ISSN 1340-3346

JIPDEC Informatization Quarterly

1995

見本

The 9th Japan-Germany Forum on Information Technology

JIQ No. 101

Japan Information Processing Development Center

JIPDEC Informatization Quarterly

1995

JIPDEC Informatization Quarterly (JIQ) is published quarterly by the Japan Information Processing Development Center (JIPDEC), Kikai Shinko Kaikan Bldg., 3-5-8 Shibakoen, Minato-ku, Tokyo 105 Japan.

Publisher: Eiji Kageyama, President

Editor: Yuji Yamadori, Director Research & International Affairs

JIPDEC is a non-profit organization founded in 1967 with the support of the Ministry of International Trade and Industry, the Ministry of Posts and Telecommunications and related industry circles for the purpose of promoting information processing and the information processing industry in Japan.

NOTE: The opinions expressed by the various contributors to the JIPDEC Informatization Quarterly do not necessarily reflect those views held by JIPDEC.

Translated and Printed by The Translation Institute of Technology, Science & Culture
Printed in Japan, March, 1995.

KEIRIN This work was subsidized by the Japan Keirin Association through its Promotion funds from KEIRIN RACE.

CONTENTS

No. 101

From the Editor

Various media created by the development of information and communication techniques are called new media in Japan, as opposed to conventional media such as newspapers, TV, and radio. New media is considered to play an important role in developing the informatized society, and the Japanese government has been taking various measures in its regard. MITI, for example, is promoting a New Media Community plan, and the New Media Development Association was established as a base for promoting this plan. The Ministry of Posts and Telecommunications constructed a Teletopia plan, and the Ministry of Agriculture, Forestry and Fisheries created a Greentopia plan. Under the New Media Community plan, certain cities in Japan will be designated as model areas, where highly informatized societies will be constructed through new media such as optical fiber, the interactive CATV using high- speed communication circuits such as satellite communication, Videotex, and database services. This project began in 1984 to reduce the information gap among different areas.

The home electronics industry, such as computer, telephone, and TV, is being integrated with the electronics industry using digitalization and creating media with new functions. This media is called Multimedia and has been attracting much attention in recent years. The Ministry of Posts and Telecommunications estimates that the market for Multimedia will become 123 trillion yen in 2010, reaching 5.7% of the gross national product. The Multimedia market will also provide new jobs for some 2.4 million people. Problems remain to be solved, however, such as the huge expenses required for developing the infrastructure, such as optical fiber facilities, adjustment at ministries and agencies, and the complex intellectual property rights issues related to Multimedia.

The Japan-Germany Forum on Information Technology was held once a year from 1984, then later held once each year and a half, in Japan and Germany. Leaders from business, academic, and administrative fields in the two countries participate in this forum to deepen mutual understanding and friendly relationships in the information technology field in both countries.

The 9th forum was held in Beppu, Oita Prefecture, in November 1994. At this forum, which began on November 8, greetings by chairpersons and government representatives from both countries and keynote speeches were given on the morning of the opening day. Later, the forum was divided into three workshops — computer, new media, and semiconductor. At each workshop, experts gave presentations followed by discussions. On the morning of the third day, Japanese chairs at each workshop summarized the presentations and completed the workshops. At this 9th forum, a panel session by speakers was held for the first time at the computer workshop. As topics for presentations at each workshop, the most controversial issues were chosen by core members who are professionals in each field in both countries. At this forum, presentations were held regarding the multimedia communication service, applications, and terminals for the new media field. Also, in the computer field, main topics were real-world computing (RWC), which is being developed currently in Japan, parallel processing as a basis for RWC, neuro-fuzzy theory, and virtual reality.

At this JIQ, we introduced presentations given by Japanese participants at the new media workshop and the computer workshop at the above forum. Japan's leading technologies are introduced in these reports. We hope this issue will be helpful to readers promote understanding. We would also like to take this opportunity to thank the Japanese speakers who permitted us to publish their presentations.

Yuji Yamadori
Director
Research & International Affairs

Multimedia and Human Communication

Masahide KANEKO and Hiroshi HARASHIMA
Department of Electronic Engineering
Faculty of Engineering
The University of Tokyo, JAPAN

Abstract

"Multimedia" has been usually discussed from the technological point of view, however, we think that multimedia should be also discussed from the viewpoint of its relation to humans. Multimedia will offer the information environment where humans can freely make full use of various information media. This new environment is closely related to the framework of "human communication technology" which supports better and *warmhearted* communication among humans, and further, between humans and computers. In order to make this point clear, we aim toward "human(e) media" rather than the so-called "multimedia." This paper discusses multimedia from the viewpoint of its relation to humans (human communication), and presents a concept of a "virtual humane city" which is constructed as an almost complete metaphor of a real city by means of multimedia. This concept will help us to put in order various problems involved in multimedia technology.

1. Introduction

As we obtain information from the outside world through various senses such as vision, hearing, touch and so forth, humans have made full use of multiple information representation means. In this sense, the use of multimedia is quite natural for humans. Since the technology had not matured until recent days, we had to do with monomedia. For example, the telephone could only transmit voice, and computer handled only characters. Remarkable development of technology in the fields of computer and telecommunication has changed this situation. The use of multimedia has rapidly progressed in various fields; computer, telecommunication, broadcasting, consumer electronics (especially audio-visual devices), and publishing. Now, "multimedia" is expected to construct the new information environment where humans can make full use of various information representation media. Here the term "information representation media" means images, video, sound, texts, and so forth. This discussion may be summarized by the following equation:

$$E = mc^2,$$

where E: media environment, m: multimedia, and c^2: computer and communication.

This new information environment has a close relation to the framework of "human communication technology." Conventional communication technology basically handles the transmission of signals between communication terminals. On the other hand, the human communication technology intends to support better and *warmhearted* communication among humans.

This paper discusses multimedia from the viewpoint of its relation to humans, and presents a concept of "virtual humane city" which is constructed as an almost complete metaphor of a real city by means of multimedia. This concept will be useful to put in order various problems involved in multimedia technology and their applications.

2. Brief Overview of Multimedia

2.1 What is multimedia?

A definition of the term "multimedia" may be described as follows:

- technology to handle several types of different information representation media considering their mutual relationship.
- fusion or unified usage of multiple media through the digital technology. [All types of media can be represented by bits (0 or 1) and can be treated with the same manner.]

Multimedia is a compound technology and it is surely expected to cause the following types of integration among different components in the near future.

(a) integration of various kinds of information representation media such as image, video, sound, text, and so forth. Not only the simple combination of multiple media but also mutual synchronization of different media, and further, manipulation and mutual conversion are important.

(b) integration of information transmission channels such as telecommunication, broadcasting, computer network, and so forth.

(c) integration of different industries or business worlds such as telecommunication companies, broadcasting stations, industries of consumer electronics, and so forth. This means the removal of existing borders among different industries and business worlds.

2.2 What will multimedia give us?

Multimedia is attractive since it has huge potentials to give us much more real, human-friendly and convenient information environment as shown below.

(a) more real: reproduction of realistic sensation of presence or feeling of sharing the same space with other persons. Here, the space means physical space and also psychological space. This has close relation to the "virtual reality."

(b) more human-friendly: reduction of human's load to carry out communication with other people or computers. This has a close relation to the "human interface."

(c) more convenient: enabling us to make full use of various media at any time, at any place, and with anybody. Important factors are interactivity (bidirectional communication), mobility and personal use. Here, the "convenience" means two different aspects: one is that a user can do everything without moving and the other is that a user can do everything even if moving.

3. Human Communication Technology

Conventional communication technology has been developed to realize faster and more reliable transmission of signals between communication terminals. On the other hand, the abovementioned new information environment given by multimedia will lead to "human communication technology," which places humans on the center in the design and use of communication systems. It supports better and *warm-hearted* communication among humans, and moreover, human-friendly interface between humans and computers.

Principal subjects required in human communication technology are as follows:

(a) multimedia (in narrow sense); ex. input and output of multimedia information, analysis and synthesis of multimedia information, multimedia database, hypermedia.

(b) advanced semantic communication theory.

(c) intelligent communication; ex. understanding of meaning and intention, acquisition and usage of knowledge, value added communication, agent system.

(d) human interface; ex. human model, man-machine interface, multimedia interface.

(e) representation and coding of information; ex. structural description, compression, accumulation, and retrieval of various information, intelligent coding.

(f) support for human's communication; ex. support for handicapped or aged people, support for creative activities and thought, support for collaborative work.

4. Virtual Humane City

There are many aspects in "multimedia" including technology, services, law and regulation, human factors, psychology and so forth. Until now, the unified and wide viewed scope on multimedia has not been necessarily presented. If we pay attention to the fact of what multimedia can offer to us through this new information environment, a concept of "virtual humane city" will help us to think over the various aspects of multimedia systematically. The above discussion about human communication technology is, if anything, an item-by-item discussion and directs to individual persons. On the other hand, the concept of a "virtual humane city" directs to a social system and relationship between humans and a social system. The term "virtual humane city" is newly presented here. "Virtual" means that this city exists virtually in computers and communication networks. "Humane" means that this virtual city is constructed for humans and not for machines.

By using multimedia technology with computers and communication networks, it is possible to carry out several social activities on electronic networks instead of doing them in the real world. Typical examples are teleconferencing, teleshopping, video on demand service and so forth. Several ideas to build virtual space which accepts multiple participants on electronic network have been already proposed: for example cyberspace (USA) [1], the Virtual Police (Carnegie Mellon Univ., USA) [2], and InterSpace (NTT, Japan) [3].

The concept of "virtual humane city" proposed here is originated from the similar idea. But we'd like to place emphasis on different aspects such as competitive principle of economics, free economy, charging method, and regulation by law in addition to the technological problems. The virtual humane city can be considered as an almost complete metaphor of real cities. Not only the communication mechanism through computers and communication networks but also the design and construction of virtual city space are important.

A real city includes various aspects of the human daily life. A virtual humane city also includes almost the same various aspects of human life in a real city. The basic conditions to construct a virtual humane city are briefly summarized as follows:

(1) GUI (graphical user interface) to represent city space and to support easy access to it. This GUI is used as an interface between a user in a real world and a virtual city constructed in computers and computer networks.

(2) Ensuring the free walk space (promenade where one can walk around free of charge).

(3) Sufficient functions and services for daily life; market (shop), office, amusement place, school, park, library and so forth. The virtual humane city is divided into the subspaces corresponding to various hu-

man activities; communication zone, market zone, business zone, school zone, amenity zone, public service zone, transportation zone, and so forth.

(4) Regulation by public law and principles of economics which are similar to those in a real city.

(5) Support systems relating to security (ex. the police system to guarantee safety; self-defense system), guide in virtual humane city, and so forth.

In addition to above, one important thing to be kept in mind is the need for first rank architects, who can design an attractive and comfortable virtual humane city.
Competitive principles of economics should be introduced in a virtual humane city, so that the city will have a free market and change dynamically according to its activities. Here, two types of competition can be considered. One is the competition among different virtual humane cities. They may compete against one another to increase residents and virtual shops (service providers) in each city. Consequently the winner will expand the activities and city area, but a defeated city will decline. The other is the competition between a virtual city and a real city. A user will choose a virtual humane city or a real city according to what one can do in each city. Two kinds of cities will share the role. That is, a user will live in both cities, and this will cause the integration of living space.

By employing this concept, it is easy to put in order various problems including charging, competition in markets and so forth. Usually charging is a very difficult and delicate problem. Application of the charging mechanism in a real world to a virtual humane city will help to decide the charging principle in the use of multimedia. Residents can walk around in public space free of charge. They can enjoy window shopping. When one carries out economic activities such as to buy something, to sell something, to open one's shop and so forth, one will be charged. Several types of tax systems may be introduced. This concept is quite different from the charging method employed in the current telecommunication services.

5. From Multimedia to Human(e) Media

As a real city cannot exist without residents, a virtual humane city is constructed on the assumption that there are residents or users who live in it. The residents will communicate to one another over various kinds of actual gaps such as distance, physical handicap, language, age, culture and so forth. Moreover, they will enjoy the human friendly interface to communicate with computer systems.

Multimedia should support the human life and activities. The new information environment obtained by multimedia will lead to the framework of "human communication technology." To put emphasis on this, we would like to introduce a new term "human(e) media (human-centered media, human-oriented media). "Multimedia" discussed until now is rather a technical term. On the other hand, "human(e) media" implies a clear sense of purpose to discuss multimedia with relation to humans. So far multimedia has been discussed from the viewpoint of what we can do by using it. However, now we have to think over of what we should do by multimedia (humane media) and why we use it.

6. Conclusion

In this paper, we have discussed about "multimedia" from the viewpoint of its relation to humans. The information environment which is indispensable for us will be constructed by means of multimedia and it will support daily human life and activities. This new environment leads to the framework of "human communication technology," which support a better and *warmhearted* communication among humans, and furthermore, human-friendly interface between humans and computers. The new concept of "virtual humane city" is presented to put in order various problems involved in multimedia technology. Finally we have introduced the new term "human(e) media" with the clear sense of purpose that media technology should always direct to humans, and should always be *humane* to humans.

References

[1] M. Benedict Ed.: "Cyberspace: first steps," MIT Press (1992).

[2] C. E. Loeffler: "Virtual Police: a networked virtual reality application," Proc. of IEEE and IEICE NR '94 (Networked Reality), 3-1 (May 1994).

[3] S. Sugawara, G. Suzuki, Y. Nagashima, M. Matsuura, H. Tanigawa and M. Moriuchi: "InterSpace: networked virtual world for visual communication," Proc. of IEEE and IEICE NR '94 (Networked Reality), 3-2 (May 1994).

Current Activities for Multimedia Communications

Sadami KURIHARA
NTT Multimedia Planning and Promotion Office

1. Introduction

Current NTT network provides a variety of services including basic telephones, leased circuits, packet-switched data communications, pagers and ISDN services. It has evolved from the original analog public switched telephone network (PSTN) into a set of sub networks which now suit each demand of specific service. The number of telephone subscribers in Japan has grown rapidly in the last 30 years and it has now reached as many as 58 millions. A major shift in telecommunications is now in progress, however, as the demand for the common telephone service is becoming saturated, and widespread interest is beginning to focus on new categories of services such as high-speed data transmission among computers, multimedia communications, mobile communications and interactive video on demand (VOD).

With those transformations of communications networks in mind, NTT has released a strategy to promote the development of multimedia communications services as of this January. This presentation reveals our current activities as the first step aiming for the early arrival of the coming multimedia age. First, R&D activities for the future multimedia communications are listed. Secondly, the pilot tests of multimedia services using a nationwide high speed backbone network based on ATM technology and optical fiber data transmission technology are outlined, which aim for promoting the development of new information providing services and high speed computer communications.

2. Examples of R&D Activities

There are two types of multimedia applications. Overlaying advanced functions to existing tools is the first type. Offering new tools which create new work styles is the other. Personal Multimedia-multi point Teleconference system (PMTC), shown as an example of the first type, adds the video teleconference functions to PCs or WSs which are already used for many purposes on the desk. Team WorkStation (TWS) and ClearBoard (CB) are examples of the second type. They offer users a cooperative work space on the desk top by applying video communication functions.

In the future, we will use computers and communication systems more often as information access tools. In this case, multimedia presentation techniques must be effectively applied. The ISDN visual information system (IVIS) has been developed to offer the visual information service for video phones. The digital video response system (D-VRS), which stores and delivers digital video information, has been developed to offer video information services such as the video on demand services which can transmit any video program whenever requested.

Those systems are described below.

2.1 Personal multimedia-multi point teleconferencing system [1]

The PMTC has been developed with four design concepts, which are offering new conference locations, creation of virtual conference spaces on display screens of WSs or PCs, application of multimedia information technologies to make documents for conferences, and offering new environments for group works.

There are three main features of the PMTC multimedia user interface. The first feature is the virtual conference spaces composed with common space, closed space, and local space. The second point is that not only the conferees but any material can be easily captured and displayed throughout the conference using the multi-window format. PMTC is user-friendly because it allows us to control the conference windows with the same techniques we use to manipulate out regular files. The third is use of audio windows. These help us to recognize which participants are speaking. They also heighten the sense of attending the conference. If the image of a certain person appears on the right-hand size of the workstation display, then his voice should come from the right-hand side. In these ways, this system provides enhanced multimedia communication services, and we are able to participate in a teleconference while remaining at out own desk.

2.2 Team WorkStation [2]

Team WorkStation is a multimedia application system that allows geographically separated people to share each other's desktops by means of video communication functions. When we look at the tasks we perform at our desks, we find that we write and draw often. We also find a lot of cooperative tasks, for instance, design meetings and instructional meetings. This sharing of desktops has several important implications that have passed unnoticed so far. For instance, our desk top becomes extended. It contains not only our materials and files, but also the materials, such as printed books, and files of our partner.

Major components are as follows. Each user has two video cameras to capture the desktop and the user. Only one monitor is needed to display Team WorkStation images and those of the user's computer. The user also needs coding equipment, a video CODEC, and a TeamWork control box which combines different images using translucent overlays. An ISDN network or LAN might be the connecting bridge.

The ways of the overlay function in this system are realized as the following. First, video images of the face and the desktop are combined using the picture-in picture technique. Each user then transmits his combined image. Upon receiving the combined image from his partner, the user converts it into a translucent image which is then overlaid on his screen. In effect, both sides share the same screen image.

2.3 ClearBoard [3]

Team WorkStation is quite advanced but we have already created an alternative communication tool named ClearBoard in some superior. The concept of ClearBoard is to realize seamless communication between conversation, writing and drawing in the meeting. When conference participants look at the blackboard they do not see their partner's face. Looking at each other makes writing impossible. This problem is completely solved by ClearBoard. The half-mirror allows the participant to be photographed by the overhead camera. This camera also records the information drawn on the board. The video signal, with audio, is transmitted to their partner. A video projector is used to display the remote image on the back of the screen. Both participants can see their partner's face and work as it lays under their own work. Face-to-face discussions become very easy and the work flow is not interrupted by the need to switch the gaze direction. In this way, ClearBoard allows two people to have a conversation while virtually annotating their partner's drawing.

The original ClearBoard, called ClearBoard I, uses marking pens so the images are made manually and are difficult to manipulate and record. A computer-based drawing system has been added to ClearBoard II. The inclined screen is actually a digitizer that overlays a large LCD display screen. ClearBoardII allows personal computer files to be placed on the screen and to be shared and modified easily.

2.4 Visual information system [4]

The ISDN visual information system have been developed to offer visual information services by using visual terminals through ISDN. This system is composed of a visual information center system and visual terminals such as video phones or teleconferencing terminals. Examples of the services include bulletin board services, message services, mail services, and gathering board services. The video information center is composed of a general purpose workstation, video information storage equipment, and video information transfer control equipment. The maximum number of channels for simultaneous connections is 50. Terminal speeds range from 64K to 1.5M. The center can hold audio visual information equivalent to 500 hours on video. This system is actually aimed at video phones and teleconferencing systems.

2.5 Digital video response system [5]

A more advanced system, the digital video response system, has been developed. The digital video response system provides retrieval-based video with broadcast or video quality. D-VRS is composed of a video information center, B-ISDN and visual terminals. The functions of the center includes video information storage and delivery control to realize the same services as video-on-demand services which is a very puller now.

The control equipment installed in the center accepts the request through the communication network and delivers the digital video data through B-ISDN. It can control various video handling functions such as start-stop, slow-quick and forward-reverse for each user.

Hierarchical memory control technologies performed with optical disk libraries and array disks have been adopted in the storage system to realize multimedia services economically. For example, public news or town information will be hold on array disks, whereas video libraries will be stored as optical disk files.

3. Multimedia Utilization Pilot Tests

NTT is promoting two types of specific experimental plans. Those plans will be conducted with the cooperation of customers, manufactures and information service providers.

3.1 Pilot test of high speed backbone network

Responding to user needs for computer communications, NTT is closely involved in the ATM technology development and is now at the stage of commercializing it. Utilizing a combination of ATM and optical fiber technologies, NTT will construct a high speed nationwide backbone network as part of its intracompany networks operating at a gigabit level. It is built on Synchronous Digital Hierarchy (SDH) transmission systems at the speeds of 2.4 Gb/s, 10 Gb/s, etc., and provides various types of User Network Interface (UNI) up to 156 Mb/s to users. Through this project, NTT will establish construction and management technologies as well as new applications for the broadband network.

About 90 projects are planning to join the pilot test. A part of the pilot tests will start from this September.

3.2 Pilot test of multimedia services

Due to advances in technology, interactive video communications such as video on demand (VOD) have been developed and are expected to result in a great market demand. Under this background, NTT will conduct pilot tests on integrated systems that provide communications circuits to cable television companies and highly sophisticated services such as VOD along with its existing telephone services. The experiment targeting ordinary home users, which reach the number of several hundred in a few areas, will be launched in 1995. The test program includes the provisioning circuits for cable television companies, a trial test of VOD, and telephone services.

References

[1] T. Nishimura, S. Masaki, H. Yamaguchi, H. Ichihara, T. Sakatani, and S. Ishibashi: "System Design of Personal Multimedia-multi point Teleconference System for N-ISDN", Proc. 1993 IEICE Fall Conf., D-220 (1993)

[2] H. Ishii, and N. Miyake: "Toward An Open Shared Workspace: Computer and Video Fusion Approach of Team WorkStation", Communications of the ACM (CACM), Special Issue on CSCW, ACM, Vol. 34 No. 12, pp.37-50 (Dec. 1991).

[3] H. Ishii, M. Kobayashi, and J. Gurdin: "Integration of Inter-personal Space and Shared Workspace: ClearBoard Design and Experiments", Proceedings of CSCW '92, ACM, PP.33-42 (Nov. 1992).

[4] K. Tamura, C. Matsuda, H. Tsuchiya and M. Maruyama: "A Study of the Data Channel Control Method in Visual Message Handling System", Proc. of the 1992 IEICE spring Conf., B-696, (1992).

[5] H. Sakamoto, and H. Nakano: "Video-on-Demand Service System", Tokai-Section Joint Convention Record of the 6 Institutes of Electrical and Related Engineers (1993).

