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BULLETIN OF THE COMPUTER ARTS SOCIETY
MARCH 1973

HONORARY LIFE MEMBER

One of the things that dissatisfied me with my representational pieces was that I felt that what was wrong with them was they didn't move. I was trying to capture movement in them without succeeding and I thought that the type of work which I envisaged using engineering would short cut this by simply enabling me to reproduce the actual physical motion, which has never really been done very successfully to my mind. We have pieces which move by electric motors, we have pieces that move at random by swaying in the wind, but we now have the technology which can generate any type of movement we imagine. This technology is necessary when we are putting people on the moon, but it's never been actually made use of for anything really interesting like art.
EDWARD IHNATOWICZ
From an interview broadcast by BBC Radio 3

Each year the Committee of the Computer Arts Society selects as an Honorary Life Member someone who has made an outstanding contribution to the creative use of computers. In 1971 John Whitney Sr. was selected for his work in film, and in 1972 Iannis Xenakis was chosen for his work in music. This year we are conferring Honorary Life Membership on someone who has created his own art form and taken the use of computers beyond the existing means of expression: Edward Ihnatowicz. His most important work so far is the *Senster* which can be seen at Philips *Evoluon* Pavilion in Eindhoven. The computer-controlled *Senster* responds to its environment and is capable of many patterns of behaviour.

Ihnatowicz is currently working in the Mechanical Engineering Department of University College, London. Where is knowledge of Hydraulic Control is of use in the Development of Prosthenic Devices – Artificial Limbs. He is now concerned with problems in Pattern Recognition, so that his creations can have more understanding of their environment. He is developing a Robot that will respond to touch for the Society's Eventibition in Edinburgh later this year.

MEETINGS IN LONDON

7.30pm on the 3rd Wednesday of each month John Lansdown's office, 2nd floor, 50/51 Russell Square, London WC1
Members and guests may attend free.

7.30pm Wednesday 21 March 1973
ARE BRAINY NETWORKS WITH US?
Dr. Igor Aleksander, director of the Cybernetics Research Lab at the University of Kent, describes the work on learning networks at Kent, raising and hopefully answering the following questions:

* What has a learning network got that a computer has not?
* Why does it act intelligently?
* Where does this leave the mind-matter problem?
* What kind of developments is the concept likely to lead to?

7.30pm Wednesday 18 April 1973
POETRY DEBATE?
Details to be announced

7.30pm Wednesday 16 May 1973
THE COMPUTER AND ALIENATION
Jonathan Benthall, writer and ICA director, speaks critically, referring to Marxist theories of technology

A MULTIDISCIPLINARY APPROACH TO ARTIFICIAL INTELLIGENCE
EDWARD IHNATOWICZ

There is no definition of Artificial Intelligence which would satisfy all the workers in the field. The best that can be done is to list a number of topics which occur regularly in the literature and so loosely define the area. These are: perception, recognition, learning, information, memory and robotics. The word intelligence itself does not occur very frequently being probably too emotive, but the desire to understand the process of intelligence is nevertheless the basic motivation in most cases.

A number of characteristic approaches to Artificial Intelligence can be distinguished:

1. The engineering approach:
   The automation of specific tasks so far performed only by human operators such as mail sorting, assembly of components, classification of samples, etc.
2. The biological/psychological approach:
   Modelling of the structure and processes of the mammalian brain in order to understand its function and organisation, beginning with simulations of synaptic junctions and ending with complete robots.
3. Pattern recognition:
   Devising of generalised and adaptive pattern classifiers.
4. The games approach:
   Devising of games to be played by machines and of machines for playing them.

There is one common factor which may also be a flaw in all these approaches and that is that they all depend on human criteria. We either determine beforehand which are going to be the correct answers or responses, or, as in the case of games, invent the rules of the game.

In a typical pattern recognition situation, for instance, the procedure is, first, to supply the machine with some data and a set of rules for the classification of this data into a number of groups which we select beforehand. We then make the machine perform the classification. If the system is adaptive we apply some feedback to make it more likely to return the answer we expect the next time. This procedure has proved very valuable in many practical applications but its usefulness in the investigation of intelligence must be considered doubtful. Since we are by definition the only teachers the machine has, we are unlikely to learn anything we did not know when we began.

