DOCUMENT RESUME

ED 303 666 CE 051 951

AUTHOR Fang, Rong-Jyue; Kuo, Shin-Gia
TITLE A Study of Integrated Instruction for Flexible Manufacturing Systems.
PUB DATE 5 Dec 88
NOTE 15p.; Paper presented at the American Vocational Association Convention (St. Louis, MO, December 5, 1988).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction; *Computer Oriented Programs; Computer Simulation; Foreign Countries; *Manufacturing; Manufacturing Industry; Material Development; Online Systems; Postsecondary Education; *Trade and Industrial Education
IDENTIFIERS *Computer Integrated Manufacturing; *Taiwan

ABSTRACT

A study was undertaken to develop hardware and software to help students learn the operation of real production lines and imitate them without disturbing the actual working of the production line. The study also identified major research topics according to the list of eight major technologies targeted by the Taiwanese government and considered the resources available to be used in the research. Another focus was the setting of instructional goals compatible with industrial needs and skills. Success of the instructional process was measured by student application of skills and knowledge in other situations. Manufacturer input was solicited for design of the training equipment to ensure the actual use of the machines within the manufacturing industry. Computer-assisted instruction was recommended for training for flexible manufacturing systems. The project itself used an image process camera to aid the student learning through a simulation. Computer-assisted instruction was found to be necessary to train students for the computer-integrated manufacturing systems being adopted by the manufacturing industry. (YLB)

A Study of Integrated Instruction For Flexible Manufacturing Systems

Presenter: Rong-Jyue Fang

(This paper is prepared by Dr. Rong-Jyue Fang Asso. Prof. &
Dr. Shin-Gia Kuo Asso. Prof.
Industrial Education Department
National Kaohsiung Teachers' College
Kaohsiung, Taiwan Republic Of China)

I. Introduction

Mass production, applying diverse manufacturing machine tool techniques, may eliminate some factory employees. High technological development and Flexible Manufacturing Systems (FMS) eliminate the chances for stoppage and lead man power training to a bottle neck. The worst situation, however, is that high technologies usually go with "high take" which means much higher costs than the traditional operations and set all production lines in a non-stop condition. Hence, the chances for learning the operation of these highly technological machines become a very unreasonable possibility. How to adapt the training procedure to a real production line is the critical question.

This study intends to develop hardware and software to

help students learn operations and immitate real production lines without disturbing its original work. Trainees also can see through the whole process at the same time and learn their own operation at their own speed. This study also develops the following to facilitate instruction and learning.

1. Applied FMS machine tool(built by Industrial Education Department of National Kaohsiung Teachers' college) to communicate with microcomputers.
2. Expand interactive instructional software.
3. Creation and evaluation of integrated instruction which includes:
   a. Arrange a cooperative learning process.
   b. Provide self-paced learning module.
   c. Interact trainees, trainers, and the machine.
   d. Evaluate the whole instruction process.
   e. Revise the software and hardware.

II. Combine Instructional Trends and Community Resources

The former President of The Republic of China, Mr. Chiang, Chin-Kuo stressed in a Treasury Meeting November 6th, 1984:"... in recent years, all highly developed countries do emphasize efforts on informatics, electronics, communication technologies, material science, and bionics;

make a great social and economic impacts to the global village. Which encourages developing and under-developed countries all set forward on these subjects as a tool to upward their technologies and industrial levels. We need to go further in these areas. All related divisions shall do the best to train more science and technology persons; to apply technological resources effectively; to encourge more investment in research and development; to motivate institutions and academic research divisions in cooperate with private enterprise; to access in R&D of these major technologies."

Thereafter, the government assigned Energy, Material Science, Informatics, Automation, Bionics, Laser Technologies, Food Processing, Prevention and Protection of Liver Disease, as eight major technologies. Among these eight major technologies "Informatics" has played a very important role in all other major technologies. Cost effect and quality mass production are both directly or indirectly related to informatic technology. Because of the advantage of its effectiveness quality education, with no exception, should use computers.

Education is a tool of human development; a school provides a versatile environment. Educators and schools no longer are the only resources of learning; many social institutes and working places also provide good information service and function as educational resources; the essence

of education changes rapidly and life long learning merges to the surface of the learning cycle.

Technological changes, pushing the improvements of a working environment, also indicate a highly flexible working social strata. To cope with these rapid and flexible changes, traditional education and a limited study source is not an efficient and capable method of training effectively. A well organized community resources and computerized learning environment will be the right answer to social changes.

