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Basic Education of CAD/CAM Through Multimedia and Network Aid

Tsutomu Araki

Department of Mechanical Engineering, Tsukuba College of Technology
Amakubo 4-3-15, Tsukuba, Japan
email: araki@a.tsukuba-tech.ac.jp

Abstract. In the Department of Mechanical Engineering, Tsukuba College of Technology, multimedia is used for presentation using computers as visually interactive intelligent teaching methods for hearing-impaired persons. In another multimedia method, the system is developed and used in education by visual sensing and bodily sensing for teaching materials suitable for hearing-impaired persons. In order to carry out the guidance on the education of "Machine Design and Drawing" and "CAD/CAM" for them smoothly and so as to be easily understandable, various devices have been made. At the same time, when used with a multimedia network system, the communication method is expanded in education, to broaden students' social horizon, and their desire to improve themselves. Furthermore collaborations with a sister school in the US and other schools in Japan by utilizing a network also creates opportunities. Sending and receiving CAD and multimedia data with visual communication on the computer screen via the internet is useful for the basic CAD/CAM education. The development and the study of a visually interactive education system, with the multimedia and teaching materials suitable for hearing-impaired students by using networks, and the results of the practice on education, are reported on.

Keywords: Basic Education of CAD/CAM, Multimedia, Network, Hearing-impaired.

1 Introduction

Tsukuba College of Technology was inaugurated as the only national advanced education organ of a 3-year system for the handicapped in Japan, and has carried out education and research activities in the departments related to auditory and visual senses. In the Department of Mechanical Engineering, education of students who have disabilities in the auditory sense has been carried out. And among the special subjects in this Department, "Machine Design and Drawing Seminar" and "CAD/CAM Practice" are becoming important subjects for such students who as well as those who have a very high possibility of finding employment. This is

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clear also from the results in the past several years of having sent graduates into society. At present, 50–60% of the students who got employment actually engage in the works related to CAD/CAM, and this tendency has become stronger judging from the state of the practice in companies this year. Therefore, the author considers that he would like to do education that is easy to teach and understand by students, and so that students acquire a special sense and utilize it in future applications. The efforts of the Department of Mechanical Engineering of this College are introduced. These efforts with the aid of multimedia and network, strive to realize the optimal education that becomes the base of special education for the students who are hearing-impaired.

2 Method

2.1 Background of utilizing multimedia

Generally, when the expression "utilize multimedia for education" is used, there is a tendency to consider it the ideal system for educating while presenting material which can be understood easily, by using a computer. However, the students in this College have grown up, entered schools and studied as their information by hearing was squeezed by the children who have defects in the auditory sense. Upon teaching those who have grown up in an educational environment without voice information, it is known that in receiving advanced education, they have suffered various hardships. There are some cases where even very common words, when they do not appear in printed form frequently, are missed entirely, even by university students. Not only in the words as language, but also living activities. Generally speaking, multimedia comprises all of the information of images, voices and others, and gives a splendid feeling. However, seeing the students who receive advanced education as simple knowledge is not inputted only because hearing information is lacking, and for aiming at social independence, they exert efforts very much to overcome the gap of thinking including general common sense, the fear that the sense of accumulating the creative experiences to make by themselves as bodily feeling drops out becomes very large. It is considered that students who are going to start an engineering career in the future, that multimedia education through bodily feeling to learn through whole senses may be necessary by all means. Thereupon, the development advances toward the basic education for machine design by teaching through practical approach such as the making of paper airplanes and paper cars by CAD. And further, the utilization of a network to effectively aid these tasks.

2.2 Environment of equipment of the network

This College is a college of technological course, and utilizes computers diversely. The LAN within the College connecting these computers is in almost all the rooms, that is, lecture rooms, experiment and practice rooms, offices, the living rooms of the dormitory in the College and others not to mention respective laboratories, information receptacles were equipped. Addresses were allotted to the computers that are connected to these information receptacles, at the center, the computer which becomes the server was set, thus the environment of the network was in order, and it started operation. Utilizing this LAN within the College has been useful for the communication and liaison with the Department of the Visually Impaired of this College, the campus of which is distant as Tsukuba University is located between them, not to mention the utilization within the Department of the Hearing Impaired. This resulted in the connection with the whole world through Internet, not only within the College.