The problem is similar to that of trying to measure the temperature of a small quantity of water with a large thermometer when we know that the thermometer itself will significantly affect that temperature. When investigating the way in which we acquire or interpret information it is important that we should not ourselves be a part of the investigating mechanism. And yet we are not used to evaluating information in relation to anything other than ourselves and tend to think that any information processing system designed to operate without regard to any human need must be useless. This is difficult to prove or disprove since the definition of information is as difficult as that of intelligence itself.

The concept of information is the key element in all A.I. work and is worth while considering in detail. If we consider its simplest necessary requirements we get the following list:

1. Information must be about something.
2. It must be capable of being transmitted or recorded.
3. It must mean something to whoever receives it.

When we say that information must be about something we mean that it must be about something other than some aspect of itself. One can always argue that there are abstract relationships even between the individual elements of the given information which can be considered formally but this is no more than playing games. In fact most of the games played on computers are in this category.

Information is concerned with relationships. It is an indication of correspondence between two or more items from independent types of data like an object, say, and its image or its name. This means that there is no inherent intelligence in any message, whatever the medium, as long as it is the only medium. The only way in which any information can be interpreted is by correlation with a different type of information about the same subject either arriving simultaneously or previously stored in some sort of memory. Even an optical image – a picture of an object or scene will have no meaning to a receiving system however complex and sophisticated unless that system has a way of experiencing this object or scene by other means, or has a representation of the world.

Consider, for instance, the case of a man blind from birth suddenly recovering sight. If at that instance he is presented with a picture of, say, his own mother he will find no more significance in it than in a piece of wall-paper. The recognition will come not as a result of prolonged inspection but of the establishment of correspondence between the elements in the picture and those in the person whom he will have known by touch, sound, smell and so on.

Our second characteristic of information is straightforward. If we are able to gather information, i.e. to establish relationships between different forms of perception of the same phenomenon we know that we can encode it in some arbitrary way and store or transmit it. The problem arises when we insist that it must mean something to the recipient. If, as is usual in the case of most A.I. projects, we are sending information to ourselves, there is no problem. If, however, we want to send it to an unknown recipient we can see that this is only possible if, first, the method of encoding (language) is agreed upon, and second, the recipient is already familiar with the subject matter of our communication. If the recipient is a machine we come to the central problem of Artificial Intelligence: how to make a machine know enough to be able to interpret our information when the interpretation of information is apparently the only means of acquiring this knowledge?

SIMULATING EVOLUTION

One possible way of tackling this problem is to take an evolutionary approach. This means not only to try to discover the mechanics of various cognitive processes in animals and the methods and conditions of their evolution but to try to recreate these conditions in relation to our machines; to consider them as elementary, very imbecile units of life. Unless we mistrust Darwin's conclusions we must accept that the organisation of even the simplest animal contains most if not all of the elements of an evolving adaptive intelligent system. Although a truly exhaustive analysis of a living system in all its aspects is beyond us at present, some insight might be gained through simulation. Grey Walter's tortoises are an excellent example of this approach. They are too simple to shed much light on the complex problem of information but they do contain the essential concept of completeness of an animal situation. Since the intelligence of any animal can only manifest itself in its behaviour, any attempt at simulation must contain all the elements involved. This means not only representation of the relevant aspects of the physical animal but also its environment, the means of observing and interacting with it and the necessary psychological elements of drive and fear.

This necessitates a considerable shift in our viewpoint. In the first place we see that the most important type of information is not so much the exchange of information between two systems but rather the gathering of information by our system about itself and its surroundings. Secondly, that the visual and accoustic forms of information are not necessarily the most important ones.

