Link-System For Internet Educational Materials In Physics

Japan Universities Association for Computer Education
Committee on the Application of Information Technologies in Physics Education

Tsunenori Suzuki [1], Shuichi Kawabata [2], Masami Fujiwara [3], Katsuaki Kasahara [4], Seiya Satake [5], Namio Matsuda [6] and Hiroshi Nagano[7]

1 Tokai University, Faculty of Science: E-mail suzuken@keyaki.cc.u-tokai.ac.jp
2 Tokyo Institute of Polytechnics, Faculty of Engineering: E-mail kawabata@gen.t-kougei.ac.jp
3 Nihon University, College of Engineering: E-mail fujiwara@ge.ce.nihon-u.ac.jp
4 Shibaura Institute of Technology, Faculty of Systems Engineering
5 Musashi Institute of Technology, Faculty of Engineering
6 Tokyo Denki University, College of Engineering
7 Asahi University, School of Dentistry

(1) Introduction

Japanese education is facing a difficult problem in that the educational level of students both at the high school level and the undergraduate level is gradually declining. It is very difficult to maintain the educational level of students who are going to college or university, because most junior high school students now enter senior high school with the entrance rate reaching 97% at preset in Japan. The Japanese Ministry of Education has begun to take action to keep a definite standard level of education in the high school. A reduction in the amount of the subjects and to allow schools more freedom in the curriculum are recommended for high school. Under the current situation, the ministry has recognized that multimedia education is one of the major issues in education. The Ministry of Education has distributed computers to elementary schools and high schools in order for the student to become familiar with the information technology. The subject concerning the information skills is going to be taught at senior high school from next year in Japan.

On the other hand, the use of computers in physics first began when the computer was invented. Applications of the computer in physics have grown with the development of the hardware and the algorithm of the computer. The physical phenomenon can be simulated on the computer and we can estimate what will happen in extreme conditions by using the computer. As a result, computational physics is equally established in both theoretical physics and experimental physics.

The computer is also a very useful tool in education. The simulations make it possible for the student to understand the physical phenomenon visually and intuitively in the education of physics. Many teachers have developed their own teaching materials individually and put them on their web sites on the Internet. But it can be very inconvenient to find resources due to the complex directory. We have constructed the link system to utilize the resources which are dispersed on the Internet. The link system is composed of the database, the collection of link of Internet physics and the search engine robot. We collected the URL directories of educational materials for physics on the Internet,

and the search engine robot checks and updates the URL directories.

(2) The link system of physics education

We have developed "the link collection of Internet physics" to utilize the educational materials for physics on the Internet. The link collection enables us to share teaching materials on WWW. We have built a tentative link collection to show how versatile it is.

The teaching materials consist of lecture notes and simulations of physics on WWW and are categorized. The collection covers the entire field of physics from elementary physics to exclusive physics. At present, the teaching materials are categorized into mechanics, electromagnetism, thermodynamics, quantum mechanics and experimental physics. The contents of the database contain the name of the authors of the teaching materials and their URL.

Figure 1 shows the top page for an experimental project and a page of links for the link collection of physics on the Internet. We have developed the experimental project that contains the following four areas.

(1) Collection of link related to physics on the Internet.
(2) CAI problems; To be able to utilize lectures.
(3) Physical simulations written in JAVA.
(4) Electronic sentence method of the educational materials by latex2html.

The page of the links related to physics is shown in fig.1(B), if the user clicks the buttons on this page, the display jumps to each category of physics. Moreover the left side of this page indicates each chapter and section, and the central part of this page indicates the links for educational materials. The items that users can click are the target page of the teaching materials and the top page of the materials' group.

(A) (B)

Fig.1 Home pages of the committee of computer education and research for physics.
(A) Experimental projects; The opening page of educational materials.
(B) Page of links of Internet physics.

Figure 2 shows the diagrams of the “Link System” for the educational materials of physics on the Internet. This “Link System” builds the database of educational material on the Web Server, and accumulates necessary data, for example the provider's name of the materials and its URL. The committee staff can modify those data and they can also update the data. The link collection of physics on the Internet has an advantage that the stacks of the directories is thin on WWW. If the URL of the provider changes, the access to the page is lost. To avoid such cases, the maintenance of