2.3 System constitution

The machinery and equipment being used which are related to multimedia and the network are enumerated. They are used for efficient teaching, mainly centering around the utilization for CAD/CAM, and by transmitting CAD data and the data files of pictures, images and voices through the LAN within the College and Internet and visual communication including electronic mail. Besides, the dispatch of information began also from the home page of the World Wide Web, but in this report, enumeration is done as to the constitution of machinery and equipment as the client in the LAN within the College.

3 Practice of education

The experiential practice of drawing education aided by multimedia and the network is introduced. The teaching of CAD in which drawing is performed by using computers has been carried out for third year students in CAD/CAM practice so far. However, the special training for doing the practice in companies has been performed, and the number of the students who are assigned as the type of occupation suitable to the persons who have auditory defects increased, thus those results became experientially remarkable, and it was decided to strengthen the teaching. At present, from the third term of graphics exercise which is performed in first year, the teaching of the basic operation of CAD is begun. However at this stage, students scarcely learn special subjects, and it is too difficult to do machine drawing including machine elements for them, therefore, the drawing education in which the experiential multimedia through bodily feeling is taken so as to be able to learn the sense of using CAD begins.

3.1 Make and fly the Flying Seagull — the print explaining CAD concept

The print teaching material for learning and experiencing CAD concept. Let students grasp CAD concept by the explanation for 5 minutes, and image the function of CAD. It was written by Araki [1]. In Fig. 1 it is shown that an airplane can be made even with copying paper, and it is a teaching aid to the way of thinking for devising paper airplanes and paper cars thereafter.

3.2 Making of "paper airplane which is made with one sheet of postcard" by CAD

The conditions for making a paper airplane with a sheet of postcard size by CAD (Table 1). Under the condition of flying over the 7 m line for passing the test, remake airplanes until the condition is satisfied by effectively using CAD functions. For this remaking, of course CAD is utilized. The teaching material for learning the basic operation of CAD is studied before learning machine elements [2].

Table 1: Conditions for making a paper plane

1. *Making a paper plane from postcard-sized paper using CAD:* Using the functions of CAD which you have learned, make a paper plane which flies well. Make use of experimentally-learned CAD data and general ideas of CAD for the final product.
2. *Designing/Building conditions:*