The type of information which is seldom transmitted in artificial systems is mechanical, yet this is essential in any natural system as a direct result of the fact that animals are solid objects and need therefore to understand the laws of nature appertaining to solid objects. The awareness of gravity, mass, force,acceleration, distance etc. is taken for granted in animals but is seldom considered in relation to artificial systems. We take it for granted in relation to ourselves too and seldom need to pass it on. For our own use we have a huge amount of unexpressed, intuitive knowledge about the mechanics of ourselves and the objects which normally surround us. We know how to stand and walk without falling over, how to carry a glass of water, catch a ball or bite an apple. We all know how to tie a tie, but would find it extremely tedious to have to explain it to someone in a letter.

Our model, if it is successfully to pretend to be a unit of life is obviously going to need a lot of mechanical, kinetic and dynamic information and moreover ought to be able to acquire it for itself. If however, we provide it with means of obtaining this information designed along the lines along which we normally transmit information we are going to be in difficulties. This is because our mode of thinking and communicating is serial while mechanical phenomena are not. We use language for our thinking and communicating and language is serial process. It is also an artificially contrived device and is probably completely irrelevant to such processes as perception and recognition. To use it for communication about mechanics would be like teaching someone to walk by Linguaphone.

Our predisposition for serial processing explains the enthusiasm with which we have embraced the serial digital computer largely ignoring the available alternatives. Significantly,mechanical engineers have a strong bias in favour of analogue machines.

PARALLEL COMPUTATION

There is no denying the great success of the digital computer and the fact that without it there would have been little progress or indeed interest in Artificial Intelligence. Nevertheless the development of parallel digital machines has suffered greatly as the result. And yet for our type of investigation the parallel machine is of equal if not greater importance.

A true parallel computer in which a large number of information channels is processed simultaneously and allowed to interact with each other closely mirrors much of what is known about the construction of animal nervous systems. This in itself may be fortuitous but there is another factor of even greater significance — the speed of operation. We are discouraged by the contemplation of the sheer bulk of data which our brains appear to digest with ease and speed in sharp contrast to the spectacle of a digital computer taking fourteen minutes to recognise a tea-cup. In a parallel computer we have a machine in which the speed of processing is largely independent of the amount of data, and is determined mainly by the number of processing circuits available. These properties, apart from making it eminently suitable for preliminary processing of large amounts of data may also offer some insight into the vital problem of the representation of data inside the machine.

If we accept the premise that information is essentially an indication of relationship, then we should concentrate on the methods of representation of our data which would be universal in their ability to represent all types of data, i.e. visual, accoustic, kinetic, dynamic, etc., and be able to do it in such a way that any correspondence or similarity would be immediately apparent even to the machine.

A possible approach would be to think of data as being represented in the form of two- or three-dimensional structures perhaps reverberating in an electronic network and to look for some adaptive criterion of similarity. It may prove that only the data which exhibits this form of correspondence represents real information and is worth while storing in the long-term memory.

The representation of visual images in the form of two-dimensional matrices is a familiar occupation for many programmers but it only accentuates our ineptness in the representation of any other form of data. How should we represent the direction of gravity, for instance, or a shade of colour? In view of the fact that the information most vital to our model will result from a correlation of visual and mechanical data it is particularly important that our expertise in presentation of mechanical and kinetic data should be greatly improved.

In summary the element of A.I. which needs investigating most of all is the concept of information. And here the most important aspect of information is that it should be of interest to the recipient. There is no escaping the psychological implications and this presents a special problem in artificial systems. The most promising approach seems to be the construction of models of complete animal situation including models of simple animalistic units able to receive data of at least two types and in which the elementary types of psychological elements of fear, curiosity and appetite could be simulated.

BIOGRAPHY OF A NEW LEONARDO

Edward Ihnatowicz was born in Poland. At the outbreak of the second World War his mother fled with him to Rumania and, from there, to Algeria. Finally, in 1943, they arrived in England.

He attended the Polish School in Glasgow and from there went to study at the Ruskin School of Drawing and Fine Arts at Oxford.

He worked for a year as a photographer in 1949 before moving to London. After having spent some time as an industrial photographer he became partner of a small firm that manufactured modern furniture. At that time he was also active as a designer, concentrating on items of interior decoration and lighting, mostly in metal. Since 1962 when he withdrew from business he has devoted himself to sculpture, with emphasis on bronze.

