SID JOURNAL

The Official Journal of the Society For Information Display

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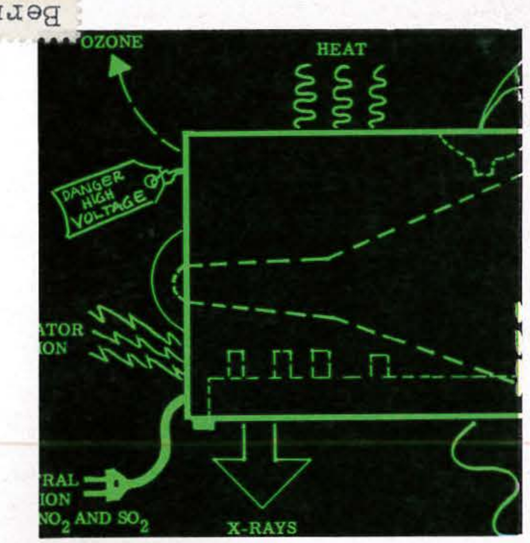

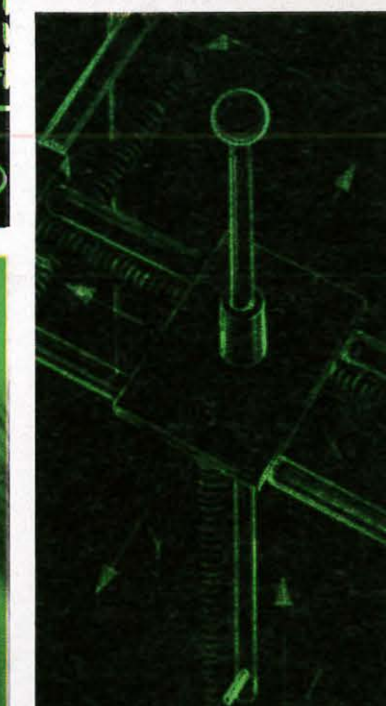

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ENT'S MESSAGE PRESIDENT'S ME

As incoming President I believe that each of you are entitled to know about the major objectives of the Society. I recognize that the activities of the Society are many and diverse, and each constitute an important and valuable function for our discipline, and yet, particularly in these hard economic times, we must have priorities.

In addition to providing support to our active Chapters in their local activities, I recognize that our primary contacts with the general membership are through the means of our technical meetings and publications. Our Society can take pride in the excellence of our annual symposia; they provide an ever-increasing level of excellence and technical breadth on a broader variety of subjects. In this regard, I recommend to each of you our next semi-annual technical meeting in San Diego on December 8.

The establishment of our Proceedings as a truly professional publication has been a major undertaking of the Society. It has taken a significant voluntary effort by some of our members to overcome the many hurdles to achieving a successful publication. Steps are currently underway to provide for an even better Proceedings in the coming years.

There is, finally, this SID JOURNAL which is still in its infancy. It, too, has involved a major expenditure of time and effort to launch.

Which brings me to my final point: money is not the only limit on a small, highly professional society such as ours. We are highly dependent upon YOUR contributions to the activities of the Society. There are many jobs which must be done and I would entreat each of you to volunteer to serve our Society for the mutual benefit of all.

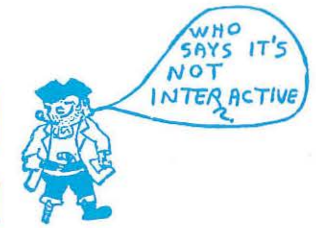
CARLO P. CROCETTI

President

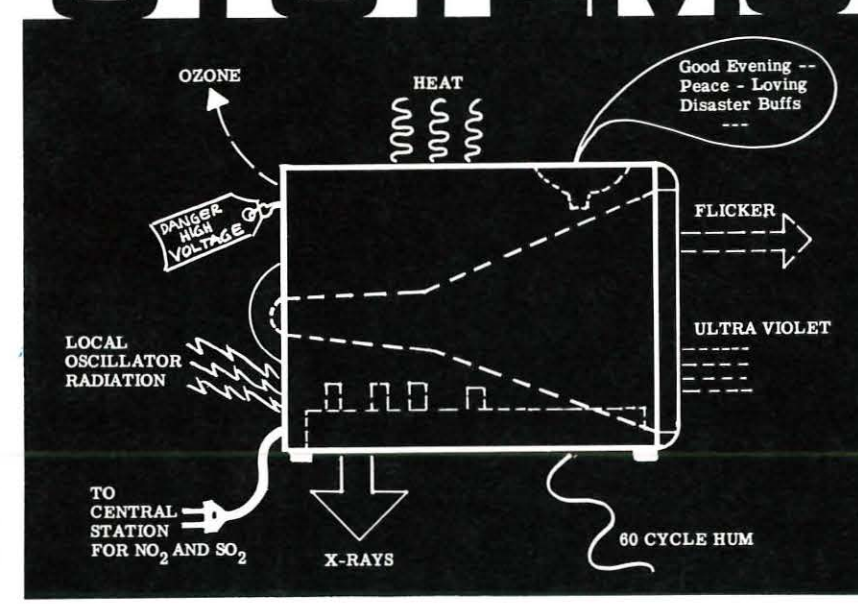
By E. A. Ulbrich

*McDonnell Douglas Astronautics Company
Orange County, California*

Demand Information SYSTEMS



TELEVISION POLLUTION



A discussion of the social implications of consumer demand information systems for the U.S. public. The emergence of this area as a major economic sector is documented; the revolution of the 1940's in household use of artificial information is described; and a second revolution in the 1980's, in which consumers will demand information instead of having it broadcast, is hypothesized. Some future systems costs are shown.

Two major sectors of the economy of the United States are beginning to merge. These are the computation and communication sectors. Typical data on the magnitude of these sectors for 1970 are shown in Figure 1. The merger of these sectors has been noted by many authors, and at the IEEE International Conference on Communication (San Francisco, June 1970) the merger could be clearly seen throughout all of the technical program. See Reference 7. The coined word, electrospace, has been used to describe the area in which these two sectors exist. See Figure 2 for a visualization.

The common ground between these sectors is information systems. The key word of the two is information and the merging sectors may well come to be known as the information industry. In this nontechnical paper all information for human consumption is arbitrarily divided into two classes:

Natural—
received from the real world through senses.
Artificial—
received through various media primarily as an extension of the senses and often filtered by other intelligence.

Figure 3 shows a typical piece of artificial information demonstrating the merger of communication and computation as it exists today. Computer generated titles on the television are an inverse example. It is the contention of this paper that past growth in the area of information systems has been accomplished with inadequate consideration of the social implications either by the public or by the technologist.

The First Revolution

During many of our lifetimes, a revolution has occurred in the area of information systems, and this revolution, as shown in Figure 4 has been widely noted but little understood. A previous paper, Domestic Data Flow Analysis 1969-1979, Reference 8, was an attempt to quantify this revolution. The natural asymptote shown is based on the gross assumption that information is flowing into an individual during his waking hours equivalent to ten color televisions continuously in operation. No assessment of cost per individual bit is attempted since the value of any bit might be very high (survival) or very low (ignored TV commercial for something you don't want). However, at this time, the average cost in 1970 might be estimated.

It has been shown then that a veritable revolution has occurred since the 1930s' in the household consumption of information. Primarily this revolution, although heralded, has gone unnoticed because of its gradual growth throughout one generation and because of the nature of the principal medium in which it developed: broadcasting through radio frequency transmitters. A study for November 1970 by the Television

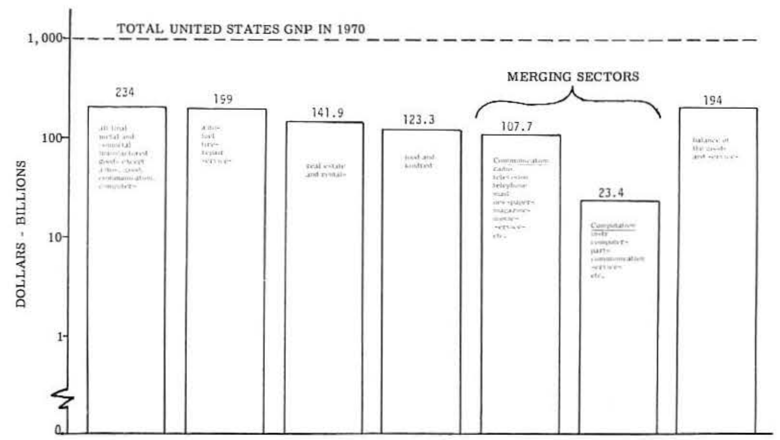


Figure 1. A comparison of various sectors of the United States economy. (Based on a 1970 projection of 1963 data using Leontief's input/output technique—not actual data—See References 1-6 for details).

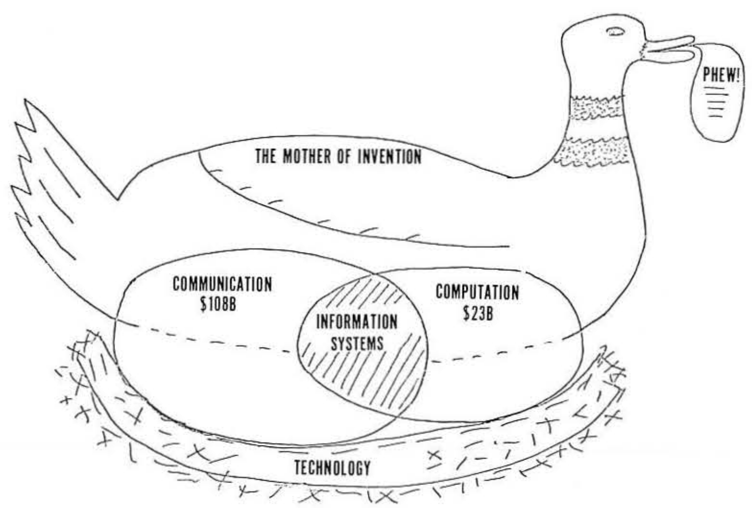


Figure 2. The merger of communication and computation.

$$\text{average cost per bit} = \frac{\$107{,}700{,}000{,}000/\text{year}^{*}}{(365)\,\frac{\text{days}}{\text{year}}\;(63{,}900{,}000)^{**}\,\text{households}\;(1.47\cdot 10^{11})^{***}\,\frac{\text{bits}}{\text{day}}} = \frac{\$31.30}{\text{terabit}}$$

*Figure 1
**Statistical Abstract of U.S. for 1965
***Figure 4 (probably a maximum number)

Reference 8 brackets this figure with similar average 1969 costs based on one particular household.

	dollars/terabit
television	$ 4.18
radio	$ 328.00
publications	$ 2,040.00
telephone	$86,000.00
average for a month	$ 13.60

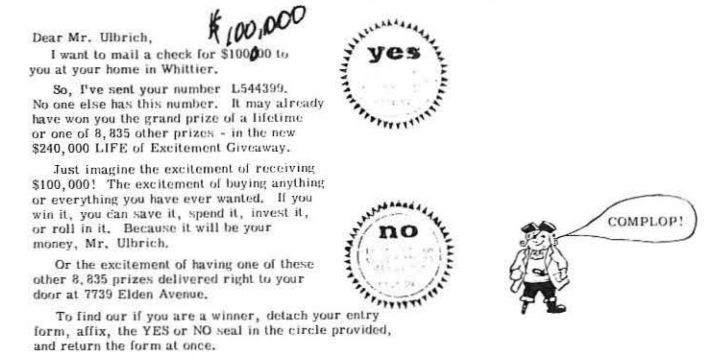


Figure 3. Example of communication and computation working together.

