The Advent of New Information Content

Through the development of Information Technology (IT) and the realization of Internet infrastructure, multimedia information provided via the Internet (audio, text, and images [both still and moving]) has come to have very rich content. For example, color has progressed from monochrome to full color, shapes have advanced from two dimensions to three, and in addition, sound has progressed from single sounds to harmonies and multi-channel sound. As a result, the amount of information being processed has increased dramatically. (Refer to Figure 1.) This volume of information has already exceeded the amount carried by the mass media (newspapers, radio, and television) and multimedia information has quite become the leading player in the information arena. However, on the other hand, individuals are not satisfied with multimedia that appeals only to their eyes and ears; they want information which also stimulates their other senses. To respond to this demand, every industry is tackling a variety of research projects.

One technology which has made an appearance to respond to these requirements is that of virtual reality (VR.) The objective of VR is, through skillful stimulation of human senses, to create an artificial reality sense which is essentially realistic, even though its appearance is different. The amusement industry moved quickly in applying this VR technology to games. This same industry, in the game space where the games of the past had stimulated the senses of sight and hearing, now has built in body-sensation information to stimulate the sense of touch. This has given birth to a new kind of content which creates a sense of presence (i.e. of truly “being there”), and the game makers have thus succeeded in making the games more interesting. This means that it is now possible to deliver a new level of satisfaction to game players who felt that in the multimedia information of the past, there was not enough of that sense of presence.

Also, concerning robot technology, development of technology which utilizes this sense of presence is being actively pursued. For example, in controlling a robot in a remote location, via the Internet, by giving the operator this sense of presence, operability and reliability of remote operation can be improved.

In the future, it is expected that the infrastructure for this new information content will continue to develop, using the Internet. Then communication of such content can be done on an open basis, aimed at each individual, in real time and bi-directionally.

A Technology Revolution Based on E-mechatronics

At our company, recognizing this trend, we will be proposing e-mechatronics solutions. The aim is to enable transmission of information content having a sense of presence, via the Internet, bi-directionally, and in real time, thus giving a sense of “oneness” to senders and receivers of

---

information. (We call this “remote collaboration.”) Moreover, information content which carries this sense of presence takes conventional audiovisual multimedia information and adds to it motion information (movement, pressure, vibration) to stimulate the senses of touch and pressure of both information sender and receiver.

Figure 2 shows the basic concept of an e-mechatronics system. E-mechatronics links three elements—micro-mechatronics (MM), computers, and software—to the Internet, to form an Internet mechatronics system which skillfully stimulates the senses (sight, sound, touch, and pressure) of each individual. In other words, it is a network infrastructure for providing to each individual a sense of presence, openly, bi-directionally, and in real time.

MM performs the function of an interface directly linking the senses of the individual to the Internet. For that purpose, in addition to micro-actuators which stimulate an individual’s sense of touch and sense of pressure, it requires [a] micro-sensors which convert the body gestures and hand movements of the individual into information and [b] input/output devices for inputting/outputting multimedia information. Computers perform the function of controlling the elements remotely, via the Internet, in real time and bi-directionally. For software, the scheme requires software which enables the computer to remotely control the MM, software which communicates multimedia information and motion information, etc.—all of which can be freely created and modified over the Internet. Through the above configuration, e-mechatronics achieves an information communication system in which it is just as though the Internet had reached a hand directly to the senses of each individual.

To realize e-mechatronics, there are still a variety of issues. For example, concerning software, it is necessary to consider compatibility with the software which already can be freely created and modified over the Internet. Specifically, this requires that data formats which describe the various kind of information (control information for controlling MM’s, multimedia information, motion information), communication protocols, etc. have compatibility with the formats which are considered standard. Robot technology, already having accepted this concept, is leading the way. In the future, while paying attention to such trends, it is necessary for us to develop the interface portion which connects the computer and the MM so that it is applicable to the software which has been standardized. Also, concerning the interface portion between the MM and the individual’s senses, it must provide operability which is easy and safe. This is because the MM is the part which directly stimulates the senses of the individual. If there is a mistake in the stimulation control, in an instant, a feeling of satisfaction can turn into a feeling of fear. For that reason, at present, while paying attention to the trends in VR technology at each company and each university, our company is skillfully applying the man-machine interface technology which we have built up over many years, through our development of automatic teller machines (ATM’s.) We intend to develop the best possible MM operating unit.

We can expect that, by solving the above challenges, e-mechatronics will be the optimal solution for achieving Internet services which have a true sense of presence.

Solution concepts based on e-mechatronics

Figure 3 shows an outline of the basic concept of solutions based on e-mechatronics (abbreviated hereafter as “the concept.”) The concept is to offer e-mechatronics solutions that give the provider and the receiver of information a sense of oneness and a feeling of satisfaction with the information communication. In other words, the goal is to enable the provider and receiver of information to experience a feeling of presence by simultaneously stimulating [a] their senses of sight and hearing by means of multimedia information and [b] their sense of touch using motion information and doing this in real time and bi-directionally. Among the feelings which a receiver could feel are [a] feelings of safety and piece of mind, just as though the information provider himself were right in front of the eyes of the receiver and [b] feelings of satisfaction that he (the receiver) has been able to receive motion information which could not be experienced before. At the same time, among the feelings which an information provider could feel are [a] a sense of tension, just as though the information receiver himself were right in front of his eyes and [b]...
a sense of achievement in having provided a high-level learning experience by conveying body movements and hand gestures, along with conventional sight and sound information. In Figure 3, we represent the case of information communication accompanied by the kind of feelings described above by an example where the provider and receiver of information virtually shake hands.