In his studio in a garage in Hackney, London, he soon became interested in the application of scientific and technological ideas to sculpture. His first effort in this direction to be exhibited publicly was SAM, a sound activated mobile, shown at the Cybernetic Serendipity Exhibition of the ICA, London, in the autumn of 1968.

Realization of the concept of the Senster took up more than two years. During the latter stages of his work on it he enjoyed the hospitality of the Thermodynamics Laboratory of University College, London. What he was doing there was so different from the usual activities of the laboratory that it attracted intense interest, the more so because of his scientific approach to problems and the original solutions he found for them.

All who came to his assistance, including the engineers from Mullard and Philips who helped with the final development of certain structural details, were struck by his scientific insight and his command of technology — remarkable enough qualities in themselves, but the more so in combination with artistic talent.

DIARY: October 1972

VICKY MEYER

I have written specifications for a program of modular sculpture moving in harmonic times. The program is dynamic (real time) and interactive. It is written in Graphx language by William Brastow. The hardware is the Adage Graphics Terminal/30 at Industrial Engineering Department, Stanford. This program has a 3D rectangular module of variable length to combine into sculptural structures, subimages. Several subimages can be composed in one total image space, each capable of trajectories with independent parameters of time and space. The total image space with all the moving subimages can also be rotated on its coordinate system. Movement was conceived as simultaneous and harmonic compliment-aries, with occasionally a single eccentric subimage juxtaposed by an eccentric motion. These images are accompanied by synchronized electronic sounds.

The first results of the program were difficult to 'read' in the Z dimension because of inadequate perspective. The Adage has built-in orthogonal instead of true perspective, so images in the distance are just as large as the ones close up. A dimming feature with furthest points dimmest, tries to redeem this probelm. Nevertheless, with several images moving, the space became confused. I therefore specified display of the coordinate axes: one set of axes for each subimage at the time its trajectory parameters are to be set, and a second set of axes for the total image space into which all the subimages are placed. These axes may be called into view or deleted at any time. Presently, Bill Brastow is testing the possibility of a program to diminish size of image as it recedes along the Z axis.

Because the logic deals with three dimensions and the visualization is basically a two dimensional interpretation (of interplay of X, Y, and Z), the smooth motions cannot be analysed by the viewer, but are beautiful besides. The logically simple program is visually complex.

Beauty, however, is not the aim of the program. Likewise, logical simplicity and visual complexity are not the aim. These primary qualities are not under my control; they are determined by limitations of the Graphx language and consequent limited computer storage capacity. For example I must rule out many visual possibilities because too much calculation is involved, or the refresh rate on the scope becomes a ridiculous flicker. The second limitation: my inabilities as a programmer. I should be writing the programs myself, in machine language, to achieve optimal results.

CONTROL AND FREEDOM

The interactive freedom provided through twisting 8 dials and pushing 16 function buttons while flicking around the light pen, all the while adjusting bass and treble on the amplifier: this is slavery. I am madly manipulating controls with coarse adjustments. Consequent images are almost uncontrolled and surprising. With program control I might direct the movements and timing in clear relationship. But right now I cannot handle, for example, trajectory relationships as simple as twice-as-fast or twice-as-far because I can only try to approximate this by twirling dials. The dials feed into transformation hardware. Much transformation of equations is handled by this hardware instead of by the computer CPU. In this case information is lost to the programmer, the computer designers assumed manual control to be more desirable. Bill Brastow has discovered a possibility of tapping information from the calculation hardware. This might be found at some crucial point, and if it works, then a readout and recording can be made of crucial coordinate changes, thereby allowing more program control. In addition it might also allow recording the output electronically so that editing could be efficiently internal to the computer before hard copy has to be made.

As a positive note: Surprise imagery is often exciting, and it is challenging to try to recognize motion pattern that is occurring. In conjunction with this, the generation of sound is a terrific enhance-ment. By this further involvement of the senses, the audible rhythm emphasizes, and indeed often precedes and promotes recognition of visual patterns on the tube. But even the sound lacks control. It is generated directly by the computer hardware controlling the X function, but there is no separate control of this parameter by program. The whole output should come under program control.

