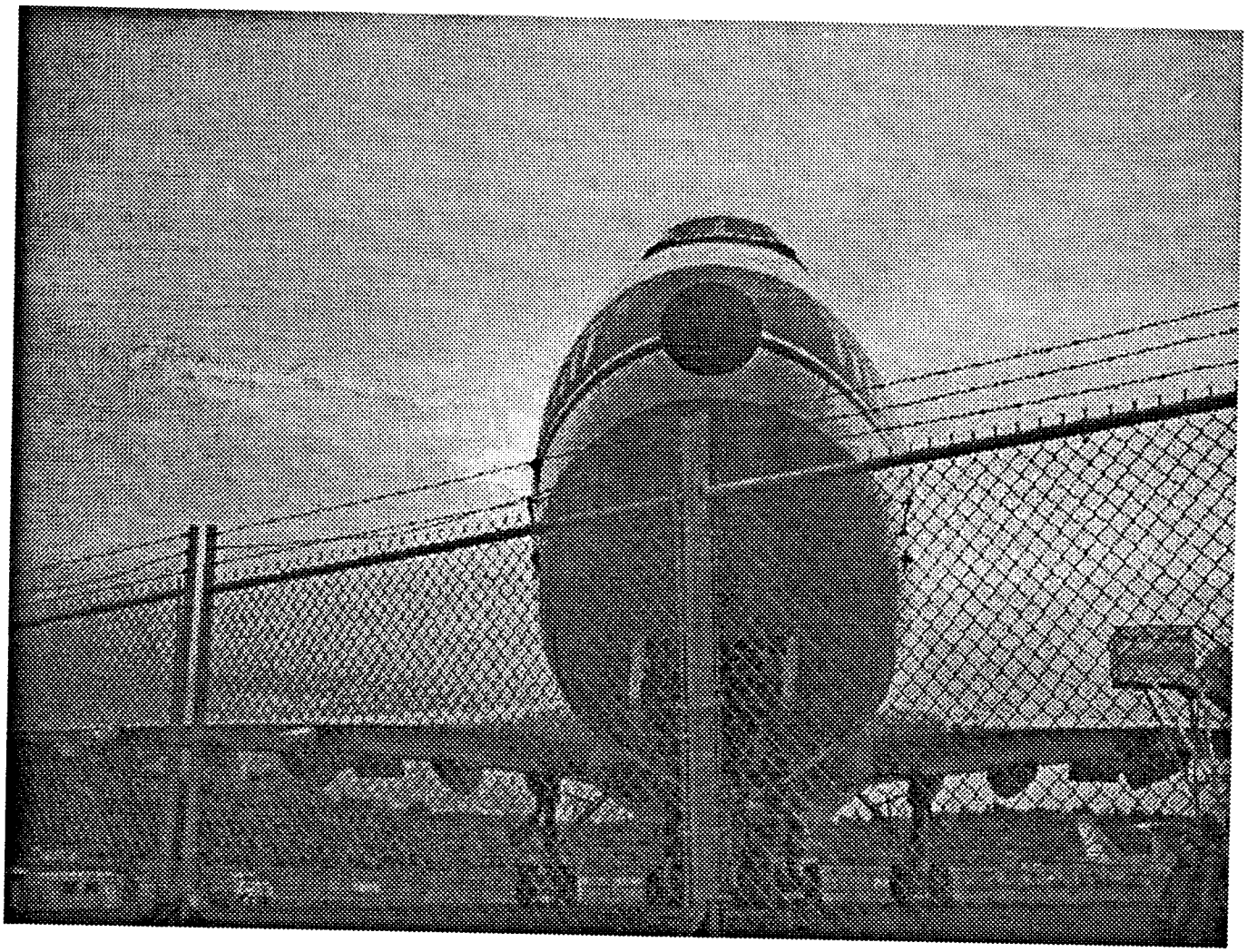
Airplane Pictures

We found some neat photos of airplanes we thought you might like. Some of them are kind of big so be ready for them to take awhile. If you don't see anything right away, try moving around with the arrow keys.

- **F-14 in banked flight**
- **B-57B in flight**
- **AD-1 in flight with wing sweep**
- **Controlled Impact Demonstration Crash**

There are literally thousands of more photos available.

Figure 2: "How an Airplane Flies" Homepage



igure 3: A Sample Airplane Picture

The Parts an Airplane Really Needs

Airplanes have many parts, but some of them are more necessary for flight than others.