Development of Multimedia Services for Current and Future Broadcasting Media

Akio YANAGIMACHI
NHK Science and Technical Research Laboratories, Japan

1. Introduction

To be competitive with other areas of the electronic information media industry in the multimedia era, broadcasters will need to integrate advanced features of multimedia into their services.

ISDB (Integrated Services Digital Broadcasting) has been proposed as the broadcasting infrastructure for the coming years, which is total digital broadcasting and integrates many kinds of multimedia services into broadcasting channels. Meanwhile, as an important step toward the realization of full scale future multimedia services with ISDB, broadcasters can implement basic multimedia broadcasting services by using the data channel capacity of current broadcasting channels.

2. Enhancement of Broadcasting Services in a Multimedia Context

It is predicted that information transmission and exchange techniques in the broadcast, communications, and computer areas, supported by digital technology, will develop dramatically over the next couple of decades. The computer area, in particular, will see very rapid improvement in performance and fusion with multimedia services, and it will also have a strong impact on other areas. In the communications area, plans are under consideration to connect all households to a high-speed digital network by optical fibers through which various services will be provided.

If the above-stated predictions and plans are realized, all information media industries related to broadcasting will undergo radical changes. The proper role of broadcasting of offering accurate information to a large number of people simultaneously at reasonable cost, and the social and cultural needs for such a role will continue unchanged. The audience, meanwhile, will gradually grow accustomed to the everyday practice of taking the initiative in accessing personally necessary or preferred information by means of computers, communications services, and video packages, all having multimedia functionality. It should be noted that the audience will be more active than at present in selecting information. This implies the necessity of reviewing broadcasting services from the unbiased standpoint of active users along with that of traditional passive audiences, to renew the conception of broadcasting services.

Under such circumstances, broadcasters will need to integrate advanced features into their services, such as interactive functions and reinforced user-oriented attributes. This can be implemented by broadcasters remodeling their industry into ISDB that also accommodates wired networks in addition to the basal radio transmission media.

3. Concepts of ISDB Multimedia Services

Described below are the primary concepts of broadcasting services using ISDB when combined with wired networks.

(1) Accessible to anyone, anytime, anywhere
(2) User friendly
(3) Dynamic representation
(4) Real-time advantages
(5) Interactive with users

4. Layer Model for Broadcasting Services

Figure 1(a) shows the composition of current broadcasting services presented in a layer structure. This figure indicates that at present one-way type programs are broadcasted using the SDTV (NTSC, PAL or SECAM) or HDTV system as representation media by means of wireless analog transmission.

In contrast, the structure for future multimedia broadcasting services is illustrated in Figure 1(b). Transmission will be digitalized to facilitate the functionality of upper layers, as well as to give flexibility and expandability to broadcasting services. A new layer will be introduced that will function to support the selection of programs and information by users. Services will be reinforced with dynamic representation functions included in the representation layer. Into the program layer, functions which offer interactive programs will be introduced. Interactive programs will be available in two types: pseudo two-way programs using terminal functions and actual two-way programs using networks. Figure 2 illustrates the two types of interactivity in the broadcasting service. In the former type, users will interactively access a variety of information broadcast and store it in the receiver memories. In the latter case, users will be connected to a broadcasting station through a two-way network and will interactively access information or participate in programs prepared by the station.

5. Service and Program Images

Considering the concepts and structure

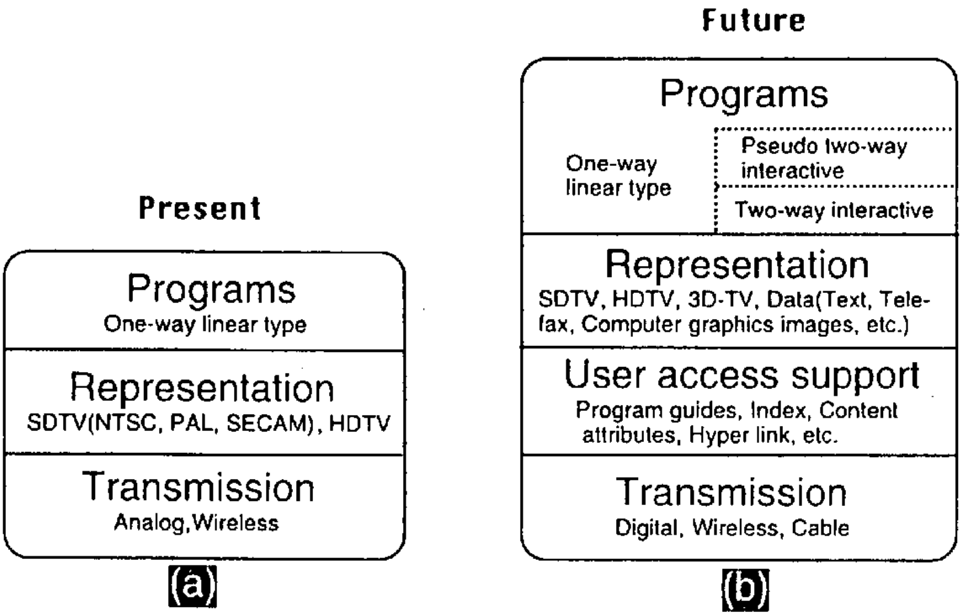

Figure 1 Composition of Broadcasting Services

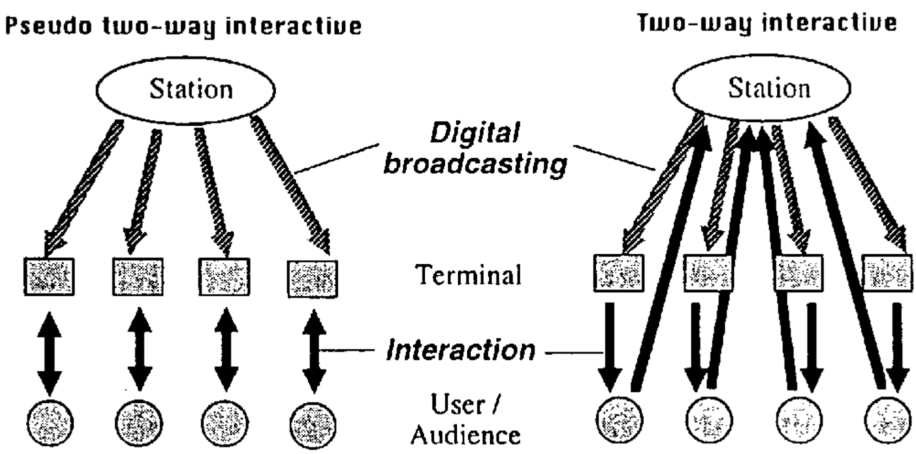

Figure 2 Interactivity in Broadcasting Services

described above, we have imagined the services and programs of ISDB and their utilization by users, for the time around 20 years from now when ISDB is supposed to be fully operational and the images will reach fruition. Even after this time has elapsed, the way people generally watch broadcast programs may be unchanged, i.e., mostly the so-called 'couch potato' style. One of the goals of ISDB is to make it easier and more comfortable for the 'couch potato' users to access programs and information. Meanwhile, ISDB will respond to the requests of users once they become active.

6. Requirements for the ISDB System

The considerations described above lead to the following requirements for an ISDB system.

(1) Reliable transmission through various types of transmission channels including satellite, terrestrial and cable. Figure 3 illustrates the relation between the transmission channels and possible services to be carried.

(2) Flexible integration of various types of services.

(3) Commonalty in the transporting format for various types of services.

(4) Programs of different types: real-time, down-loaded type; one-way, pseudo two-way and two-way type.

(5) Programs and information which can be presented either by a single medium or a combination of representation media (program components).

(6) Various definitions or quality levels and scalability introduced in video and audio representation.

(7) Various representation possibilities by data: text, still-pictures, graphics, facsimile print, PC software and real-time computer graphics, etc.

(8) Synchronization among the combined program components, and those with an absolute time if necessary.

(9) Supporting schemes to improve human interface.

(10) Guides for users: menus, previews, summaries and indexing.

(11) Identification of services and information: Selection by categories and attributes.

(12) Description schemes associated with a breakdown of program content into parts.

(13) Addressing of individuals or groups of users including conditional access.

(14) Interface with network and package services.

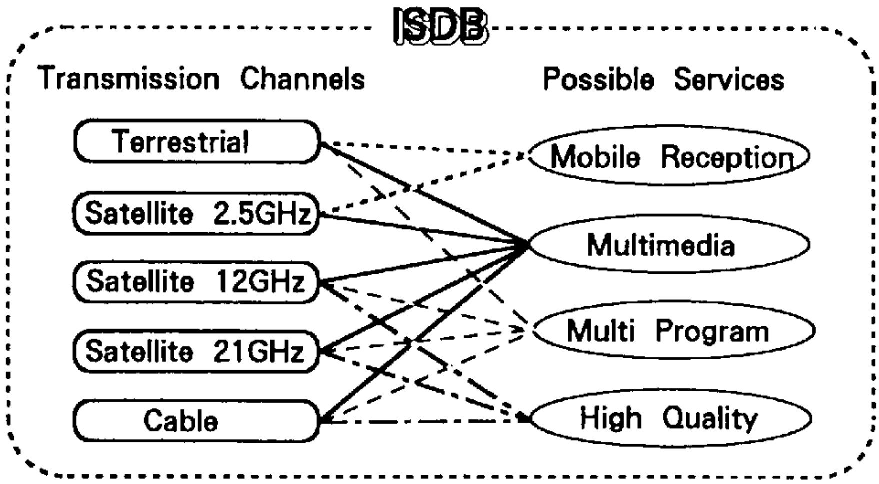

Figure 3 ISDB Transmission Channels and Possible Services

(15) Expandability for future extension of services.

To confirm the feasibility of the ISDB system, an experimental system has been built. The experimental system is based on the syntax of MPEG-2 System for its signal multiplexing functions.

7. Multimedia Service Implementation with Current Broadcasting Media

Japanese satellite broadcasting systems, including the *MUSE*-HDTV system, have a data broadcasting capability called the data channel. The technical standards for transmission and the protocols for basic multimedia services have been established. It is important to gradually start the introduction of services using current broadcasting media such as the satellite data broadcasting channel, since the complete implementation of future multimedia services will need not only high technical competence but also the experience of those providing multimedia programs and the adaptation of users who will be utilizing such services in their daily lives. Commercial services to deliver electronically the video game software directly to the home by using the satellite data channel are planned and the multimedia services in which audiences can access to hyper linked information content are being developed for the *MUSE*-HDTV system.

8. Conclusion

ISDB will be the infrastructure for future broadcasting services in the 'multimedia era' that will arrive with the new century. Basic characteristics such as the multiplexing of various kinds of program component signals and the transmission of multiple program TV signals have been tested by using the MPEG-2 based experimental system. Since ISDB has a very high potential, studies have to continue to examine the feasibility of more sophisticated functions, while at the same time there should be a gradual introduction of basic multimedia services using current broadcasting channels to gain experience in program production as well as in the utilization of these new services by users.

Collaboration and Communication
– A videoconference system with facilities for multiple eye-contact –

Yutaka MATSUSHITA
Department of Instrumentation Engineering
Faculty of Science & Technology
Keio University, Japan

1. Historical Turning Point of Communication Infrastructure

More than 100 years have passed since the telephone service started. The telephone network is spreading all over the world and has matured as a social infrastructure. We cannot conduct business and also cannot pass out daily life without such facilities. However, so called civilized diseases steal up unconsciously to the facilities.

It is said that the probability on which you can catch an average businessman through a phone by one trial is roughly 25%. The other people of the same section to which the businessman belongs have to usually respond to you three times out of four times. This shows that they are interrupted very often by telephone ringings despite the fact that they have to work hard.

It can be said without exaggeration that a telephone deteriorates the productivity in an office.

It is expected that new communication facilities supplementing the telephone will be realized.

It is said that we receive almost all information unconsciously in our daily life through images or pictures.

We face a historical turning point of communication infrastructure. A new infrastructure called visual communication is expected in the 21st century. We therefore, are existing in the days before the telecommunication revolution.

2. Importance of Non-Verbal Information

A psychologist indicates the importance of non-verbal information when delicate nuance between two correspondents has to be transmitted as shown in Table 1.

Table 1

Verbal	7%
Voice	38%
Non-verbal	55%

The calling party can send only 7% of the information to be transmitted verbally. If he can use a telephone, he can send 38% of further added information since the partner (called party) can understand whether he is angry, sad, glad, etc., or not.

Furthermore, if the calling party can transmit motion pictures, he can send 55% additional non-verbal information such as facial expressions and gestures so that the partner can read his inmost thoughts.

From these considerations, multimedia networks transmitting high quality motion pictures are essentionally required for two collaborating people being at different sites.

3. Layerd Architecture for Human Relationship

Two people are sitting on a bench in a platform occasionally. Copresence between the two is established. One of them calls out "Excuse me, could you tell me the way to the temple." The called people aware the existence of the calling people. Then awareness (second layer of Figure 1) is achieved between the two. Do we have to distinguish copresence, awareness from communication when two people want to communicate each other?

When two people are in the same place, it is not necessary to distinguish copresence, awareness from communication since they are automatically involved in communication.

In order to transmit delicate nuance between two communicating people, it is extremely important that eye-contact between the two is achieved. When I was invited to an NTT's systems show a few years ago, I came to a stop for a while at the corner of TV telephone. I and a beautiful woman (instructor) were participated in a small experiment using the compact TV telephone with a built-in small camera. I was strained for talking with the young beautiful woman through a TV telephone. However, her picture on the screen was no more than a broadcasting picture on a TV set because she did not gaze at me. I did not feel her eyes

- Collaboration
- Communication .... verbal, non-verbal (eye-contact)
- Awareness .... gaze awareness, aura, nimbus
- Copresence

Figure 1 A Layered Architecture for Human Relationship

since our eyes never met. As the phrase says, "Eyes are more eloquent than the tongue," it is essential that eye-contact between two people is achieved.

It is called gaze awareness to be able to understand what the correspondent is gazing on. We can feel a kind of aura of a passionate speaker and further recognize the atmosphere (nimbus) of the meeting site when we are in the site. Such aura and nimbus can be regarded as a kind of awareness.

When two correspondents are in the same location, gaze awareness and eye-contact are automatically achieved, in addition, they can feel aura and nimbus. However, those are not achieved automatically through communication circuits. Such an interaction of which delicate nuance has to be transmitted is called collaboration. Such an interaction, such as teaching the way to the temple is called communication. It is expected to distinguish communication from collaboration clearly so that we can understand easily what kinds of functions are installed in a terminal and network. Collaboration is a process for creating new values by supplementing each other. Some examples are shown in Figure 2.

Such a brain storming that each participant provide only his own idea to the issues is communication but not collaboration. However, the case where new ideas are created by supplementing each other is collaboration.

In order to support high level collaboration for many members being in different sites, high quality awareness must be installed in either terminals or networks.

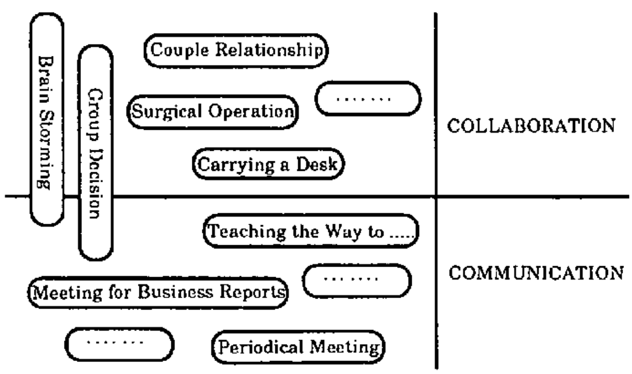

Figure 2 Collaboration/Communication

4. A Videoconference System with Facilities for Multiple Eye Contact

Here, we describe the design and implementation of a multi party videoconferencing system "MAJIC" that projects life-size video images of participants onto a large curved screen as if users in various locations are attending a meeting together and sitting around a table. MAJIC also supports multiple eye-contact among the participants and awareness of the direction of the participants' gaze. Hence, users can carry on a discussion in a manner comparable to face-to-face meetings. We made video-tape recordings of about twenty visitors who used the prototype of MAJIC at the Nikkei Collaboration Fair in Tokyo. Our initial observations based on this experiment are also reported in this paper.

4.1 Design of MAJIC

We identified the following four design requirements to implement "Multi-Attendant Joint Interface for Collaboration" (MAJIC):

(1) Multi-way (more than two-way) round-table meetings and multiple eye contact between participants must be supported,

(2) Users can become aware of the gaze of one participant toward another participant, in other words, users maintain awareness of who is visually attending whom,

(3) Life-size video pictures of the participants are shown without boundaries to achieve a sense of reality, and

(4) A shared work space must be provided at the center of the participants.

4.2 Implementation of MAJIC

Figure 3 shows a prototype of MAJIC; there is a desk equipped with a workstation and a curved screen, four feet long by eight feet wide, forming an arc with a radius of four feet. Video images of other participants are projected on the screen by video projectors. When the user sits at the center of the arc, the distance between him and other participants is around four feet. We have concluded that around four feet may be the best distance for face-to-face meetings with 3 or 4 colleagues, since the distance from people who work together tends to be shorter at a social distance or it is sometimes at a personal distance. Figure 4 is a picture of the back of the screen in which you can see the desk through the screen.

How to support eye-contact

The MAJIC screen is a thin transparent film with a large number of very small hexagons printed on both faces. White hexagons are printed on the back side (face A) and black hexagons are printed on the back side (face B) as shown in Figure 5. Since the white hexagons reflect light and is dark behind the screen, face A can be used as a normal screen (see Figure 3). The black

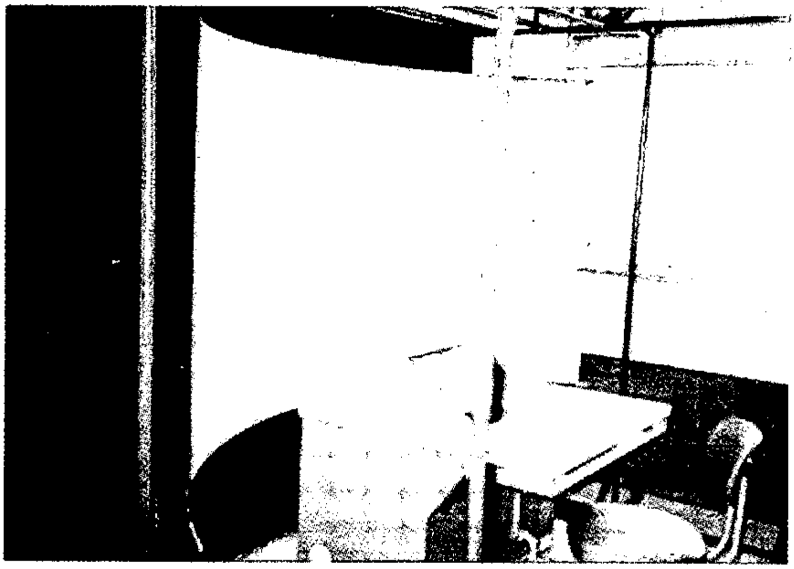

Figure 3 A Prototype of MAJIC (front view)

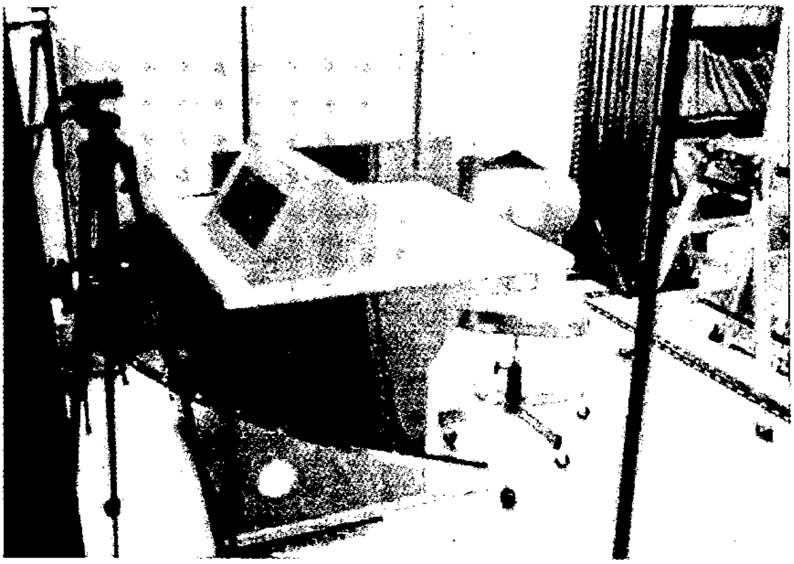

Figure 4 A Prototype of MAJIC (back view)

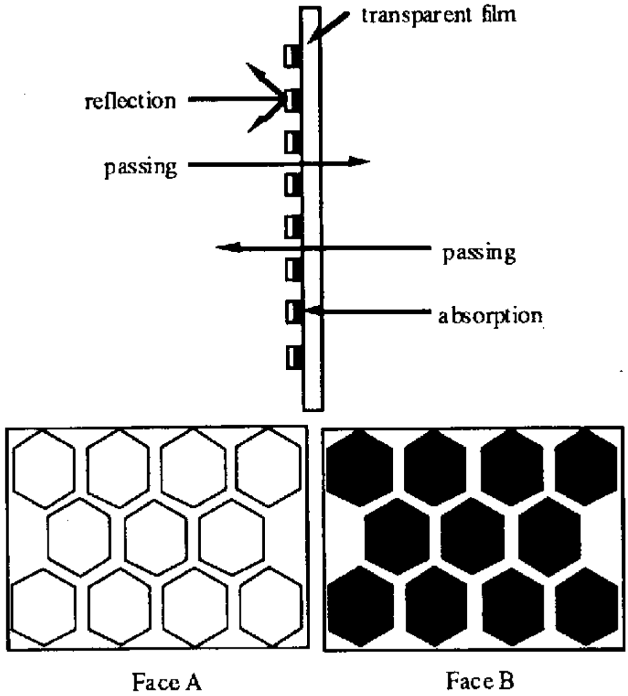

Figure 5 MAJIC Screen

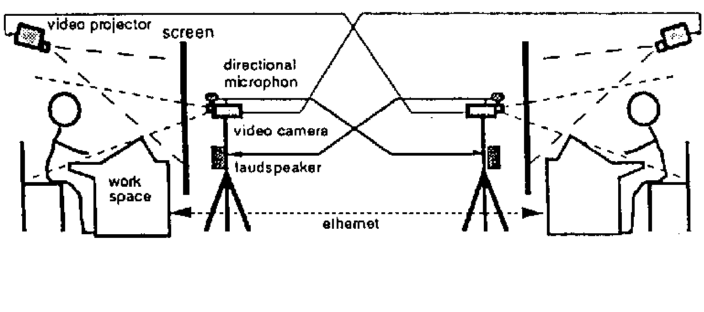

Figure 6 System Architecture of MAJIC

hexagons, on the other hand, do not reflect light at all and it is relatively light in front of the screen, and consequently one can see the other side through the screen from face B (see Figure 4). The transmissibility of the screen depends on the size and the number of the hexagons. We have used a 40% transmissibility screen for the MAJIC prototype.