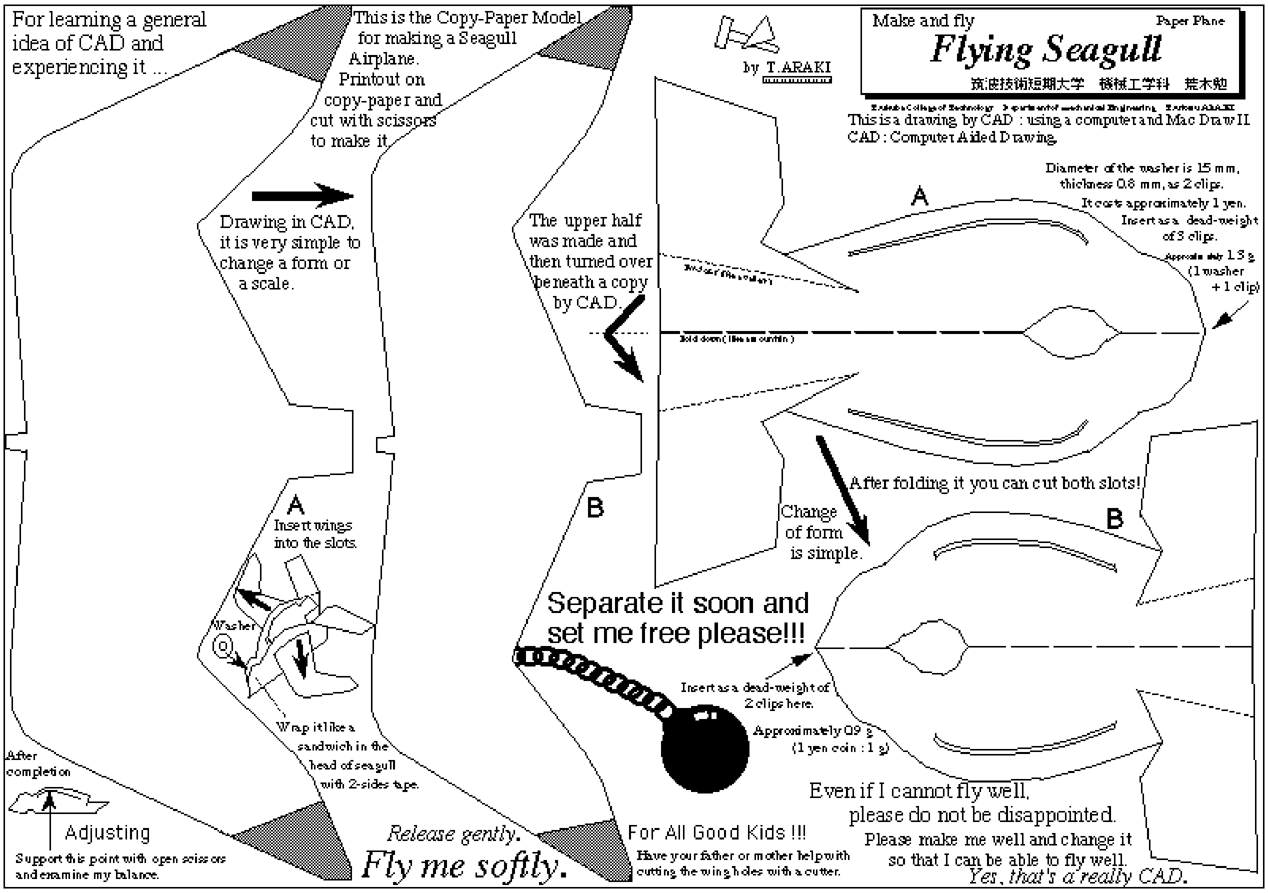

Figure 1: The print teaching material "Flying Seagull"

(a) CAD must be used to draw the paper plane parts. Please use CAD to make design changes.

(b) Drawing limit space is postcard size, and you must draw the parts on a postcard-sized Kent paper.

(c) For the weight and balance of the plane you may use paper clips or use Kent paper.

(d) The name of the school must be written on a wing and the name of the maker must be written on the body in conspicuous letters (alphabet).

(e) Choosing lines. Cutting line: wide line, Center line: alternate long and short dash lines, Bending line: broken line. Do not forget a tab for sticking space.

3. *Flight conditions:*

(a) Use the hand throw method for takeoff.

(b) Your paper airplane must fly over 7m on a level flight from the start point in a room.

— Try to make a good paper plane which flies well! —

3.3 Design, drawing and manufacture of display stand for airplane

After designing and making drawings by themselves, two students are paired, and read the drawings of each other and begin the making. If the method of drawing, the entry of dimensions and others are not correct, though it is known by himself, the partner cannot read it.

The drawings are inputted into a computer, and acrylic plates are cut by laser machining, thus the pedestals are made instantly (Fig. 2). Whether the drawings are made accurately or not and the quality of the planning, design and drawing can be confirmed by themselves accurately and in a short time is how the project is evaluated.