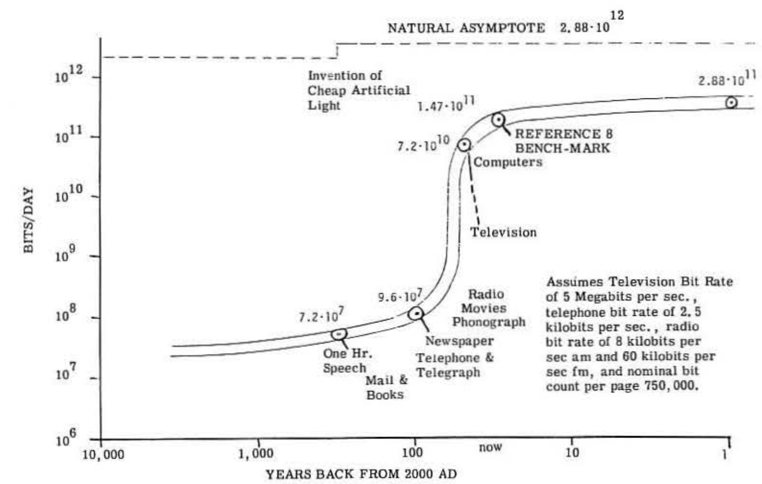


Figure 4. Household use of artificial information. (Based on reference 8).

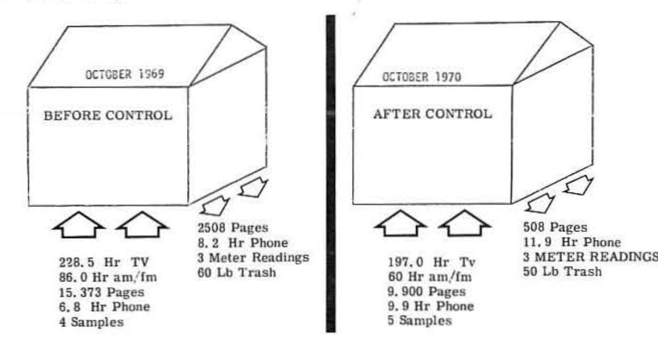


Figure 5. One household information flow data.

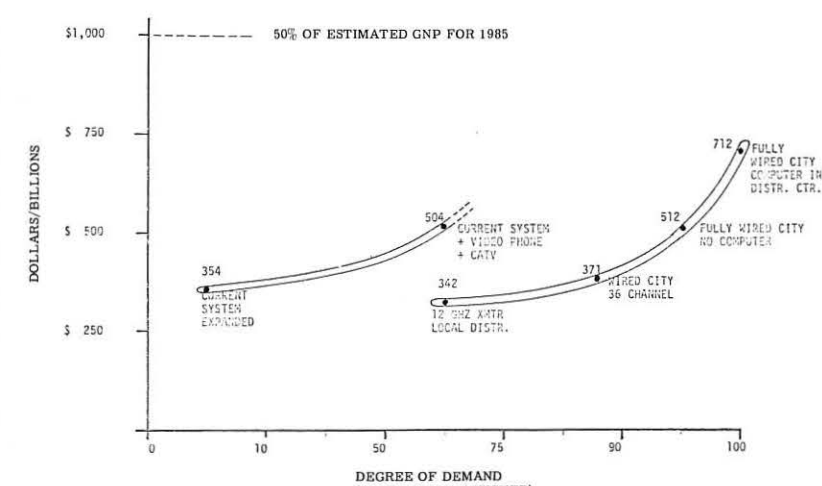


Figure 6. System acquisition costs versus degree of demand.

Bureau of Advertising and the National Association of Broadcasters showed that for programming that starts at 11:30 p.m. on the East and West coasts and 10:30 p.m. in the midwest, there are 11,804,000 homes viewing which represents perhaps 10% of the population awake receiving information virtually in the middle of the night. This would probably have been hard to forecast in 1900 by the light of a carbon filament lamp, although the avid listeners to "I LOVE A MYSTERY" which started at 10:15 p.m. in the 1930's probably had an inkling.

One of the writers on this subject, Marshall McLuhan, characterizes some media as hot and some as cold based on participation (Reference 9). For instance, television is cool and movies are hot. I feel that a much more direct temperature measurement for a given message through some medium is what price you will pay for the message. On that basis television is cool not because it involves 30 frames per second of 525 lines on CRT but because of the peculiar way that we pay for it: buying products that interrupt programming to advertise on the medium thereby paying for the preparation and radio frequency broadcast of programming material without short term regard for consumer interest or any immediate participation. It is probable that the increasing use of cable television systems will result in a heating-up of the medium, especially if programs are paid for directly rather than just being retransmitted in the sense of a master antenna system. This has not yet commonly occurred although the 1965 "pay TV" hassle in Los Angeles was a harbinger.

The recent ruling by the FCC that cable television operators with more than 3500 subscribers must originate some programming starting 1 January 1971 was a landmark decision in this area. (See Reference 10). The intention of various cable television operators to put up their own satellite with six additional networks possible is clearly another landmark. (See Reference 11).

The revolution which has occurred has had a wide variety of effects. Only two will be mentioned out of the wide variety. One of these is the advanced level of preschoolers arriving at kindergarten who have already been exposed to 3,000-6,000 hours of telecasting of a wide variety. The other effect is the great filtration of human events to provide 300-600 hours per year of continuing stories such as the extended coverage given to the Manson trial in Los Angeles. It is hard to make value judgments because of the interaction of the medium with what is an accepted standard. On the whole I view the first effect cited as sociologically positive and the second effect cited as sociologically negative. Another way to state this is that I would probably pay for the first effect and not pay for the second effect if I had a choice.

The Second Revolution

Now a second revolution is looming: the merging of computation and communications with the concomitant switchover from broadcast information to demand information systems. By demand information systems, I mean systems where a consumer of information requests, receives, and pays for the information and processing that he requires. Most computer systems now are demand systems whereas most communication systems are not. The principal communication system which is a demand system, the telephone, is already widely used by computer systems for that reason even though it is relatively expensive.

It is difficult to conceive of a full demand information system after some generations of conditioning with a broadcast system. In 1969, I collected data on how much information I consumed in my own household during the month of October. This data was presented in a talk to The Society for Information Display in December 1969. See Figure 5 for the data. The purpose of the talk was to propound the wired city concept.

The question was asked in the discussion that followed the paper, "How are you going to control this flow of information?" The only definitive answer I could give was that I was going to cut off some of the unread IEEE transactions that were accumulating. After suitable rumination, I decided that I might achieve more of a demand system by controlling volume. I established what control I could without too much static from my family. The results are shown in Figure 5. On the whole, there is very little difference between the two samples, perhaps 15% of the total bits at most. At least the bit consumption didn't increase.

The revolution that I foresee, however, will not grossly effect bit rate and bit consumption as much as it will effect bit value. This will be a quality not quantity revolution. The social implications of this in general increase as the value and the impact of the information that is moving around effect the lives of the population. The remainder of this paper will try to assess this in a more quantitative fashion.

Future System Costs

Since there is a large investment in the present system, it can be expected that any revolution will occur quite slowly taking account of system amortization costs. For this reason, I have assumed that the revolution will occur between 1980 and 1990 and have tried to assume what the United States might be like in 1985 in mid-revolution.

Give or take the usual demographic weasel words about pills, bombs, liberation movements, etc., I have assumed that there will be 100 million households in the United States in 1985. These will be largely contained (80%) in 1,000 urban areas. There wil be five megapolises: Boswash, Chipitt, Jacmia, Dalhous, and Sansan. The average household will consume 200 hours of information per month at a rate between 5 megahertz and 15 megahertz. It will send out 5 hours of information per month at a rate between 5 megahertz and 10 megahertz. Most information to be transmitted consists of soft copy but the average consumer will want a hard copy of 0.1% of his information (300-400 pages). This simplified set of requirements can be nicely met by a cable TV system such as currently exists with a limited number of households and a two-way coaxial cable dedicated to them. Currently this number is 6 households, each with three 5 megahertz channels. The coaxial cable is augmented with a low bandwidth cable such as a telephone currently uses to set up what is happening on the high bandwidth cable. In most systems which you can envision, a set of distribution centers would be desirable internal to a given urban area. A system such as this was analyzed for 1979 in the earlier paper, Reference 8, and was determined to have two advantages in 1979 over the present broadcast system as it is evolving. These were lower cost and better program selection. The usual conclusions were made about how difficult it would be to change the existing system.

Imagine my surprise when I found out that such a system was already in existence in Great Britain and that currently 750,000 households were being serviced. See Reference 13.

A similar cost analysis was made for the hypothetical 1985 system described earlier. The technique used was to build a node and link model to meet some fraction of the overall requirements and then to cost the system investment as the sum of the costs of all the nodes and all the links. Operating costs were not considered. It is obvious that there is a lot of witchcraft in this sort of a number, but valid considerations of social implications may still be drawn from it. The nodes considered were:

National information center	(1)
Megapolis information centers	(5)
Area information centers	(1,000)
Distribution centers	(10,000)
Households	(100,000,000)
Businesses	(1,000,000)

The links considered were:

National links	(5)	satellite or ground-based
Urban links	(1,000)	satellite or ground-based
Distribution links	(10,000)	satellite or ground-based
Household links	(100,000,000)	ground-based
Industrial links	(1,000,000)	ground-based

In general, any component could be put anywhere in the system. For instance, a cassette player might be located in the household and cassettes shipped in; or it might be located in the distribution center and accessed through the low bandwidth system; or it might be in a library in the area center and again accessed through the low bandwidth system. Obviously, minimizing system cost will be done by keeping the equipment cheap that is associated with the larger numbers of links and nodes. An infinite number of systems are possible. I have plotted in Figure 6 the investment costs of six different systems versus my opinion of the degree of demand capability provided. All six of these systems can be used to replace the following services:

- mail including recorded music and imagery,
- magazines and newspapers,
- broadcast radio and television except to automobiles
- telegraph, telephone and videophone,
- library books,
- balloting

The systems were not considered either for replacing classroom instruction or replacing commuting to work, either of which might pay for the system by themselves.

I draw two conclusions from this analysis relevant to social implications. One of these is that systems currently exist that can largely increase the amount of demand capability at similar costs to what is now paid. The other is that a massive amount of money is involved that will no doubt be spent under some sort of government regulation.

It is an interesting aspect of these systems that everything currently exists that is necessary for these systems to work. No significant technological breakthroughs are required nor are any extensive developments required. Both the hardware and software associated with the system, whatever it is, will have a large technological content. Perhaps this will be a new market for the beleaguered aerospace industry to supplement their conventional government business. They certainly have the technologists and the technology. The market, in addition, has the volume even today to support the industry whereas many of the diversification efforts they are attempting do not, (for instance, earth resources.) It is obvious that many of them are looking at this possibility with satellites, computers, communications, or systems analysis as their entree.

Many new techniques are under development that may also impact this area. It is outside the scope of this paper to describe these, but the bibliography lists some pertinent references by technique. It should be noted that the increasing use of the computer in conjunction with the communication system will often involve these new techniques. Various forms of block coding which require computation on both ends of the link are an example. The possibility of using a reverse channel in a two way (one at a time) link is another.

Social Implications

It has been noted earlier that people are consuming a large quantity of artificial information through a wide variety of channels. This information has a large value for them even though much of it is transmitted in a parallel format without any hope for conversational interaction. Now we technologists are on the verge of being able to provide the same quantity of artificial information at reasonably similar costs but with a custom format (demand) and with conversational interaction augmented by all of the things that our big dumb computers do so well: arithmetic, filing, remembership, etc. I submit that the value of this information will greatly increase to the consumer and that it will have more impact on his life, liberty, and pursuit of happiness than any other revolution that has occurred since the industrial revolution started.

Life and life style will be affected grossly. Decisions will have to be consciously made on what to demand and for what to pay. The role of the urban center will probably be emphasized while that of the megapolis will probably be deemphasized. All sorts of work/home relationships will be changed. Commuting costs could conceivably be cut as much as 50% if some fraction of a worker's job could be performed at home. On the other hand, it may be psychologically desirable for workers to get away from home. The same 50% cost reduction is possible for entertainment, both programmed and live. On the other hand, will we ever get the bandwidth high enough to transmit the real impact of a hockey game as seen in person as part of a large crowd? Educational costs could be reduced and appropriate software could be developed that would allow students to naturally explore their way through a body of knowledge rather than the read-lecture-write-quiz method currently employed that leaves a certain fraction of the students uninspired and untaught. See Reference 18. On the other hand, could we ever get the bandwidth high enough to let a good teacher learn the real problems a student may have especially if the student were in his home and the home caused the problems. All of these things seem to have very large social implications.