Figure 6 illustrates how MAJIC supports eye contact. A video projector located above user A projects a life-size video image of user B on the screen and a video camera located behind the screen takes a picture of user A and vice versa. In order to take clear pictures of users, the video projectors are set up so that they do not enter the field of vision of the video cameras. Since each video camera is set up at the center of the partner's face on the video image, user A and B can make eye contact. Moreover, since video images of participants are life-size, users can read their partner's facial expressions and observe the direction of their partner's gaze.

Multi-Media PC Communications

Hiroshi FUJIWARA
Graphics Communication Laboratories

1. Summary

Personal Computer (PC) environment is changing rapidly in the 1990s towards the 21st century. Multi-Media technologies, which are the greatest inventions in the latter half of the 20th century, have provided PC environment with the biggest influence in any other environments.

This paper analyzes the essence of Multi-Media from the technological point of view, and predicts the future of PC environment through our related trials.

2. Information Infrastructure

"Information Infrastructure," which will definitely grow from a national to a global scale, and could play a key role towards the 21st century as the "Industrial Infrastructure" has played a key role in the 20th century.

A network of highways or a network of railways are included in "Industrial Infrastructure." On the other hand, "Information Infrastructure" should include any kind of information media rather than a networking media. Therefore in this paper, "Information Infrastructure" consists of computers, communication, broadcasting and storages (see Figure 1).

3. What is Multi-Media?

Definition of Multi-Media is still uncertain. There are various kinds of definitions according each ground. In this paper, defining Multi-Media has been tried for focus of discussion. For example, Media is a generic name of representation media (text, voice, video, graphics, etc.) and transmission media (cable, satellite, ATM, etc.). Multi-Media is defined as integration of several representation media by one transmission medium.

Based on this viewpoint, special features of Multi-Media are as follows.

(1) All information are digitized.

(2) Human beings can use multi-media information interactively by the help of computers.

Current information media exist depending on the frequency and the number of users as shown in Figure 2. However, Multi-Media technolo-

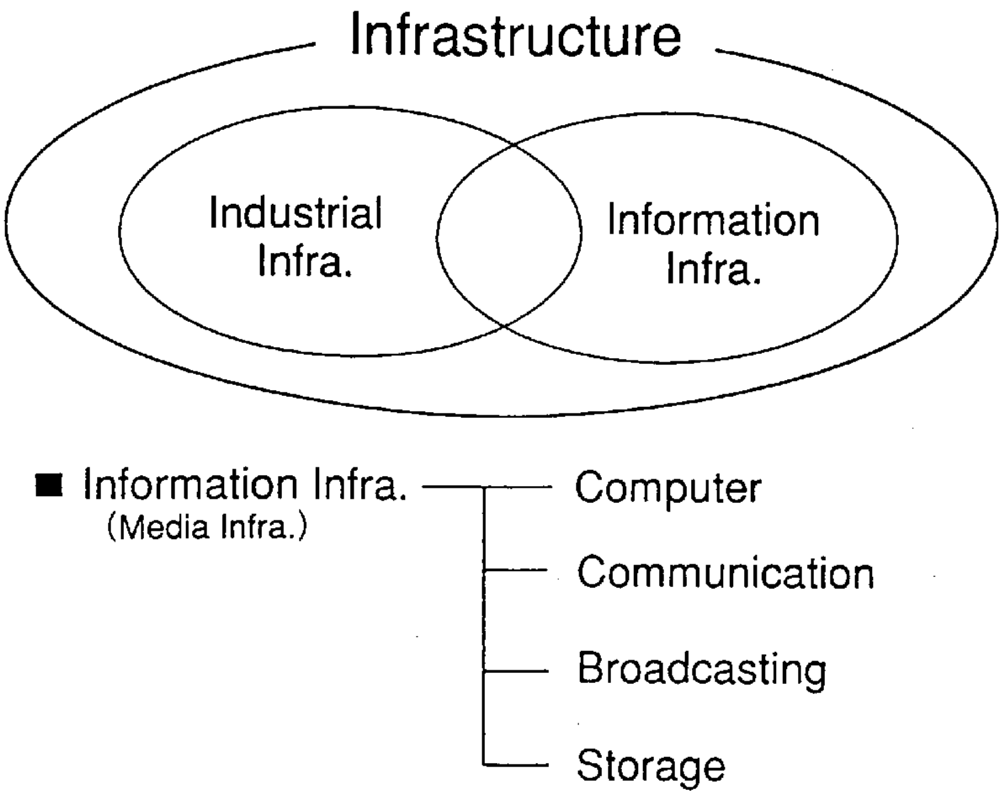

Figure 1 Information Infrastructure

gies might change the existing information media into Multi-Media.

4. What are Multi-Media Technologies?

In various kinds of Multi-Media technologies, the most important technologies are thought to include computer technologies, compression technologies, VLSI technologies, and transmission technologies.

In computer technologies, interactive software technologies and 3D graphics are more important than any other ones. In compression technologies, whether they might be video, audio or still-images, they should be optimized to transmission media and required quality. VLSI architecture and implementation are also important especially for Multi-Media coding. Finally transmission technologies are used for personal digital communication between users and information providers.

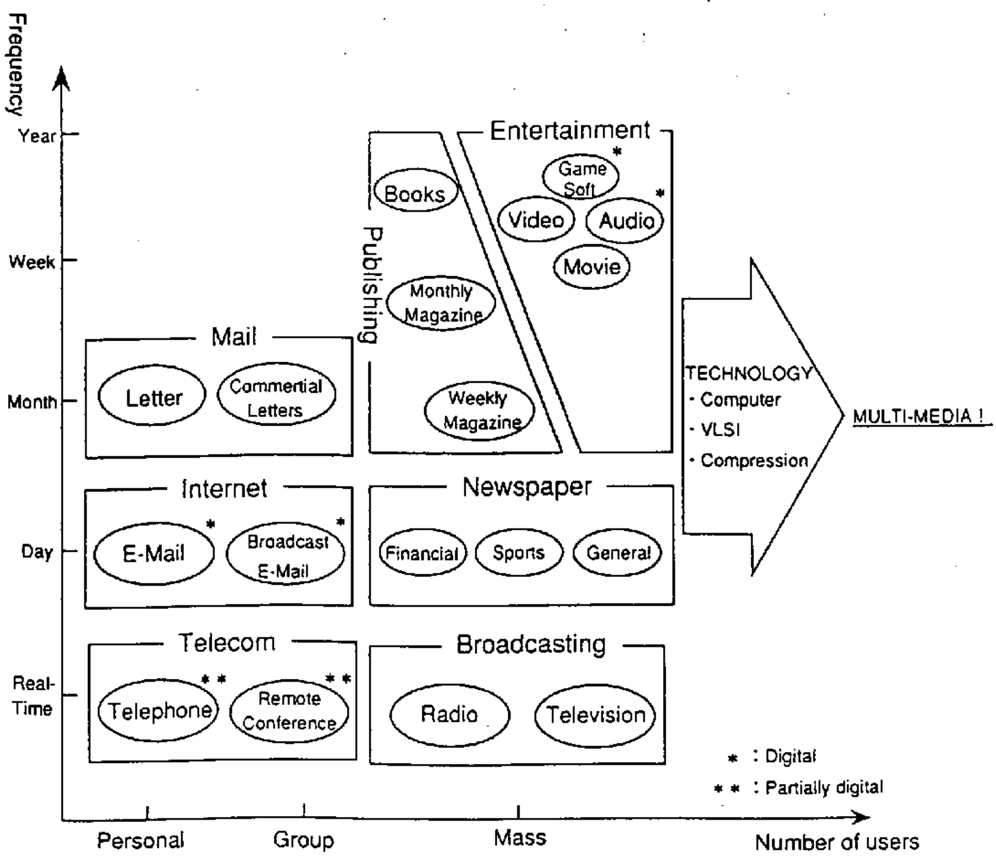

Figure 2 Potential Information Media for Multi-Media

5. What is PC in Multi-Media?

PC's have changed over the past 20 years since the 1970s along with the progress of microprocessor technologies and so on. Based on these discussions, I would like to predict PC in a period of Multi-Media.

Firstly, PC's could have additional representation functions rather than display of text and graphics. Secondly, PC's could have the advanced networking functions including telecommunication and broadcasting.

However, improvement of the network environment should be promoted in advance, or in other words, Multi-Media PC's might be the driving force to promote network infrastructure.

In this paper, the concept and opinion for PC's in the Multi-Media period is described clearly and concretely.

Super High Definition Image Application for Medical Use

Sadayasu ONO
NTT Optical Network Systems Laboratories

1. Overview

Assuring that people's lives are comfortable and worry-free requires the establishment of a social medical system in which a wide range of advanced medical technologies is available and that can be effectively implemented without major economic burdens. The diverse range of medical equipment developed over the years, while mainly helping to raise the level of medical technology, has not been effectively implemented.

Of course it is possible to attain the required level of image quality for medical diagnostics using film and paper, but use of such media has a major drawback. It is difficult, using such media, for doctors to obtain diagnostic information whenever and wherever they want.

The root of this problem until now has not been dealt with effectively. The medical profession in various countries has been doing what it can to provide diagnostic information, but this requires that images on film and paper be physically transported, making it difficult for doctors to get the necessary information at the required location and in the required time frame.

Because people's lives sometime rest on medical diagnostic information, the medical field has been doing whatever it can to obtain, to the extent current technology allows, necessary information. This often, however, leads to the same medical exams and prescriptions being given over and over and is one of the factors that prevents the medical system from operating effectively. More than economic considerations, however, is the concern that such repeated prescriptions damage the preciseness of medical diagnoses and in worse case scenarios lead to the death of patients.

SHD imaging and recent high-speed LAN and B-ISDN have enabled the creation of paperless/filmless hospitals, making it possible to obtain medical diagnostic information anytime, anywhere through the shared use of electronic clinical charts on a nation-wide basis. It is becoming clear that this method of medical information exchange will both advance medical technology and help the medical system operate more economically.

2. Medical Image Quality

Figure 1 shows the wide variety of imaging techniques used in the medical field. It is apparent from this figure that for monochrome images, X-rays demand the highest level of quality while for color images, the same is true for pathological exam images. Note that Figure 1 shows only the most frequently used representative forms of medical imaging techniques. The authors do not mean to suggest that there are not any other applicable imaging technologies, just that they are few and far between and there are many methods for dealing with such images.

If there was an electronic imaging technology that could adequately handle X-rays and pathological exam images, we could satisfy one of the conditions for establishing the filmless, paperless hospitals we discussed earlier. The authors of this paper determined, through the cooperation of a number of clinicians and pathologists, that SHD images have a high enough level of image quality to be used for X-rays and pathological exam images. Since the SHD imaging technology used for medical purposes corresponds to CDs (Compact Discs) used for recording audio, a large amount of data can be maintained, allowing the reproduction of high quality images.

3. High Speed Communication Networks

The data volume of a single still SHD image is typically 12 Mb while moving SHD images require a bandwidth of 6 Gbps. In the past it has been next to impossible to rapidly process, transmit, and store such large volumes of digital data. Recent advances in optical fiber and ULSI technology, however, is making it possible, both technologically and economically, to rapidly transmit and store large amounts of data.

Concrete examples include optical fiber technology that has allowed the development of FDDI, ATM-LAN, high-speed Ethernet, and B-ISDN, which all utilize 100 to 156 Mbps transmission lines, and ULSI technology that has supported the development of high speed processors and large volume/high speed memory. In addition, recent advances in the amount of data that magnetic storage devices, such as magnetic disks and magnet-optical disks (MOs) can store has made systems that rapidly process large amounts of data more economical.

The spread of high speed networks will continue along with the increased use of image data. The authors believe that medical imaging will be the motivating force behind this spread.

4. Current Issues

The two main areas under development for implementing filmless/paperless hospitals are listed below.

1) LAN interfaces for X-ray equipment,

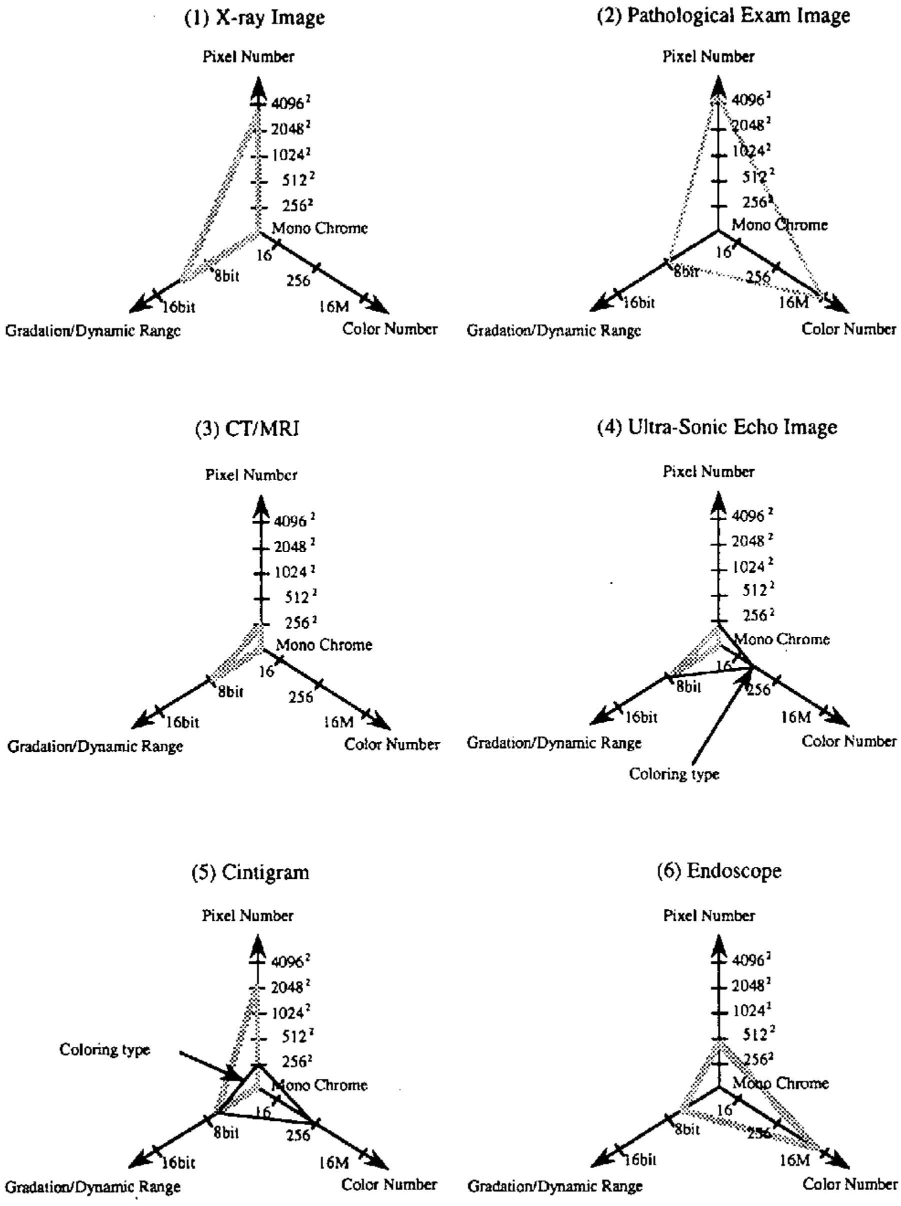

Figure 1 Characteristics of Medical Images (performance of optical system is considered)

endoscopes, MRI, and CT scanners, etc.

2) Utility programs for creating clinical charts.

Both of the above are vital for creating an environment where medical data can be processed, transmitted, and stored electronically. Number one of concerned with the data generated by imaging devices, while number two is concerned with the data gathered by doctors and examination specialists.

Using existing hardware and software such as scanners, word processors, and graphic editors, it is of course possible to digitize the information recorded on film and paper (clinical charts and examination result sheets), but this can lead to various problems in terms of cost, time precision, and even input mistakes. It is therefore necessary for information to be immediately digitized at the source.

There are few difficulties in developing interfaces for the devices listed in number one above. In particular, MRI and CT scanner images are obtained using computers, and the systems for controlling these computers have already been put into use. Developing LAN interfaces is therefore relatively easy. X-ray equipment using the IP (imaging plate) method, which directly digitizes data without using film, already exists. Such images rival the quality of film-based X-rays. An endoscope that can produce NTSC class images has already been commercialized, and it would be relatively easy to raise the image quality to the HDTV level, which in fact is the maximum quality image an endoscope can produce due to its optical limitations.

The utility programs mentioned in number 2 above for creating clinical charts is an area in which a great deal of research is required. There are, of course, database applications already available such as FileMaker Pro and 4th Dimension that can handle image data. The main subject that needs to be researched is what sort of user interface doctors find easiest to use. The number one goal should be making it easier to enter data into clinical charts.

5. Present State of Medical Information Systems

Establishing an electronic medical information system on a national scale will greatly benefit the population. These benefits include, as stated in the opening paragraph, the spread of a wide range of advanced medical technologies and the economically efficient operation of the medical system, which will make possible such things as the shared use of clinical charts and remote diagnoses. If there is no strong motivating force, however, to promote the transition to a nation-wide electronic medical data system, this topic might just end up being an idealistic proposal.

In reality, the computerization of medical information systems still faces many unresolved technological barriers and development in this area is at a near standstill. The use of such equipment as MRI and CT scanners that directly help increase the precision of direct diagnoses is increasing at a modest pace, while that of equipment with a more indirect role such as PACS (picture archiving communication system) is not. As a result, there are almost no hospitals in Japan today that are using 100 Mbps class LANs in their clinical departments. This is mainly because they do not see any apparent benefits to be obtained through introducing such networks.

This situation, however, is in the process of being dramatically altered through recent advances in medical technologies and the increasing versatility and wide-scale spread of medical equipment. The end result will mean an increase in the amount of clinical chart data per patient, as well as the cost of maintaining that data. The proper maintenance of charts is vital for accurate diagnoses and treatments. It is therefore critical to find some way of properly maintaining patients' charts; computerized medical information systems are extremely effective in this respect.

6. Benefits of Computerization

The reduction through computerization of chart maintenance costs will be most apparent in relatively large hospitals (between 200 to 500 or more beds) that have full-time staff for maintaining clinical charts. Hospitals with 1000 beds, for example, have a staff of little less than thirty solely for the purpose of maintaining charts. Through computerized chart maintenance this figure can be reduced to one-half to one-fifth of the current level. The resulting cost reduction is not solely related to cutting back labor costs. It also is a factor of reducing chart storage space, which is especially expensive at large hospitals in major cities. Obviously, the larger the hospital is, the greater the level of savings will be.

Direct cost reductions are nearly negligible for family doctors and small hospitals. The benefits for small hospitals is the increased shared use of clinical charts, which will result in a greater role for family doctors. This role will include medical exams that do not use large-sized equipment, health consultations, and making the rounds to patients homes - all well suited to the graying population in Japan.

The benefits of computerization will in the future be most apparent in the area of diagnoses and treatments. In particular, this will lead to cost reductions in general tasks such as processing insurance bills.

Progress in the field of medical science is based on experience, and statistical analysis of medical data is vital for gaining this experience. Medical charts contain the raw data to be statistically analyzed. Computerizing this data will play an indispensable role in ensuring that statistical analysis of medical data is both swift and accurate. It will thus be possible to analyze the side-effects of medications, quickly respond to the treatment of communicable diseases, and obtain quick official approval for effective new treatments.

7. Conclusion

The authors of this paper are proposing the implementation of filmless/paperless hospitals and building of a "Medical Internet." The present Internet mainly transfers relatively small text files and isnot capable of handling the large medical data files containing high quality SHD images. Problems lay not only with the issue of file size, but in addition other conditions, differing from those on the Internet, must be satisfied, even in such areas as reliability and the protection of confidentiality. This obviously includes the standardization of file formats for medical diagnostic data (primarily clinical charts), and the establishment of a file management system.

These conditions necessitate building a dedicated medical network, completely different from the present Internet. Using B-ISDN will be the fastest way to economically build a network of the required scale. The initial phase of building this network, however, will require rather strong promotion and leadership form all corners.

The funds required for promoting this policy also must come from financial support by all areas of the public sector. Sufficient public approval, however, for this financial support must be obtained before a dedicated medical network of an effective scale can be built.

Personal Information Terminals

Masafumi MINAMI
Development Department, Business & Industrial Systems Company
Sony Corporation

1. Introduction

Recently, several types of Personal Information Terminals have been introduced into the market. The application trend for these devices is shifting from just data management tools (e.g. scheduling, address cards, etc.) toward richer communication capabilities. In this talk, the author will present Magic Cap[1] device and the supporting technologies, which are developed by General Magic Inc., as an example of the latter approach. In the following sections, the key technologies are first presented, then some application examples of these technologies are discussed.

2. Key Technologies

The basic concept of this technology is that in order to realize new communication features which do not currently exist, it is not sufficient to only define user-friendly Personal Information Terminals. Support for network infrastructures is also needed. The key technologies, therefore, consist of the followings:

i. Telescript as a support for network infrastructures

ii. Magic Cap as an OS for Personal Information Terminals

iii. Magicmail as an Telescript-enabled messaging application

2.1 Telescript

Telescript is a distributed object-oriented interpretive programming language for developing communicating applications over the network.