Also, regarding the relationship of the information provider and receiver, besides feelings of the 1-to-1, or "man to man," (human contact) type shown in Figure 3, the concept applies equally to feelings of unity with the group in group situations of “N-to-1.” (Refer to Figure 4.) In this case, the feeling of “unity with the group” in a group of (N+1) members (all of whom have very different knowledge), each member, by experiencing real-time, two-way communication of information with the rest of the group, can have the knowledge of the other N members added to his own knowledge due to the strong sense of presence. In other words, as shown in Figure 4, the knowledge of numerous information providers can be extended to innumerable individuals just as the hands of the multi-armed Buddhist Goddess reach out. With the kind of sense of presence which comes from shaking hands with these symbolic hands, multifaceted and multi-level knowledge will be gained by the individual. For example, if a new product planning meeting is held via e-mechatronics, the planning group and the related groups can achieve a sense of oneness among the total group. Then, without regard to the physical distance between the planning group and other groups or to their various business schedules, a sense of presence can be achieved just the same as if all the involved groups had been gathered together in a conference room for discussion, thus enabling effective consideration of product specifications by all the groups involved. In Figure 4, the “Individual” is the planning group, while “Information Provider A” through “Information Provider F” are the mechanism designer, the electronic circuit designer, software designer, frame and mounting designer, manufacturing engineer, and the sales person in charge. The planning group, by creating a sense of presence through “handshakes” with the other departments involved, can have mechanical technology, electronic circuit technology, software technology, mounting technology, manufacturing technology and the market information known to
the sales group added to the planning group’s own ideas. As the new product is actualized through this process, there is a sense of satisfaction. Moreover, these feelings of presence and satisfaction can be experienced in the same way by all the groups which are bound by the feeling of oneness with the group.

As described above, the concept provides not only a feeling of satisfaction for each individual receiving information, it even adds new and different knowledge to individuals, heightening their value. In this way, it can be described as a “true ‘customer value creating’ type of solution.”

Prospects for 21st Century Based on e-Mechatronics

As we approach the 21st century, a variety of experiments are being conducted with the aim of solving all kinds of social problems by means of IT. In particular, regarding the problem of the “aging of society” which is faced by all developed countries, including Japan, expectations are high for the realization of IT solutions which can contribute to medical care and other assistance for the aged and to the social welfare system. For example, in the field of in-home care services, there is demand for a solution which would enable medical facilities to provide each individual care-receiver with speedy and personalized service.

To deal with this, if the concept is utilized for in-home care service, an Internet service, as shown in Figure 5 could be provided. This service is a “remote assistance service for care-giving” which utilizes image input/output devices (referred to below as “eyeglasses”) and instruction devices (referred to below as “hands”) both of which were developed using e-mechatronics. In Figure 5, A is the care-giving expert. B, in his own home, while receiving help from A, is performing the latest care-giving procedure on the person (a relative, for example) which he is taking care of. A and B are wearing the same eyeglasses. These special eyeglasses consist of a camera, a display, a pointing device, etc. Through these eyeglasses, the image of the care receiver which B sees is outputted in real time to the display in his own eyeglasses and to the display in the eyeglasses of A who is connected via the Internet. A inputs into this image, via a pointing device, a mark indicating the point his own line of sight is aiming at and the text explaining the care-giving procedure. This mark and explanatory text are displayed in his own display unit and in that of B, who is connected via the Internet. In this way, B, looking at the care-receiver along the same line of sight as A, can learn the care-giving procedure.

Also, the force and movement of A, as he moves the hand, are communicated in real time to the hand of B, who is connected via the Internet. Moreover, if we consider A’s hand the master and B’s the slave, A can do remote control of B’s in real time, using the master-slave method. In this way, B can actually perform A’s care-giving procedure with a sense of presence, just as though A, who is in the remote location, were actually there guiding his hand. Through this technique, the care receiver, while in his own home, can receive through the hands of a family member the care service of the expert A, even though he is in a remote location. At the same time, B, while in his own home, can
utilize the sense of presence to learn through experience the care-giving procedure of A, the expert.

The system shown in Figure 5 need not be limited to this care-giving service example, but can be used to deliver an optimal Internet service in a variety of areas. For example, applied to the field of education, in areas where there is a shortage of specialized teachers, it can be used to provide a “professional education assistance system.” Similarly, in cases where emergencies occur in locations such as Japan’s remoter islands, the system can be used to assist the local workers to perform special tasks.

To convert the Internet services proposed here into actual businesses, further development of the Internet infrastructure is required. However, judging from the recent speed of the IT revolution, it can be forecasted that achieving these advances will not take that long. In actuality, the Ministry of Public Management, Home Affairs, Posts and Telecommunications is moving ahead preparing the next generation network infrastructure.2 We are convinced that for the new Internet services, which become possible once those advances have been made, solution concepts based on e-mechatronics will become very effective network solutions.

Conclusion

Since the time of its founding in 1881, our company has created a variety of solutions, skillfully melding information, networks and mechatronics, and we have responded to the confidence customers have placed in us by providing products which are impressive and satisfying. Today, through this new solution concept based on mechatronics, we are aiming to respond anew to this confidence and provide customers with impressive and satisfying products. In the future, as well, it is our intention to boldly challenge the development of new technologies for network solutions.

References