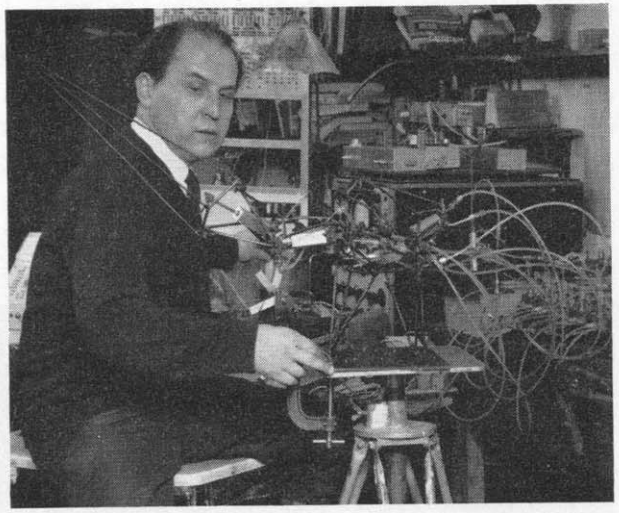
Sound-activated mobile

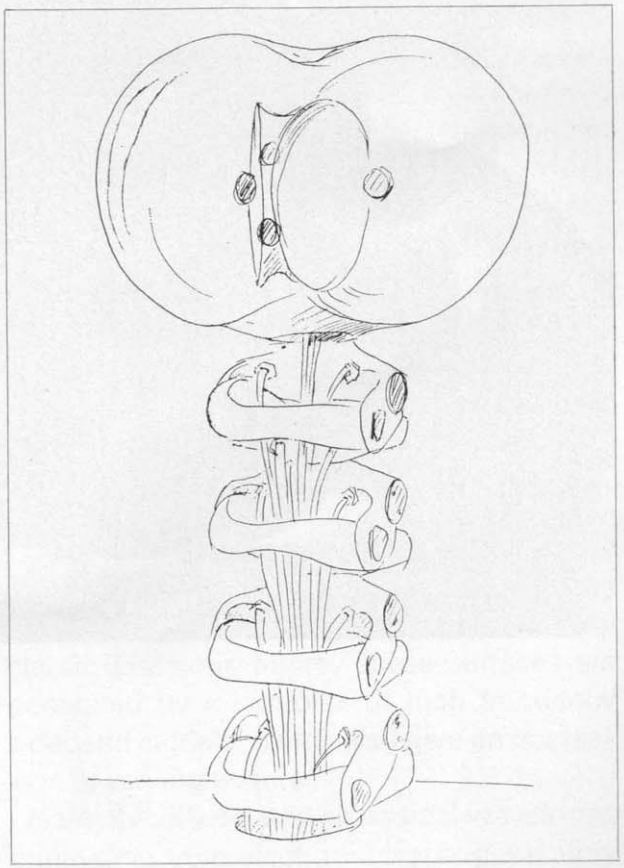
Edward Ihnatowicz

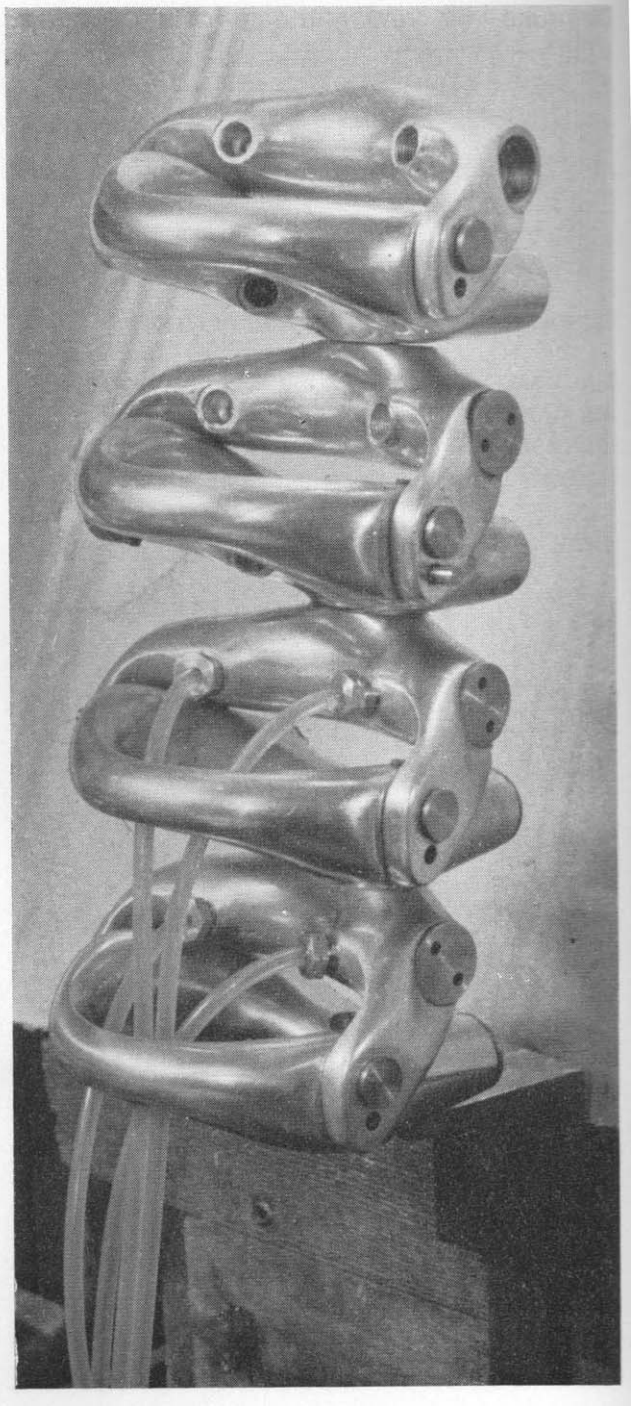
This electro-hydraulically operated, environment-sensitive mobile is my first attempt at an articulated structure capable of being controlled by an electronic system.

It was also an exercise in developing shapes by following a strictly functional discipline, in the hope that the final appearance would become a reflection of the motive as well as of the method.

I am currently working on a large structure to be operated by a computer and designed to explore the possibility of a much more subtle and varied movement, as well as more complex reactions to the environment.







Top right, Edward Ihnatowicz in his studio workshop ; right, a drawing of the mobile ; far right, the partially-completed mobile.

Art at large

By Jasia Reichardt

Published in New Scientist

May 4th, 1972

The ultimate machine

The ultimate machine will have desires and needs, and its own machine Buddha nature. It will respond to the environment, move, participate in dialogue with others, and have means of restoring its energy. Finally, it will be a sculpture. It hasn't been made yet but it has two predecessors. These two penultimate machines are the works of an expatriate Pole, sculpturer and inventor, Edward Ihnatowicz, who is working currently in the engineering department at University College.

SAM

Having made conventional sculptures - mostly figures in bronze, Ihnatowicz became increasingly interested in applying technological ideas to art and by 1968 produced an extremely sophisticated cybernetic sculpture called SAM (sound-activated mobile). The work consisted of a form constructed from four petals on top of a vertebrae-like neck. The sculpture was sensitive to sound and inclined towards any source of quiet but sustained noise. Shrieks failed to provoke a response, but quiet words did, and a great many people spent hours in front of SAM trying to produce the right level of sound to attract its attention.

Ihnatowicz himself described it as his first electro-hydraulic sculpture, articulated, sensitive to the environment and controlled by an electronic system. The appearance of the work was to reflect the idea behind the work and the technology necessary to realise it.