Running the program is too involving manually and mentally to judge output as it happens. The computer makes no provision for saving the ouput. Some form of hardcopy is therefore necessary to review output. For the Adage this means photographs, movies or video taping. Photographs or movies give the extrmely fine detail characteristic of the original CRT display. The only low cost hard copy of moving images is by video tape. Video tapes lack the clarity of detail, but give a very good allover black and white contrast of image shape, different from the original fine lined picture, but satisfactory in its own right. These tangible results are very important to the artist. There is no way to evaluate my ideas until I have them outside my head and in the very medium of their final presentation, namely on tape or film.

VIDEO HANGUPS

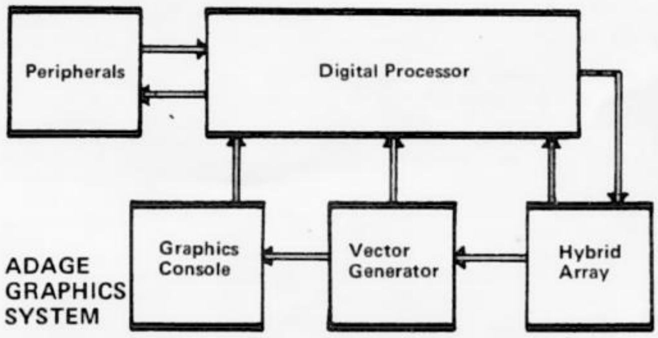
Unfortunately, there is not proper video camera at the Adage for high contrast resolution on tape. The Sony Portapac (model #3400) video system available to me at the Industrial Engineering Department cannot catch a good image from the CRT. For a long time I thought the problem was due to an automatic contrast leveler considerately provided in the Portapac camera by Sony for people who are without under-standing, or wanting to understand, camera light adjustments. The image I recorded left me with a half imaginary and half visible spectre of the original; little better than no hard copy at all. I had one very fine recording done for me by the technician at the Education Department's Audio Visual office on their Sony 3600. So I knew that video tape results could be infinitely better than most of mine. Recently I took a Portapac recording to the Stanford TV Network station and had it tested electronically. The oscilliscope showed clearly that the problem was more serious than just the automatic light leveler. The light from the CRT is too dim; I simply need a more sensitive camera than the Portapac, one with a videcon tube. The tube costs around $1,000, which is about 10 times as much as I figure it cost to remove the light leveler.

Another possibility to check out was a GBC camera which costs around $500 and is portable. This latter camera was suggested to me by the Telemation Company as the solution. I am arranging a demonstration of this camera at the Adage machine.

Meanwhile I continue running around trying for funds or proper equip-ment. All the proper equipment exists right here on compus, but is not available to me. Time spent this way, running around, is discouraging. I'd rather get to work.

If I have to spend so much time and money on video equipment, its appeal as a low cost favorite is gone. Filming is still fairly expensive as long as my program cannot be pre-edited. I need much footage which means it would cost around $200 to get a finally edited 5 minute black and white sound film. The advantage of filming is the availability at the Adage of a 16mm film camera, and a Fortran IV program running it in synch to the display. Drawback: there is no sound equipment with this camera. I prefer video taping to film since my usual method is to work through many ideas rapidly and get them down quickly. I need to make a recording or two a day. Taping has the advantage of instant replay.

An alternative way to spend my time is in learning the machine language to improve the program and enable me to edit in the computer before making hard copy. It is suggested to most engineers that Adage language takes about 6 months to learn. Since that would take me up to about 2 months before I would graduate and leave Stanford, it seemed the investment of time would not pay off.