The main concept of the language is "Agent" and "Place" (as in Figure 1). These are both running programs, i.e. process. A "Place" is a stationary process whereas an "Agent" is mobile in the Telescript network.

A Telescript network is a network consisting of machines with Telescript language interpreters (Telescript Engines or TSE's in short). Agents, therefore, can go to any Place on the network and do the specified tasks there on the be-

[1] Magic Cap and Telescript are trademarks of General Magic, Inc.

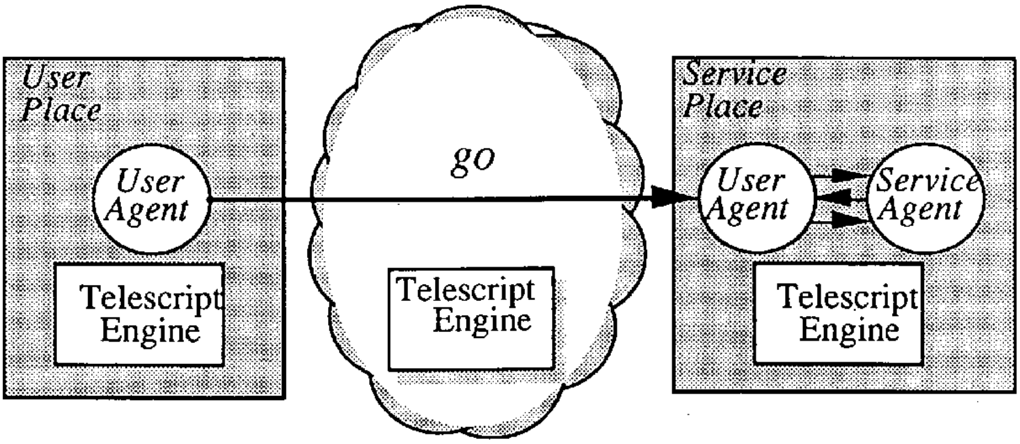

Figure 1 Agents and Places in Telescript

have of the end users.

From the programmers' point of view, there are the following advantages over the existing technologies.

i. "Go" method invocation to move another Place

   To visit several Places, the programmer need only invoke "Go" methods with destination ID's in the Agent program.

ii. Independence from Network Protocols

   All concepts in the language are protocol-independent. The programmers can focus on the behavior of applications, i.e. where to visit next and what to do there.

   As consequence, the programmer can develop Agent programs with more ease.

2.2 MagicCap device

MagicCap is a Telescript-enabled (therefore TSE inside) Operating System with the user interface as in Figure 2.

The users can send:

i. Magicmail messages

ii. Other Agents developed by 3rd software developers to networks to accomplish his/her objectives.

   From the user's point of view, Magicmail "Telecard" is simulating the physical postcards. It has additional functionality, utilizing Telescript capabilities. For example, as shown in Figure 3, the Telecard (for arranging a meeting with recipients) includes a button which, in turn, includes a specific agent.

The agent is programmed as:

If Yes button is pressed,

Then fill in the meeting date & time in the local scheduler and go to the next destination,

Else just go back and inform the sender that date is not good.

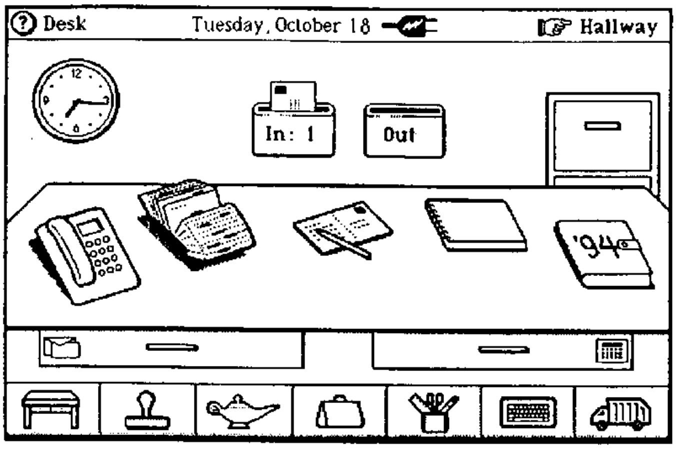

Figure 2 Magic Cap Start-up GUI

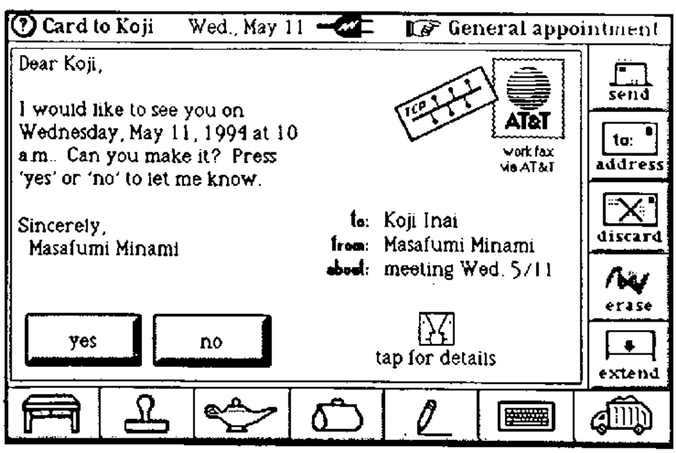

Figure 3 Telecard for Meeting Arrangement

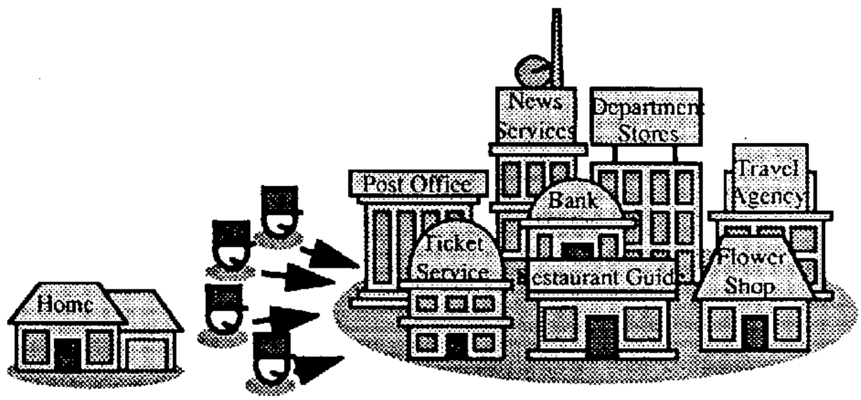

Figure 4 The Conceptualization of Electronic Marketplace in Telescript

3. Application Examples in Electronic Marketplace

Besides Magicmail, another Telescript-enabled applications is the realization of the "Electronic Marketplace." Using Telescript, it is not only very straight forward to implement it over a network (as in Figure 4), but it is also possible to provide new features which do not exist in the current network services. We will present the three examples.

3.1 Watching the events

It is often the case that users don't want to "busy-wait" for expected events. For example, waiting for desired stock values, looking for used cars, knowing the change to flight schedules and so forth. In today's infrastructure, all we have to do is to contact periodically and to check if the events occur. By utilizing Agents, user can specify the desired events and send it to the network. The agent waits for the event to occur and if it occurs, it informs the user (as in Figure 5).

3.2 Navigating through the huge amount of information in the network

There are huge amounts of information in networks — too much information to search for desired things. Users have to seek for the desired information manually, e.g. net-surfing on WWW servers. By utilizing Telescript, users can specify to an Agent the desired items and the agent can seek for them in place of the user (as in Figure 6).

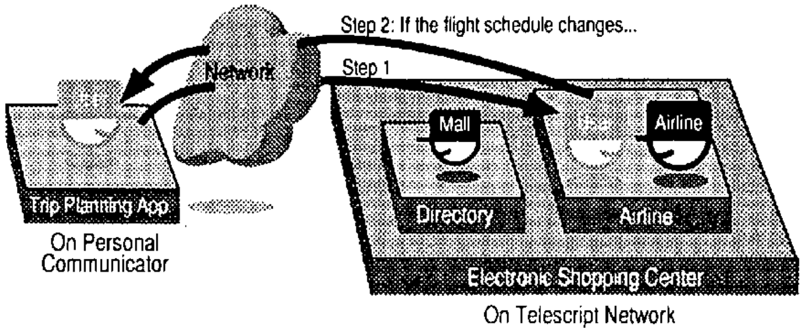

Figure 5 Watching Events

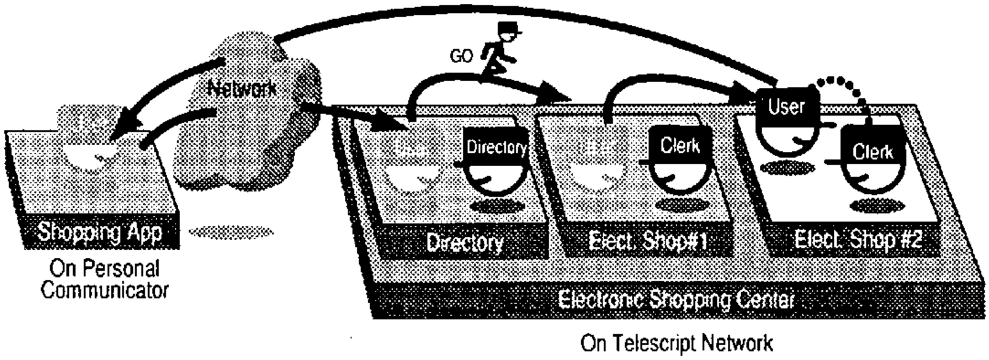

Figure 6 Navigating through the Huge Amount of Information

3.3 Coordinating multiple events at one time

It is also often the case that end users would like to make multiple appointments for one day. For example, to make reservations for a concert and a restaurant seating for Valentine's day. In this case, each appointment has some mutual constraints, i.e. avoiding time conflicts. Under Telescript, this constraint is expressed by variable bindings in the Agent program. All the user has to do is just to parametarize the agent and send it to the marketplace (as in Figure 7).

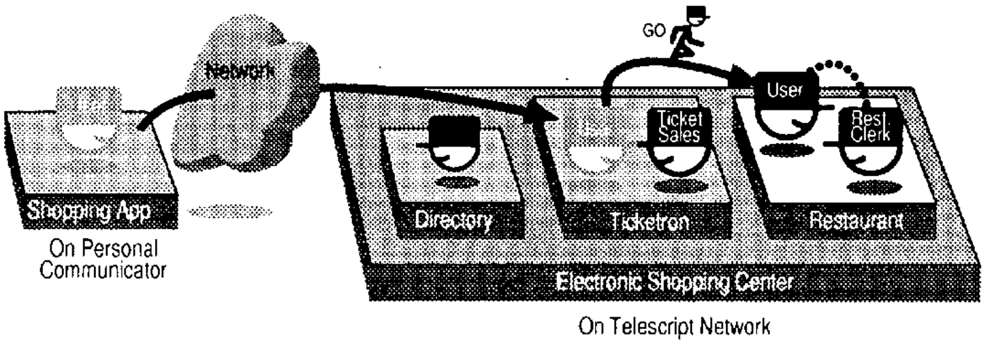

Figure 7 Coordinating Multiple Events

4. Summary

We presented Telescript and Magic Cap technology, as an example of Personal Information Terminals and supporting infrastructure technology and showed their possible application examples.

All application examples might be realized by the combination of other existing technologies. The important point is, however, that without the scheme presented in this talk, creating such applications will be a very time-consuming task, i.e. we have to define the interface and/or protocols possibly for every application. The Telescript/Magic Cap solution is one of the first to solve the above problem for providing the end users the new convenience of communications.

5. Acknowledgment

We thank Jim White and George Fan at General Magic Inc. for providing us the technical suggestions and the some of the presentation materials.

6. References

1. White, J., Telescript Technology: The Foundation for the Electronic Marketplace. General Magic Inc. 1994

2. White, J., Telescript Technology: Scenes from the Electronic Marketplace, General Magic Inc. 1994

Portable Multimedia Machine for The Business Person

Kensuke ADACHI
Multimedia Engineering Laboratory
Toshiba Corporation

1. Introduction

The PC has been widely popular in the office and now there is a strong requirement that it be used anywhere out of the office. LSI and integration technology makes the PC higher in performance and smaller in size. Popular PC types are shifting from desk-tops to lap-tops and portables; the Note-type PC and Sub-Note-type PCs have appeared. MMPC (Multi-media PC) integrated with CD-ROM is likely to spread widely. The number of software titles stored in a CD-ROM is increasing following the increase of MMPCs. The MMPC is expected to be very popular at the office and home in the near future. Generally the MMPC deals with video information compressed usually by MPEG. Judging by these trends, a portable MMPC is desired strongly and will do well in the market. The following requirements for the MMPCs are considered.

1) Portability;

MMPC should be small and light enough to be taken out easily.

2) Capability of multi-media processing;

MMPC should have the following functions. Character, voice, image and video processing.

3) Compatibility;

A lot of application software should be available for the MMPC

2. Pen Computer

To realize portability, a pen based computer is more suitable than a keyboard based computer. But there are several problems in producing a pen based computer. The first problem is the handwriting recognition needed to enter characters, is not yet mature enough and has some limitations in accuracy; usually to write a character in a box on an electronic form which pops up on the screen, and to keep the number of strokes consisting of a character. Especially Japanese language 'Kanji' consists of so many strokes that we have trouble writing a character of many strokes. Therefore, Kana mixed by

Kanji to Kanji conversion is necessary to enter any Kanji easily. We have developed this elementary technology, and have installed them in the following Pen Computers.

1) Dynanote

Dynanote is a Pen Computer which is optionally connected to a keyboard. It is designed as an ordinary PC with a keyboard in the office but to be a Pen based PC without a keyboard out of the office. Touching a menu on the screen with a pen, salespeople in the field can enter several customer orders into the Pen PC. Before salespeople return to their office, they can send the entered data to a host computer through the telephone lines, and when they return, they can deal with the data using a keyboard and send the data to the host computer via a LAN. Dynanote is expected to be used effectively in the sales field. The successor to the Dynanote, the T200, the first color pen PC, is developed and shipped. Its shape and main specs are shown in Figure 1 and Table 1.

2) XTEND

XTEND is an organizer but it has a large display (640dot ¥ 400dot) and 3.5' FDD. It is designed to be a portable information tool with the concept to bring the information, references, make notes and to utilize it. Different from the other maker's organizers, in addition to PIM (personal information management), it has a WP (Word Processor) software compatible with Toshiba's Rupo software and reads/writes the document file of Rupo through FD. Moreover, it has the ability to reference a document filed in MS-DOS format. Its size is 225(W) ¥ 175(D) ¥ 30(H)mm and the weight is about 900g. Its shape and one of its screens are shown in Figure 2 and Figure 3.

3. System Examples of Pen Computer

Pen PC (Dynanote) is being used in the business and manufacturing fields because of its portability and easy manipulation. Two examples are described in the following.

1) To make daily and monthly business reports

Salespeople who are trading communication equipment will inquire about information of their customer from the database of the host computer and download it onto a Pen PC. Before visiting the customer, they have the knowledge of the status of existing equipment. They can take the information with them, trade with the customer referring to the information, and enter the order into their Pen PC. After the meeting, detailed requirements of the customer are made on their Pen PC. When the salespeople come back to their office, they send the data from their Pen PC to the desk-top PC connected to the host computer. The host computer upgrades its database using the data and makes daily and monthly reports. Figure 4 shows the system configuration.

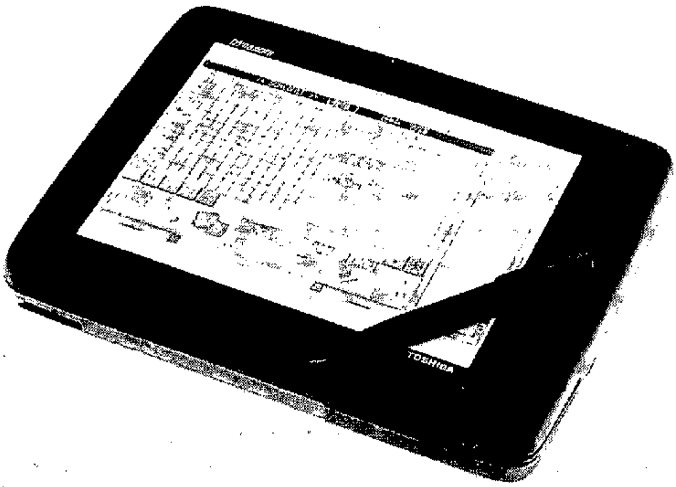

Figure 1

Table 1

Item \ Model	T200CS (color) T200 (Black&White)
Software	Windows for Pen Computing
Processor	i486D× 2–40MHz 32bit 8KB cache in CPU
Memory	Standard: 4MB, Max: 20MB
Display	9.5" 640 × 480dot Color STN LCD (T200CS) 9.5" 640 × 480dot Monochrome STN LCD (T200) Simultaneous Display on External Monitor
Input	Cordless Stylus Pen (Electromagnetic Conductive Digitizer) Keyboard (Option)
Disk Drives	1.8" 80MB HDD 3.5" External FDD (Option)
Interfaces	User-installable Memory card, RS-232C, Printer, FDD Keyboard, PCMCIA (Type2 × 1 Type3 × 1)
Power	Lithium-ion Battery (3000mAh), AC Adapter
Dimensions	27.0W × 21.0D × 4.1cmH 1.95Kg (T200), 2.0kg (T200CS)

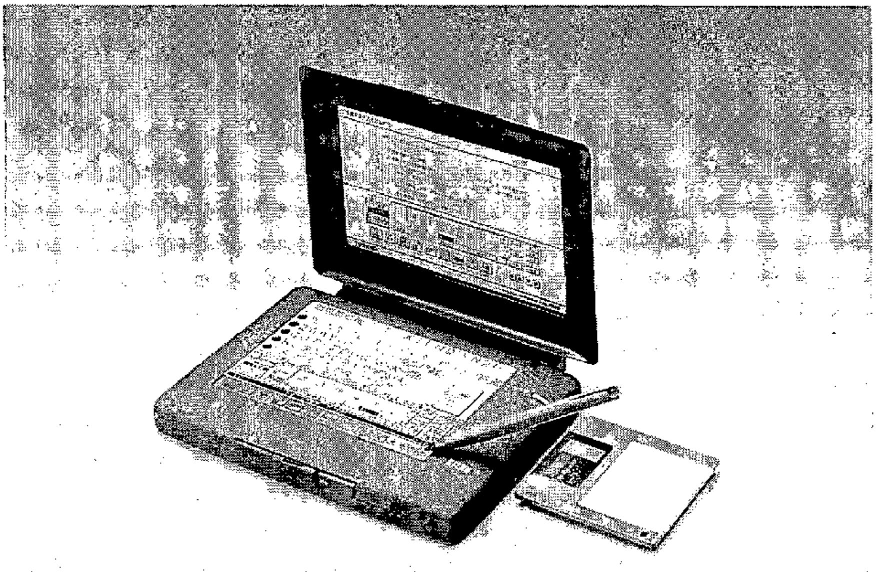

Figure 2

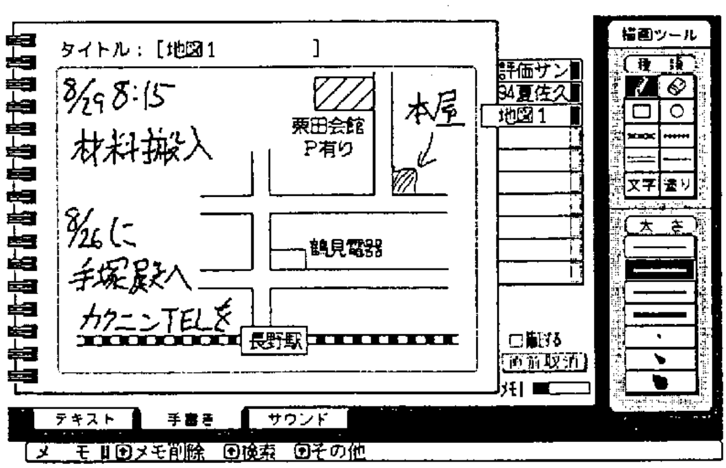

Figure 3

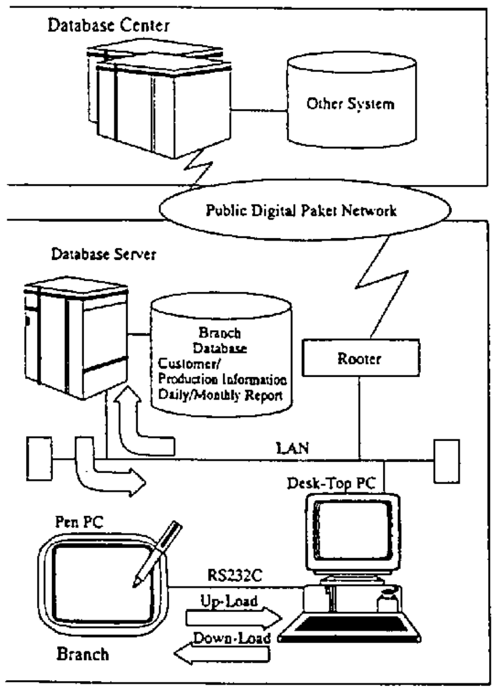

Figure 4

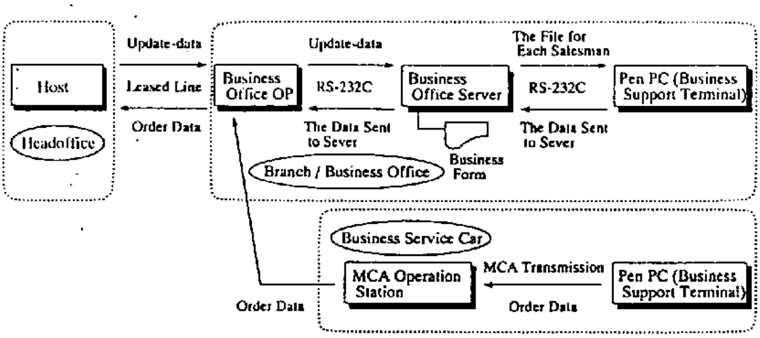

Figure 5

2) To utilize portable database stored in Pen PCs

Salespeople trading medicine to a doctor need correct information about a lot of medicine. Therefore, they had to take a thick pamphlet in which medical information of more than 15,000 medicines are described, or ask about the information to their office through telephone. Pen PC enables them to take the information, to retrieve medical information easily and to give correct information to a doctor. Generally, original medical information is stored in the host computer and the latest information is downloaded onto the Pen PC before the salespeople leave the office. This system configuration is shown in Figure 5.