As a concrete example from Reference 18, our current system of teaching biology involves the dissection of animals. Mostly the animals are pre-killed. This is often the first and perhaps the only whole animal ever dissected by a student, give or take a turkey at Thanksgiving time. It would be relatively simple to provide a three-dimensional CRT representation and a light pen scalpel and allow him to dissect a model animal in an exploratory fashion using a demand information system. It seems to me that the implications of this are very large. It not only saves animals, but allows for re-dissections by the simple operation of a function switch.

As for Housewives

A sizeable period of the life of each household is spent in shopping and accounting (check-writing, etc.). It would seem that a demand information would also affect this area. On the one hand, we could visualize the wife in the morning being paid by sponsors to watch their commercials before she goes shopping. On the other hand, she could use the system to actually do the shopping itself. As mentioned earlier, it may be psychologically desirable to get away from home. Even then a demand information system might be useful where you could shop from a sociable meeting place without having to commute to different stores. Every time I sit down to pay my household bills, the phantom of a cheap terminal hooked to the bank can be dimly seen on the desk. When it comes it will have great impact.

In the 1970 economy, $8.8 billion of the GNP is paper excluding paperboard, etc. The great bulk of this paper is consumed in the $27.5 billion printing and publishing industry. After use, probably 90% is discarded and burned or buried. This whole process could conceivably be replaced by the demand information system for those applications where a hard copy is not required. The pollution prevention and conservation aspects of this are enormous. Existing forests could be saved, odiferous paper mills could be eliminated, printing presses could be reduced in size and speed, and in 1985 a billion garbage cans of paper trash could be eliminated for the year.

Effects on Democracy

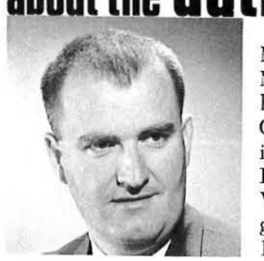
Thus, we have seen that the demand information systems that are upon us will have gross social implications in our lives especially in work, commuting, entertainment, education, shopping, accounting, and pollution.

This is also true to a greater-or-lesser extent in the area of our lives involving our liberty. What's more, the changes in our liberty may not be entirely beneficial. Polling could be automated and speeded up allowing rapid and cheap assessment of the desires of the electorate. This would appear a positive effect but taken to the extreme, polling could take place each day after the evening news report of your persuasion had been purchased and watched. This might be a negative effect for any effort requiring sustained support. There are, of course, many checks and balances in our democratic republic system that would help regulate this. There have been a great many writers of late discussing the problem of national data banks on people's personal history, credit rating, arrest records, etc. Most writers view this as a limitation to ones personal liberty. They disregard the corollary that people might learn to play the system and could hide forever in a crack somewhere in a giant underground disc file located in rural Maryland. It would seem that a demand information system could be useful in this area if appropriate laws were passed. All that would be needed would be provision for each person to have free or paid access to his own files wherever they might be located. Thus the demand information system might help ensure personal liberty.

The junk mail industry, which can be viewed as an imposition on our time if not our liberty, might also be switched to a demand information system. Presumably the industry would pay the consumer upon his request to view their promotion whatever it is using a menu or an index. This ought to have benefit to all concerned.

It would also be possible to know a lot about a person's desires, ac-

about the author



Mr. Ulbrich, at the McDonnell Douglas Astronautics Co. in Orange County, California since 1967, is Manager, Information Systems Development, Advance Systems and Technology Division. In 1967 he helped set up the Information System Subdivision. Previously, he had worked for the General Electric Company, North American Aviation, and Genisco Technology. Service in the Navy involved engineering instruction on nuclear weapons. A Registered Professional Engineer (Ohio), he is a member of SID, IEEE, AIAA, Air Pollution Display, and other groups. In SID, he is Society Secretary; and has been Western Region Director and past President, Los Angeles Chapter. He has a BS degree in electrical engineering from Rose Polytechnic Institute (1954) and his MS from University of New Mexico (1961). He is married and has two children.

By E. A. ULBRICH

By E. A. ULBRICH

tions, beliefs, etc., just by observing what information he does consume. This would seem to be a limitation of his liberty on one hand although it might get him better programs to watch on the other, depending on its use. Presumably such knowledge would have to be controlled by law.

Another question in this area is whether or not to establish a public monopoly for demand information such as the telephone company. Sixty years ago when the GNP was smaller and the capital expense of a telephone system was relatively large, it was probably important to have such a monopoly.

Choose Your Phone Company?

Although it is hard to conceive of a telephone pole in the backyard with a first-of-the-month toggle switch allowing you to use the telephone company of your choice for the month; it is certainly feasible to take the feed for a given channel of the high bandwidth system from a variety of sources at the area distribution center. On the other hand, it would certainly ease system integration if all equipments operated to the same specifications which is relatively easy in a public monopoly, but has also proved to be easy in the computer time share industry.

Thus, we have seen that demand information systems will also have implications in our liberty especially in the polling, data bank, promotional, and beliefs areas. Also we have seen that these implications may be sociologically negative as well as positive. Finally, we have brought up the question of how to organize the system.

The remaining area to be discussed is the pursuit of happiness. It is hard to define let alone discuss. Suffice it to say that a demand information system should tend to increase the communication between people whenever an artificial information channel is used. Doing this, it should reduce barriers, reduce ignorance, and promote understanding. These in turn should promote the pursuit of happiness.

In summary then, I hope to have shown that technologists are about to present a second revolution in one century to the people in the United States. This revolution will have a profound impact on our lives, liberty, and the pursuit of happiness. Planning for this revolution to date has been almost nonexistent. In my view-point, the people who are providing the revolution, the technologists, are the ones who should plan it. The time is now.

I would welcome any comments or rebuttal to this thesis. At least one technical society, AFIPS, has recognized the need in this area and has set up a cognizant committee, headed by Dr. Harold Sackman. This committee can provide a forum for your ideas. The Board of Directors of SID has recognized the importance of this area and has asked me to set up a committee within SID to represent us. I would welcome any volunteers, suggestions, or publications. Let us not allow this second revolution to occur guided only by the short term entrepeneur's profits, by government fiat, or by the laws of chance.

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Power Supplies

CAN MICROWAVES DELIVER POWER? by Justin Blazer Scott, Microwaves, November, 1970, Page 14.

Cassettes

Wall Street Journal, 16 December 1970,

turn to page 29

Display Update 73, SID Meet Set in San Diego December 8

The 5th annual one-day SID Technical Conference will be held in San Diego, at the Sheraton Inn - Airport, Friday, December 8. Morning and afternoon sessions will be held, Richard Thoman, Conference Chairman, announced, and a featured guest speaker will address the luncheon meeting. Gerald Chandler, Chairman of Papers Selection, says the response to the call for papers has been excellent.

For advance copies of the program and registration, contact: Harold P. Field, Conference Publicity Chairman, c/o Gamma Scientific Inc., 3777 Ruffin Road, San Diego 92123, tele. 714-279-8034. The Sheraton Inn - Airport is located immediately adjacent to the San Diego Airport on San Diego Bay. A block of rooms has been reserved for those wishing accommodations.

Photo Engineers In Denver Seminar

The Society of Photographic Scientists and Engineers, in cooperation with Lowry Technical Training Center, Lowry AFB, Denver, conducted a two-and-one-half-day Tutorial Seminar November 2-4 entitled "COLOR: THEORY AND IMAGING SYSTEMS." Governmental, academic, and industrial participation includes the National Research Council of Canada, U.S. Army Topographic Command, Houston Manned Space Craft Center, Rochester Institute of Technology, and research laboratories of major U.S. organizations.

The first day was devoted to "Theory," i.e., perception, colorimetry, densitometry, sensitometry, image structure, masking for optimum reproduction, and the chemistry of color development. "Silver Halide Color Photographic Materials and Processes," including discussion of negative and positive systems, reversal systems, quality control, and diffusion transfer systems engaged speakers the morning of the second day; "Aerial Photography" was covered in the afternoon as it relates to color films, silver dye bleach systems, TOPOCOM's readiness program, APOLLO and SKYLAB programs. The final session, "Color Microfilm," encompassed color hard copy, including a review of techniques and materials and an overview of "Rapid Access," xerography, and "Color-in-Color."

Low Loss Fibre For Laser Systems

Practical fibre-optic communications systems came a step closer last week when Robert D. Maurer of Corning Glass revealed that his company had succeeded in reducing optical transmission losses by a factor of five to just over 4db/Km. The announcement is significant because each improvement in transmission efficiency permits repeaters to be more widely spread thus improving the economics of optical transmission.

Tests were carried out on fibre-optics just over a third of a mile in length at wavelengths between 600 and 1,100 nanometers, comfortably within the waveband of gallium arsenide lasers operating in the 800 to 900 nanometer range.

SID Chapter Hears Acupuncture Talk

The summer doldrums are upon us, we have only one meeting to report on, and an interesting topic it was. The San Diego Chapter invited Mr. Tomson Liang to speak on 'The Practice of Acupuncture' at a meeting held September 12, 1972. Mr. Liang, an electrical engineer with Hughes Aircraft, has bachelors degrees in both engineering and physics, and is also a minister in the Chinese Mandarin Church.

Mr. Liang discussed the history, technique and application of acupuncture which he learned from his parents, both of whom are medical doctors as well as acupuncturists. Having learned acupuncture from medical doctors, as well as having been involved in the manufacture of medicine, has made Mr. Liang more knowledgeable in the physiological aspects of acupuncture than most practitioners. In China acupuncturists usually do not have an academic degree and have not studied medicine or modern medical practices. They learn during an 8 to 10 year apprenticeship and provide their services free of charge to their neighbors as a community service.

The turnout for the San Diego meeting was excellent and Mr. Liang's lecture was well received.

1972-73 SID Chapter Officers

New 1972-73 officers have now been elected by local chapters of the Society for Information Display. Chapters and their new officers follow:

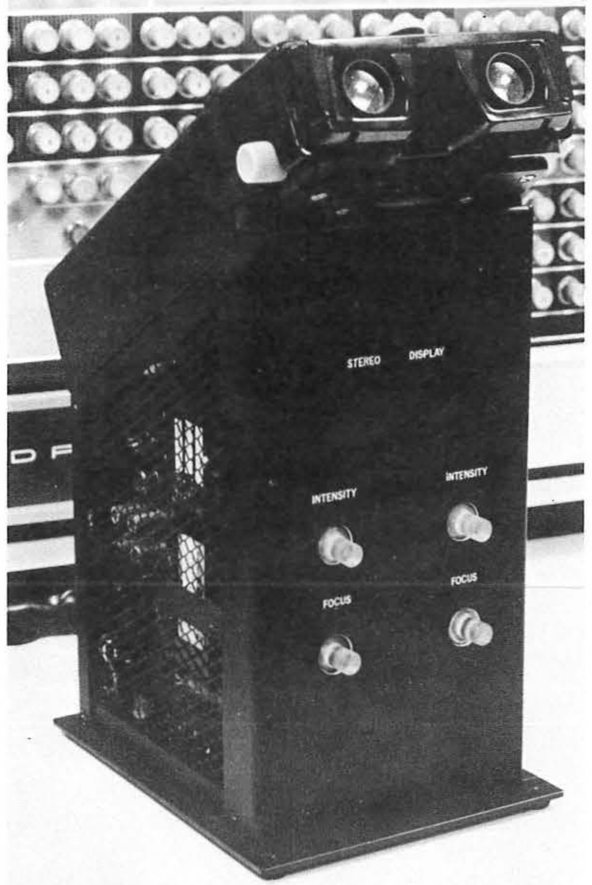
BAY AREA: Herbert C. Hendrickson, Chairman; F. John Marshall, Vice-Chairman; James Thompson, Secretary-Treasurer. DELAWARE VALLEY: Arthur D. Hughes, Chairman; Charles P. Halstead, Vice-Chairman; I. Gary Bard, Secretary; Nathan Rubin, Treasurer. HUNTSVILLE: H. K. Johnson, Chairman; Thomas Rowan, Vice-Chairman; Carl D. Wright, Secretary-Treasurer. LOS ANGELES: Arch H. Wisdom, Chairman; E. H. Schauwecker, Secretary-Treasurer. MID-ATLANTIC: Thomas C. Maloney, Chairman; Patrick F. Grosso, Vice-Chairman; Harvey P. Sherman, Secretary; Albert Loshin, Treasurer.