Senster

His next project was a large structure operated by a computer, designed to explore the possibility of a much more subtle and varied movement, as well as more complex reactions to the environment. It looks like a giant lobster claw, is called Senster, and is now in the Evoluon in Eindhoven. Senster responds to directional sound by moving in what could only be described as an organic way, indeed the same way as the real claw of a lobster. The mechanics of Senster are readily visible - the actuators, pipelines and wiring are undisguised. A hydraulic system supplies the power for the independent movement of the joints of the Senster. It was chosen because it is quiet and facilitates fast and accurate movement. Each of the activating mechanisms forms a closed electro-hydraulic servo system which responds to the analogue signals from the control unit. The sculpture was intended to react to the environment in a more complex fashion than was actually feasible within the limitations of budget and time. The input of information is twofold. Microphones listen to the sounds made by the visitors and a radar watches their movements. This information in combination "motivates" the movement of the claw. Since the Senster responds to a number of stimuli simultaneously its reactions are more life-like and less obvious than if merely the volume of sound were to provoke a slow or fast movement. Senster is controlled by a computer which coordinates its activities, translates the input signals into instructions and modifies the behaviour of the sculpture according to past experience and the

present contingencies. An important part of the interface are the so-called "predictors" which determine the accelerations and decelerations required for the most efficient movement of the claw.

One of the initial problems was how to pick out the sound to which the Senster should respond amidst the noisy background of a public hall. What in fact happens is that the sounds which reach the two channels are compared at frequent intervals through the use of the control computer, and reaction is motivated when the sounds from the two sources match as far as possible. What occurs visually is that the microphones point at the source of sound and within a fraction of a second the Senster turns towards it.

Towards the ultimate

Senster provoked the kind of reactions which one might expect from people who are trying to communicate with a person or an animal. It appeared more as an organic creature that is capable of evaluating the messages that are sent, and responding to them. This is some-what reminiscent of the program DOCTOR developed in America, where patients had a conversation with a computer and were convinced that their partner in dialogue on the teletypewriter was a human doctor sitting in another room. This sort of confusion is merely at its beginning. As machines begin to simulate even more convincingly all aspects of human behaviour so the spectator will have to become more conscious of the processes involved. Indeed, the next work Ihnatowicz is planning will demonstrate even more accurately a pattern of behaviour which is organic in character rather than mechanical. One could say that animal behaviour is the result of a response to a series of inputs operating in combination, competing with one another, and finding some sort of a resolution which ultimately ends in an action. As Ihnatowicz is evolving a system for more combinations of inputs, so his works will one day have that uncanny quality of the inhabitants of a mechanical zoo, which to all intents and purposes demonstrates the behaviour associated with living creatures.

While what Senster does is more fundamental than what it is, the ultimate machine will be a more complete being with the hardware determined by software. The machine will express itself even to the point of getting extremely bored and manifesting this state by going to sleep. But how much of a spirit can a machine be endowed with? A machine which is essentially a sculpture and not the ultra-intelligent machine of Irving John Good which will eventually resolve our problems. The ultimate machine is a very extraordinary proposition since it will be modelled on nature and yet have that irrationality which is a part of every work of art.

Extract from

Science and Technology in Art Today

By Jonathan Benthall

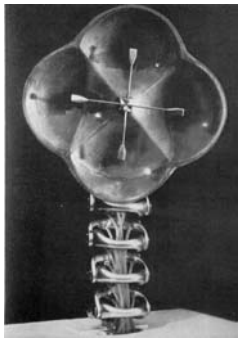
Thames and Hudson, London

1972

[The same article (with a slightly different first paragraph) was published in Studio International, 1971.]

Probably the most technically ambitious computer-based artefact yet made anywhere is the Senster, which was officially set in motion in 1971 at the Evoluon, a permanent industrial exhibition run by Philips, the giant electrical firm, at Eindhoven in Holland. The physical context is distracting, for the Evoluon is a paean to technology in the form of a flying saucer on legs, opened in 1966 and already something of a period piece. But Philips are to be congratulated on their intelligence and enterprise in commissioning this costly project.