Therefore, this study organized major research topics according to the list of eight major technologies and considered the abilities and resources that can and cannot be accomplished. Among all this configuration, however, some research centers also have their own concentration. For example, the Mechanical Research Institute of Industrial Research Yuan identified twelve major topics according to the needs of this nation, they are:

1. Nummerical studies in surface/solid modelling and numerical control
2. Utility designs in a CAD/CAM software
3. Chinese information processing
4. Image processing
5. Low cost three dimension coordinates CAD input system
6. Nickel soakage etching system

7. Carbon dioxide laser axially discharger dischage phenomena
8. Cutting techniques of carbon dioxide laser
9. Thermal control of PID tuning technique
10. Low temperature fluid (LHe/LN2) characters of two phase thermal conduct
11. The effect of suspending system of turning motorcycle to driver control
12. The mechanism of connecting rod and cam combination converting lead screw

There are sub-topics under each of this twelve topics. Universities and colleges could organize their course content to involve students in this research. NKTC Industrial Education department considers it a great opportunity as a community resource. Some faculty members have applied for grants on one or two of these topics and work through several courses such as: industria. automation, microcomputer interfacing, microprocessor, assembly language, manufacturing process, ...etc. One of the technological courses, on industrial technological project, pushes students to combine their learning through a final project. Students have to design an industrial education related project and get the approval of their advisor. Some of students under this challenge are willing to learn more. They volunteer to join other research projects which could have been funded by research

institutes.

This research need is evident for the following reasons:

1. CNC is too expensive for schools.
2. Most CNC controllers are imported. Dealers don't support hardware input or output information. The only way to learn is to follow instructions.
3. The current CNC machine are mostly designed for manufacturing factories. They are not designed for instructional purposes.
4. There is poor convertibility and compatibility between different CNC machine tools.
5. The CNC softwares are not compatible with graphics.
6. All CNC machine tools don't have instructions and is not applicable in Chinese.

III. Set Instructional Goal

Current industrial processing software use control codes supported by the manufacturer, such as: G code, APT, interactive language,...etc. Following instruction one will be able to produce whatever is needed; this is good for the manufacturer but for a school setting or training unit the actual cutting process and further control technique is needed. Hence, the chance of further improvement and re-design will be impossible. This research will try to

make users develop their own system and software, to control their own software by graphic input, to control by communication, to monitor and remote control by handshake communication. This could provide the manufacturer a concept that an out-connected microcomputers NC machine will be able to expand regarding capabilities, memory, and management.

Instruction must coordinate with practical life; also its goals must be compatible. Teachers coordination among courses become a very important matter. This department provides courses for high school teachers. They have to understand the concept of automation in order to cope with a rapidly changing technological society. While training teachers, the national trends, community needs, and instructional goals must go together. The "automation industry" course of this department provides the following instructional goal:

COGNITIVE:

1. Understanding definition of industrial automation
2. Understanding the effect of automation and economic development
3. Understanding the need of automation and its trends
4. Familiarity with automation equipment usually encountered
5. Familiarity with equipment operation and related terms

6. Analyze, apply, and comprehend industrial automation concepts

AFFECTIVE:

1. Explain relationship between industrial automation and environment protection
2. Explain personal perspective of automation
3. Analyze industrial automation and its relationship with social changes
4. Have personal perspective of automation
5. Analyze problems and suggest personal solution

PSYCHOMOTOR:

1. Capable of operating automation equipment usually encountered
2. Being able to disassemble, assemble automation equipment usually encountered
3. Capable of maintaining automation equipment
4. Capable of analyzing and designing basic automation equipment

IV. Confirmation Of Instructional Process

The instructional goal setting has a limitation, the necessity to make sure it goes as planned and is coordinated with other courses. Industrial technological project is the major support. Students of Industrial Education must prove they are capble of working on a project by composing what

they have learned through four years of education. Among all of senior students in 1986, two of them volunteered for the manufacturing of CNC lathe and milling machine; in 1987, two more senior students volunteered for Unmanned loading car, automated press unit, quick die change unit; also two senior students in 1988 are willing to be involved in the process of image processing and make the whole system more integrated.

An IBM PC-AT, compitable as monitor, processes like a CAD computer. After simulation is done its output is directly sent to a lathe, milling machine, unmanned loading car, automated press unit, and quick die change unit. A monitor could catch its processing status, take over controller computer and remote control manufacturing process which lead to a great advantage in manufacturing in that it can go with or without controller. Its configuration is organized as Figure -- A.

To apply IBM PC-AT microcomputer as controller is a low cost, easy to learn, high potential of expansion equipment. This research using a graphic input process, combined with CAD/CAM, makes CNC operation an easy task. For efficiecy, well organized management system could be developed to manage more manufacturing cells.

After completing this approach, students are capable of developing their own automation system. One special case is that two NKTC IED graduates took responsibility for the

development of automation equipment for Taiwan provincial government for the purpose of setting instructional needs.