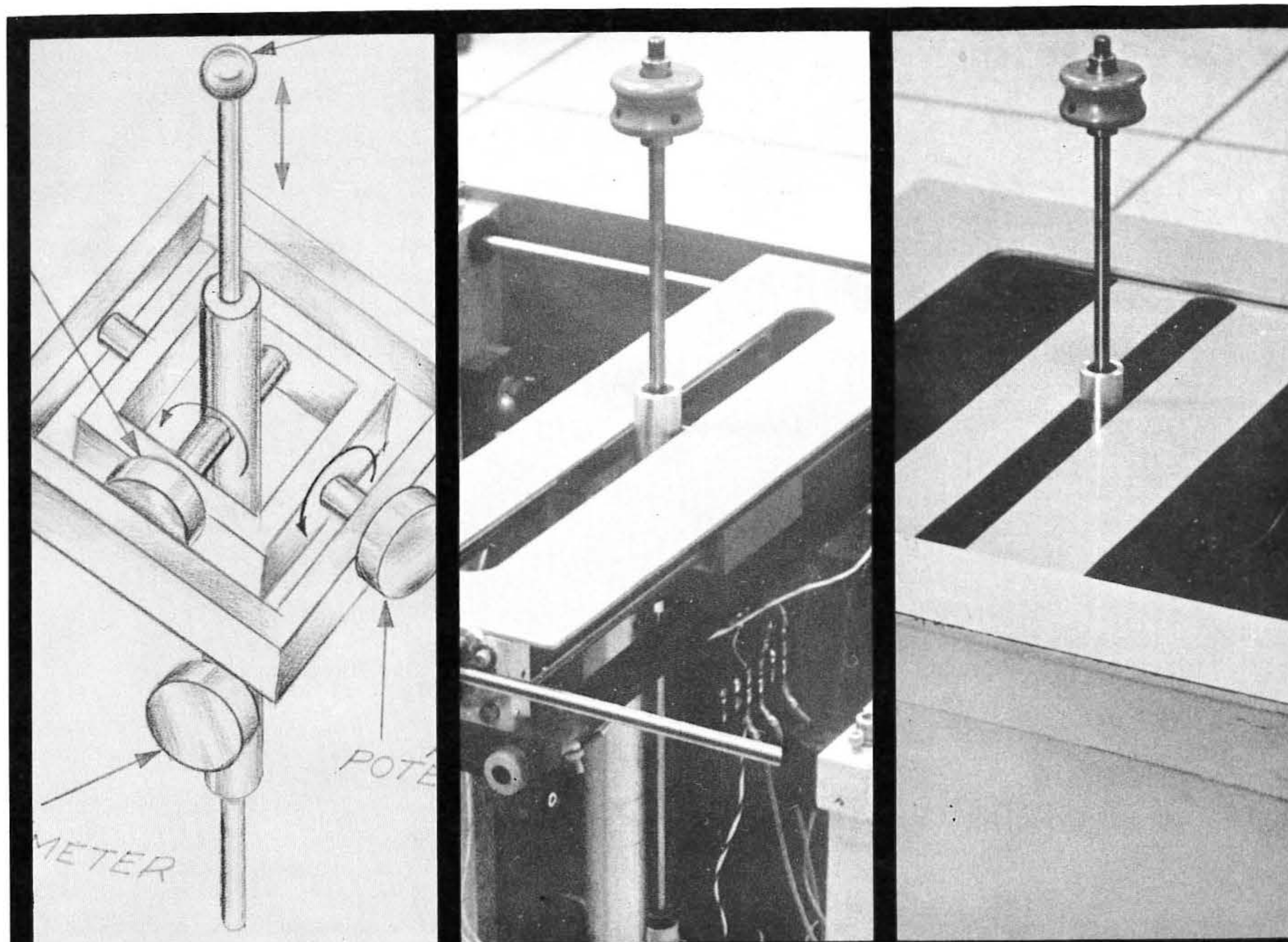
MINN.-ST. PAUL: Marlin Noffke, Chairman; Vern Born, Vice-Chairman; Thomas Werner, Secretary; William Swanson, Treasurer. NEW ENGLAND: Robert T. Schwartz, Chairman; Albert V. Shortell, Vice-Chairman; Richard D. Wright, Secretary; Daniel Enxing, Treasurer. SAN DIEGO: Gerald F. Chandler, Chairman; Donald J. Pugh, Vice-Chairman; Edward B. Herron, Secretary; Gerald T. Stebbins, Treasurer. SOUTHWEST: Richard A. Reynolds, Chairman; Brian Holgate, Vice-Chairman; Edmund E. Snuggs, Secretary-Treasurer. WASHINGTON, D.C.: John Edgbert, Chairman; William Roberson, Vice-Chairman.

Real-Time Interactive Stereoscopy

by A. Michael Noll

Bell Telephone Laboratories, Incorporated
Murray Hill, New Jersey





Man is a creature inhabiting a world of three spatial dimensions jointly with his computer progeny. Effective communication between man and the computer should involve the manipulation and stereoscopic graphic display of three-dimensional data. This paper describes a real-time interactive stereoscopic computer facility with stereoscopic displays for output from the computer and a device for three-dimensional input to the computer.

● This is an age when science and technology looks upon itself, or is looked upon, as having a great influence upon art and artists.[1] However, throughout history art and science have been so intertwined that any attempt to discover which has influenced the other is extremely difficult and speculative. However, on some splendid occasions a contribution from one culture to the other culture is clearly and distinctly made. Such an occasion occurred during the Renaissance when the Italian painter Leone Battista Alberti expounded in an essay on painting, usually referred to as the *della Pittura*, the earliest known geometrical scheme for depicting objects in a unified space, or what is today known as "perspective."[2]

Perspective Projection

Most artists are thoroughly familiar with simple graphical techniques for using perspective in their work. Similarly, geometricians are thoroughly familiar with the simple equations, derived from nothing more complex than similar triangles, that characterize and define perspective projection from three dimensions to two dimensions. Since modern day digital computers are unable to manipulate straight edges and other drafting tools, this mathematical formulation of perspective geometry was an absolute necessity for using computers and automatic plotting devices for calculating and plotting perspective projections of three-dimensional data. Similarly, as soon as computer-generated movies were discovered, it was only natural that perspective was added. This perspective greatly enhanced the naturalness of these early computer-generated movies.[3]

Stereoscopy

Man experienced the sensation of depth because he has two eyes, which view the world from two slightly different locations. Thus, if two slightly different perspective pictures are presented separately to each eyes, the human brain will translate their minute differences into a very realistic depth effect. As a computerized technique, the computer need only calculate two perspective projections of the three-dimensional data, from two different viewing points. Pioneering work in the production of computer-generated stereoscopic pictures was done by Bela Julesz for stimuli in psycho-physical investigations of depth perception.[4] Computer-generated stereoscopic pictures and movies were later used rather extensively to present scientific and technological data.[5-9]

Real-Time Interactive Stereoscopy

As another aspect of computer graphics as a new form of man-machine communication, computer-generated images were being displayed in real-time on cathode ray tubes. Elaborate programs were written to permit the manipulation of images in an interactive man-machine environment.[10-11] The marriage of stereoscopic computer-graphics with real-time interactive computer-graphics was a natural and obvious union. There were, however, a number of problems in terms both of hardware for input and output of three-dimensional data and of appropriate software for quickly and easily manipulating three-dimensional data, and for calculating the final stereo pair of images. This paper discusses the compromises and final solutions of these problems and which made possible the actual implementation of a stereoscopic real-time interactive computer-graphics research facility. Descriptions are given of some of the practical uses of the facility and also some of the research work presently being conducted and planned for the facility. The derivation of the simple equations for stereoscopic projection are given in the appendix.

Stereoscopic Displays

A stereoscopic display presents the left and right images separately to the left and right eyes. There are many ways to accomplish such a separate presentation. This section of the paper discusses some of the more common methods.

The old stereopticon consisted of two lenses and two pictures placed

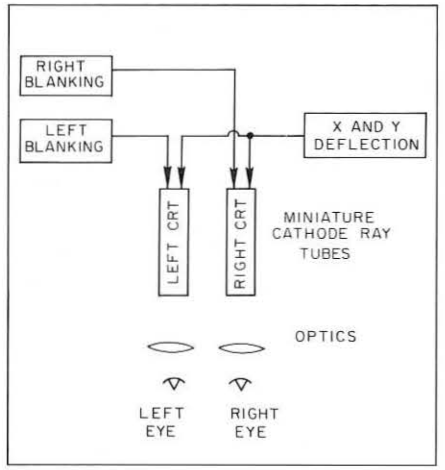


Figure 1. A stereoscopic viewing system using two miniature cathode ray tubes and blanking signals so that the image on only one of the tubes is displayed at a time.

Figure 2. Photograph of a dual cathode-ray-tube stereoscope. A conventional hand-held stereoscope has been modified and fitted with two Thomas Electronics one-inch diameter tubes.

about 2.5 inches apart. Borrowing upon the simple concepts of this old method results in a computer-generated display counterpart as shown in Fig. 1. Two miniature, 1-inch diameter, cathode ray tubes separately display the left and right images. The viewer observes the faces of the two tubes through a simple lens system which has provisions for adjusting the focus and the interpupilary distance of the lenses. The small tubes provide high resolution (about 1000 lines per inch) and fast deflection speed, so that a reasonable amount of data can be presented flicker free. However, high voltages are necessary for the deflection plates of the tubes, and these voltages are quite close physically to the viewer, Apparently, the safety problem does not appear, since two miniature cathode ray tubes are being used on a helmet-mounted stereo system designed by Bell Helicopter Company for use by helicopter pilots and later adopted for computer graphics displays.[12-13]

A dual cathode ray tube display was constructed at Bell Labs using miniature tubes manufactured by Thomas Electronics (Fig. 2). The computer outputs the left and right images to both tubes. A blanking signal is used to turn off one of the tubes so that each eye sees only its appropriate image. One disadvantage of this system is the added electronic circuitry required for the blanking signals and the high deflection voltages for the cathode ray tubes. Also, a sizeable expenditure is required for a system which can be used only for three-dimensional computer-graphics.

A single large-screen cathode ray tube can be used for stereoscopic displays by plotting the left and right images side-by-side on the same screen. Since the two images are now widely separated, prisms or mirrors have to be used for viewing the images as shown in Figs. 3a and 3b. This mirror system is normally used in those applications requiring exactness and careful control of image presentation, because with the mirrors, both images are viewed perpendicularly. However, since mirror systems tend to be large and bulky, the prism system seems best as a general purpose stereoscope. Even though the images are not being viewed perpendicularly, the viewer does not usually notice any image distortion. A simple prism stereoscope can be made and is a light weight attachment that can be easily slipped over the face of the cathode ray tube, as shown in the photograph of Fig. 4b. A mirror stereoscope is shown in the photograph of Fig. 4a.

The last method of viewing stereoscopic images does not involve any stereoscope at all but is based upon the ability of the viewer to interrupt the normal relationships between his visual functions of convergence and focusing. In Fig. 3c, the viewer simply looks cross-eyed at the screen. At first this task is very difficult, but practice seems to help. Also, three images are seen, and it is the center image which must be focused upon. However, although this "method" is the simplest, its expense is in terms of the headaches and the frustration of the inexperienced as they attempt it!