Edward Ihnatowicz, a wartime refugee to Britain from Poland and now a British subject, studied at the Ruskin School of Drawing and Fine Arts at Oxford, and has worked as a sculptor, photographer, designer and furniture manufacturer. He exhibited SAM (Sound Activated Mobile) at 'Cybernetic Serendipity' in London in 1968, and was commissioned by Philips at the suggestion of the designer James Gardner.



Realization of the Senster took more than two years. Ihnatowicz was helped by engineers from Mullard and Philips, and by the mechanical engineering department at University College, London, but his own self-taught command of scientific and technical detail is equalled by very few other artists.

About 15 feet long by 8 feet high, the Senster consists of six independent electro-hydraulic servo-systems based on the articulation of a lobster's claw, allowing six degrees of freedom. Crustaceans move by means of hinges, whereas most animals move by pivots, which are more difficult to reproduce in engineering.

The Senster has a 'head' with four sensitive microphones which enable the direction of a sound to be computed, and also a close-range radar device which detects movement. The whole is controlled by a digital computer, which tells the servo-system how to move in response to various

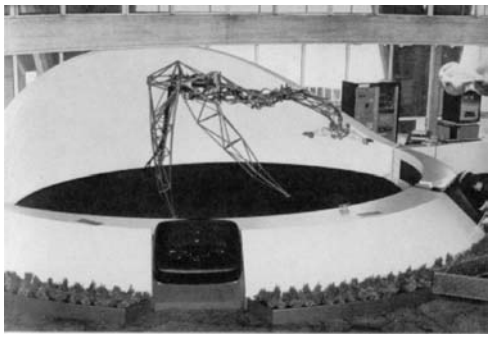
combinations of sound and movement from visitors to the Evoluon. The acoustic 'head' is so designed as to give a vivid impression of an animal's eyes flicking from one object to another. The servo-systems can position the head within a second or two anywhere in a total space of more than 1000 cubic feet.

No attempt is made to conceal any of the mechanical or electronic components, or to give the surface of the machine a biomorphic ('lifelike') appearance.

Ihnatowicz decided that the most economic way of moving the claw would be by effecting constant acceleration and deceleration. Halfway through any movement, an instantaneous reversal is made from a constant rate of acceleration to a constant rate of deceleration. An electronic predictor was designed to achieve this. Only after beginning to implement his idea did Ihnatowicz discover that measurements made on human beings, for the purpose of designing artificial limbs, had proved that human movement follows a similar principle.

The computer programme is not fixed but can be varied so as to generate different responses. At present, the head moves swiftly towards any source of quiet motion, as though hunting for food. But if the motion becomes violent - say, a spectator tries to strike out at the claw - or if the amplitude of the sound rises - one person is monopolizing attention by shouting at it - the head will shy away as though frightened. Ihnatowicz hopes that new computer programmes will be developed so that the Senster will 'learn' new behaviours.

It will be easier to say how fully successful the Senster is when it has settled down with the half a million visitors who come to the Evoluon annually, and with the scientists who wish to experiment with it. In any case, the Senster is no monument to an artist's genius but a step towards new forms of creative collaboration on the highest level between scientists and artists. Ihnatowicz likes to work on projects where everyone involved is intellectually stretched.