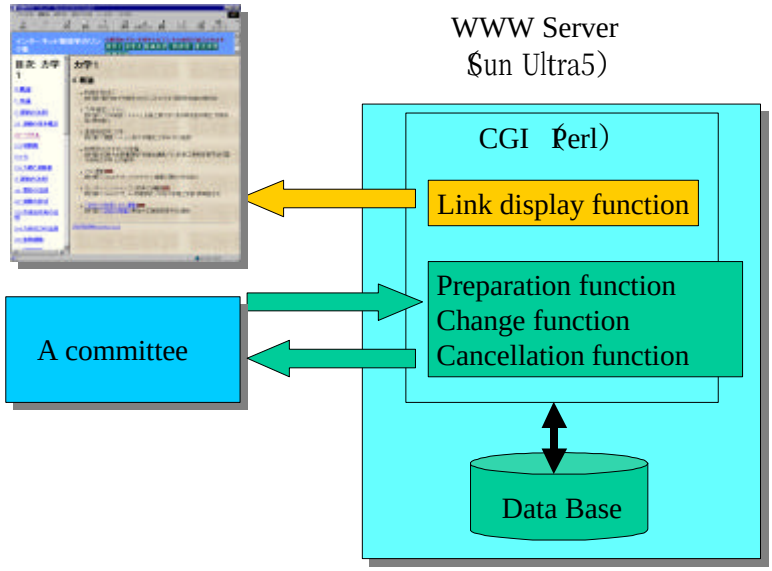

Fig.2 The diagrams of the link system for educational materials of Internet physics

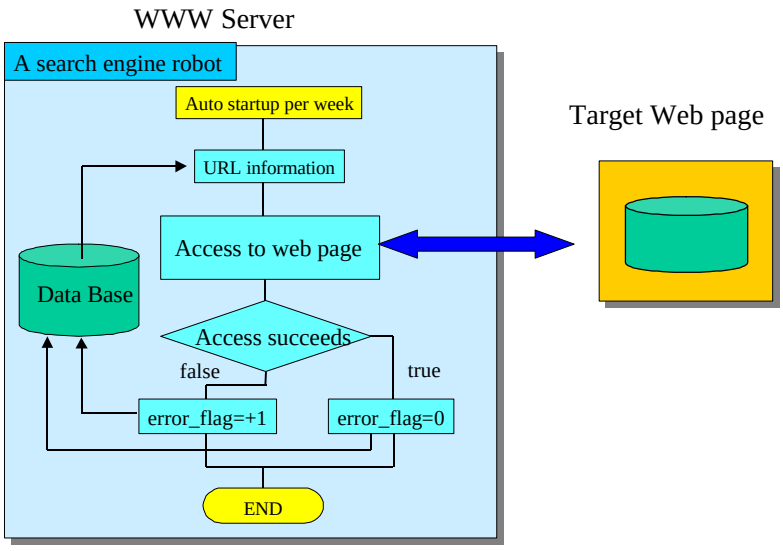

Fig.3 The diagrams of the search engine robot for link system of Internet physics

the database is indispensable. We developed the search engine robot that searches for the URL directories of the provider to check. By using it, any changes of URL directories is easily looked up, and we can keep the database update. Figure 3 shows the search engine robot. The search engine robot updates a new URL continually and connects it with our link collection and with the URL of the provider. The maintenance of the URL directories of teaching materials is accomplished automatically with a constant interval of a week by the search engine robot.

We will now introduce the simulations, which were developed by Mr. Masastoshi Ito of Meijo university. The title of the teaching material of physics is " a linear motion simulator". Figure 4 shows the top page of his teaching material that was made using JAVA. The simulator contains 10 themes from "free fall" to "The movement on the force of restoration with the displacement of the sin function type". Each theme consists of several sections that contain simulation and the users can change the parameters of the simulation.

As an example of the lecture on physics using HTML, we introduce the educational materials that were developed by Dr. S. Kawabata. These are the simulations and explanations of the contents for the introductory physics as shown in fig. 5. The topic begins with the basic explanation of physics and the operation of the simulation written in JAVA. The simulations of physics on LAN and Internet are closely related to the explanations of the contents. He obtained the results of a questionnaire about the lecture, which indicate that students have a great interest in the method of the lecture.

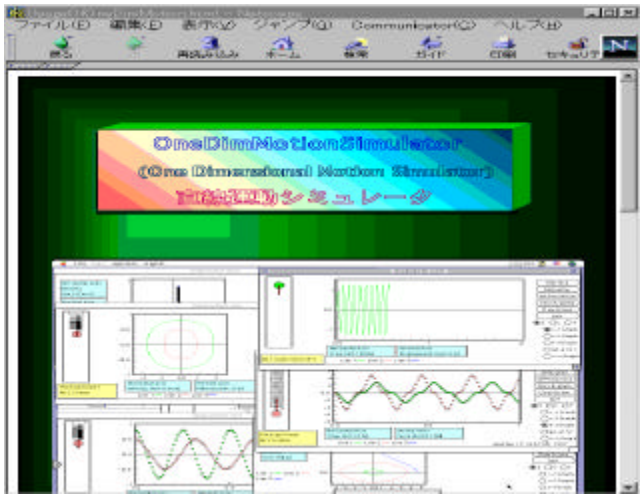

Fig.4. The linear motion simulator developed by Mr. M. Ito (Meijo university).