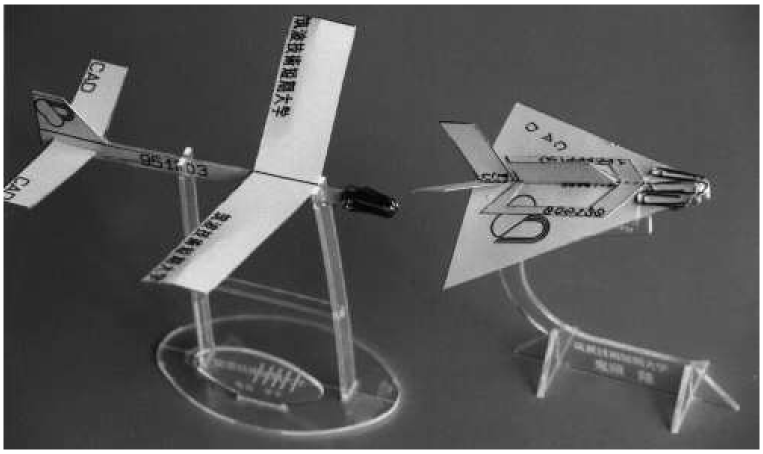

Figure 2: Paper planes on display stands

3.4 Making of paper cars (conditions)

The cars are made of Kent paper, of which the drawings are made by CAD, and the paper is cut out, pasted and assembled. Restrictions are placed on the size and the material, and it becomes one of the purposes of education to observe these restrictions (Table 2). Thanks to rival schools which are the opponents in the competition, the conditions for the making have come to be observed, and this has become a good place of interchange among universities. By the planning, design, making and investigation, even the optimization can be done.

Table 2: Conditions for making a paper car

1. *Rules of construction and competition:* Assume paper car company has access to the following materials only. Each person will produce one paper car. (There may be components that you do not use.)
   - (a) Mabuchi FA130 motor — 1 and a plastics pulley for motor shaft — 1
   - (b) A 2-cell AA Battery Box — 1 (Each person obtains AA batteries, 1.5-volt SUM-3 type)
   - (c) 2 colored wires for wiring
   - (d) Wooden dowel for axle. Diameter choices 5, 8, or 10 mm.
   - (e) Thumb tack (to attach wheel to axle)
   - (f) Kent paper (size A3, as many sheets as needed)
   - (g) A rubber band (of your choice)
   - (h) Cementing bond (of your choice)
2. *Paper car must meet the following conditions:*
   - (a) Maximum length 200 mm, Maximum breadth 200 mm, height is free.

(b) Contact between the car and corridor floor will be Kent paper ONLY. No other material will be allowed to touch the floor.

(c) A rubber band only is used for transmission of power — from the electric motor to the drive wheel or wheels, and the rubber band may not contact the floor.

(d) May use wooden dowel as an axis for the wheels and/or for power transmission.

3. *Time race:* The course is a straight line 15 m long. The car that covers the 15 m in the shortest time wins.
— Make use of the functions of CAD and carry out design drafting to make the fastest paper car! —

3.5 Homepage of this college published in World Wide Web on Internet

The paper car race was taken up as news in the home page of this College, and has been widely opened to the public. Furthermore, students summarized their own tasks in the special research, registered to take part in the event of 24 HOURS in Cyberspace sent out from USA, printed as an invitation to participate in the paper car race, and joined other university studentsacross the world. The tasks that are most advanced in the world heightens the conscientiousness of students, and produces a splendid educational effect (Fig. 3).

3.6 Collaboration in education through multimedia and the network

The drawings made by CAD which are those of paper airplanes or paper cars can be utilized as drawing data. At the time of the paper car race, in cooperation with the teachers at the sister school in USA, National Technical Institute for the Deaf (NTID), the drawings for making paper cars of American students which were transmitted through Internet have come (Fig. 4). Students assembled them, and participated in the race of this College and Tokyo Kaseigakuin Tsukuba Junior College, and brought excitement to the people at the site.

3.7 Machining by computer control which is learned by modeling

The teachers who actually manufacture automobiles come from Mitsubishi Motor Corporation for lectures on CAD/CAM. A enthusiastic education is carried out while conveying sufficiently the atmosphere of the company to students. This is the first step to becoming a professional engineer. Students study using easy-to-understand modeling methods through this CAD/CAM practice (Fig. 5). Students learned by actually operating machines, via and “experience-oriented education” It is very useful to get a good creative sense for them [3]. As described above, a series of the flow is made, experiences are piled up in proper order, and guidance is carried out so as to be understood easily.