Three-Dimensional Input Devices

If a 3-D, interactive, computer-graphics facility is to be useful, then the user must be able to communicate in three-dimensions with the computer. This means that a device, allowing effective and efficient input of three-dimensional data, must be available. This section of the paper discusses a few such three-dimensional input devices.

The simplest, and in this case, the worst, 3-D input device uses three knobs to determine the X, Y, and Z input values. However, past experience demonstrated that two knobs for two-dimensional input to the computer are awkward to use, while such devices as light pens and pen-tablets are infinitely better. So adding a third dimension, in the form of a third knob, only makes more difficult an already miserable system. Hence, attention must be given to some pointer-like, or stick-like, or pencil-like device that controls all three dimensions at once so that one hand can be used to "draw" the three-dimensional data.

Conversion Required

As a possibility in this stick-like direction, consider the device shown in the sketch of Fig. 5. This device works in a spherical coordinate system. The two potentiometers mounted at the gimbal sense the angular position. A third potentiometer senses the position in the radial direction. The major problem working in this type of coordinate system is that the angular and radial position data must be converted to rectangular coordinates, since in nearly all applications computations are most simply performed by the computer in a rectangular coordinate system, for example, stereoscopic projections. This conversion would have to be made by the computer and would be time consuming enough to interfere with normal computational efficiency.

Fig. 6 depicts a system using mutually orthognonal linear potentiometers to sense directly the position of the stick in rectangular coordinates. This was constructed and is shown in Figs. 7a and 7b. Since easy movement in three dimensions was critically important, the moving mass had to be as low as possible. Hence, aluminum and other light-weight materials were used. Thomson linear bearings were used to keep friction to a minimum. This simple-minded, but most effective, device has been in use now for about three years and has performed satisfactorily. All the applications described later in this paper have used this device for three-dimensional input to the computer. Figure 8 is a photograph of the 3-D input device used with the prism stereoscope.

Other three-dimensional input devices have been reported in the literature, most notably the Lincoln Wand which used arrays of microphones to sense a high-frequency pulse.[14] Timing information is used to fix the position of the wand within a three-dimensional space. Unfortunately, this device is subject to spurious reflections of the pulses and also requires somewhat complex electronic hardware. It is nevertheless an interesting gadget.

Software

The prime philosophy in the software package for stereoscopic computer-graphics was ease of use, with as simple a data structure as possible. Essentially the software package was to be user-oriented with simple FORTRAN-callable subroutines, with simple argument strings. The final software package actually consists of two groups of subroutines: one group for stereoscopic projections and a second group for

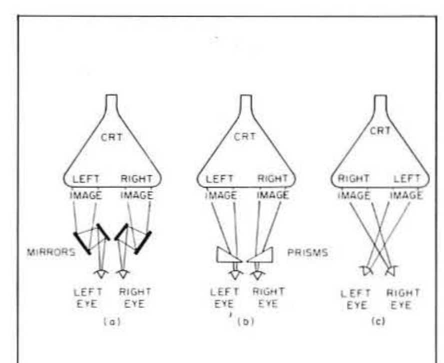


Figure 3. Different stereoscopic viewing systems for viewing left-eye and right-eye images presented on a large cathode ray tube: (a) mirror stereoscope, (b) prism stereoscope, and (c) cross-eyed viewing.

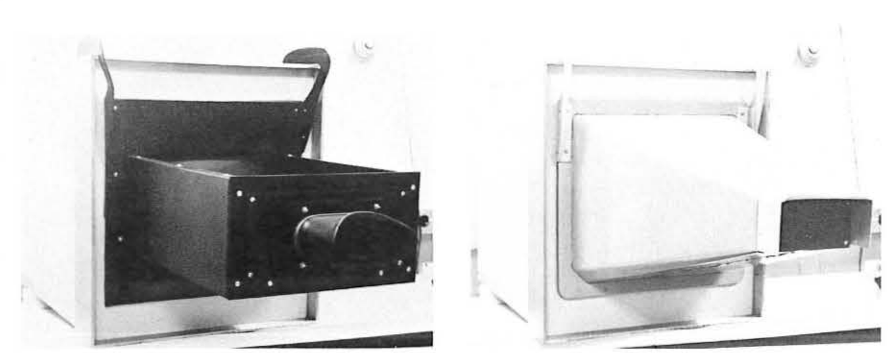


Figure 4. Photographs of (a) a mirror stereoscopic attachment and (b) a prism stereoscopic attachment.

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general-purpose graphics. This section of the paper gives some feel for these subroutine packages.

Graphics Package

The general purpose graphics package has subroutines for drawing dots, lines, and characters at specified places on the display screen. The lines are drawn as a series of closely-spaced dots, which are interpolated between the end points of the lines. The interpolation is in terms of equal intervals along either the x-axis or the y-axis depending upon the slope of the line. The characters are produced from a basic 5 by 7 dot matrix and can be varied in size. All of these subroutines result in sets of x-y packed coordinate pairs being placed in specified output arrays. Other subroutines specify the names and sizes of the output arrays and turn the display interrupt on or off. The programmer deals with his data in terms of x and y coordinates, while the actual output data is packed for him by the subroutines. Hence the data structure is simply arrays of x and y coordinates while, the names of these arrays and their sizes form the bulk of the subroutine argument strings. Of course, everything is FORTRAN-compatible and the complete package requires about 600 (decimal) locations.

Stereoscopic Package

The stereoscopic package is also FORTAN compatible, consists of two subroutines, and requires about 180 (decimal) locations. The three-dimensional data must fall within a cube centered about the origin and with an edge length of 4095. The first subroutine is for initialization and for specifying the interfocal distance D and the viewing distance R. From these parameters, the scaling factor S and origin offset correction factor D/(2R) are computed. The second subroutine performs the stereoscopic projections from a single array containing the X, Y, and Z coordinates in sequence into three arrays containing X_L, X_R, and Y_{LR} also in sequence. Sense switches on the console of the computer are used to specify whether the left and right images are to be displayed on the single large cathode ray tube, or on the dual miniature cathode-ray-tube device, and whether the left image or right image is to be plotted on the left or right side of the display. This information is used by the stereoscopic projection subroutine to calculate the appropriate constant offsets so that the values of X_L, X_R, and Y_{LR} can be used directly without further modification in the general purpose graphics subroutines for actual final plotting.

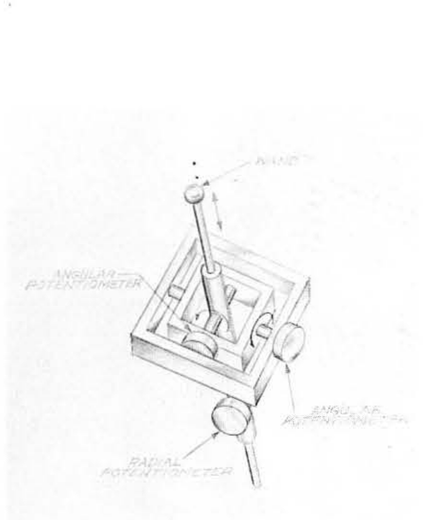

Figure 5. Sketch of a three-dimensional input device. The wand is free to rotate in a gimbal whose angular position is sensed by two potentiometers. Radial movement of the wand is sensed by a third potentiometer.

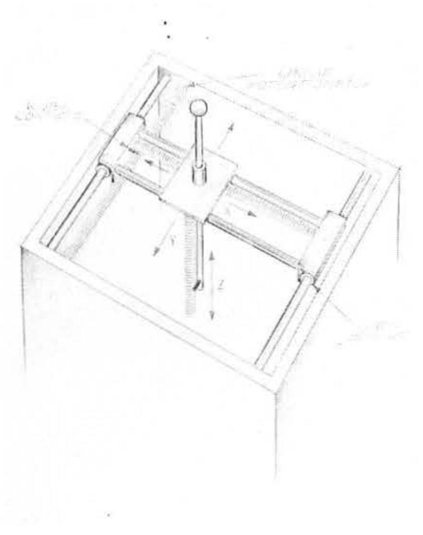

Figure 6. Sketch of a three-dimensional input device based upon a cartesian system using three mutually-perpendicular linear potentiometers.

Some Applications

All of the preceding hardware and software was implemented on a Honeywell DDP-224 computer with 32,000 words of core storage. This computer is a 24 bit machine with floating-point hardware and a cycle time of 1.9 micro-seconds. The actual hardware and software details of this facility have been previously described.[15] In addition to its use as a research facility for investigations of new forms of man-machine communication, the computer facility is also being used quite extensively for on-line speech research.[16, 17]

Speech scientists are quite accustomed to spectrographic displays of speech in which time is plotted along the X-axis, frequency is plotted along the y-axis, and spectral energy is plotted as a darkening of the paper. If the spectral energy were plotted in a third spatial dimension and if short-time spectral slices were calculated by the computer, then a three-dimensional plot of the speech spectra could be made. This was done before, but the plot was not very successful in making the spectral peaks or formats more apparent.[18] Speech spectra were hence displayed stereoscopically with provision for rotating the spectra so that they could be viewed from different directions. In this way one might look down the valleys between the spectral peaks and better distinguish these peaks. Although the technique worked, no new insight was gained about the speech spectra.

4-Dimensional Hypercube

In another application, the facility was used to display stereoscopically the three-dimensional perspective projection of a four-dimensional hypercube.[19] The stated purpose of the experiment was to determine if real-time interaction in the form of rotation in four-dimensional space might help to give some feel for a fourth spatial dimension. Unforunately, once again no new insight was obtained.

Using an interactive computing facility for simply rotating three-dimensional data is a waste of computing power since such rotation is best done with computer-generated rotational holograms.[20] The computer is needed when calculations and interaction other than three-dimensional rotation is required. As an example, the display of the results of three-dimensional statistical scaling calculations normally would involve nothing more complicated than rotation, and hence a computer-generated rotational hologram would suffice. However, when a considerable number of data points must be displayed, each point cannot be individually identified since this would clutter the display. In an interactive facility, the user can use the three-dimensional input device to latch on to a point, and this point can then be identified by a number of some other information. Also, the display might be recalculated for only a selected subset of the data points.

Full Power Application

The full power of interactive three-dimensional computer graphics was required for a program for drawing in three dimensions. Straight lines and curves could be drawn by using the three-dimensional device. These lines and curves could then be latched onto and either translated or rotated. All of this was real-time and only when extremely-complicated objects were drawn did a noticeable delay in rotation or translation occur, and for these cases, flicker was already also becoming noticeable.

A scanned-type display was also available, and a stereoscopic software package was written for use with it.[21] Although this scanned display had such a low resolution that only a little over 100 points were available for each separate image of the stereoscopic pair, a reasonable depth sensation was nevertheless possible. A stereoscopic scanned display would be particularly useful for presenting detailed surfaces stereoscopically without flicker although research in this direction has not yet been conducted using the DDP-224 computer facility.

Concluding Remarks

Over the past few years computer systems have been designed that use special digital hardware for performing rotations and perspective projects.[22] Also, fairly elaborate and sophisticated programming languages and data structures have been devised for interactive computer graphics.[23] The computer system described herein does the rotation and stereoscopic-projection calculations by software written in assembly language for use as subroutines in FORTRAN or in assembly-language main programs. These software calculations are sufficiently fast to insure real-time operation, and the data structure and argument strings are sufficiently simple to insure programming ease. One can only wonder whether the special-purpose hardware was perhaps a needless complication and expense for most applications and whether the elaborate programming languages and data structures might not have actually impeded many application oriented uses. Most certainly the final responsibility is upon the user to make use of the most appropriate and expedient techniques for his particular application. Also, many of the special purpose hardware, sophisticated programming languages, and elaborate data structures are most interesting as research entities which must be adequately explored and evaluated for application to extremely complex interactive display situations.