Extract from

Robots: Fact, Fiction + Prediction

Jasia Reichardt

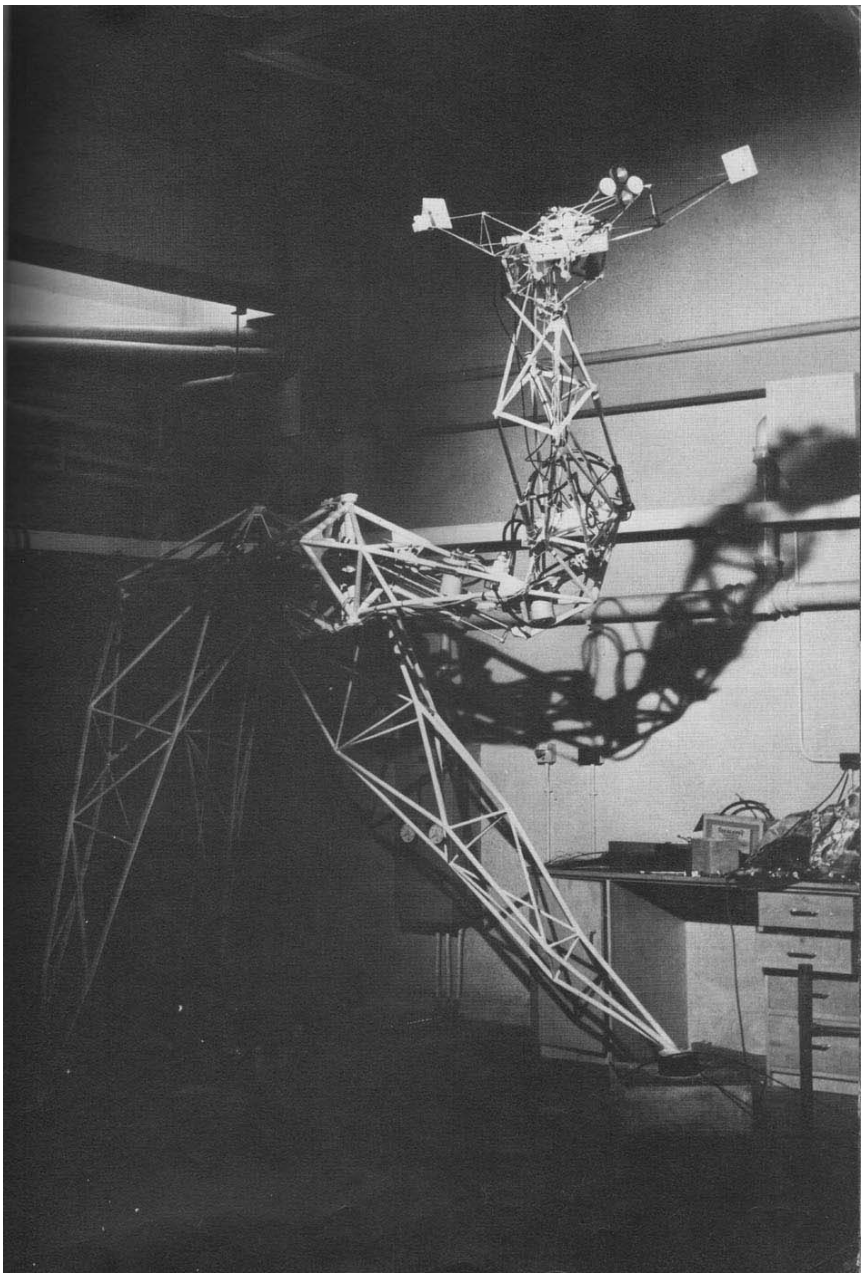
p56, Thames and Hudson, 1978

Edward Ihnatowicz's cybernetic sculpture *The Senster* was constructed in 1970 for Philips' Evoluon in Eindhoven. It is a large electro-hydraulic structure whose form is based on that of a lobster's claw, with six hinged joints allowing for a great range of possible movements. When in motion, *The Senster's* behaviour is completely unexpected because it is so close to that of an animal that it is difficult to keep in mind the fact that one is in the presence of a machine. It is as if behaviour were more important than appearance in making us feel that something is alive.

The Senster reacts to its environment through two types of input: sound channels which pick up directional sounds, and a radar system which watches the movements of visitors walking around. The mechanics of *The Senster* – the actuators, pipelines, and wiring – are readily visible and form a part of its visual structure; a hydraulic system, which was chosen because it is quiet and facilitates fast and accurate movement, supplies the power for the independent movement of the joints. Each of the activating mechanisms forms a closed electro-hydraulic servo-system which responds to the analog signals from the control unit. A computer co-ordinates its activities, translates the input signals and instructions and modifies the behaviour of the sculpture according to past experience and current contingencies. An important part of the interface are the so-called 'predictors' which determine the accelerations and decelerations required for the most efficient movement of the claw.