5. MM-Dynanote

We think that in the near future, portable MMPCs will appear on the market. We are developing a MM Pen PC, video PC card and MPEG1 decoder PC card to strengthen video processing. MM Pen PC has color VGA LCD, PC card slot, CD-ROM and Video for Windows as the OS does, so the title software can be displayed on screen. If a MPEG1 decoder PC card is set in the PC card slot, movies can be displayed at the rate of 30 frame per sec. If a video PC card is connected to MM Pen PC via the PC card slot, video data, for example TV, VCR and Video Camera, are entered into the MM Pen PC.

6. Conclusion

It is considered that portable MMPCs will be popular in the near future, and they will be used for multi-media presentation and video conferencing. Video processing and integration technology is needed to realize portable MMPCs. We have been developing elementary technology and have made several products including some of this technology. We are aiming at producing a portable MM Pen PC to be used by any person, at any place and any time.

Multimedia Home Appliance and its Trend

Sukeichi MIKI
Audio Video Information Technology Laboratory
Corporate Product Development Division
Matsushita Electric Industrial Co., Ltd.

Abstracts

As a result of the Japanese Government's National Broadband ISDN (B-ISDN) Plans as well as the Information Superhighway, a wide variety of experiments on multimedia system has been starting. This year may be the second year for experiments on multimedia systems.

This paper gives a forecast for home information and communication services on emerging multimedia infrastructure. Information-oriented home appliance required by the services will be also discussed.

1. A New Information and Communication Infrastructure and a Culture Change

In the Kansai Science City, the Broadband ISDN (B-ISDN) experiment of B-ISDN Business-chance & Culture Creation (BBCC) started last year. Various Information Superhighway-related experiments have begun in the United States since last year. Shipments of CD-ROM, which stores multimedia on an optical disk, have rapidly increased. Personal information terminals with handwriting input (ink media) have been introduced to the market. Experiments for a Personal Handy Phone System, which is a wireless multimedia system, have also begun.

Then, this year may be the second year of experiments of multimedia systems.

When we think about the future of multimedia information-oriented home appliances, it is important to consider not only the new service made possible by technological advances but also the new life styles and culture which will be created. We are able to forecast the specifications of information-oriented home appliance products.

In multimedia systems, there is a cycle wherein:

Changes in the regulatory infrastructure, such as those pertaining to broadcasting and telecommunication, and developing infrastructure, such as a fiber-optic network, will lend themselves to the creation of new multimedia home appliances; these new products will in turn create new information services and/or a new multimedia information-oriented culture; and, this will accelerate the development and/or expansion of new multimedia infrastructure. There is also a reverse cycle. A multimedia system will be established in the next 10 to 20 years. The starting point for this is previously-mentioned cycles based on an existing system.

2. Multimedia and Existing Systems

Multimedia systems combine a variety of digital coded media such as character data and video data.

However, there can exist a system that combines both digital and analog media. In reality, it is most likely that a digital system will be integrated into an existing analog system so as to create a new multimedia system.

3. New Multimedia Services and Their Impact on Home Appliances

New multimedia home-information services can be classified into the following four categories;

(1) An information service for entertainment (a service through which we can enjoy and benefit from TV much more than now, 100 times more)

(2) An information service for daily life (a service through which we can have spare-time much more than now, 100 times more)

(3) An information service for education (a service through which we can educate ourselves much more than now, 100 times more)

(4) An information service for social relationship (a service through which we can enlarge acquaintances much more than now, 100 times more)

4. A Client-server Model with Seamless Access

As mentioned above, multimedia systems will initially come about the result of the fusion of the following systems;

- the fusion of broadcasting, telecommunication, publishing and computer systems,
- the fusion of packaged media, wired media and wireless media,
- the fusion of existing systems and new multimedia systems, and
- the fusion of a variety of code media.

Then, the fusion of the above systems will result in very sophisticated and complicated systems. However, we anticipate the development of a multimedia infrastructure consisting of a delivery and/or switching system comprised of distributed multimedia database servers storing movies and other information, and thousands of client terminals. The system should provide for a seamless access.

The Personal Handy Phone System in Japan has a data transmission speed of 32 Kbps, and is a seamless access allowing wired and wireless systems to be linked. The Asymmetric Digital Subscriber Line (ADSL) system in the United States has a data transmission speed of 1.5 Mbps, and can also be expected to become a seamless system capable of both phone-line switching and movie delivery.

5. Multimedia Home Appliances

When the anticipated and requisite infrastructure and multimedia systems come into being, multimedia home appliances will need to possess the following features in order to meet consumer needs;

social and consumer needs		features
high quality and long product life	→	low trouble rate
easy use	→	human-machine interface
suitability for small rooms and personal use	→	small size and energy save
ease of recording information for future use	→	precise and intelligent control
communication function to communities	→	interactivity

Considering the features above, the following are typical examples of multimedia home appliances;

- set top for interactive TV
- electronic book
- wireless communication terminal
- portable information terminal

A broad array of new information-and-communication multimedia appliances as the above is certain to become available in the international marketplace with the increasing establishment of infrastructure in the years to come.

The Real World Computing Program

Ryuichi OKA
Theory and Novel Functions Department
Real World Computing Partnership

The Real World Computing Program (RWC) is a national research program funded by Japan's Ministry of International Trade and Industry (MITI) with a budget of $500 million for 10 years (1992-2001). The RWC has as its overall technical objective on the development of flexible and advanced information technologies, that are capable of processing a variety of diversified information (such as images, speech, texts, and so forth). The RWC emphasizes technologies that match the flexibility of human information processing capabilities such as pattern recognition, handling of incomplete information, learning and self-organization, all of which are manifested in the way people solve problems in the real world.

The approach to the objectives of RWC research program may be structurally explained as follows (see Figure 1). The flexible information processing will be based on three types of research categories: novel functions, parallel systems, and optical systems. Since patterns and symbols are basic and common information found in the real world, the novel functions will be required to carry out the integration of symbols and patterns for obtaining intuition-like functions. The integration will be realized by exploring both problems of representation and algorithms which occur in the real world. Representation concerns the framework for modeling the real world and is also strongly related to parallel systems including optical systems. Algorithms concern the dynamics for solving problems formulated in terms of the representation. Neural models are seen as promising candidates to realize both the representation and algorithm.

Five major research themes, described here, will give a more concrete image of the technical objective.

Theoretical foundations: The theoretical foundations for flexible information processing will provide new methods for solving ill-posed problems by the integration of symbols and patterns in connection with learning and self-organization. In order to promote integration of conventional methods, theories for pattern recognition, multivariate data analysis, probabilistic and statistic inference, neural computing, and machine learning will be deepened and unified.

Research Categories

RIIC

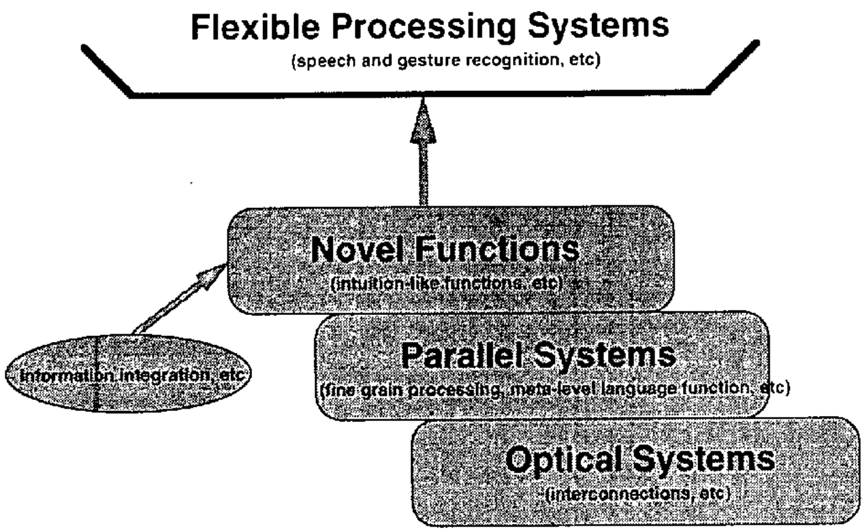

Figure 1

Novel functions: The goal is to develop the technologies for flexible information processing that conventional technology lacks in terms of robustness, openness, and real-time capability. Specific research goals include:

(i) Establishing schemes for flexible recognition and understanding of multi-modal information, including moving images, speech, texts, and gestures, and developing interactive information systems with which humans can communicate through such information media such as

- Graceful man-machine dialogue systems using speech, facial expressions and gestures with at least a 3000 vocabulary unit.

- Information retrieval systems with learning and inference capabilities for understanding users' intentions for newspaper articles of several years.

- Speech understanding systems which can detect and understand special topics in at least 2 hours conversation speech using 2 or 3 thousand keywords.

(ii) Developing flexible systems that are able to autonomously sense and understand, and also control their real world environment.

- Robots which imitate human actions for performing cooperative works, like wrapping and delivering objects to humans.

Massively parallel computing: A massively parallel system (called RWC-1) which will be developed to support the 'real world computation.' Research goals include:

(i) Providing multiple computation paradigms such as shared memory, message passing, data parallel, multi-threading and neural networks.

(ii) Establishing flexible adaptation to the execution status of problems and computation resources, i.e. such parallel systems will have the mechanisms for being adapted to the system load condition, variety os properties of information, requirements of real-timeness, robustness for both hardware and software, etc.

(iii) Providing computation and memory capacity to permit an unpredictable amount of computation which will allow programmers to give primitive description of their problems, and

(iv) Providing extremely fast interconnection networks and synchronization mechanisms, both of which are essential for massively parallel processing and the implementation of neurons and elements of other novel models.

The software architecture of the massively parallel system consists of the kernel, implementation language, base language, operating system, and programming environment layers. The base language supports the notion of object-orientation, reflection, and time-dependent programming. Using reflection, the programming language semantics as well as the resource management strategy is modified by the programming language itself. The new language functionalities might be easily constructed by the base language. Since we have to consider "time" in the real world, the base language provides the facility to describe the real-time system.

Neural network systems: Here the goal is to establish a new type of neural model or computation, which is different from conventional models such as back-propagation, Boltzmann machine, and so forth. Connectionist models will be pursued as candidates that will provide a new scheme for representation of the real world. The domain of 'neural' research should be extended to deal with noisy, uncertain and incomplete information encountered in the real world.

Optical computing systems: the RWC aims at establishing basic technology for;

(i) Optical interconnection devices and networks.

(ii) Optical neural models, devices, and systems.

(iii) Optical logic devices, circuits, and digital systems, and

(iv) Advanced opto-electronic integrated circuits development environments.

Summary: The objectives of the RWC meet the challenging problems in pattern recognition and artificial intelligence in both conceptual and computational aspects.

First, the approach towards the integration of symbols and patterns should lead to new models and algorithms suitable to realize functions with robustness and openness beyond that of conventional pattern recognition and artificial intelligence. Scalable algorithms with simplicity and transparency will also be expected to process a large amount of information such as images, speech, text and so forth.

Second, real-time realization of these models and algorithms will require a new architecture of massively parallel computation which possesses a wide spectrum of real time Input/Output channels, that make close contact with the real world.

Typical applications of RWC will include the realization of information systems capable of supporting human activities, such as: i) a new viewpoint for humans in their creative activities by means of automatic search and inference of information in large data-base including images and speech, ii) an interface between humans and their environment, e.g. supporting disabled people by means of intelligent monitoring.

In conclusion, the RWC program is not a simple successor of the Fifth Generation Computer Project, but will promote challenging research to solve intrinsic problems related to artificial intelligence and pattern recognition. The key concept of the RWC is thus the integration of symbols and patterns for realizing intuition-like functions, which allows the computer to communicate in terms of pattern like images and speech, while using symbolic representation for the information processing.

Appendix

The research themes of the Program currently pursued by the Partnership are as follows:

[Tsukuba Research Center (TRC) and Domestic Distributed Laboratories]

- Ecological and Evolution Models for Massively Parallel/Distributed Systems (Theory Fujitsu Laboratory)

- Statistical Inference as a Theoretical Foundation of Genetic Algorithms (Theory GMD Laboratory)

- A Vision Processor in Neural Architecture (Theory Mitsubishi Laboratory)

- Computational Learning Theory of Probabilistic Knowledge Representations (Theory NEC Laboratory)

- Information Integrating Interactive Systems (TRC Information Integration Laboratory)

- Real World Autonomous Systems (TRC Active Intelligence Laboratory)

- Learning and Growth Functions for Autonomous Mobile Robot (Novel Functions Fujitsu Laboratory)

- Information Integration Technology for Applying Sign Language Recognition (Novel Functions Hitachi Laboratory 1)

- Desk-work Support-based on Episodic Memory (Novel Functions Hitachi Laboratory 2)

- Self-Organizing Information Bases (Novel Functions Mitsubishi Laboratory)

- Generic Tasks for Symbol Information Processing and Pattern Information Processing (Novel Functions MRI Laboratory)

- Parallel Information Processing Mechanisms and Attention Mechanisms in the Brain (Novel Functions NTT Laboratory)

- Cooperative Problem Solving Based on Heterogeneous Knowledge (Novel Functions Oki Laboratory)

- Vision Based Autonomous Systems (Novel Functions Sanyo Laboratory)

- Multi-Modal Human Interface with Secretary Agents (Novel Functions Sharp Laboratory)

- Programming Interactive Real-Time Autonomous Intelligent Agents (Novel Functions SICS Laboratory)

- Active perception Cognition (Novel Functions SNN Laboratory)

- Flexible Storage and Retrieval of Multi-media Information (Novel Functions ISS Laboratory)

- Adaptive Evolution Computers (TRC Neural System Laboratory)

- A New Model of Neural Networks Called Neural Logic Networks (Neuro ISS Laboratory)

- Pattern Recognition Based on Structured Neural Networks (Neuro Toshiba Laboratory)

- Massively Parallel Computation Model, OS, Programming Language and Environment (TRC Massively Parallel Software Laboratory)

- Massively Parallel Execution Models and Architectures (TRC Massively Parallel Architecture Laboratory)

- Development, Implementation, and Evaluation of a Programming Model for Massively Parallel Systems (Massively Parallel Systems GMD Laboratory)

- Massively Parallel Object-Oriented

Models (Massively Parallel Systems Mitsubishi Laboratory)

- Massively Parallel Programming Environment (Massively Parallel Systems MRI Laboratory)

- Adaptive Massively Parallel Systems (Massively Parallel Systems NEC Laboratory)

- Resource Management in the Massively-Parallel Computing (Massively Parallel Systems Sanyo Laboratory)

- A Massively Parallel Machine with Optical Interconnection (Massively Parallel Systems Toshiba Laboratory)

- Special Light Deflectors (Opto-electronics Fujikura Laboratory)

- Optical Interconnection by Wavelength Domain Addressing (Optoelectronics Fujitsu Laboratory)

- Wavelength Tunable Surface Emitting LD Array (Optoelectronics Furukawa Laboratory)

- Optical Interconnection and signal Processing Exploiting through Optical Frequency Addressing (Optoelectronics Hitachi Laboratory)

- Stacked Optical Computing Systems (Optoelectronics Matsushita Laboratory)

- Optical Neurocomputing (Optoelectronics Mitsubishi Laboratory)

- Electro-Photonic Processor Networks (Optoelectronics NEC Laboratory)

- Optical Bus Interconnection Systems (Optoelectronics NSG Laboratory)

- 3-Dimensional Optoelectronic Interconnection (Optoelectronics Oki Laboratory)

- Research of 3D-Integrated Stacked Optical Devices for Optical Computing Systems and their Applications (Optoelectronics Sanyo Laboratory)

- Parallel Optical Interconnection by Optical Fibers (Optoelectronics Sumiden Laboratory)

- Multi-Functional Surface Optical Devices for Optical Interconnection (Optoelectronics Toshiba Laboratory)

[Overseas Subcontractors]

- Learning a Map with a Stereo-Vision Based System (Istituto per la Ricerca Scientifica e Tecnologica)

- Hybrid Evolutionary Programming: Development of Methodology and Applications in Softautomation for High Autonomous and Intelligent Robotic Systems (Goedel School Software Development Company)

- Integrated Information Processing for Pattern Recognition by Self-Organization, Prototype Optimization and Fuzzy Modeling (University of

Sydney)

[Domestic Subcontractors]

Theory/Novel Functions

- Bi-Directional Translation of Pattern and Symbol Information (Takashi Omori, Department of Electronics and Information Science, Tokyo University of Agriculture and Technology)
- Modeling of Visual Recognition Based on the Interaction between Pattern Information and Symbolic Information (Masumi Ishikawa, Department of Control Engineering and Science, Kyushu Institute of Technology)
- Discrimination of Spoken Languages and Dialects (Shuichi Itahashi, Institute of Information Sciences and Electronics, University of Tsukuba)
- Spontaneous Speech Understanding (Tetsunori Kobayashi, Department of Electrical Engineering, Waseda University)
- Example-Based Translation on Massively Parallel computers (Satoshi Sato, School of Information Science, Hokuriku Advanced Institute of Science and Technology)
- Acquisition of Linguistic Knowledge for Natural Language Processing from Text Corpora (Takenobu Tokunaga, Department of Computer Science, Tokyo Institute of Technology)
- Natural Language Understanding Based on Massively Parallel Processing (Tsunenori Mine, College of General Education, Kyushu University)
- Unified Planning of Recognition and Action in Changing Environments (Yoshiaki Shirai, Department of Mechanical Engineering for Computer-Controlled Machinery, Osaka University)
- Description/Understanding of Images and Performance Evaluation of Image processing Algorithms (Keiichi Abe, Department of Computer Science, Shizuoka University)
- Parallel Cooperative Image Understanding Systems (Takashi Matsuyama, Department of Information Technology, Okayama University)
- Adaptive Object Model for Changing Environment (Michihiko Minoh, Integrated Media Environment Experimental Laboratory, Kyoto University)
- Image Understanding of Presentation Media by Integration of Multiple Informations Sources (Yuichi Ohta, Institute of Information Sciences and Electronics, University of Tsukuba)
- Computer Vision Algorithm Based on Cooperative Computation (Naokazu Yokoya, Information Technology Center, Nara Institute of Science and Technology)
- Active-Control Robot Head for Vision-sound Information Integration (Hiro-

chika Inoue, Department of Mechano-Informatics, University of Tokyo)

- Task Execution System with Multi-Sensor Fusion in Human Robot Cooperative Work (Tomomasa Sato, Research Center for Advanced Science and Technology, University of Tokyo)

Neural Systems

- Dynamics of Neural Networks (Shuji Yoshizawa, Department of Mechano-Informatics, University of Tokyo)

- Feedback Learning on Neural Network (Yoichi Okabe, Research Center for Advanced Science and Technology, University of Tokyo)

- Modeling 3-D Visual Information by Neural Processing Systems (Yuzo Hirai, Institute of Information Sciences and Electronics, University of Tsukuba)

- Neural Mechanisms and Information Representation for Color Vision (Shiro Usui, Department of Information and Computer Sciences, Toyohashi University of Technology)

- Constraints Satisfaction Systems Using Hopfield Neural Network Modules (Yutaka Akiyama, Institute for Chemical Research, Kyoto University)

- Temporal-Pattern Dependent Learning Rule and a Model of the Hippocampal Cortical Memory System (Minoru Tsukada, Department of Information and Communication, Tamagawa University)

- Computational Dynamics of Chaotic Neural Networks (Kazuyuki Aihara, Department of Mathematical Engineering and Information Physics, University of Tokyo)

Massively Parallel Systems

- Real Time Music Information Processing Based on Parallel Processing (Yoichi Muraoka, Department of Information and Computer Science, Waseda University)

- Flexible Computer assisted Analysis Systems for Non-Liner Problems (Shinichi Oishi, Department of Information and Computer Science, Waseda University)

- Distributed Shared-Memory Systems for Massively Parallel Processing Systems (Kei Hiraki, Department of Information Science, University of Tokyo)

- Super Parallel Architecture Based on Functional Model (Toshio Shimada, Department of Information Electronics, Nagoya University)

- Object-Oriented Concurrent Description Frameworks for Massively Parallel Computing (Akinori Yonezawa, Department of Information Science, University of Tokyo)

Optical Systems

- Semiconductor Laser Diodes for Optically Triggered Digital IC's (Takeshi Kamiya, Department of Electronic Engineering, University of Tokyo)

- Optical Properties of Quantum Well Structures in a Micro Cavity and those Application for Semiconductor Laser Switches (Masahiro Tsuchiya, Department of Electronic Engineering, University of Tokyo)

- Optical Parallel Digital Computers (Yoshiki Ichioka, Department of Applied Physics, Osaka University)

- Architecture and Packaging Technique of Optical Computer (Jun Tanida, Department of Applied Physics, Osaka University)

- Development of an Integrated Optical Neural Network Module (Toyohiko Yatagai, Institute of Applied Physics, University of Tsukuba)

- Learning Capabilities and Massively Parallel Processing (Masatoshi Ishikawa, Department of Mathematical Engineering and Information Physics, University of Tokyo)

Massively Parallel Computer RWC-1

Shuichi SAKAI
Massively Parallel Architecture Laboratory
Real World Computing Partnership*

Abstract

This presents a massively parallel computer which is being developed by Real World Computing (RWC) Program in Japan. The purposes of this research and development are to efficiently support flexible and integrated information processing which are research targets in RWC, and to pursue a general purpose stand-alone massively parallel system efficiently supporting multiple programming paradigms. For the purposes, a new massively parallel computer RWC-1 is now under development with a strong collaboration among hardware people, software people and application people.