4 Conclusion

The education of heretofore served the purpose by considering only the matters of the students who are in the custody of teachers within a school, but at present, as the home page of this College was published in the World Wide Web, and the form of opening the door and offering information toward the whole world began to be adopted, the necessity of considering from wider standpoint has arisen. It became possible indeed as the form of multimedia is taken, and it was able to introduce the task with CAD education through bodily feeling from this home page as an example of practicing design and drawing education in the Department of

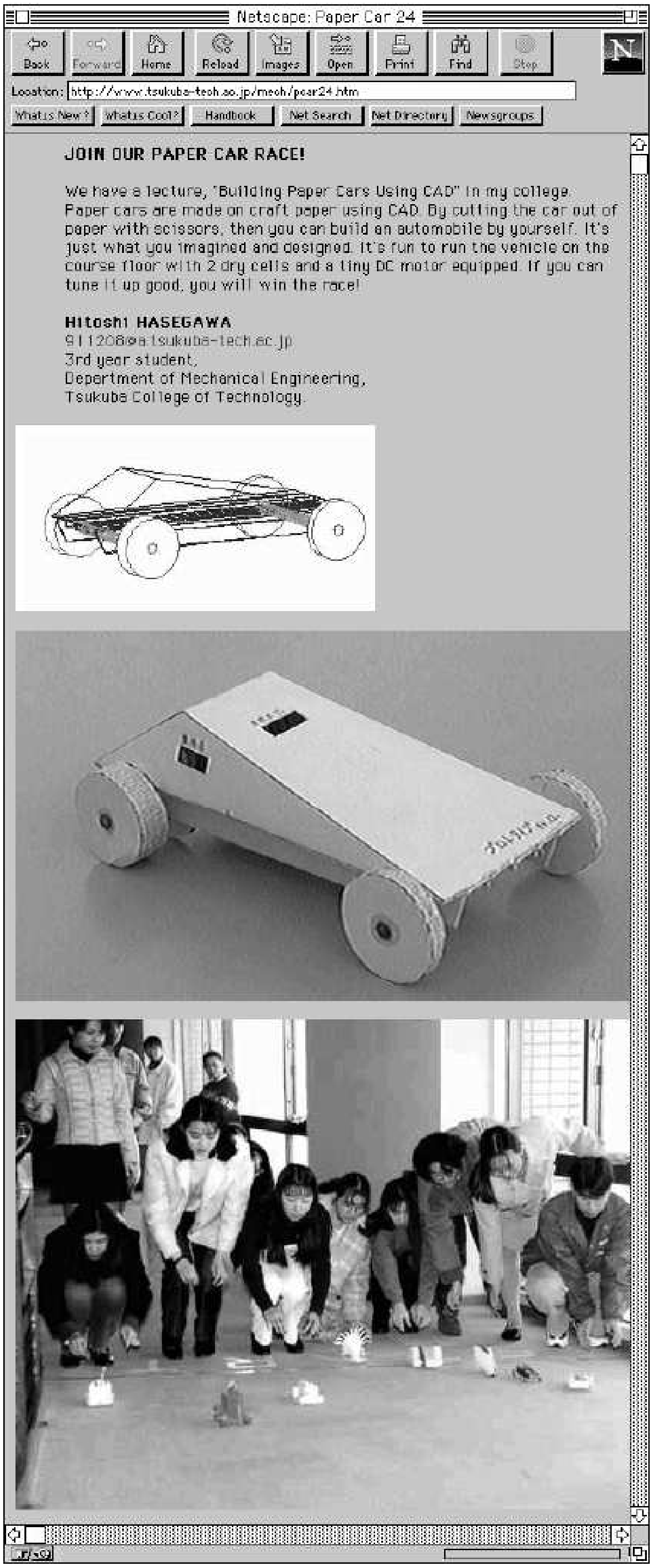

Figure 3: Student's page of TCT

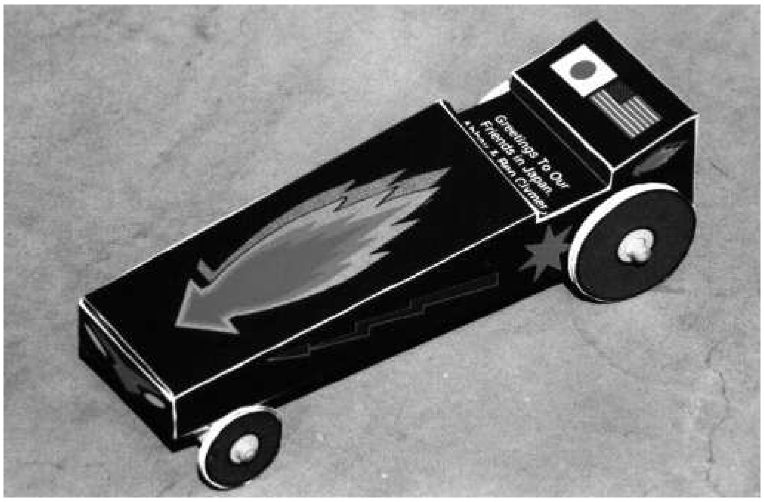

Figure 4: An American student's paper car which was sent via the Internet as a computer data

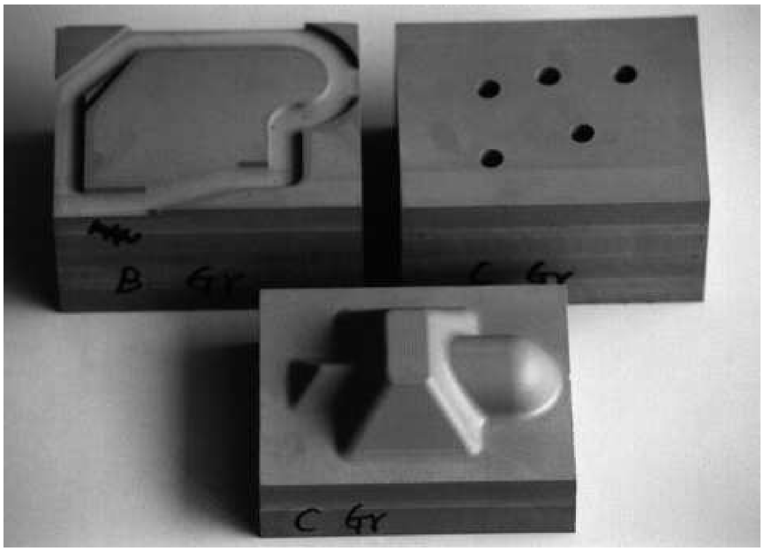

Figure 5: Utilizing easy-to-understand modeling method

Mechanical Engineering, as the results of paper car race of "Making of paper cars by CAD". Further, through the page made by students, participation in the paper car race of this College is invited from allover the world. Education by collaboration with the sister school and rival schools obtained excellent results as interchange education, and the extension of the range of an education system up to education support by specialists in an enterprise and international education support through multimedia and Internet is shown. There were also opportunities such that students performed visual telecommunication through the network with the people who made connection th rough Internet to the computer in the CAD/CAM room. The opportunity of having relation with the surrounding in various forms and making PR of this College is clearly increasing. In order to grasp firmly the standpoint of this College and to have people understand correctly the existence and role of this College and even the form of teaching, the age in which information must be shown in person positively has come. As for this, not only teachers but also students themselves must have a similar conscience. The facts of reflecting such interchange and information exchange to the education in this College and developing better guidance offer a good chance for students to obtain social awareness and to gain independence in society. It is also the first step of starting from the world of the hearing-impaired education into real society. Moreover, it is added that this research is titled "Design and drawing education system by the aid of multimedia and the network suitable to these who have defects in the auditory sense", and was carried out by accepting the Grant-in-Aid for Scientific Research (C) (subject No. 07808021) of The Ministry of Education, Science, Sports and Culture in fiscal year 1995.

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