Other than three-dimensional drawing program, real-time interactive stereoscopy would seem to have been nothing but another academic exercise in man-machine communication. In most data display applications, the monocular

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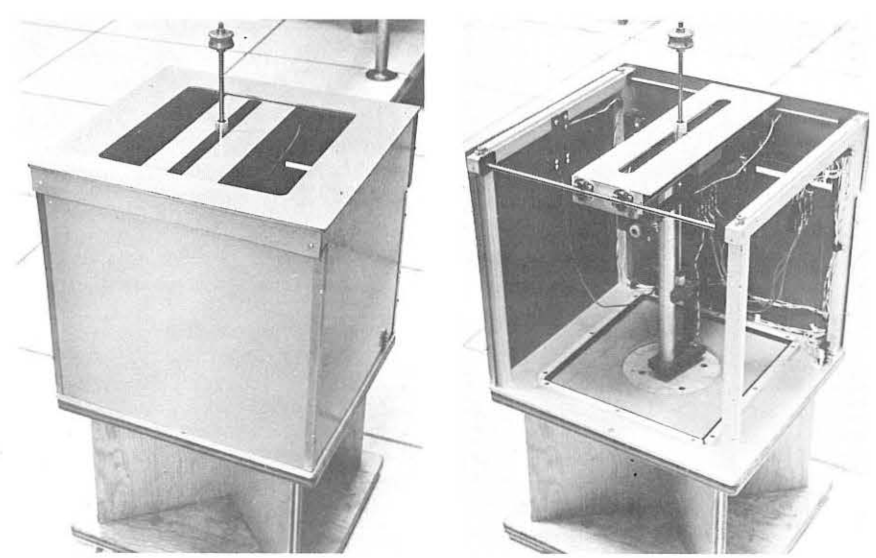

Figure 7. Photographs of a three-dimensional cartesian input device both (a) with and (b) without external covers.

Figure 8. Photograph of an interactive, stereoscopic, man-machine communication system.

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perspective depth clues are sufficiently strong that stereoscopy can add very little more. For this reason, stereoptical data displays either interactive or non-interactive have not been widely used. The data must be devoid of monocular depth clues and reasonably complex before stereoscopy can be of assistance. Hence, the prime areas of use thus far are in design and in the visual arts.[24] However, the display of data involving four or more dimensions in such a way that the user can easily and quickly grasp the structure of the data is an unsolved and most challenging problem. Stereoscopy might be of critical importance in the solution of such display problems.

The work described in this paper is really a small subpart of a project to develop a tactile man-machine communication facility, and it is within this context that real-time interactive stereoscopy will be of crucial importance. The tactile device will be used to augment the stereoscopic display for such tasks as latching on to a line or object in three dimensions. It will also be used in psychological investigations of interactions between the human tactile and visual communication channels. A tactile communication facility opens the door to a totally-new man-machine communication channel and quite obviously is a totally-new story worthy of its own paper which was published in SID Journal, July/Aug. 1972.

Acknowledgments

The circuitry for the dual cathode-ray-tube stereoscope was designed by John J. Dubnowski, while the subroutines for displaying characters were written by Miss Martha J. Southern. The mechanical design of the stereoscopes and the 3-D input device was performed by Charles F. Mattke. The DDP-224 computer facility with all its associated hardware interfaces and software was constructed by O. J. Jensen and programmed by Mrs. Barbara E. Caspers under the supervision and guidance of Peter B. Denes.

Appendix: Theory of Stereoscopic Projection

Although the equations for stereoscopic projection are simple and easily derived, they will be given here since the definitions of terms used in the equations might not be familiar and will be used later. Many mathematical techniques can be used to derive the equations. The simplest method involves the geometry of the situation (Figs. A1 and A2) and nothing more complicated than similar triangles.

Consider a cartesian coordinate system X, Y, and Z with a point P in this system defined by the coordinates x, y, and z. This point is to be perspectively projected on to the left and the right picture planes with viewing points VP_L and VP_R separated by the "inter-pupilary" distance D and at a "focus" distance F behind the picture planes. The viewing points are at a distance R from the X-axis. The perpendicular projection of VP_L and VP_R on to the left and the right picture planes, respectively, defines the origins in the picture-plane coordinate systems.

Figures A1 and A2 depict the geometry of this situation as seen perpendicular to the XZ and YZ planes, respectively. The coordinates of the projected point in the left and the right picture planes are (X_L, Y_{LR}) and $X_R, Y_{LR})$, where positive X_L and X_R are to the right. The vertical distance, Y_{LR}, of the projected point is the same in both the left and the right picture planes. The right triangles making up the geometry of the situation, as shown in Fig. A1, are similar triangles so that the unknown distance X_L is easily calculated. A similar situation exists for X_R and also for Y_{LR} as shown in Fig. A2. The equations are

$$X_L = \left(x + \frac{D}{2}\right)\frac{F}{R-z},$$

$$X_R = \left(x - \frac{D}{2}\right)\frac{F}{R-z},$$

and

$$Y_{LR} = y\,\frac{F}{R-z}.$$

The focus distance F manifests itself in these equations as a constant scale factor, equally affecting all three coordinate values. Hence, it will affect only the overall size of the left and right images. If the final images are to be scaled in size to fill the available plotting space, then the focus distance, F, can be ignored since it will only be replaced by some other scale factor.

In the derivations of the stereoscopic projection equations, the origin in the left and right picture planes was assumed to be defined by a perpendicular line from the viewing point to the picture plane. The result of this definition is that the origin of the three-dimensional coordinate system will be displaced sidewise in the left and right picture planes by an amount D/(2R). If the three-dimensional data is centered about the three-dimensional origin, its projections will similarly also be displaced. More efficient use of the plotting space will be made if this origin displacement is corrected for, and this correction results in the following equations:

$$X_L = \left[\left(x + \frac{D}{2}\right)\frac{1}{R-z} - \frac{D}{2R}\right]S,$$

$$X_R = \left[\left(x - \frac{D}{2}\right)\frac{1}{R-z} + \frac{D}{2R}\right]S,$$

$$Y_{LR} = \left[y\,\frac{1}{R-z}\right]S,$$

where S is a scaling factor into which the focus distance F has been absorbed.

about the author

A. Michael Noll, Ph.D. (E.E.) is on the staff of the Office of Science and Technology of the Executive Office of the President, Washington, D.C., a post he came to from ten years with Bell Telephone Labs, Murray Hill (N.J.). There, he was early concerned with computer simulations and investigations of short-time spectrum analysis and the cepstrum method for vocal pitch determination. His interests also included computer-generated 3-dimensional displays of data, application of computer technology to the visual arts and psychological investigations of human reactions to pseudo-random patterns. At the time he left Bell Labs in 1971 he was exploring more effective forms of man-machine communication, including real-time 3-dimensional computer graphics and tactile communication. He has been widely published and his "computer art" has been exhibited throughout the world and shown on network television. He holds four patents in automatic speech production. He is the recipient of numerous degrees and honors. He is a native of New Jersey.

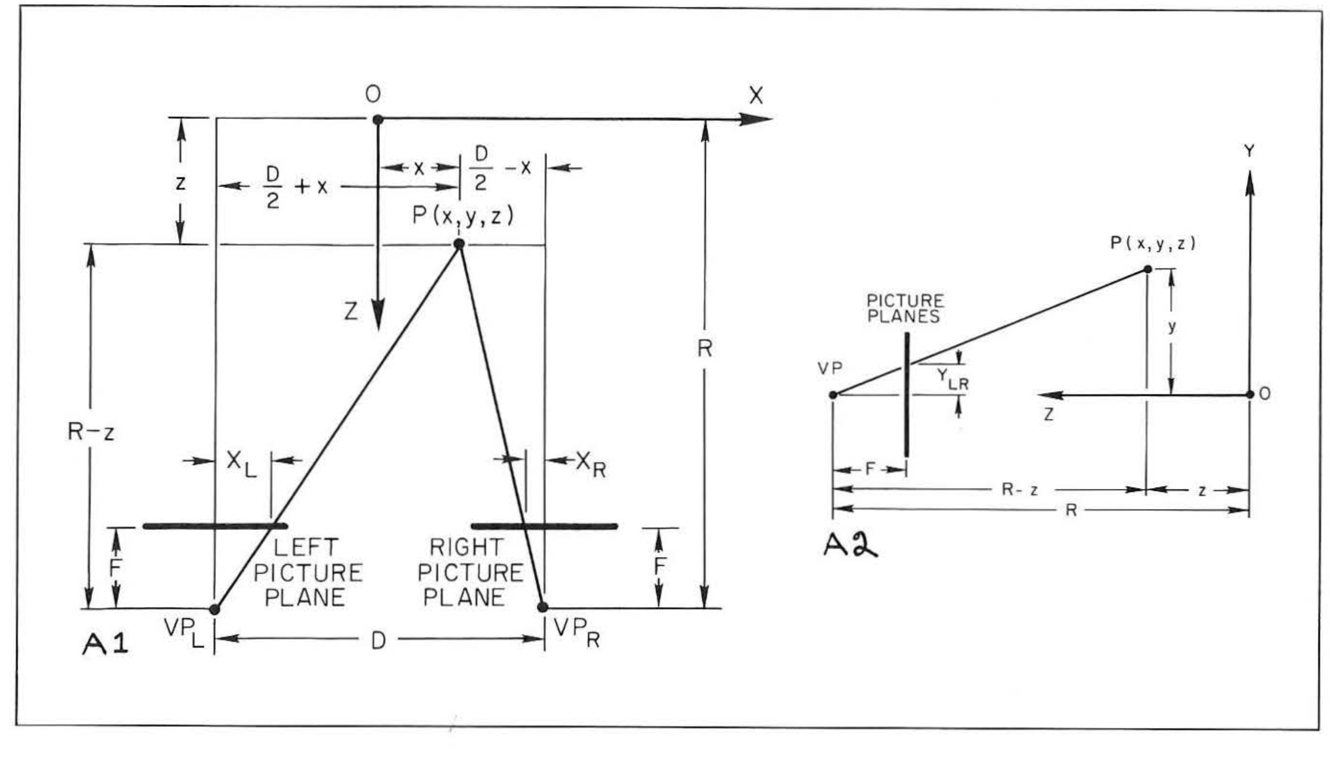

Figure A1. The geometry of stereoscopic projection as viewed perpendicularly to the XZ plane. The point P is being projected on to the left and right picture planes.

Figure A2. The geometry of stereoscopic projection as viewed perpendicularly to the YZ plane.

This paper is submitted in partial fulfillment of the requirements for the Doctor of Philosophy degree at the Polytechnic Institute of Brooklyn.

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17. Peter B. Denes, "Some Experiments With Computer Synthesized Speech," Behavior Research Methods and Instrumentation, Vol. 2, No. 1, 1970, pp. 1-5.
18. A. Michael Noll, "Computer Graphics in Acoustics Research," IEEE Transactions on Audio and Electroacoustics, Vol. AU-16, No. 2, June, 1968, pp. 213-220.
19. A. Michael Noll, "A Computer Technique for Displaying n-Dimensional Hyperobjects," Communications of the ACM, Vol. 10, No. 8, August, 1967, pp. 469-473.

20. Michael C. King, A. Michael Noll, and Daniel H. Berry, "A New Approach to Computer - Generated Holography," Applied Optics, Vol. 9, No. 2, February, 1970, pp. 471-475.
21. A Michael Noll, "Scanned-Display Computer Graphics," Communications of the ACM, Vol. xx, No. xx, xxxx, pp. xxxx.
22. Thomas G. Hagan, Richard J. Nixon, and Luis J. Schaefer, "The Adage Graphics Terminal," *AFIPS Conference Proceedings*, Vol. 33, 1968 Fall Joint Computer Conference, pp. 747-755.
23. Carl Christensen and Elliot N. Pinson, "Multi-Function Graphics for a Large Computer System," *AFIPS Conference Proceedings*, Vol. 31, 1967 Fall Joint Computer Conference, pp. 697-711.
24. A. Michael Noll, "Computers and the Visual Arts," *Design and Planning 2: Computers in Design and Communication*, Martin Krampen and Peter Seitz, Editors, Hastings House, Publishers, Inc., New York (1967), pp. 65-79.