The presentation shows the RWC-1 architectural features, RWC-1 software features and the plan for machine development.

The architectural features of this system are: (1) Reduced Interprocessor-Communication Architecture (RICA) where communication, scheduling and instruction execution are tightly integrated, (2) support for a massively parallel operating system, (3) a cube connected circular banyan interconnection network, and (4) an independent I/O network.

Figure 1 illustrates an organization of RICA. RICA means an architectural fusion of computation and communication and simplification of the whole structure.

A massively parallel operating system is necessary for an efficient and safe stand-alone computer. A global virtual memory is one of the most important technologies for achieving it. We propose the global virtual addressing, where PE address is virtualized as well as local memory address.

* Tsukuba Mitsui Building 16F, 1-6-1 Takezono, Tsukuba, Ibaraki 305, Japan
Phone: +81-298-53-1650
Fax: +81-298-53-1652
EMAIL: sakai@trc.rwcp.or.jp

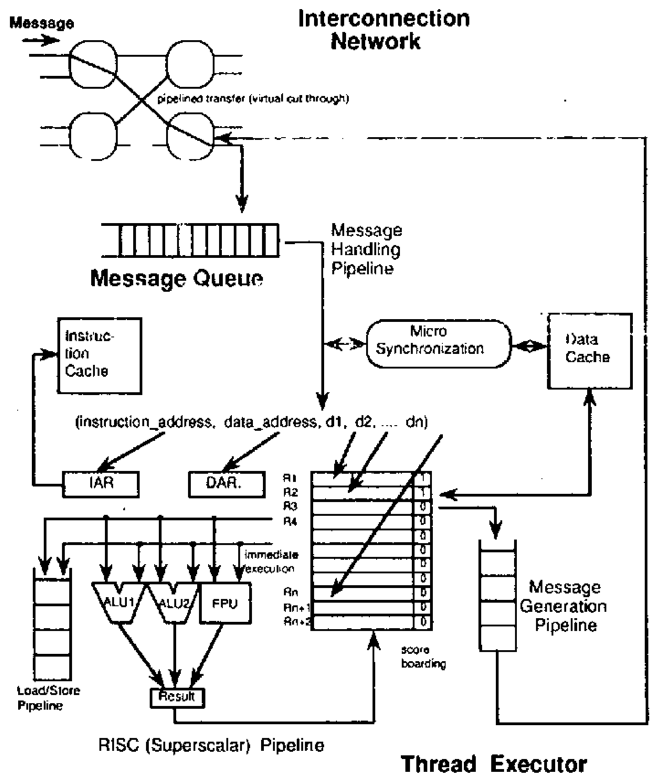

Figure 1 Reduced Interprocessor Communication Architecture

As an interconnection network, we adopted Cube Connected Circular Banyan (CCCB) (Figure 2), since (1) it needs only a small hardware, (2) operates with a high band-width and small delay, (3) performs self routing, (4) store-and-forward deadlock is easily prevented with this network, and so on.

Figure 3 illustrates the RWC software. The main software being developed in TRC is a kernel *SCore*, a description language *MPC++*, and a base language *OCore*.

TRC is now developing a massively parallel prototype called *RWC-1*. RWC-1 will have 1,024 PEs and will be assembled in March 1996. RWC-1 is an experimental machine for proving the concepts, mechanical features and efficiency. The absolute peak performance is not the purpose of this system.

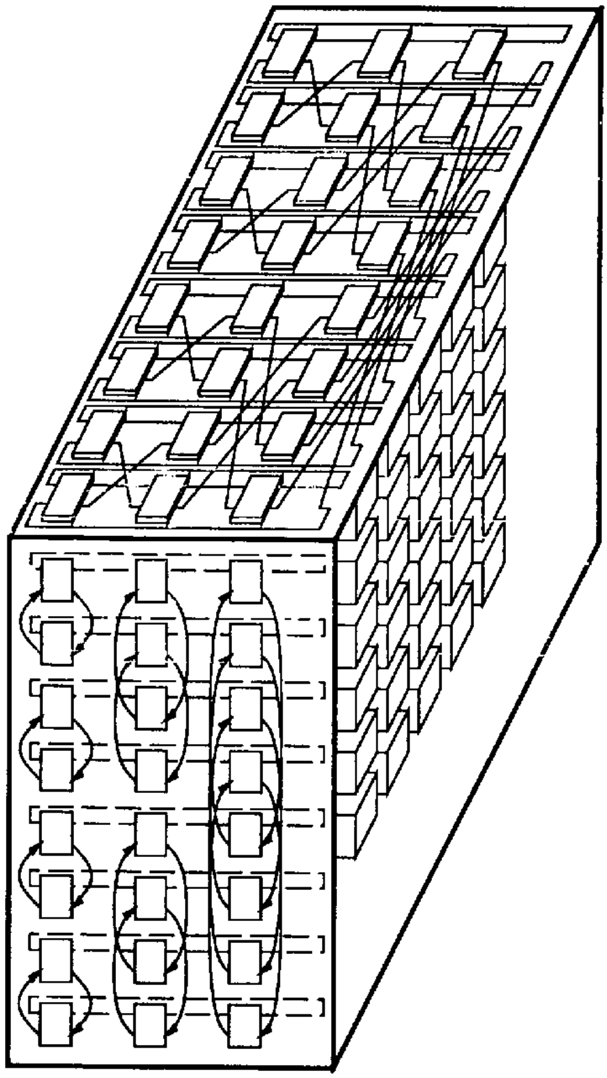

Figure 2 Cube Connected Circular Banyan Network

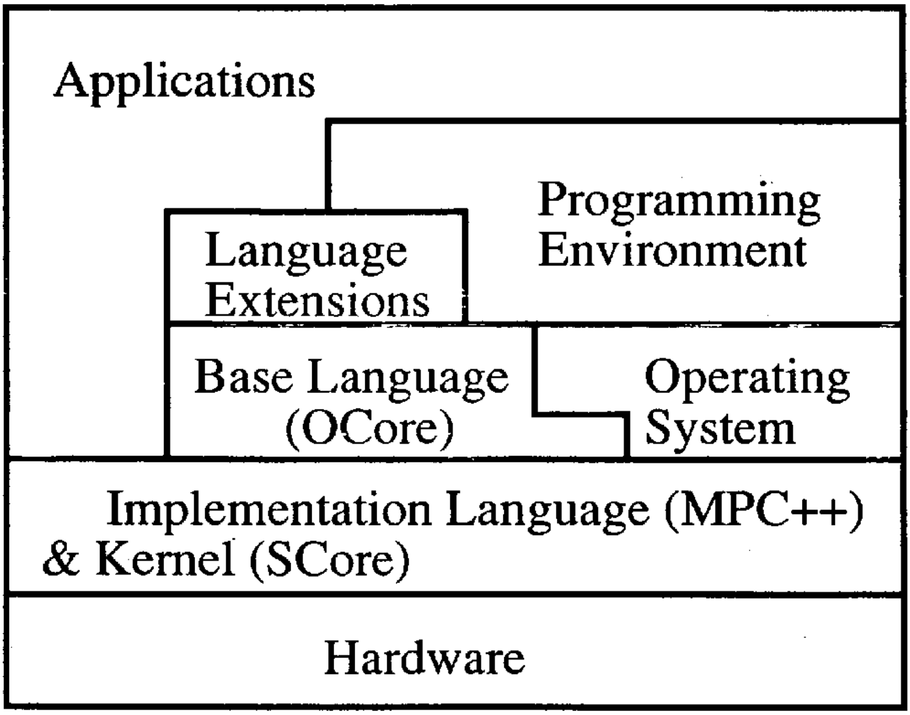

Figure 3 RWC Software

RWC-1 contains original processor chips, original interconnection switches and original maintenance hardware. As for the first step, we have been developing the first tested since 1993.

Cooperative Interactions in Fuzzy Decision Support Systems

Koichi YAMADA
Advanced Technology Center
Yamatake-Honeywell Co., Ltd.

Introduction

Human-computer interaction (HCI), or the human interface, is one of the most vigorous research topics in computer science and the related areas. However, there are many conflicting images of HCI research, and sometimes the field seems to be chaotic. Whatever the viewpoint, the final goal is a common one; realization of easy, intelligent and friendly systems — systems with cooperative interactions.

There are two major streams of research that deal directly with cooperative interactions. One is cooperative answering in information retrieval [1]. However, most research in the field is dependent on a priori domain knowledge, or on heuristics in the domain. The other is an approach that deals with the user's intentions in more general dialogues [2] [3]. They are, however, too precise for use in practical systems.

In this paper, we introduce some alternative approaches employing fuzzy logic which we have investigated at the Laboratory for International Fuzzy Engineering Research (LIFE). First, we demonstrate an approach for cooperative interactions in information retrieval systems which requires no a priori knowledge or heuristics dependent on the domain. Then, we discuss another approach that utilizes the user's preferences.

Cooperative Answers to Queries [4]

Information retrieval (IR) is one of the most basic decision-making tasks. However, the task is not so simple for most decision makers, who often have to access unfamiliar databases using unfamiliar IR systems. In such cases, queries frequently fail (retrieve no data) or retrieve too much data to examine all of them. Then, they have to construct a new query to retrieve a manageable number of data. But there is still no guarantee that this next trial will be successful.

Cooperative answering is one technique to support such unhappy users. Cooperative answers are those that give the user some helpful hints for construction of the next query. These are given when 1) the query fails, or when 2) too much data is retrieved. Unlike approaches proposed so far, our approach generates cooperative answers without domain dependent heuristics and knowledge given a priori. Instead, it creates knowledge about the distribution of data in the database for itself, and utilizes it. The created knowledge is called a macro database, because it describes the contents of the database globally.

Generation of the macro database

The macro database is a set of linguistic expressions each of which describes a fuzzy cluster of data in the data space. It is generated by the following algorithm:

(1) Express nominal attributes by numerical ones; e.g. in the case of an apartment database, the attribute "floor type" (see Figure 2) is expressed by its average floor space, and "the nearest station" by a pair of map coordinates.

(2) Define linguistic labels by membership functions on these numerical attributes (See Figure 1). Each linguistic label expresses a certain concept on the attribute. These membership functions must cover the entire universe of discourse of the attributes.

(3) Apply a fuzzy clustering method called Fuzzy C-means to data in the database, and create fuzzy clusters from the data. In the first trial, set the number of clusters to two.

(4) Try to express the generated fuzzy clusters by the linguistic labels defined before. If the fuzzy clusters are expressed well by the linguistic labels — that is, their projections to attribute axes are almost included in membership functions defined on the attributes, go to the next step. Otherwise, increase the number of cluster by one, and go to (3).

(5) Express all fuzzy clusters by the combinations of linguistic labels. Then, each cluster is a factor of the macro database.

Cooperative answering when a query fails

The user's query is given in a conjunction of fuzzy conditions expressed in fuzzy sets on attributes. If the matching degree of data to the query is greater than a certain value, that data is retrieved from the database. If there is no such data, the query fails.

When a query fails, the system gives the user the following information in order; 1) the nearest cluster to the query, as a set of data that the user might accept, 2) the nearest data to the query as an alternative, then 3) compromises that the user must accept if not satisfied with the alternative (Figure 2). The linguistic expressions of the macro database described before are used to provide the information.

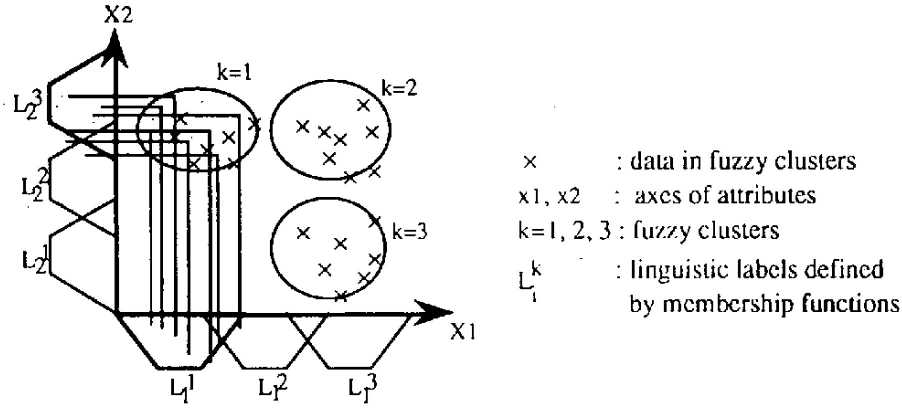

Figure 1 Fuzzy Clusters and Their Linguistic Expressions

U: Show me some apartments with
the nearest statation = Tama-Plaza,
floor type = 1R (One room).

S: There is no such an apartment.
But, there are some apartments you might want;
the nearest statation = around Kajigaya,
floor type = around 1R.
How about the next one, for example:
the nearest station = Miyamae-daira,
time to station = 7 min.,
how old = 0 year,
floor type = 1K (1 bedroom and small kitchen),
Rent = 73,000 yen.
If you want an apartment around Tama-Plaza,
the available apartments are limited to
floor-type : more than 3LDK (3 bedrooms).

Figure 2 An Example of Cooperative Answers of Real Estate Advisor [4]

Cooperative answering when too much data is retrieved

Queries sometimes return too many data from the database for the user to examine all of the data precisely. In that case, the user might want to refine the retrieved data set by giving additional conditions. However, this is not so easy, because there is no extra information to shrink it to a proper size. So, the system gives the user the linguistic expression of the retrieved data set and the number of data, then, after checking the distribution of the retrieved data set for each attribute, it urges the user to provide an extra condition for the attributes for which the distribution is the largest.

Decision Support with a User Model

In consulting systems such as apartment-hunting [5] and book-selection [6] advisors, the user often does not have any clear prior image about his/her decision. What the system must propose in these applications is "a favorable decision" rather than "the best one." A user model expressing the user's preferences is effective for this purpose. Preferences, for example, can be used as additional conditions for queries in data retrieval systems, when too much data is retrieved, and can also be used as information for derivation of fuzzy goals for interactive fuzzy programming [7], which is a fuzzy version of multiobjective programming.

User modeling in decision support systems

In general, there are two ways to build a user model. One is explicit modeling, which requires the user to inform the system of his/her preferences. The other is implicit modeling, where the system guesses the user's preferences during interactions. For the aim of cooperative interactions, implicit modeling is preferable.

Stereotyping [6] is one of the major approaches for implicit modeling. A stereotype is knowledge that represents typical traits of a typical user. It also has its activating conditions, which are usually based on the basic profile of the user, such as occupation, gender, age, etc. Using stereotypes as knowledge, the system can guess many aspects of the user's preferences in the first stage of interactions.

However, stereotyping has inherent shortcomings — the initially obtained user model usually includes some wrong guesses, so, the system always has to monitor the interactions, infer the user's preferences from clues in interactions and correct the wrong guesses.

The user's preferences, however, are not easy to infer from the interactions, because the user talks about different levels of preferences. Sometimes he/she may say directly: "I prefer a cheaper apartment." In other cases, the user may mention a higher level of preference such as "I want safety," which lets the system deduce that he/she wants an apartment with a caretaker and/or remote lock system. Furthermore, when the user talks about concrete requirements such as the desire for an apartment with tiled walls, it is possible to hypothesize that he/she prefers a "good-looking" apartment. From the hypothesis, you can also assume that the user prefers a new apartment.

Though the system which we are implementing at LIFE employs only the direct and the deductive approaches, we discuss the third approach of hypothesizing, which involves the inferencing process called abduction.

Fuzzy abduction

Abduction is the inferencing process by which to derive a set of hypotheses that explains a given set of events with a set of rules. A derived set of hypotheses is called an explanation. As a simple example of abduction, suppose that you love to go to the races, and that a friend says you must be a gambler. In this case, probably, his inference is NOT a deduction, because he does not seem to use a rule saying "you are a gambler, because you like to go to the races." A more probable rule is "you like to go to the races, because you are a gambler." So, what he did was finding a hypothesis that explains the fact that you like to go to the races. That is an abduction.

Fuzzy abduction [8] is defined as follows; when a set of rules R, where each rule "R_{ij} : P_i -> Q_j" has a truth value r_{ij} in [0, 1], and a fuzzy set $\underline{Q}$ on Q (the set of Q_js) are given, fuzzy abduction is the procedure by which to obtain a fuzzy set (fuzzy explanation) $\underline{P}$ on P (the set of P_is) that derives $\underline{Q}$ with R. Here, "$\underline{P}$ derives $\underline{Q}$" means that the following equation holds:

$$q_j = \max_{i,\ p_i + r_{ij} \geq 1} (p_i + r_{ij} - 1), \qquad (1)$$

where p_i and q_j are truth values of P_i and Q_j, and are also membership values of P_i in P and Q_j in $\underline{Q}$, respectively.

Theoretically, there is no guarantee that fuzzy explanations always exist. However, if any fuzzy explanations do exist, there are, in general, only the largest and multiple minimal fuzzy explanations. The largest fuzzy explanation, $\underline{P}^{max}$ is given by the following equations:

$$\underline{P}max = \Diamond_{i,j} (p_{ij}^\wedge / P_i), \qquad (2)$$

$$p_{ij}^\wedge = \begin{cases} q_j - r_{ij} + 1 & \text{if } r_{ij} \geq q_j, \\ 1.0 & \text{otherwise,} \end{cases} \qquad (3)$$

where $\Diamond$ is an operator defined as:

$$a/A \Diamond b/B = \begin{cases} a/A + b/B & \text{if } A \neq B \\ \min(a, b)/A & \text{if } A = B \end{cases} \qquad (4)$$

Then, $\underline{Pk}^{min}$ (k=1,...,N^{min}), given in the next equation, is a minimal fuzzy explanation, if it is a subset of $\underline{P}^{max}$ and does not include other $\underline{Pk'}^{min}$ ($k' \neq k$).

$$\underline{Pk}^{min} = \Sigma_{j,\ q_j \neq 0} (\Delta_{i \in \phi(j)} (q_j - r_{ij} + 1 / P_i)), \qquad (5)$$

R1: Good-looks -> New (1.0)
R2: Good-looks -> Tiled-wall (1.0)
R3: Good-looks -> Remote-lock-system (0.6)
R4: Safety -> Remote-lock-system (1.0)
R5: Safety -> Caretaker (0.8)
R6: Safety -> Residential-area (0.8)
R7: Comfort -> Caretaker (0.8)
R8: Comfort -> Basement-garage (0.8)
R9: Silence -> Residential-area (1.0)
R10: Silence -> Sound-proof (0.6)

(a) Rules that derive lower-level preferences from higher-level preferences.

Remote-lock-system (0.8)
Caretaker (0.6)
Residential-area (1.0)
Sound-proof (0.6)

(b) The user's lower-level preferences.

0.8 / Safety + 1.0 / Silence

(c) higher-level preferences that explain (b).

Figure 3 Inferencing Higher-level of Preferences by Fuzzy Abduction

where f (j) means a set of "i"s such that $r_{ij} - q_j \geq 0$ for the given j, and Δ_i is an operator which chooses a term from amongst those with different "i"s.

<u>Reasoning preferences by fuzzy abduction</u>

Suppose that there is a real estate agent who has some knowledge about the tendencies of apartment hunters. For example, customers who want good-looking apartments always require new ones with tiled walls, and tend to want remote lock systems as shown in R1, R2 and R3 in Figure 3(a). In these rules, preferences in the antecedents are customers' basic inclinations, or higher-level preferences. Those in the consequents are their concrete requirements, or lower-level preferences.

Now, suppose again that a customer has come to the agency, and that the agent understands him/her to want an apartment shown in Figure 3(b), after some discussion with him. Then, the agent can apply fuzzy abduction to infer the customer's higher-level preferences. Since the best explanation of the given facts is usually given in minimal explanations [8], we use eq. (5) to obtain a solution. In this case, only a minimal fuzzy explanation is obtained, as shown in Figure 3(c).

Conclusions

A few approaches related to cooperative interactions in fuzzy decision support systems are proposed. In these approaches, fuzzy logic plays important roles in dealing with the fuzziness which is essential in macro expression of a database, and in users' preferences.

References

[1] T. Gaasterland, et al.: An Overview of Cooperative Answering, Journal of Intelligent Information Systems, Vol. 1, pp. 123-157 (1992).

[2] J. F. Allen, C. R. Perrault: Analyzing Intention in Utterances, Artificial Intelligence, Vol. 15, pp. 143-178 (1980).

[3] K. Yamada, R. Mizoguchi, et al.: Model of Utterance and Its Use in Cooperative Response Generation, Lecture Notes in Computer Science 753, Human-Computer Interaction (Eds. L. J. Bass, et al.), Springer-Verlag, pp. 260-271 (1993).

[4] J. Ozawa, K. Yamada: Cooperative Answering with Macro Expression of A Database, Proc. IPMU '94, pp. 17-22 (1994)

[5] N. Harada, K. Yamada, et al.: User Modeling for Cooperative Decision Support with Fuzzy Representation, First Asian Fuzzy System Symposium, pp. 142-150 (1993)

[6] E. Rich: Users are individuals: individualizing user models, International Journal of Man-Machine Studies, Vol. 18, pp. 199-214 (1983)

[7] A. Nukuzuma, K. Yamada, et al.: Decision Support System Aiming at Cooperative Interactions, Proc. 2nd Inter. Conf. Fuzzy Theory & Technology, pp. 26-28 (1993)

[8] K. Yamada, M. Mukaidono: Recognizing Intentions by Fuzzy Abductive Reasoning, Proc. Fifth IFSA World Congress, pp. 187-190 (1993)

Neuro-Fuzzy Application for Intelligent System

Toshio FUKUDA and Koji SHIMOJIMA
Department of Micro System Engineering
Nagoya University

1. Introduction

Intelligent autonomous robot systems are required in many fields and places. The intelligent robots have to carry out tasks in various environments like human beings. They have to determine their own actions in uncertain or changeable environments based on sensory information and their knowledge. Human operators can give the robots their knowledge in advance concerning tasks and skills in a top-down manner. However, when the robots perform tasks in an uncertain environment, the knowledge may be meaningless. In this case, the robots have to adapt their actions to their environments and acquire new knowledge or skills by themselves through actions. This process proceeds in a bottom-up manner.