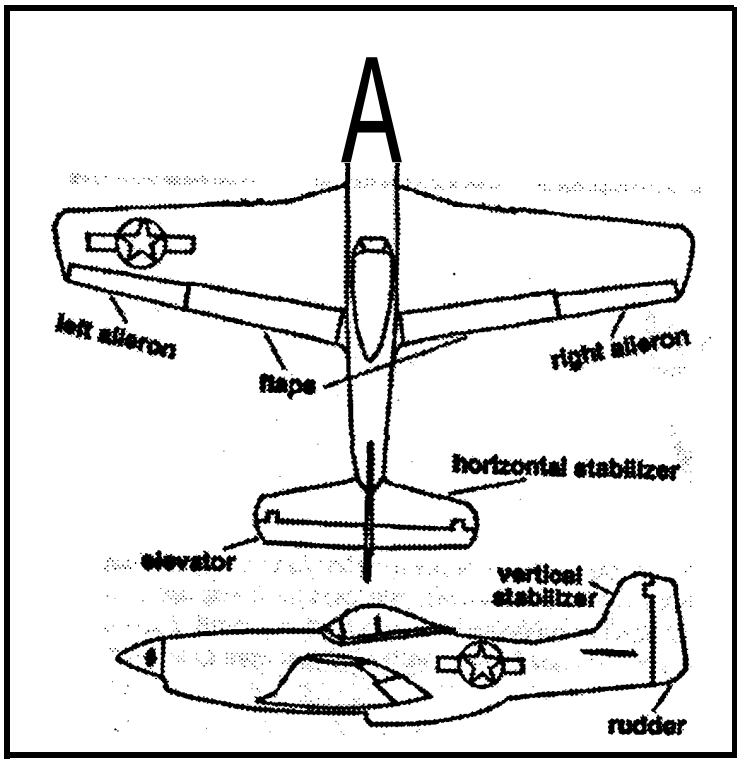
FUSELAGE

This is the main body of an airplane without the wings, tail, or power source.

WINGS

These provide the lift needed to lift the plane by pushing down on the air. The air pushes back with an equal force making the plane go up into the air.

This is all it really needs to get off the ground, but to keep it from crashing, these parts in the picture are helpful. Click on the name of each part to see a brief explanation of what it does.



These **devices may sound like** enough to get the plane flying, but once you are in the air, you **may** want to come down. For this purpose it is nice to have some landing gear.

Figure 4: The Airplane Image Map

How is computer-generated animation used in movies?

Created by **Julie** Sandberg and Michelle Roberts, two high school interns at Iowa State University in the Program for Women in Science and Engineering summer internship program.

_. This is such abroad question we have to break it into several questions to answer it.

- First of all, what is **computer-generated** animation and what can it be used for?
- What are some **examples** of movies that used this technique?
- What are the steps involved in **creating** this animation?
- What are some other techniques for creating animation and how do these compare to computer animation?

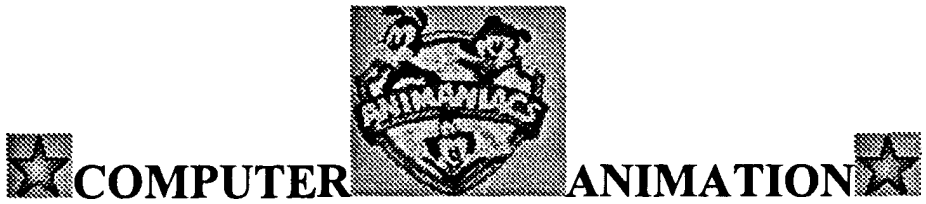


Figure 5: "Computers and Special Effects" HomePage

References

[1] Montgomery, Christine, "Summer Internships In Science and Engineering for High School Women," Proceedings of the ASEE Gulf-Southwest Section Meeting, pp. 454-460, April, 1993.

[2] Genalo, L. J., Windom, K. D., Jolly, S., and Semple, A., "K-12 Linkage for Women Engineers - Students Creating Courseware for Other Students," Proceedings of the ASEE Annual Conference, Vol 1, pp1033-1036, June, 1995.

[3] Evans, Mary Ann, "Summer Science and Technology Programs for Young Women," GASAT 7 International Conference Proceedings, Vol 1, pp. 490, August, 1993.

[4] Sandberg, Julie, Summer Intern Program Final Report, 1995.

[5]"Riveters to Rocket Scientists: Exploring the Gender Gap in Quantitative Fields." Change Nov./Dee. 1994:41-4.

[6] Kumagai, Jean. "St. Louis Program Pitches Science to Girls and Minorities (Project SEER)." Physics Today May 1991:54-5.

[7] Slom, Celia. "Encouraging Girls to Pursue Math and Science Careers." McCall's May 1990: 58+.

[8] Roberts, Michelle, Summer Intern Program Final Report, 1995.

[9] Taylor, Dave. Creating Cool Web Pages with HTML. Chicago: IDG Books Worldwide, Inc. 1995.

[10] A Beginner's Guide to HTML. National Center for Supercomputing Applications. http: //www.ncsa.uiuc. edu/General/Intemet/WWW/HTMLPrimer. html.

LAWRENCE J. GENALO
obtained his Ph.D. degree from Iowa State University in 1977 in Applied Mathematics. He has served ASEE as Program and Division Chair for Freshman Programs and DELOS. His current research interest is in bringing high-technology classroom delivery systems into greater use in engineering education through his work with the NSF-funded Synthesis Coalition.

CHRISTINE L. COLLIER
is an undergraduate student at Iowa State University pursuing a B, S. degree in Civil Engineering with an environmental emphasis. She is currently involved in the creation and upkeep of various World Wide Web homepages . Ms. Collier was a participant in the PWSE undergraduate internship at ISU in 1994, and became a supervisor for two PWSE interns in 1995.

MICHELLE ROBERTS
is a senior at Ames High School. She has been listed on the Honor Roll throughout high school and was named a National Merit Finalist. To recognize her excellence in athletics and academics, she was named to the Academic All-Conference Team. Ms. Roberts also participated in the Program for Women in Science and Engineering High School internship program during the summer of 1995.

JULIE SANDBERG
is a senior at Graettinger Community High School. Ms. Sandberg is valedictorian of her graduating class and the president of Graettinger's National Honor Society. She is a piano accompanist and is involved in band. Ms. Sandberg participated in the Program for Women in Science and Engineering High School internship program in 1995. Ms. Sandberg plans on pursuing a degree in chemical engineering.