Fall Joint Computer Meet At Anaheim December 5-7

Members of the Society for Information Display are reminded that the Fall Joint Computer Conference will be held at Anaheim (Cal.) in the Anaheim Convention Center, December 5-7. SID is one of the supporting societies of the American Federation of Information Processing Societies (AFIPS) which sponsors the FJCC.

Besides the usual outstanding technical program at the Conference, the event will include an exhibition of about 350 booths, displaying the newest in information processing equipment and systems.

Persons not members of Society for Information Display, who register for the FJCC at Anaheim can turn in their registration stub for a $15 credit on membership in SID, according to Dr. Carlo Crocetti, President, SID. To register, or for information, call or write SID, 654 N. Sepulveda Blvd., Los Angeles 90049, 213-472-3550.

GOOD WORD FOR THE DAY — O.B.T.W. — def. — an afterthought, the harbinger of bad news. Roughly translates to 'Oh By The Way'. Phrase is often used in place of 'and now for the bad news'.

SID Standards & Definitions

The activities of the Standards and Definitions Committee have been conducted primarily in conjunction with other organizations such as IEEE, ANSI, and EIA. The ANSI/X3 Ad Hoc Committee on Display Parameters, which is made up primarily of SID Committee members and is chaired by the SID Chairman. Several proposals have been rejected by ANSI/X3 as beyond the scope of that group and efforts are being made to have one or more sponsored by SID in conjunction with the Computer Group of IEEE. Of the remaining ANSI/X3 proposals, one requires revision and another is still to be reviewed. The Ad Hoc Committee is presently inactive but will be reconvened once final disposition of all proposals has been made by the parent ANSI/X3 Committee.

Another activity is that conducted jointly with the EIA 6.16 Committee on Industrial Cathode Ray Tube. The working group on Terms, Definitions and Measurements is chaired by the SID Chairman and is presently engaged in developing standards which should be completed in 1972. A similar situation exists in the IEEE where a working group on display devices of the Electron Devices Committee is preparing Standards on Light Emitting Diodes. The chairman of that group is J. Pucilowski, an SID member who is also secretary of the ANSI/X3 Ad Hoc Committee. The Electron Devices Committee is also reviewing several standards on CRT's and related devices and some revision may result.

To summarize, there is a good deal of standards work going on which is led by SID committee members or in which they participate very extensively. While there has been no activity exclusively SID sponsored and none is projected for the immediate future, a program to standardize terms and definitions is under consideration and may become active. To date, however, it appears that SID is most effective in generating joint actions and participating in other industry, and technical society activities. We have tried to enlist SID members to the fullest extent possible, and would welcome expressions of interest and participation by any others who want to contribute their time, effort and knowledge.

SOL SHERR, Chmn.

Edgerton 1st SPSE Visiting Lecturer

Harold E. Edgerton has agreed to serve as the Society of Photographic Scientists and Engineers' first Visiting Lecturer in a new program which will enable Society chapters to host a meeting with an exceptional guest speaker. Wide advance publicity will be provided so that the complete audience is reached and cordially invited to participate, and the incumbent lecturer will make four presentations on topics of his own choosing. The occasion of hearing Dr. Edgerton in various parts of the country this year is expected to be well received by a varied group of scientists and engineers.

The international and interdisciplinary reputation of Professor Edgerton is based on undertakings and accomplishments too numerous and varied to describe briefly. An admittedly superficial enumeration would begin with the calibre of his scientific inventions and developmental activities in ultra high-speed and multiple-action photography and cinematography and continue with his literary contributions in articles, technical journals and books. It would take note of his design of specialized instruments in many fields including underwater photography and research, high-resolution sonar equipment, photography of shock waves set off by rockets and aircraft in flight, night aerial reconnaissance, and nuclear-test measurement, as well as the rare distinction of his being Institute Professor Emeritus at MIT, Honorary Chairman of the Board of EG&G, the international corporation he co-founded, and a recipient of many international honors and awards. Contact Russell P. Cook, Polaroid Corporation, 730 Main Street, Cambridge, MA. 02139.

Welcome! New Members of SID

The Society for Information Display welcomes the following new members:

Ralph M. Adams, Loma Linda, Ca.; Robert M. Adams, Omaha, Nb.; Harold B. Aldrich, III, Copperas Cove, Tx.; Paul M. Alt, Yorktown Hts., N.Y.; Terry G. Anderson, Pasadena, Ca.; Allan A. Arthur, Berkeley, Ca.; Dr. Kanu G. Ashar, Hopewell Junction, N.Y.; Albert Axelrod, Scarsdale, N.Y.; John A. Barnes, Forest Hill, Md.; Dr. Allen M. Barnett, Latham, N.Y.; George W. Barrowcliff, Euless, Tx.; Roy F. Bartlett, Chevy Chase, Md.; Robert R. Beck, Palo Alto, Ca.; Selwyn S. Berg, Claremont, Ca.; Anthony J. Bernot, Tempe, Az.; Billy B. Boyett, LaHonda, Ca.; Jenny Bramley, Falls Church, Va.; Robert E. Brooks, Redondo Beach, Ca.; John A. Buell, Jr., San Diego, Ca.; Frederick T. Buhler, Newark, Ca.; Earl E. Burnett, Orange, Ca.; William L. Callaghan, Leesburg, Va.; Wayne R. Campbell, Ambler, Pa.; Gerald L. Caprio, Franklin Park, Il.; Robert Dale Carlson, San Carlos, Ca.; David P. Casasent, Pittsburgh, Pa.; Walter S. Chambers, Winter Park, Fl.; Roger Chang, Thousand Oaks, Ca.; Richard N. Cheek, Arlington, Tx.; Georald J. Chodil, Harwood Hts., Ill.; Frank W. Champion, Sunnyvale, Ca.; Francis G. Christian, Tempe, Az.; Robert M. Clary, Santa Rosa, Ca.; Allen R. Clyde, Bedford, Ma.; Arthur R. Colgan, Palos Verdes, Ca.; John H. Congistre, Santa Clara, Ca.; Richard E. Cook, Holland, Mi.; Neal H. Cosand, Fullerton, Ca.; William W. Cowles, Palo Alto, Ca.; Gerald J. Crawford, Warrensville Hts., Oh.; Phillip P. Currier, Lawrence, Ks.; Chris J. Curtin, Beaverton, Or.; Michael Daniels, Salt Lake City, Ut.; Alan J. Dawes, San Jose, Ca.; Michael C. DeJule, Chicago, Il.; Anthony DeLorenzo, N.Y., N.Y.; George W. Dick, Colt's Neck, N.J.; Hans G. Dill, Newport Beach, Ca.; Gary A. Dir, Webster, N.Y.; Joseph A. DiSabato, Whippany, N.J.; Pat DuPuis, Los Angeles, Ca.; Frederick A. Ebeling, Urbana, Il.; Millard J. Edgerton, Palo Alto, Ca.; Raymond Ellis, London, England; Adam B. Empacher, N.Y., N.Y.; James R. Fagan, Columbus, Oh.; Jerome Feder, Murray Hill, N.J.; Bernard Feldman, Goleta, Ca.; Jack D. Finley, Boston, Ma.; Clyde A. Flackbert, Phoenix, Az.; Michael A. Form, Cambridge, Ma.; H. Fukui, Summit, N.J.; Aaron D. Gara, Warren, Mi.; Michael F. Gates, Dallas, Tx.; Jai P. Gaur, Dayton, Oh.; David G. Geis, Skokie, Il.; Frank N. Gillette, Pleasantville, N.Y.; Tommy P. Glenn, Las Cruces, N.M.; Ronald P. Globus, N.Y., N.Y.; Paul G. Goodwin, Medford Lakes, N.J.; D. Harrison, Grantham, Glastonbury, Ct.; Richard W. Gurtler, Phoenix, Az.; James Guynn, Chico, Ca.; Andrew Haban, Park Ridge, Il.; Jerald R. Haegele, Menlo Park, Ca.; Roland H. Haitz, Palo Alto, Ca.; M. M. Halberstam, Brooklyn, N.Y.; J. O. Hamby, Baltimore, Md.; Ralph D. Hasenbalg, Canoga Park, Ca.; Charles B. Heffron, Ft. Wayne, Ind.; John C. Hemingway, Warminster, Pa.; Terrence A. Hicks, Ontario, Canada; Alvin M. Hlady, Ontario, Canada; Keith E. Hooey, Ontario, Canada, Donald J. Horowitz, Santa Clara, Ca.; S. L. Hou, War-

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SID Book Review

DISPLAYS. Conference Publication No. 80. 375 pp./SID, 654 N. Sepulveda Blvd., Los Angeles, Ca. 90049.

IEE Conference on Displays

The Conference on Displays, organized by the Control and Automation Division of the IEE, with the assistance of seven co-sponsoring bodies, was held at Loughborough University of Technology from 7-10 September. The purpose of the Conference was to bring engineers and human factors scientists together to examine new research methods and applications relevant to this complex subject. Over sixty papers were presented, in two parallel sessions, covering a very wide range of topics, from the uses of liquid crystals to the evaluation of ergonomics problems at the Air Traffic Control (ATC) interface. Contributors and delegates from many disciplines attended from countries as far away as Japan and the USA.

Display Technology

Several papers were concerned with specific applications of modern electronics knowledge to the problem of producing better hardware for the display of volatile data. Until very recently the cold cathode numerical indicator tube and the cathode ray tube have been the most suitable for this purpose. The former were used almost exclusively in instrumentation and electronic calculators, the latter wherever large alphanumeric and symbolic displays were required. This state of affairs is now changing with the advent of practical and economic plasma and discharge panels.

Software

Most of the displays described at the Conference rely on a computer of some form to collect, analyze and arrange the data for display. This reliance creates software problems which were described in a few papers. For larger systems, one paper described a 3-D graphics package operating in Atlas 2. For alpha-numeric applications, another paper described an applications independent package for use with touch-wires.

In discussion, delegates emphasized that software is now more expensive than hardware for many projects, and is responsible for greater delays in project completion. Regret was expressed that few papers tackled the software engineering difficulties, or explained the principles or techniques involved.

Human Factors

The papers dealing with human factors aspects attracted considerable interest. The topics covered ranged from general recommenda-

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NEW PRODUCTS

SID SID SID SID

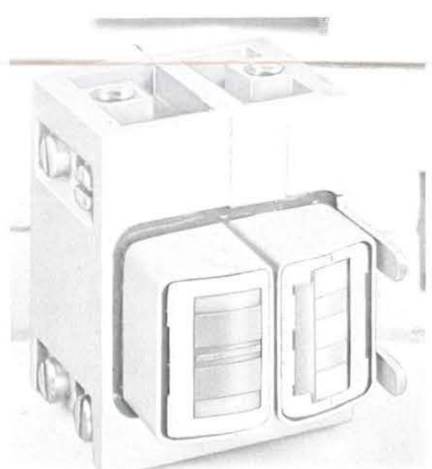
Tektronix Display System

Tektronix, Inc. has just announced the "first off-the-shelf APL Graphics System" at a low price. It includes a 4013 Computer Display Terminal with full ASCII and APL capability, 188 printing characters; and PLOT-10 APL/GRAPH Software. All of the accessories and interfaces in the Tektronix 4010 family are fully compatible with the new 4013 display terminal. This offers the user the flexibility of interfacing with as many as 20 major mini-computer systems; IBM 360/370 Systems, as well as the major computers in use in time-sharing systems. In addition, the 4013 display terminal can be easily interchanged with existing APL typewriter terminals.

Circle #101 on Readers Service Card

Read-After-Write Pioneer Head

Pioneer Electronic Corporation, Components & Data Products Division announces a dual channel, read after write head for .150 inch cassette and mini digital computer applications. The magnetic reading head model RAW-7201 is a dual gap, Hall-Effect head. RAW-7201 generates an output signal proportional only to the recorded magnetic flux and is totally independent of the tape speed. This, it is said, eliminates the need for additional circuitry to compensate for output level variations at different tape speeds.