This paper introduces a *hierarchical intelligent control* scheme for intelligent robots. The hierarchical intelligent control has consists of three levels: the adaptation level, the skill level, and the learning level. This scheme has two characteristics with respect to the learning process: top-down approach and bottom-up approach. To link the three levels and have such characteristics for knowledge acquisition, the scheme uses artificial intelligence (AI), fuzzy logic, neural networks (NN) and genetic algorithm (GA) [1-3]. Each technique has advantages and disadvantages. In order to overcome the disadvantages, this paper introduces their integration and synthesis techniques. Those are key techniques for intelligent control of the systems in robotics and mechatronics.

2. Integration and Synthesis of Neural Network, Fuzzy Logic and Genetic Algorithm

The AI, fuzzy logic and neural network have similar performance with respect to signal transformation, though their methods are different. Each method has some merits and demerits. Table 1 is the comparison of them. To overcome their demerits, some integration and synthesis techniques and GA have been proposed.

The fuzzy logic and the neural networks can be used as preprocessors of the AI. They transform numerical data set to the symbolic data set. To give the rules for transformation, human operators easily determine rules of the fuzzy logic. However, when the number of input parameters increases, determination of the rules becomes laborious for the human operators. In this case, the neural networks are useful. While showing data sets of input/output to the neural network, it learns them and works as a transformative function. Drawbacks of the neural network are that the human operators can not give their knowledge beforehand nor understand the acquired rules. Moreover, the convergence of the learning is very slow and the neural network can not lean new patterns incrementally. To solve these problems, the structured neural networks were investigated.

The fuzzy neural network is a combined neural network with the fuzzy logic. Human operators are able to give their knowledge in the fuzzy neural network by means of membership functions. The membership functions are modified through the learning process. After the learning process, the human operators can understand the acquired rules in the network. With respect to the convergence of the learning process, the fuzzy neural network is faster than the conventional neural network. For multiple input parameters, the hierarchical fuzzy neural network is available. However, it is difficult to optimize the structure of the hierarchical fuzzy neural network. On the other hand, the fuzzy logic is used as a critic for improvement of convergence of learning of the neural network. In this case, the fuzzy logic determines the learning step depending on the state of convergence.

The neural network with radial basis functions is also the structured one. It has potential to learn more quickly and is easier than the neural network with the sigmoid functions. For incremental learning, the Adaptive Resonance Theory (ART) model has been proposed. It has a two-layered structure. It learns patterns one by one incrementally. That is, it can correct errors by learning new patterns without using the old patterns. However, the ART model has a problem of bad classification ability.

The Neural network based on Distance between Patterns (NDP) has the abilities of incremental learning and classification. The NDP learns categories of patterns one by one. It increases neurons of the output layer using the incremental learning algorithm. It uses the radial basis function at the output layer. Depending on its aim, human operators should give the neural network efficient structure if they have experiences. Or else, heuristic approach for structure optimization is necessary.

The GA is a powerful tool for structure optimization of the fuzzy logic and the neural networks. Particularly, the GA is a powerful tool for optimizing the hierarchical fuzzy neural network. On the other hand, the fuzzy logic and the neural network can be a evaluation function for the GA. It is difficult to define evaluation functions for complex optimization problems. However, while using the fuzzy logic or the neural network, human operators can transfer their criterion. Those are the complicated reinforce learning techniques because they do not use teaching signal but obtain desirable states while manipulating a lot of parameters at the same time. The Genetic Programming which is one of the applications of the GA and manipulates symbols can produce new rules or knowledge for the AI.

3. Hierarchical Intelligent Control

The hierarchical intelligent control scheme comprises three levels: a *learning* level, a *skill* level, and an *adaptation* level as shown in Figure 1 [4]. The learning level is based on the expert system for a reasoning mechanism and has a hierarchical structure: recognition and planning to develop control strategies. The recognition level uses neural networks and fuzzy neural networks as nodes of a decision tree. In the case of the neural network, inputs are a numeric quantity sensed by some sensors, while outputs are a symbolic quality which indicates process states. The structured neural network for incremental learning is effective for memorizing new patterns. The fuzzy neural network transforms numerical quantity into symbolic quality by using membership functions. Both the neural network and the fuzzy neural network are trained with the training data sets of a-priori knowledge obtained from human experts. As a result, the neural network and the fuzzy neural network can transform various sensed data from numerical quantities to symbolic qualities, and perform *sensor* fusion and production of *meta-knowledge* at the learning level. The important information is sensed actively by using the knowledge base. The sensors of vision, weight, force, touch, acoustic, and other can be used as nodes of the decision tree for recognition of the environment.

Then, the planning level reasons symbolically for strategic plans or schedules of robotic motion, such as task, path, trajectory, force, and other planning in conjunction with the knowledge base. The system can include another *common* sense for robotic motion. The GA optimizes control strategies for robotic motion heuristically. The GA also optimizes structures of neural network and fuzzy logic connecting each level. Thus, the learning level reasons unknown facts from a-priori knowledge and sensory information. Then, the learning level produces control strategies for skill level and adaptation level in a feed-forward manner. Following the control strategy, the learning level selects initial data set for a servo controller at the adaptation level from a database which maintains some gains and initial values of interconnection weights of the neural network in the servo controller. More-

Table 1 Comparison of Neural Network, Fuzzy Logic, AI, and Genetic Algorithm

	Math Model	Learning Data	Operator Knowledge	Real Time	Knowledge Representation	Nonlinearity	Optimization
Control Theory	○	×	△	○	×	×	×
Neural Network	×	○	×	○	×	○	◖
Fuzzy	◖	×	○	○	△	○	×
AI	△	×	○	×	○	△	×
GA	×	○	×	△	×	○	○

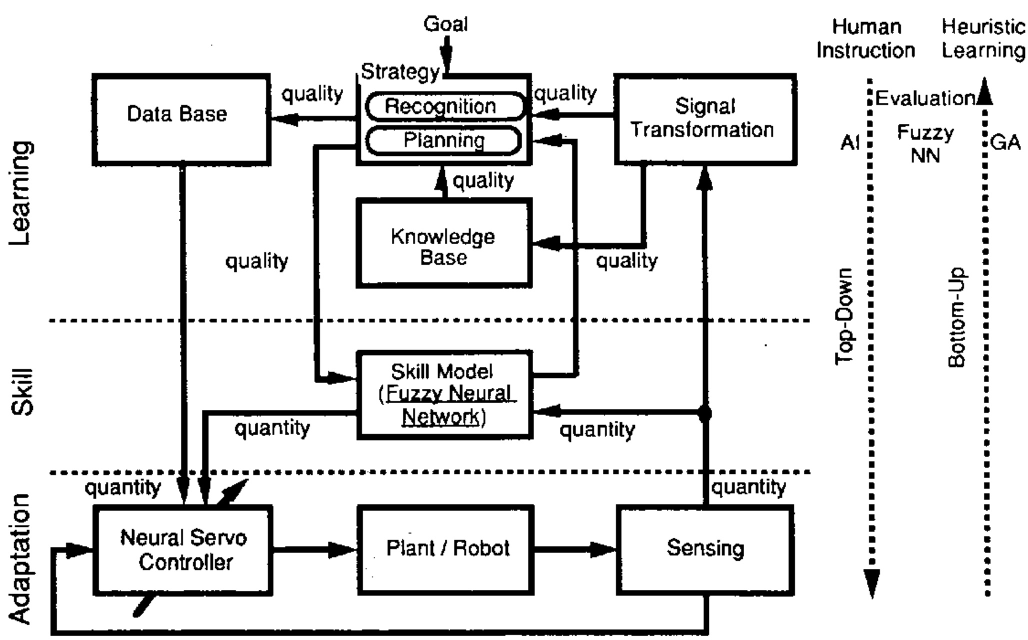

Figure 1 Hierarchical Intelligent Control System

over, the recent sensed information from the skill level and the adaptation level updates the learning level through the long-term learning process by human instruction. Therefore, knowledge at the learning level is given by human operators in a top-down manner and acquired by heuristics of the skill level and the adaptation level in a bottom-up manner.

In the same task and different environments, it is necessary to change control references depending on the environment for the servo controller at the adaptation level. At the skill level, the fuzzy neural network is used for specific tasks following the control strategy produced at the learning level in order to generate appropriate control references. Input signals into the fuzzy neural network are numerical values sensed by some specific sensors and some symbols which indicate the control strategy produced at the learning level. Output of the fuzzy neural network is the control reference for the servo controller at the adaptation level. This output is based on the skill extracted from human experts through learning and training sets obtained from them. At the same moment, the fuzzy neural network clusters the input signals in the shape of membership functions. These membership functions are used as the symbolic information for the learning level.

In the adaptation level, a neural network in the servo controller adjusts the control law to current status of dynamic process. Particularly, compensation for non-linearity of the system and uncertainties included in the environment must be dealt with by the neural network. Thus, the neural network in the adaptation process works more rapidly than that in the learning process. Eventually, the neural networks and the fuzzy neural networks connect the neuromorphic control with the symbolic control for hierarchical intelligent control while combining human skills.

The hierarchical intelligent control is also applied to the multi-agent robot system. If there is not interaction between robots, each robot has to work optimally for its own purpose, so that the total task can be achieved optimally. That is, each robot should work selfishly. Or else conflicts among the robots might occur when using a public source. The competition may cause collisions and deadlock states among the robots in a local ares. In order to avoid competition, it is necessary for the robots to communicate and to coordinate among themselves. Coordination among the robots is as important as selfishness. The GAs are applied hierarchically to balance selfishness with coordination for efficient motion planning. When multiple robots work independently as a decentralized system, the learning capability of the robots is indispensable for the evolution of the system.

As the results, integration and synthesis of AI, Fuzzy Logic, Neural Network and GA are important for the intelligent system, depending on their characteristics. Hierarchical intelligent control using these techniques is effective for the control intelligent systems in robotics and mechatronics.

4. Conclusions

This paper described a hierarchical intelligent control scheme for intelligent robots. Integration and synthesis techniques of AI, fuzzy neural network and GA make the robot system to be intelligent. The system has both top-down and bottom-up learning abilities while integrating and synthesizing those techniques.

References

[1] T. Fukuda and T. Shibata, Theory and Applications for Neural Networks for Industrial Control Systems, IEEE Trans. on Industrial Electronics, Vol. 39, No. 6, pp. 472-489 (1992)

[2] L. A. Zadeh, Fuzzy Sets, Information and Control, Vol. 8. pp. 228, (1965)

[3] D. E. Goldberg, Genetic Algorithms in Search, Optimization, and Machine Learning, Addison Welsey (1989)

[4] T. Shibata and T. Fukuda, Skill Based Control by using Fuzzy Neural Network for Hierarchical Intelligent Control, Proc. of IJCNN '92 - Baltimore, Vol. 2, pp. 81-86 (1992)

Consumer Decision Support System in Virtual Space Using Kansei Engineering

Junji NOMURA
Virtual Reality R&D Group
Information System Center
Matsushita Electric Works, Ltd.

Abstract

Virtual reality, a new paradigm for relationship between humans and computers, has been recently well-known and currently investigated for practical use in various industrial fields. Using three-dimensional computer graphics, interactive devices, and high-resolution display, a virtual world can be realized in which one can pick up imaginary objects as if they were in a physical world. Using this technology, Matsushita Electric Works, Ltd. has been developing several application systems for industrial use since 1990. This paper details Virtual Space Decision Support System employing Kansei Engineering which is applied for production and sales mainly in the system kitchen business.

Keywords
Virtual reality, DSS, Kansei engineering.

1. Introduction

Virtual reality, a new paradigm for relationship between humans and computers, has been recently well-known and currently investigated for practical use in various industrial fields such as computer graphics (CG), CAD, CAM, CIM, robotics, medical/health care, multi-media, games and so on. High-Tech companies located in the U.S.A. and U. K. have released several commercial products which can be utilized for developing VR application systems. This causes the basic VR system consisting of three-dimensional computer graphics engine, interactive interface devices with multi-function sensors and high-resolution displays to be gradually decreasing in cost and such a system including peripheral devices to be easily available.

Since 1990, Matsushita Electric Works, Ltd. has been developing several VR application systems for industrial use. In this paper, we detail the Virtual Space Decision Support System (VS-

DSS) which is utilized for production and sales mainly in the system kitchen business [Nomura et al., 1990]. This system employs Kansei Expert Subsystem [Nagamachi, 1986] which acquires consumers' liking for system kitchens by translating their images on kitchens into the real design furniture. This enables the consumers to have a concrete image on the kitchens which will be available, and also enables them to see and touch the kitchen components in the virtual space.

2. Consumer Decision Support System (DSS) and Kansei Engineering

The changing needs and values of today's consumer has had a significant impact on the sales and manufacturing process. A customer must get the necessary goods in the required quantity when needed. However, when the goods desired by many consumers are diversified, the manufacturer has a difficult time coping with the increased workload. Changing only the production system cannot deal entirely with the situation: the corresponding sales system including marketing, distribution and information services must also be improved.

Computer technology is advancing at a rapid rate. The development of a total production system incorporating CAD, CAM and CAE is possible now. This also permits movement from mass production to the production of a variety of goods in small quantities. At present, however, most computer-aided manufacturing is geared towards mass production, unable to handle one-of-a-kind products. The specifications of these products should be easily changed to accommodate individual customer's needs. To realize this concept, Kansei Engineering production system is necessary with a knowledge-based expert system at its core. Using virtual reality (VR) [Rheingold, 1991] technology, the virtual space decision support system (VSDSS) [Imamura et al., 1991] lets users design virtual products and experience them while in virtual space. VR is defined by three elements [HDTV, 1990]: three-dimensional computer graphics technology, interactive interface devices with multi-function sensors, and high-resolution displays. Studies of this computer environment are being performed by NASA Ames Research Center [Fisher et al., 1986a], the MIT Media Lab [Sturman et al., 1989], the HIT Lab [Jacobson, 1991], the University of North Carolina [Airey et al., 1990], the University of Tokyo [Hirose, 1989], the University of Tsukuba [Iwata, 1990], and the ATR Communication System Institute [Kishino, 1990].

2.1 Kansei Engineering

Kansei Engineering is defined as "a translation system of a consumer's image or feeling into the real design components" [Nagamachi, 1986]. Namely, when a customer expresses his/her image toward an object using adjective, detail design items (for instance, object style, color, material, size and so on) are selected through the Kansei

Engineering procedure, and using the outputs, a designer or planner can design the object. The Kansei Engineering Procedure is;

Step 1. Collecting the adjective words:

Collect many adjective words which have relation to the object domain.

Step 2. Assessing slides or pictures on SD scales:

Make pairs of these adjectives in a good-bad fashion for the SD (or good's Semantic Differentials) scales. Next assess many slides or pictures related to the object domain on these SD scales.

Step 3. Eliciting effective adjectives from collected adjectives:

Calculate the assessed data at *Step 2* by factor analysis or principal component analysis, and obtain the semantic factorial structure of adjectives on the related design domain. And elicit adjectives which have a close relation to the object domain from the collected adjectives.

Step 4. Subdividing the object design into the design components:

Subdivide the object design on the slides into detail design components, next classify each component into category according to it's quality. For example, L-style (category) layout (component), mahogany (category) cabinet (component).

Step 5. Getting the relevancy between an adjective and qualitative data:

At *Step 4*, analyze by Hayashi's Quantification theory Type 1, which is a kind of multivariate regression analysis dealing with qualitative data [Hayashi et al., 1976]. The results of this analysis means relevancy between an adjective and each design component.

2.2 Production and Sales Unification System (PS/US) using the Virtual Space DSS (VSDSS)

Production and sales activities start with the planning of sales and stock production. After evaluating the results of manufacturing, assembly, and sales of these products, business planning is performed again. These are cyclic and systematic activities. Conversely, the consumer must make various decisions on the product he wishes to purchase. The type and time of delivery has a significant impact on whether the user will purchase the goods:

(1) The product is bought when it can be obtained immediately.

(2) The product is bought only when it can be obtained by a specified date.

(3) The product is bought regardless of its date of delivery.

A can of soda in a vending machine is an example of (1). The soda which is bought in a cooperative store by joint purchase is an example of (2). Custom-ordered soda that is desperately needed is an example of (3). Planning on the assumption of (3) is sufficient with simple information processing. But planning on the assumption of (1) requires complex information processing.

In case of (1), it is necessary to decide production planning on the basis of sales planning information which is uncertain. Moreover, the quality of the planning accuracy has an effect on the business accounts. In this case, it is very important how to draft the production, sales and stock planning from information that is as uncertain after processing as before. For sales of type (1), it is necessary to develop an expert system on production, sales and stock planning [Nomura, 1990] with a simulation function and optimization function for the various demands.

The (2) pattern is a special case. It is very rare that products manufactured according to a standard specification are delivered on the appointed date of delivery. It is common that such products are manufactured according to the customer's specifications. Since these specifications differ among every customer, it is necessary to develop a design support and performance estimation system for the customer together with the development of a CIM production line and a standard part order/stock system. In the case of standardized parts, it is possible to decide to purchase after looking and touching the parts at the showroom. But when a product is to be designed by a customer, it is very important for him/her to be able to estimate or experience it. Current design systems are tailored for the specialist, and are not well suited for intentions of the ordinary consumer. Therefore, it is quite possible that the customer cannot imagine the completed state of the system. For example, many problems with constructed houses frequently occur since the buyer can not properly imagine the completed home. How well is the room lit after changing the lighting equipment, or how is the car noise attenuated after inserting sound-proofing material into the wall? Although these products can be seen in the showroom or reports can state "10 decibels lower according simulation results," it is difficult to actually feel what this means. VSDSS is a decision support system that ensures the performance estimation and the suspected experience are in fact what the user will experience. By using VS-DSS to produce products most suitable for the individual customer, construction of a new production and sales unification system (PS/US) becomes possible.

2.2.1 Limitations of desktop showroom

The showroom is the contact point between the customer and the manufacturer. It must contain elements of display, consultation, advisement and so on. A vast display space and many salespeople are required to display our various products at Matsushita. Since the number of showrooms are limited due to expense, the contact points between the manufacturer and the consumer are reduced. Moreover, it is difficult to display our 30,000 different products in combination with standard parts as well as large-scale products such as our system kitchen.

The desktop showroom can be applied with VR, telerobotics, and multi-media technology, and provides a display without display-space or geographic limitations. The desktop showroom would eliminate space and geographic limitations by immersing the customer in a virtual showroom, where he can see actual product images or hear real salespeople speak. For example, the products displayed in Shinjuku, Tokyo can be seen by t customer using the desktop showroom at Takamatsu, Kagawa Prefecture as if he/she were casually walking through the remote showroom. To maintain these situations, VR, telerobotics, and multi-media technology must be applied. Thus, the display space and expense can be kept to a minimum.

2.2.2 Current PS/US for System Kitchen

One of our strong products lines is the "System Kitchen": A custom planned and built kitchen using over 30,000 kitchen products and an infinite number of possible kitchen layouts. Since the customer must make many detailed and difficult decisions when selecting his/her new kitchen, it was natural to apply VSDSS and Kansei Engineering technology to this sales process.

The overview of the "system kitchen" production and sales unification system [Nomura, 1990] is shown in Figure 1. The kitchen planning process is depicted in Figure 2. We developed a prototype VSDSS system called ViVA (Virtual Reality for Vivid A&i space system) which allows our customers to pseudo-experience their custom kitchen before purchasing it. When an interested customer comes to the showroom, the kitchen planner first explains the kitchen products' descriptions using catalogues and exhibits.

The kitchen planner next draws a rough layout according to the desires of the customer. The customer can experience a similar pre-existing kitchen using the ViVA system if he/she wishes. Then a floor plan, an elevation view, a perspective drawing, and a written estimate are created on a CAD system based on the rough sketch. The customer's own kitchen plan can be translated into a ViVA database within a week. The next time the customer comes to the showroom, he/she can experience many aspects of his/her own kitchen. The customer can check his/her own kitchen and decide if it match-

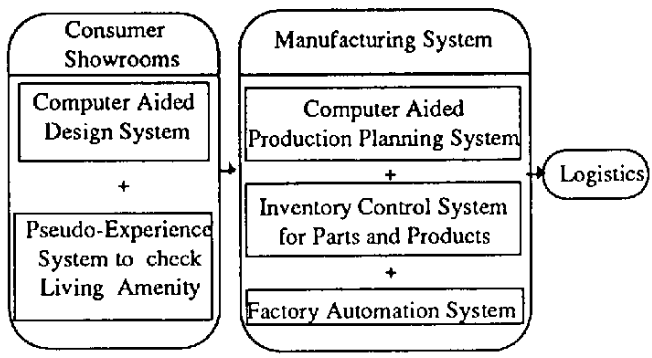

Figure 1 Consumer-oriented Integrated Manufacturing System

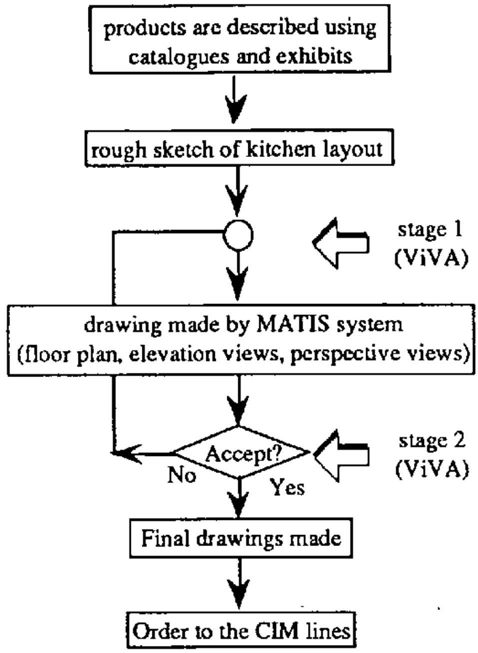

Figure 2 System Kitchen Planning Process

es his/her own idea how the kitchen should be. Once the customer approves his/her kitchen design, final approval and appliance drawings are made and the order is sent to the CIM line.