The Senster elicits from people the kind of reactions that one might expect when someone is trying to communicate with another human being or an animal. It comes close to the sort of robot which we could imagine must have feelings because it behaves like creatures that have them. Ihnatowicz's work of the past four years at the Department of Mechanical Engineering of University College, London, has concentrated on designing an autonomous manipulative system (see chapter 'To work! To work!), but his next sculpture is likely to demonstrate even more accurately the pattern of behaviour which is animalistic rather than mechanical in character. It is possible to envisage a sculpture which will have not only needs but also desires and which might even initiate a dialogue with the viewer rather than just respond to something that is already in progress. Innovation in the field of robotics could well come from art as well as from industrial robotics because the goals of art are not clearly defined and most intangible problems could lend themselves to its ad hoc methods. Whereas industry may find solutions to numerous finite problems through the use of multipurpose robots, it will not deal with effects, illusions or emotive principles which belong to art. Art, which results in physical objects, is the only activity that represents the half-way house between the regimentation of technology and the pure fantasy of films and literature; and only in the name of art is a robot likely to made which is neither just a costume worn by an actor, nor an experimental artificial intelligence machine, nor one of the many identical working units in an unmanned factory.

Edward Ihnatowicz. *The Senster*, 1970, 9 ft high with upward reach of 15 ft. The photograph was taken by the artist at the Department of Mechanical Engineering at University College where *The Senster* was put together before its departure for the Evoluon, in Eindhoven, Holland.



Extract from

Are Computers Alive

By Geoff Simons

1983, ISBN 0-7108-0501-2

A cybernetic sculpture, 'The Senster', was constructed by Edward Ihnatowicz in 1970 for the Philips Evoluon in Eindhoven. The device is a large electrohydraulic structure in the form of a lobster's claw: six hinged joints allow great freedom of movement. It is interesting that the device's unpredictable behaviour makes the observer feel that the sculpture is alive. Reichardt (1978) commented: 'It is as if behaviour were more important than appearance in making us feel that something is alive.' The Senster has senses - sound channels (effective ears) and radar - to allow it to monitor its environment: it will, for example, react to the movement of people in the immediate vicinity. Electrical signals are fed from a control unit to activate mechanisms which cause movement in the device. The brain (a computer) has learning abilities and can modify the machine's behaviour in the light of past experience. Confronted by this artificial device, it is clear that people have no difficulty in organizing their psychological responses as if The Senster were alive - an animal or another human being.

J Reichardt (1978): Robots: Fact, Fiction and Prediction (Thames and Hudson)

Extract from

Soft Computing: art and design

Brian Reffin Smith

pp. 147-155, Addison-Wesley, 1984

… Another hero of the creative use of computers is Edward Ihnatowicz whose Senster is probably the single most famous piece of such work in the world. A mixture of artist, sculptor, engineer, artificial intelligence worker and teacher, his ideas have provided food for thought for many workers in the area.

EDWARD IHNATOWICZ INTERVIEWED AT UNIVERSITY COLLEGE, LONDON

B. When I rang you to fix up the meeting, you said ‘any time after 7.30 am', and I remember you've said before that you want to do a job where you wake up each morning and look forward to work is that still true?

E. I wish it were. I still feel I'm extremely lucky, but there are problems with money and time; and at my age I'm thinking of rounding things off and completing them rather than starting on new areas and investigations. I've done too much thinking and not enough doing, which is what I've always complained about other artists.

B. Well are you in fact an artist? Here you are in the Mechanical Engineering Lab, doing artificial intelligence, research, art and design of various kinds, designing equipment, theories... do you wear all those labels equally easily?