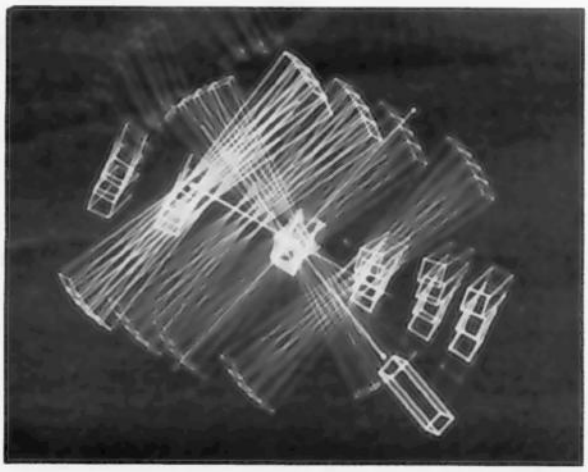
ADAGE GRAPHICS SYSTEM

Aside from such difficulties as the Computer breaking down for periods as long as a month before repair, and the lack of equipment and money for hard copy, and nobody who knows the answers to my technical problems, the idea of video taping is the best one and eventually some-body will solve it. I only wish some engineer had figured out the technology before me so I could concentrate on my first idea. There is the original purpose to consider. That is art methodology and modes of art production.

LOGIC AND INTUITION

Clearly intuition is the beginning mode for the art idea. In fact, non-logical thoughts include those of most significance in physics, human-ities, mathematics, etc. But since we use bad and good habits before intuition it is faster to work with logic, to come up with some sort of solution if not the perfect one. Problems of expressive art, and even the art idea itself, ought to be dealt with on this logical plane, after intuition. Consider it re-editing of an extreme sort. This way, logically, if we know more clearly at least some of the problems relating to an art idea we can investigate if they are more easily solved logically than intuitively; we can save valuable energy to deal with other planes of art thought, deep inside the guts of the artist where processes are most difficult to analyse, thereby ending up with an optimum product. The artist, finally, will judge the end with his whole mind — logic and non-logic. He may use computer output as the finished piece or re-edit it back to the medium with qualities more appropriate to the content. Having taken advantage of the insights provided by a translation into logic or through it, the artist will learn to communicate better.

There is in addition, a certain communication that takes place from the medium itself: computer technology, or tv video screen. I am as involved with bit switches, analogue circuits, algorithms, and the terms of computer language as with the original purpose for turning to computers to discipline my art ideas and pin them down into clear relations. There is a kind of magical attraction these elements have, and probably on the strength of the medium's attraction, as well as a narrowness in my purpose, I cannot give up despite all of the difficulties I encounter. I do not fancy myself a pioneer in this computer art work, only I do find myself perhaps in the wrong place at the wrong time so that I must find out the hard way all necessary technical information; the hard way is by running around instead of knowing who knows. It is going too slowly, but I cannot give up until I have something that shows.



If production ever does get off the ground, if technical difficulties are overcome, then consideration of the original program presents several ideas for inclusion and expansion. One is a control of the pace at which patterns evolve. There is the potential to control emotions through the tension of pattern recognition. It is a fine line dividing conscious from subconscious recognition; at just the right speed one is compelled to keep up in a terrifying pace because the change is just ahead of what we can manage but not really too far ahead that we must find out. Results of scientific perception studies suggests the exact number of changes we can notice per second.

INDEX-RELATIONSHIP

A second expansion of the original program is a variation of it also based on the division of conscious and subconscious levels of understanding. It is well known that the richness of art is due to human ability to perceive unconsciously on such a multitudes of levels that a richness of response is elicited to what is consciously perceived at a simpler level. The parameters are of many different sets of information, and yet we relate them. Relationship is the key to our perception, storage, and retreival of information; and relationship is the key to our understanding of our universe and our lives. Re-editing is the way we expand this related information. It is relationship-indexing and re-editing I wish to represent visually.

The index-relationship is more important than the visually perceived object which is merely a catalyst. It is purely psycho-experiential re-editing based on emotional content. For instance, I see a robin. I imagine it sings (but I don't hear it). Instead I experience a concert of warbling tones from an amplified guitar and the touch of a man's knee sitting next to mine and see the wool of his trousers. The perception of the robin has not registered visually. What occurred was identification of the vibration as a background enveloping the sight of the trousered leg; my stronger experience was not a sensory perception. This non-sensory experience retrieval occurs on the strongest relational link. Of course I am not sure how to do this relational link visually. But starting at the level described by the simple 'Dream' program of connected motions, I will understand better how to change the program, to visualize qualitative differences for presentation.