In a current planning system without the ViVA pseudo-experience system, the customer can only see floor and elevation plans without getting a "feeling" for the kitchen. Sometimes there are many discrepancies between the system kitchen actually manufactured and the customer's original idea. The ViVA system can eliminate these mistakes that are often made. With ViVA, the following items can be experienced in the virtual kitchen:

1) The arrangement of cabinets and appliances.

2) The general feeling of available space.

3) Overall ergonomic design: The user can open and close cabinet doors, turn on faucets, move goods in the pantry, etc.

Originally, system kitchen planning was done on a Sun-based CAD system called MATIS (Matsushita Amenity Total Interior System). The MATIS database includes approximately 30,000 of matsushita's kitchen products as well as data on previous and current customers. This customer data include fields for room dimensions, cabinet placement, standardized parts information, special order information, etc.

After drawing the plan on the MATIS system, the two-dimensional picture is first translated to a three-dimensional layout to be experienced in the ViVA system. An interactive conversion program called Starch running on a Silicon Graphics Iris can be used to convert this monochrome, wireframe data to the ViVA format. If the desired product has not yet been converted to the ViVA format (remember, there are over 30,000 possible products) or it is a special-ordered product, Starch is used to edit the product and add color or special constraints.

Once the products have been translated to three-dimensions, the Wringer program is used. This program combines the products converted by Starch and the room dimensions described by the MATIS file. As each wall is created, the products are placed upon it one by one. The output of Wringer is a Swivel file and an Isaac file used by a VPLRB2 system. The Isaac data file is used to render the virtual kitchen on a Silicon Graphics Iris, and the Swivel file is transferred to a Macintosh, where it is read by a VPL program called Body Electric. Body Electric manages the behavior of the virtual world by controlling the renderer and linking in realworld data such as head and hand positions. The customer can now experience their own virtual kitchen.

2.2.3 Future PS/US having Kansei-information interpretation capabilities

As the next version of ViVA system,

Kansei ViVA system is being developed. This system is valid to the following customers' types:

1. The customers who have no idea of the kitchen

2. The customers who are in confusion because they saw many catalogues and exhibits

3. The customers who cannot imagine what the size of their kitchen space is (usually, kitchen looks smaller than actual size in showroom because the height of the showroom is higher than housing one).

Using this system, vagueness and confusion of customer's image are cleared. So we expect that this system can decrease the number of the consultation between a planner and a customer (usually it repeat 4 or 6 times, sometimes over 10 times), and decrease the consultation time (usually it takes 2 hours, sometimes over 4 hours). First, customer inputs the field for room dimension and height of customer who use kitchen as restriction conditions. Next, he/she inputs lifestyle of his/her family and his/her image toward the kitchen in adjective words as Kansei conditions. Then the Kansei ViVA system identifies the kitchen plan in detail (for instance, kitchen layout, cabinet color, floor color, counter height and so on) using Kansei Engineering. We gathered over 200 adjectives and 18 items of featured lifestyles. Then knowledge based expert system searches some kitchen plans that match his/her preference and room condition, and edits the kitchen plan's cabinet arrangement to fit his/her room dimension, and change the kitchen plan's cabinet color. Through experience, the customer can change the wall size, cabinet arrangement, cabinet color and so on of the kitchen plan that is proposed by computer into his own kitchen plan. Figure 3 shows the relation between Kitchen design and adjective words.

2.3 Future perspectives toward an advanced system for the total house

Current ViVA system and Kansei ViVA system are dealing with kitchen space. In the future, we wish to develop to model an entire house. Figure 4 shows such a system. This development is joined with the project which is a 7-year plan since 1989 called "Technology Development Project for New Industrialized Houses" under the Ministry of International Trade and Industry. The aim of this project is to develop a system which achieves new housing for the coming 21st century. For the implementation of the project, research and development is being proceeded by "The New Industrialized House Production Technology and System Development Technology Research Association (WISH21)." MEW takes charge of the development of "resident participation" amenity simulation system in this project. Using this system, resident can experience and evaluate housing performance such as light, sound, vibration, temperature, air and so on.

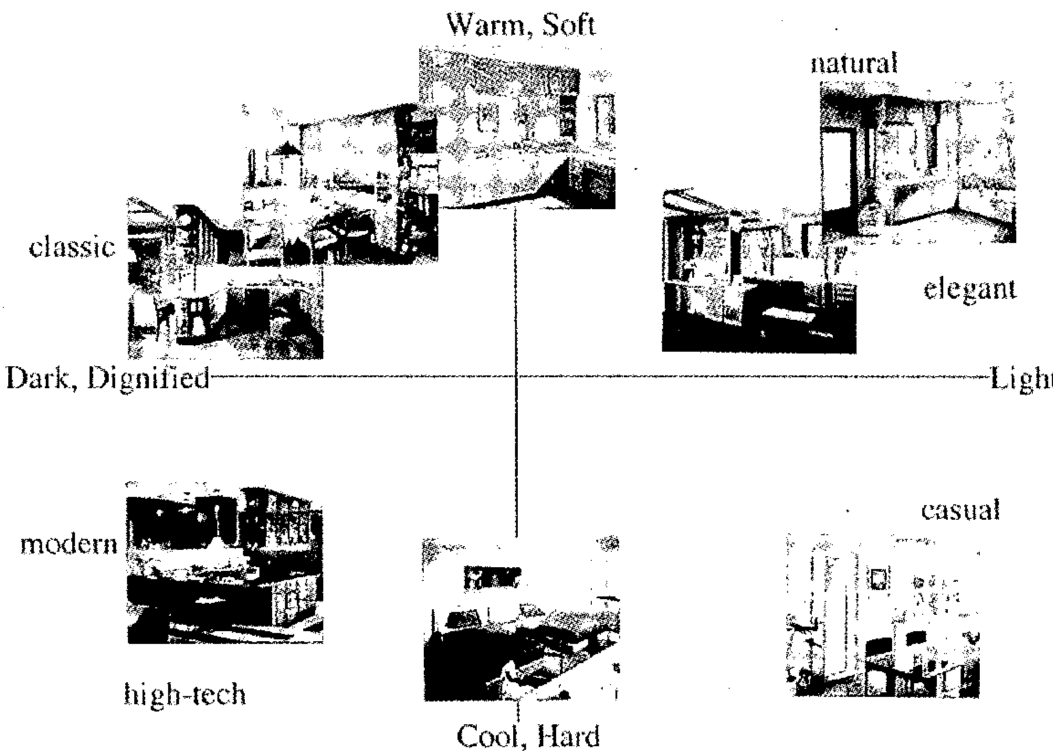

Figure 3 The Relation between Kitchen Design and Adjective Words

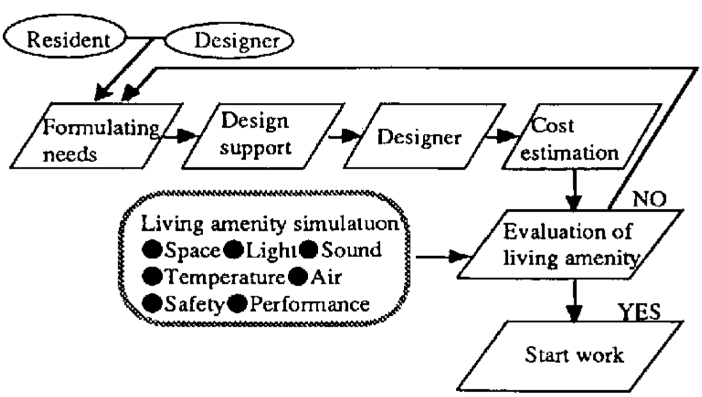

Figure 4 A House Planning Process

3. Conclusions

In this paper, VR application systems for industrial use which have been developed in Matsushita Electric Works, Ltd. is described. VR technology has recently been investigated for industrial use since the basic components for developing the VR application system are decreasing in cost. On the other hand, the research and development concerning high-cost VR systems which provide the extremely high-resolution 3-D graphics images and realize high performance is to be continued. Thus, it can be considered that the development of VR application systems divides into two directions: low-cost VR system and high-cost VR system. Considering this point of view, we are going to produce a low-cost VR system for practical use while developing a high-cost VR system. for research in the future.

Acknowledgment

The author of this paper would like to thank Mr. Akira Ohishi, Director of Information System Center, Matsushita Electric Works, Ltd., for his support and valuable suggestions.

References

[Airey et al., 1990] Airey, J., Rohlf, J. and Brooks, F. "Towards Image Realism with Interactive Update Rates in Complex Virtual Building Environments," University of North Carolina at Chapel Hill TR90-001, (1990).

[Nagamachi, 1986] Nagamachi, M., "A Study of Custom Consultation System in Terms of Knowledge Engineering," *Human Interface*, Vol. 3, (1986).

[Nomura et al., 1990] Nomura, J., Ohata, H., Imamura, K. and Schultz, J. R., "Virtual Space Decision Support System and Its Application to Consumer Showrooms," Visual Computing, Spring-Verlag Tokyo, 183/196 (1990).

[Hayashi et al., 1976] Hayashi, C. and Komazawa, T., "A Statistical Method for Quantification of Categorical Data and its Application to Medical Science," In Decision Making and Medical Care, (ed F. T. de Dombal and F. Gremy) North-Holland Publishing Company (1976).

[Hirose, 1989] Hirose, T. "Creation of Artificial Reality;" System/Control/Information, Vol. 33, No. 11 (1989) (in Japanese).

[HDTV, 1990] HDTV & The Quest for Virtual Reality ACM SIGGRAPH, (1990).

[Iwata, 1990] Iwata, H., "Artificial Reality to Walk in The Large-scale Virtual Space," *Human Interface News and Report*, Vol. 5, No. 1, 49/52 (1990) (in Japanese).

[Jacobson, 1991] Jacobson, R. "Televirtuality: "Being There" in the 21st Century," *Human* (1991).

[Kishino, 1990] Kishino, F. "Feelin Communication," *Three-Dimensional Image*, Vol. 4, No. 2, (1990) (in Japanese).

[Rheingold, 1991] Rheingold, H. "Virtual Reality." Summit Books, New York, Tokyo (1991).

[Sturman et al., 1989] Sturman, D., Zeltzer, D. and Pieper, S. "Hands-On Interaction with Virtual Environments," AGMSIGGRAPH/SIGCH (1989).

InterSpace: Towards Networked Reality

Gen SUZUKI
NTT Human Interface Laboratories

1. Cyberspace

A shared and interactive virtual space on a network is called "Cyberspace" [1]. A shared and interactive virtual space for multiple users on a network is expected as a powerful tool for human communication. A shared virtual space on the network can be applied to create various useful telecommunication services such as virtual office, virtual shop, virtual campus, and so on. Habitat [2], SIMNET [3] and DIVE [4] are thought to be the initial steps towards a future ideal Cyberspace. These virtual space services are based on information generated by computers. All the visual images of these system are made through computer graphics or animation, and are imaginary. The virtual worlds of these systems have no relation to the real world.

On the other hand, the usual communication tools, such as telephone or videophone, are based on real information, that is, real voice or real video images of real people's faces. In order to support human collaboration in business fields, a shared virtual space based on such real information appears necessary. From this point of view, we propose the new concept of a visual communication environment for human collaboration using a virtual space created by 3D computer graphics and video texture mapping technologies [5]. The proposed system consists of a combination of an imaginary location and real video images.

In this presentation, human interface design issues for a proposed shared virtual space are discussed and evaluation of the prototype system is described.

2. Concept of InterSpace

We propose a new concept of a shared virtual space, named as "InterSpace," that is based on the following necessary functions [5].

(1) Seamlessness in planned and unplanned communication

Human communication activities are classified into planned communication and unplanned communication.

In regular business meetings, date, place, purpose and members are agreed and planned before the meeting. On the other hand, unplanned and casual meetings occur unexpectedly in a elevator, on a road, or at a passageway. In such casual situation, people recall topics or think of business after seeing the partner's face unexpectedly. Both planned and unplanned communication play important roles in our social communication activities. A shared virtual space is expected as a new communication tool that is able to enhance unplanned communication opportunities.

(2) Video-based virtual space

The visual communication environment consists of human objects that express people in the space, and topical objects that transfer information in the virtual space. By introducing 3D perspective expressions, 3D computer graphics is very suitable to create an understandable and imaginative virtual space. In order to represent human objects and topical objects in the virtual space, video images are more useful and more expressive than computer animation. As the video image taken by a camera represents a subset of the information of the real world, people can recognize the actual situation of the partner easily. So, the combination of a CG-based virtual space structure with video-based objects is highly suitable as the virtual space architecture.

3. Human Interface Design Issues

3.1 Reality of shared virtual space

Concerning reality of virtual communication environment, there are the following two kinds of policies to design a shared virtual space.

(1) Creation of realistic sensation

This policy is the approach to a simulator of physical real spaces. Virtual spaces are visualized to resemble real meeting spaces. Visual images of virtual space are designed in order to realize a feeling of being there.

(2) Creation of strengthened coexistence

This policy is the approach to artificial and responsive environment for interactive communication. Visual images and audio responses of virtual space are designed in order to create artificial effective functions that surpass being there.

3.2 Visual and audio representation for virtual space

In real physical space, visual and audio information are obeyed by fixed physical laws. However, in virtual space, laws and rules of visual and audio information can be designed freely. Characteristics of human behaviors in a shared virtual space will be strongly affected by such artificial laws. One can get highly intelligent and sensitive ears or eyes in a virtual space in order to enhance the possibility of unplanned encounter.

4. Prototype System and Evaluation

In order to evaluate the proposed concept, a prototype "InterSpace" system was implemented using distributed personal computers and a system server. Visual images of every terminal are created by the personal computers of each terminal. The PC generates an interactive virtual space structure using 3-dimensional graphics. Video images are captured by a camera, and video images are pasted onto CG models using texture mapping. Audio signals of individual user's voices are gathered, mixed and delivered depending on each location in a virtual space. The system server controls data, audio and video communication between the personal computers.

The prototype system has been evaluated in our laboratory. Human behaviors in a virtual space were affected by conditions and laws of the virtual space. Walking through a shared virtual space offers new abilities and enjoyment to many users.

5. Summary

The concept of a new visual communication environment has been proposed. The proposed system is a shared and interactive multi-user virtual space that consists of a CG-based virtual space structure and video-based objects. Human Interface Design Issues are discussed from the view point of the creation of a new reality for the enhanced communication environment.

References

[1] M. Benedikt: "Cyberspace: First Steps," MIT Press (1992)

[2] C. Morningstar and F. R. Farmer: "The Lessons of Lucasfilm's Habitat," ibid. pp. (1992)

[3] E. A. Alluisi: "The Development of Technology for Collective Training: SIMNET, a Case History," HUMAN FACTORS, Vol. 33, No. 3, pp. 343-362 (1991)

[4] L. E. Fahlen, C. G. Brown, O. Stahl and C. Carlsson: "A Space Based Model for User Interaction in Shared Synthetic Environments," INTERCHI '93 Conference Proceedings pp. 43-48 (1993)

[5] G. Suzuki, S. Sugawara and M. Moriuchi: "Visual Communication Environment Using Virtual Space Technology," ICAT '93, (1993)

Current News

* Seiko Starts FM Radio Paging Service in China.

Hattori Seiko and Seiko Epson will start an information transmission service targeting nonbusiness users for wristwatch terminals using FM broadcasting. Information sent to "Seiko Receptor" terminals will include weather forecast and stock quotations broadcast to wristwatches with a digital display function. An FM frequency range not for broadcasting will be used. This type of service was started in the U.S. in 1992 and is now available in three cities, including Los Angeles and Seattle.

A trial demonstration started in September 1994 in Japan, in the Kyoto area. Since broadcasting and communications come under separate legal systems, the Ministry of Posts and Telecommunications is studying a legal revision and concerned enterprises are awaiting the conclusion. For this reason, the two Seiko enterprises selected China, where regulations are relatively relaxed. Wristwatches used as information terminals will be manufactured and marketed by a joint venture between Seiko and a Chinese enterprise.

New transmission and relay facilities need not be built for starting the FM service because existing broadcasting station facilities can be used, which means lower equipment investments than previously.

The demand for radio information services is expanding rapidly in China because telephone lines coverage is still limited. More than 10 million pagers are used in China, No. 2 in the world following the U.S. Motorola has begun producing mobile telephones in China, and Casio, NEC, and Matsushita Communication Industrial are already manufacturing pagers and mobile telephones there. The Seiko group plans to expand the sales of wristwatch information terminals through this new service.

* Fuji Bank Will Start Transmitting Information via Internet.

In February 1995, Fuji Bank will begin providing information such as the bank's business indicators and financial commodities and services via Internet; the service will cover over 10 items including financial and business information, e.g., the analysis of settlements for investors, domestic and overseas offices for clients, specific commodities and services, social contribution activities, in-house club activities, group enterprises, and money conditions in Japan. Information will be displayed in both Japanese and English. Fuji Bank started the service to meet needs in an age of international, liberalized money markets. Their purpose is to improve their corporate image and increase business by supplying information instantaneously to domestic and overseas investors and users.

In October 1994, Fuji Bank connected personal computers at its headquarters to Internet through an Internet connection company. They will develop software and construct the system required for sending information in the near future.

The Sanwa Bank has also connected its personal computers to Internet and plans to begin in the spring of 1995 sending information on the settlement of accounts, business, employment, etc., as a part of its information services (IR) for investors. The Sumitomo, Sakura, Daiichi Kangyo, and Mitsubishi Banks are also studying similar services.

Research organizations in Japan such as universities and think tanks and enterprises such as information and telecommunication equipment manufacturers have quickly started IR activities using Internet, with about 100 enterprises said to be transmitting information. An experiment of involving information transmission from the official residence of the Prime Minister has been started among nonbusiness organizations.

* NEC and C&W Tie Up in Telecommunications

NEC has concluded a contract for a comprehensive tieup with Cable & Wireless (C&W), a British common carrier. The two companies will begin with a comprehensive corporate relationship and exchange information and market strategies, then proceed to contracts in specific business areas. Because C&W is influential in wide areas of former British territory, information from C&W and their long-term strategies will be useful for NEC's marketing activities. C&W will, at the same time, greatly increase the efficiency of equipment development and selection work.

The two companies have started division-level discussions on a satellite communication system. They will subsequently proceed to areas of telephone switching systems and mobile telephones. Combining C&W's communication services know-how and NEC's switching system and satellite ground station technology, they will expand business in China, where a gigantic demand for telephone networks and radio communications is anticipated.

C&W has the greatest business strength in Asia among major European and American common carriers. Plans are to promote market expansion by tying up with NEC, the largest communication equipment manufacturer in Asia and which has communication equipment plants in China and Malaysia. By tying up with this global common carrier, NEC can gain an advantage in competing with AT&T, Alcatel, Siemens, and other American and European communication equipment manufacturers, which are becoming increasingly aggressive in Asia.

Since Asian countries are behind Europe and the U.S. in setting up telecommunication infrastructures, the potential requirements are great. China has not opened communication services to foreign funds, but plans to increase the number of telephone lines to over 100 million, more than twice as the number under current circumstances. Foreign investments will thus be essential for accomplishing this objective.

* NTT Will Establish a Virtual Company Using Young Employees.

NTT has decided to establish a virtual company consisting of about 1,000 young employees by April 1995. Those who have worked for NTT for less than ten years will be candidates. The principle behind this decision is to promote the exchange of information among young employees whose minds are flexible and who possess original ideas, and to utilize their thinking for promoting multimedia business. NTT has about 25,000 employees who meet the under-10-year requirement. These people will be invited to make applications. In the event of too many applications, the company will select employees by a fair procedure such as the drawing of lots.

The virtual company will use in-house LANs at the head office and research institutes and regional in-house networks at branch offices. LANs will be connected as necessary. Since regional branches are behind in in-house LANs, the virtual company will rent a private line network from NTT PC Communications, a NTT subsidiary. The server of the new company will be installed at the head office and connected directly to existing corporate servers. Servers will later be installed at nine communication software centers located in different areas of the country and operated under the auspices of the Communication Software Development Headquarters. Regional servers can be accessed via ISDN lines, for example. Investing about half a billion yen, NTT will install 500 to 1,000 personal computers for the new company. This is the first virtual company to have such a large scale, and will be a model for other virtual companies to follow.

* NEC Participates in the French Information Highway Plan

NEC will participate in the information highway plan being promoted by the French Government, which has introduced 49 large-scale projects for the construction of an information highway. NEC, Bull, and France Telecom have made a joint proposal for implementing a multimedia electronic telephone book service. This proposal was selected by the French Ministry of Industry.

NEC will supply the hardware and software required for providing information in characters, video images, and voice. Bull will construct a system based on France Telecom's optical fiber and other networks.

The manufacturers involved plan to supply high-quality information by tying up with service companies such as publishers in France. The service can, for example, provide the telephone number of an enterprise as well as its product information in the form of video images. The group plans to convert advertisements in telephone books to high-quality video images and develop the service to implement telephone shopping in future. The French Government plans to test the system, investing about 300 million yen over the next two years, with commercialization planned approximately for 1997.

NEC is the first Japanese enterprise to participate in such European information highway plans. NEC considers this a great catalyst for developing the multimedia market in Europe.

Back Issues of JIPDEC Informatization Quarterly (Formerly Japan Computer Quarterly) are as follows:

Please send the ORDER FORM directly to:

Promotion Division
JIPDEC
3-5-8 Shibakoen, Minato-ku
Tokyo 105 JAPAN

TEL : +81-3-3432-9384
FAX : +81-3-3432-9389

ORDER FORM

○ **Please send me JIPDEC Informatization Quarterly as checked below:**

☐ Annual Subscription — ¥13, 000 (including air mail charge)

☐ Back Copies — ¥3, 500 per copy (including air mail charge)

No. ________
____
____
____

Total: ¥ ________

○ **I will make a payment as follows:**

☐ Bank funds transfer
Bank Account: Mitsubishi Bank, Toranomon Branch
Account Number : Futsu Yokin 0000739
Account Holder : (Zaidan Hojin)
Japan Information Processing Development Center (JIPDEC)

☐ Check enclosed

Signature: ________ Date: ________

Name: ________

Position: ________

Company: ________

Address: ________

Tel: ________ Fax: ________