V. Performance of Cooperative Education

In a fairly good facility if not well maintained and used very often, the cost-effect ratio might decrease its development and is an investment waste. Although, this research project is developed under an instructional purpose, it still quests the needs of the manufacturer to make sure that this equipment won't be a waste after the project is done. The same equipment may be mass reproduced by the factories to improve their production quality. When encountered with technical problems manufacturer and research institutes are willing to invest time and money to solve problems. By the coordination among manufacturer and research institutes, the first part of this research project has been accomplished smoothly in the last two years.

VI. Transfer To Instructional Media

Manufacturing tools must be easy to learn and have great compatibility. Therefore, its operation must be standardized; its communication must be very easy. FMS is the right tool for manufacturing but ts instruction in education is almost impossible due to the expensive cost of

manufacturing. Computer aid instruction will be the right tools in solving this problem. Simulator of FMS usually is an expensive but poorly designed drill and practice software.

This project intends to utilize an image process camera to send manufacturing process to monitor; thus, when learned through simulation learner still will be able to watch the on going machine and monitor the controller. If necessary, student could apply for the operation and go through a priority check. Because they could have an opportunity to remote control the real FMS and watch through their own monitor.

VII. Performance of Integrated Instruction

Computer-integrated manufacturing system (CIMS) is now the major theme of the manufacturing industry. It consists of: artificial intelligent, computer planning, numerical control, data base, expert system, FMS, data flow, real time, material planning, schecduled and flexible control, robotics, ..etc. All of these related subjects are aimed at improving manufacture; they combine all possible resources to make software and hardware configuration closer to manufacturing needs.

First, this study is aimed at encouraging students to be involved in national construction needs; next, target to

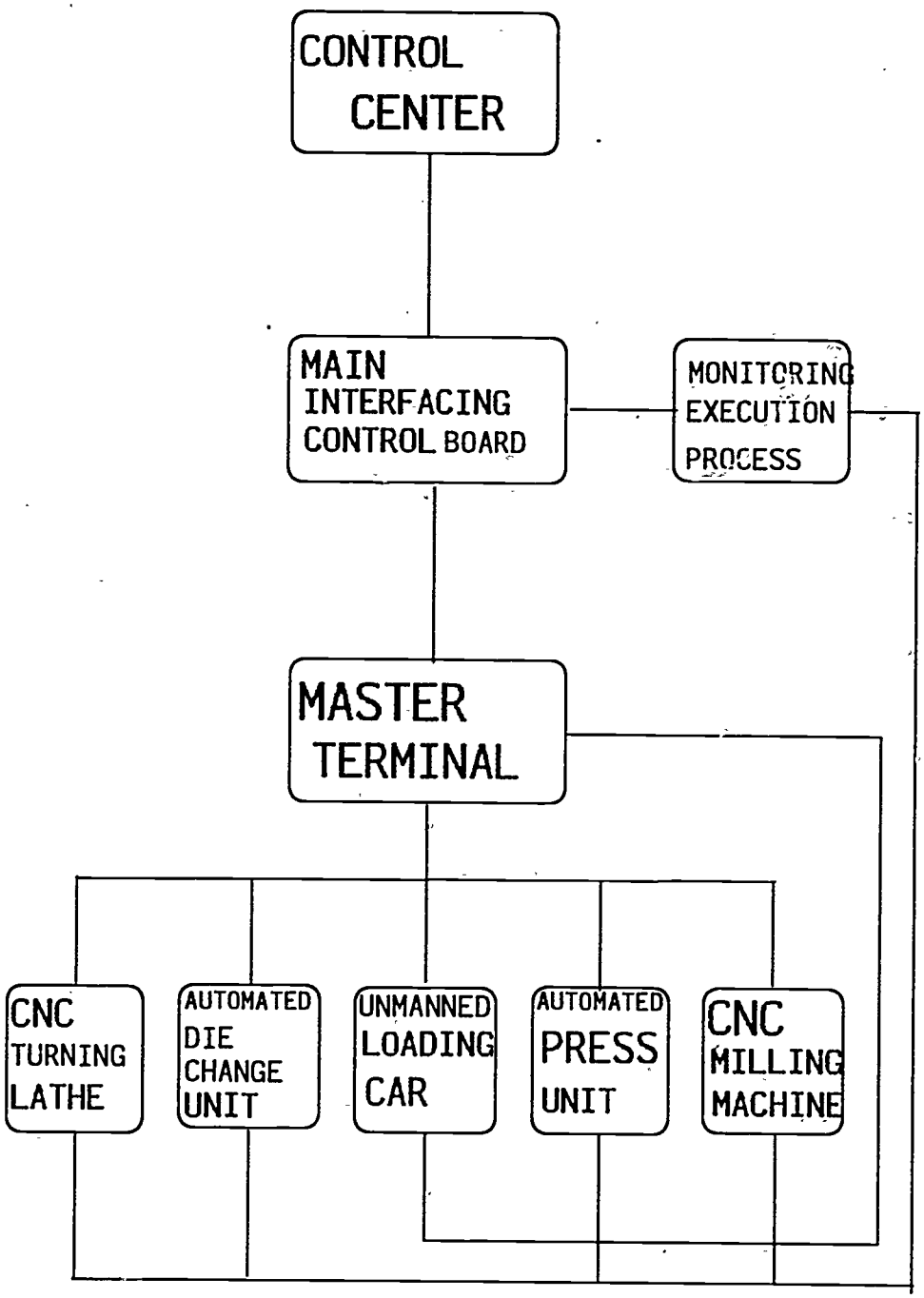
community resources and the understanding of material and equipment development; third, point to the troublesome question proposed by manufacturers; fourth, coordination among research institutes and manufacturers; fifth, design a project under very limit resources; sixth, accomplish project as planned; seventh, put on function of computer aid instruction; eighth, revise the whole system; ninth, conduct an experiment on instruction.