On the Adage CRT only line is available. Line is more quantitative in description than it is qualitative. How much movement will enlarge the qualities of line is a consideration.

Vicky Meyer
Art Department, Stanford University, Stanford, Ca 94305

AIMS AND MEMBERSHIP

The Society aims to encourage the creative use of computers in the arts and allow the exchange of information in this area. Membership is open to all at £1 or $3 per year, students half price. Members receive PAGE eight times a year, and reduced prices for the Society's public meetings and events. The Society has the status of a specialist group of the British Computer Society, but membership of the two societies is independent.

Libraries and instituions can subscribe to PAGE for £1 or $3 per year. No other membership rights are conferred and there is no form of membership for organisations or groups. Membership and subscriptions run from January to December. On these matters and for other information write to Alan Sutcliffe.

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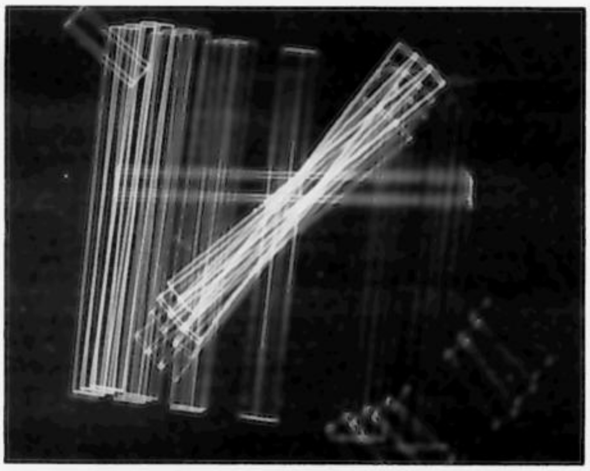

THE RATIONAL AND IRRATIONAL IN VISUAL RESEARCH TODAY

t-5 an international event in Zagreb. Constructive – Computer – Conceptual visual research

EXHIBITION 1-30 June 1973
MATCH OF IDEAS Conference and Debate 2 June 1973

In modern art there are two distinct approaches: rational and irrational. In constructive and computer assisted research the rational is expected to dominate. In conceptual art the emphasis is often on the irrational. The organisers believe that clarification and critical evaluation of these two ways of thinking are needed, particularly in relation to their social implications.

Summaries of contributions are due by 1 March 1973 (sorry) English, French, German or Serbo-Croat. For details contact Galerija Suvremene Umjetnosti, ZAGREB, Katarinin Trg 2, Yugoslavia.

EDINBURGH COUNTDOWN

Exciting new projects in bionics, electronic music and robotics are underway for our INTERACT Conference and Eventibition, 27–31 August 1973, and every post brings its batch of new proposals. Space is limited, time is passing: are you going to contribute or simply attend? Let John Lansdown know.

Details of the extensive computing facilties being provided by the University and commercial organisations are now being finalised.

PHREAKERS PHREAKED

"Pacific Telephone & Telegraph Co hopes to save $500 million a month with a computer programmed to stop credit card fraud in California".

Computerworld 12 April 1972

"When a credit card call is placed, the operator key punches the card number into the computer circuit. If the number checks out, the operator hears a recorded female voice say 'okay'. If the number if phony, the voice says 'no', repeats the number and says 'no' again. The check takes 22 seconds."

And who announced this to the astonished world? Why, none other than Ben Dial, assistant vice-president for operations at Pacific T & T.

"The computer has thus far prevented completion of 80,000 bogus credit card calls. The check is centered around Hollywood and the larger universities, where most of the phony calls occur, Dial said."

PICTURE RECOGNITION

The Frontiers of Pattern Recognition edited by Satosi Watanabe (1972)
Picture Processing and Psycho pictorics edited by Lipkin and Rosenfeld (1971)
Methodologies of Pattern Recognition edited by Satosi Watanabe (1969)
Automatic Interpretation and Classification of Images edited by Antonio Grasselli (1970)

All published by Academic Press

LEONARDO LIVES

The latest LEONARDO (Winter 1973) contains a good ration of articles on holography, the computer-amplified artist, computer and kinetic art, entropy and art, computer simulation of an art-work.