While data is being written, the RAW-7201 head can be used to check the read data. This simultaneous function allows verification of written data accuracy without the necessity of stopping the tape and reversing it for check reading. Using Pioneer's RAW-7201 saves time and equipment cost by eliminating the need for backspacing of tape which otherwise would be required.

Circle #102 on Readers Service Card

New GE Color TV Projector

General Electric has introduced a new light valve, large-screen color television projector, Model PJ-500, which provides approximately twice the light of its predecessor model. Formal introduction of the new equipment was made at the recent 1972 Society for Information Display Conference in San Francisco. By using the unique light valve which operates with a single electron beam and optical path, the PJ500 inherently provides registration of colors, while simultaneously offering high brightness, contrast and resolution. Use of the sealed light valve permits the PJ500 to be a small compact unit, adaptable to many applications not previously served by conventional video projection devices.

Like its predecessor, the PJ500 operates with a maximum of 8,000 volts, eliminating the possibility of X-ray emission from the system. For the demonstration, the equipment was shown in both front and rear projection applications. By using mirrors to fold the optical path and video sweep reversal techniques, G.E. demonstrated the equipment's flexibility in confined areas, as well as in large auditoriums and theater applications. The PJ500 accepts either RGB or NTSC encoded video signals.

Circle #103 on Readers Service Card

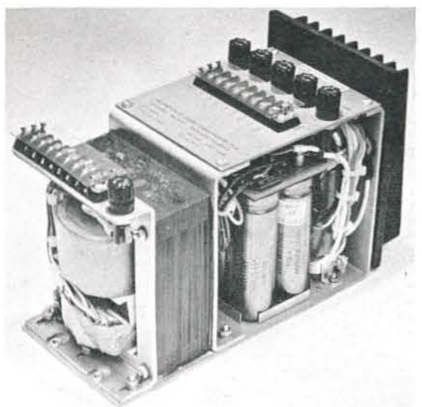
Measures Radiance

The Model 730 Radiometer/Photometer is designed to make accurate radiometric and photometric measurements in the lab, on the production line or in the field. The unit is particularly useful in accurately measuring the radiant flux output of monochromator systems over the wavelength region of 250 to 1100 nm. The NEP at 700 nm is 10^{-12} watts. When used in the photometric mode, the digital display reads directly in footcandles. The noise equivalent illuminance is 10^{-5} fc. With the optional input optics, the Model 730 also measures radiance and photometric luminance.

Circle #104 on Readers Service Card

new products

Burroughs Panel Display Subsystem



A multi-voltage, high-current, regulated power supply for use with BDS40832-200 series SELF-SCAN® panel display subsystem has been announced by the Electronic Components Division of Burroughs Corporation in Plainfield, New Jersey, manufacturer of NIXIE® tubes, PANAPLEX™ panel displays, and SELF-SCAN panel displays.

This supply, designed and built by Burroughs, provides a variety of voltages in a compact package and eliminates the need for multiple supplies in a system design. High-current capacity in the Vcc section (8 amperes) allows the system designer freedom to add function logic without the worry of overloading his supply. (When used with the BDS40832-200 series SELF-SCAN panel display subsystem, which requires +5V at 2.5 Amps, the supply has an additional 5.5 Amps capacity in the Vcc section to drive T^{2}L and DTL logic.)

The BDS40832-PSI power supply, which will find applications in terminal and display systems, develops the following outputs.

Voltage	*Current*	*Regulation*
+5.0 vdc	8.0 Amps	±2.5%
−250 vdc	0.08 Amp	+6.0% −5.0
+30 vdc	0.04 Amp	+6.0% −5.0
+12 vdc	0.175 Amp	+7.0% −5.0
−12 vdc	1.0 Amp	±5%

The BDS40832-PSI power supply can operate at both 50 and 60 Hz, and input taps are provided for operation at 115/220V input. Input is three-wire including separate earth ground. From ¾ to full load, the regulation described above includes variations for 10% line fluctuation, ripple, component accuracy, and temperature effects. Stability is ±1% for eight hours after four hours of warm up with a constant full load. The +5V section of the supply has overvoltage protection. If the Vcc rises to +7V, the Vcc is de-energized. The other voltage sections are protected with appropriate fuses of their output circuits.

Circle #106 on Readers Service Card

SolidState Display, Digital Clocks

The ERC Series 2400 Digital Clocks are compact, rugged time-of-day or real time monitoring and display instruments. The units are self contained, panel mounted, designed as easy to use system components.

BCD outputs are provided for system use plus 1.0 sec. and 0.1 sec. output timing pulses for auxiliary use. An interruption of power is indicated by an unchanging display of all "8's", and by a logic level output. Normal operation is returned by resetting the unit.

Circle #105 on Readers Service Card

New EEV Storage Cathode Ray Tube

Direct-view storage cathode-ray tube type E716A manufactured by English Electric Valve Co. Ltd., said to be completely new storage tube with square faceplate. Designed for oscilloscopes, it is equally useful for special applications such as medical instrumentation, ultrasonics, computer graphics, radar and sonar equipment. It has a useful viewing area of 10cm x 10cm and because of its good deflection sensitivities is particularly suitable for compact transistorized equipment.

The tube, which has a robust storage layer and uses an aluminized P31 screen, has a light output in excess of 90ft lamberts in the storage mode and a variable persistence giving a choice of storage time from several minutes to less than one second. With the flood gun switched off, a storage time of several days is obtainable provided that no further writing is applied.

Circle #107 on Readers Service Card

Itek Test Targets

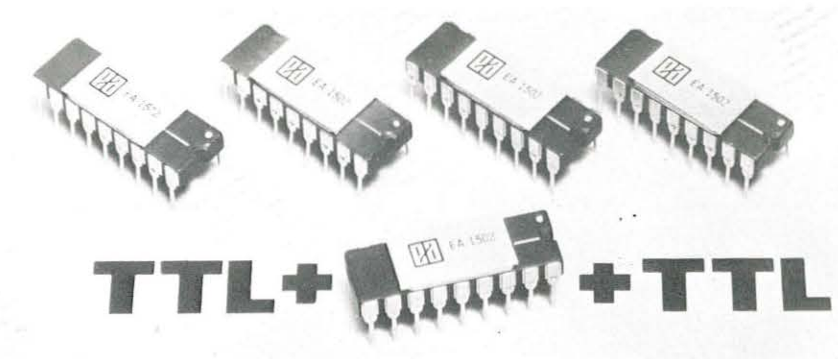
Itek Corporation Optical Systems Division announces the availability of a new set of precision photographic test targets designed specifically for electro-optical scanners and image reconstruction equipment. Originally designed for NASA under GSFC Specification for "L" Bar Scanner Targets, the targets can also be used for evaluation of a variety of electro-optical devices.

The set consists of three separate film chips of high, medium and low contrast. Each 4-inch by 5-inch film chip contains a series of line patterns located within the central 2-inch by 2-inch area. Each L-bar pattern consists of two set of lines and spaces at right angles. Spatial frequency ranges from 8 to 114 cycles/mm in a sixth-root-of-two progression.

Each target also includes a centrally located Sieman's star for distortion analysis and alignment fiducials. A microdensitometer calibration of contrast is included for each target. Bar width-to-space width ratio is maintained within 5% of unity throughout the entire frequency range.

Circle #108 on Readers Service Card

Bipolar-Compatible N-Channel Device

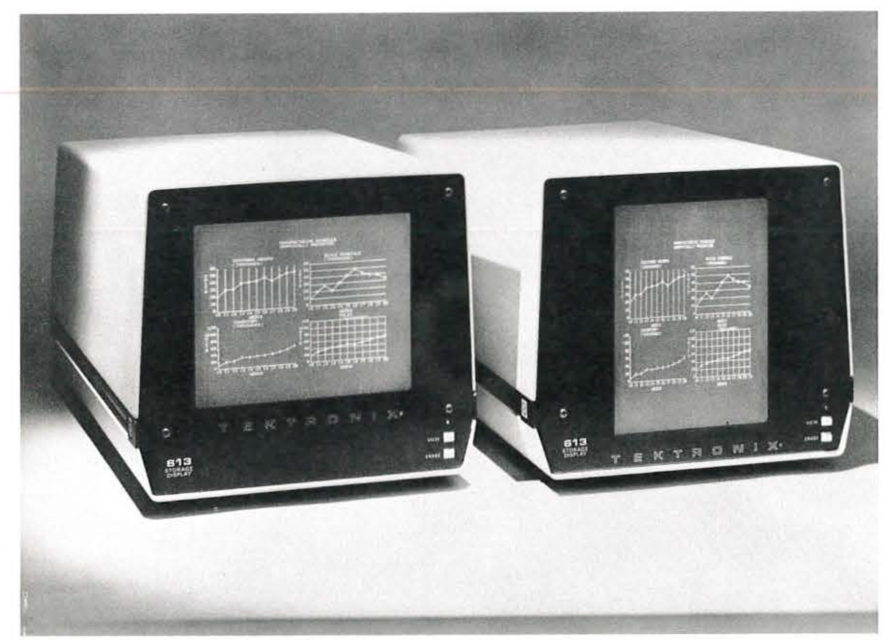


A bipolar-compatible N-Channel Si Gate RAM has been announced by Electronic Arrays. The EA 1502 is a 1024 by 1 random access memory with input level shifters and an output sense amp on the chip for direct TTL compatibility at the address and data inputs, and the data output. The EA 1502 eliminates off-chip interface circuits and has a maximum 200 nsec. access time from the TTL drive circuit to the TTL receiving circuit. The EA 1502 operates on ±12 volt power supplies. Power dissipation is typically 115 mW.

The new RAM also features EA's proprietary bit cell design which permits operation in an "automatic refresh" mode. In this mode a single write pulse applied once every system cycle refreshes the memory and eliminates any requirement for periodic memory busy signals. During write cycles, RAM's in the memory board matrix that are not enabled are automatically refreshed without being written into.

Circle #109 on Readers Service Card

Hi-Contrast Screen



Tektronix, Inc. offers large-screen CRT display with high contrast, Ultra-Bright 613. Firm says screen puts "visual appeal into your alphanumeric and graphic displays." Company asserts cost of new screens is competitive.

According to Information Display Products Division, screen is an 11-inch, flat, direct view storage display which puts out four times brightness of other large storage CRT displays. Offers "group viewing" in office where ambient lighting is as high as 100 foot candles. Said to have no flicker.

Circle #110 on Readers Service Card

new products

Digital Spotmeter

Photo Research announces the new multi-purpose SPECTRA® DIGITAL SPOTMETER™. This new Spotmeter is the latest in a series of precision light measuring instruments. The advanced solid-state electronic package is housed in the optical head to provide a completely self-contained system.

With one lens the new Spotmeter can be focussed to make precise measurements at distances from 2 inches to infinity. This lens permits measurements of spots as small as 0.010 inches in diameter with no accessory lenses.

Circle #111 on Readers Service Card

Please Pass the SID

We'd like this issue of SID JOURNAL to get as wide circulation as possible. So, let your co-workers, maybe even your boss, read this issue.

Activities SID SID SID

CALENDAR OF COMING EVENTS

1972	
Dec. 5-7	Fall Joint Computer Conference Anaheim, California
Dec. 8	5th Annual SID Technical Conference, "SID UPDATE '73" San Diego, California
1973	
May 1-3	Spring Joint Computer Conference Philadelphia, Penn.
May 15-17	14th International SID Symposium Statler-Hilton Hotel New York City
Fall	6th Annual SID Technical Conference
Dec. 4-6	Fall Joint Computer Conference San Francisco, Calif.
1974	
Apr. 23-25	Spring Joint Computer Conference Chicago, Illinois
May 21-23	15th International SID Symposium Town & Country Hotel, San Diego, California
Fall	7th Annual SID Technical Conference
Nov. 19-21	Fall Joint Computer Conference Anaheim, California

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THOMSOM-CSF
Paris, France

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Pennington, South Australia 5013

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Burbank, California 91505

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tions for design and evaluation to studies of particular display arrangements.

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