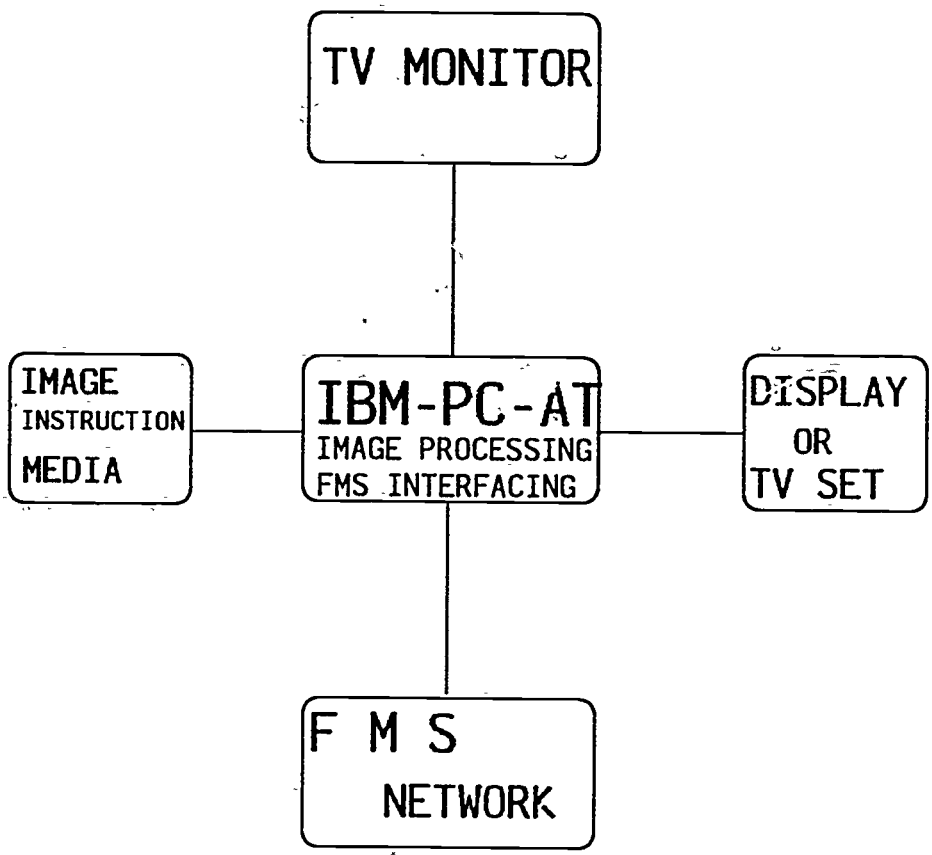
VIII. CONCLUSION

This study goes through the six of the above mentioned steps. The last part of this research is funded by National Science Council. After the final step a learner should be able to learn any set of FMS cell through net work communication or telephone. If necessary, they can interrupt the on going manufacturing process and put on their own assignment to produce whatever is needed. Also through the monitor they can see how manufacturing is processing. (The whole system will be presented with slides and transparencies.)

FIGURE -- A

FMS & INSTRUCTIONAL SYSTEM FOR INTEGRATED LEARNING




TV MONITOR
IMAGE
INSTRUCTION
MEDIA
IBM-PC-AT
IMAGE PROCESSING
FMS INTERFACING
DISPLAY
OR
TV SET
F M S
NETWORK