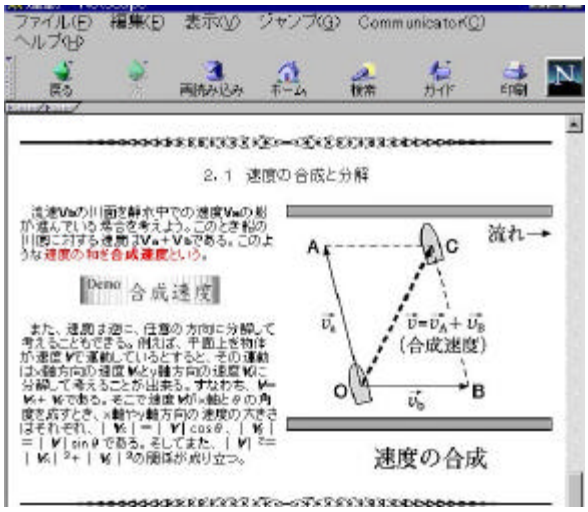

Fig.5. The explanation screen for the composition of velocity (Tokyo Institute of Polytechnics).

(3) Education using multimedia and the link collection

Japanese universities are carrying out a rapid reform of the method of teaching physics to correspond to the curriculum change of the high school. The number of applicants for entrance will decrease below the entrance capacity of all universities within several years, because the population

of eighteen-years-old in Japan is decreasing. Each university is seeking more attractive teaching methodologies, which can manage the serious problem of the student number decreasing. Each university is also addressing particular areas: To let superior students study at the upper grade (Chiba University and Teikyo University of Science and Technology). Teaching of students with a wide range of abilities by using a more attractive methodology and the teaching of problem finding/solving methods are also being discussed (Tokai University). The lectures which use not only the OHP but also the multimedia tool are coming up. Actually some of the universities, which are carrying out presentation as parts of the lecture, are assigned the use of "power point".

As an example of how multimedia is utilized for university education, we shall describe the type of lecture that Dr. S. Matsuura of Tokai University is now practicing. This lecture is in physics which is offered to the first year students of the Faculty of Engineering. Dr. S. Matsuura releases the power point file with the memo using his lecture on WWW. The students who take his lectures can access their attendance record and ask questions and check the progress conditions of learning, from WWW. On the web site, there is message board for maintaining communication between the teacher and students. Moreover the problem of the need for getting credits and related problems are being addressed on WWW.

We can execute such educational materials of physics through our link collection to Dr. S. Matsuura's home page. If the teacher has a personal computer of a notebook-type and liquid crystal projector and multimedia outlets, he/she can use the link collection in lectures. For example, if the teacher uses the simulation on WWW, he/she can explain the relationship between mathematical expression and phenomenon in physics visually. For individual use, the students can easily see the text reference and solve practice problems like CAI at any time and at any place.

Fig.6. The lecture scenery of CAI physics (Tokai university).

Figure 6 shows a lecture of introductory physics for first year students, which use the link collection. This lecture is titled " CAI physics". The main part of the lecture is the CAI system. This lecture forces the students to be active in the learning because the students must operate the computer for themselves. Details of physics phenomenon of the main theme are explained with a VTR at first. After the teacher's explanation, students operate the CAI system, and read the commentary of physics phenomenon, and answers the practice problem. As the lecture proceeds, the students occasionally carry out a small experiment in this lecture room. The students look up the background of the experiment by using our link collection and execute physical simulations. This kind of lectures is very effective in educational achievements, because these kinds of lectures attract student's interest through the use of the Internet and a student solves a practice problem by him or herself.

(4) Conclusion

We have constructed the URL directories of educational materials for physics on Internet using the link system. At present, we are intending to expand the link collection between us and the provider of educational materials. If the sources of the teaching materials are to be used openly, it is necessary to establish a moral and make clear the reliable connection between the user and the provider. There are descriptions about the conditions for linking to our web site, further we are discussing details about copyright and the right of use at the Japan University Association for Computer Education.