E. I've stopped worrying about labels, but I do appreciate now the difference between an artist and a scientist. I am definitely not an scientist, therefore I'm an artist. And there's a more positive side to it there is a common goal or preoccupation between artists and scientists: both of them are interested in discovering what reality, life, truth are but they have different criteria by which they satisfy themselves. Scientists look for an absolute solution or description, a formula which, completely dehumanised and abstract, will still stand when they're dead. Artists accept the fact that they are their own vehicles, means, of information transport, in and out. Anything that comes in to them is modified by their own sensitivity, prejudices and so forth, and they accept that as the standard, they say ‘It seems to me like that' in other words their own bodies and equipment produce a frame of reference within which they're quite happy to operate. That's what's exciting in art you have to communicate with the person but scientists would like you to communicate with the idea, without regarding the person. (They fail in this respect, I think. There is no absolute truth to be found.)

B. So are you saying that art is making a virtue out of a necessity, that it's including the very obviously subjective?

E. The artists don't necessarily know that's what they are doing. They have no necessity to do anything at all.

B. But can a mode of enquiry be said to be going on if even the participants don't know that that is what is happening?

E. Well, you're putting the question in a scientific way... I don't know that I accept the original premise. Artists are people who look at various processes that people are

capable of controlling, and use them so that they communicate their involvement in some aspect of reality, which is not expressible in any other way.

Certain things preoccupy people certain things are in the air which have not yet been described. To somehow reinforce their existence, you can't use language unless you're a poet; generally you try to enhance your own experience of this subject, through doing something. It's no use simply looking at the beautiful sunset and saying it's lovely. Many people do that, but the artist tries to paint it, photograph it, do something with it.

In our present period, appearances of things are no longer particularly vital, important or exciting. I am interested in the behaviour of things. And it will always be a close run thing between technology and art, because technology is what artists use to play with their ideas.

I can be very precise about when I discovered technology it was when I discovered what servo systems were about. I realised that when I was doing sculpture I was intrigued or frustrated, because I was much more interested in motion, I was trying to make my figures look as if they were about to take off and start doing something. We respond to people's movements to a much greater extent than we are aware of.

Now the movements prior to 20th century technology were only achieved by very crude means, or extremely complex and inflexible automata which the Chinese and others used very subtly, but they were `once and for all'. Servo systems let you produce subtle motions and then modify them at will.

Most motions are expressions of something, so the person producing that motion must be aware of what it is a response to. Now we have the technology for all that we can make robots... devices having both sensory input and mechanical output, and a control box for co-ordinating the brain like functions. In theory, we could imitate life if we understood what it is about. But now, we can start investigating what it is.

I'm interested in birds for instance. If I'd been born in the last century, I'd have tried to capture their appearance as accurately as possible. Now, of course, I'm much more interested - I think most people are - in the fact that birds are self contained little cognitive systems. People see the birds, and the birds see them. There is an interaction going on. The spectator's behaviour affects the behaviour of the bird.

When a bird comes in my garden, I'm much more interested in whether it will fly away if I come near it, whether it will come if I offer it some bread, how close can I approach, will it be startled by anything, will other birds come down...

The bird is not there to be observed, it is there to be interacted with. This is the exciting thing about life. I am surrounded by cognitive systems like yourself whose every action is an interaction with me, and me with them.

B. Do you use computers because they're the best device or `fabric' to explore this?

E. The only one. The only one.

B. You're saying it's not pretend interaction, it's actual interaction that's important...

E. Precisely.

B. Between you and it, or the world and it?

E. I am part of the world: What makes me interesting to the animal, is what makes it interesting to me. In the case of my Senster for instance, it made people feel that it spotted them. The game was always to try and attract its attention. There was no pretence it was anything other than a piece of machinery. Nevertheless it endeared itself to them. The way it moved, which I went to a great deal of trouble to make lifelike in the sense that I tried to make its movements efficient. In the process of doing that, I discovered that animals, when they perform competent movements, are extremely efficient, and my machine looked animal like, even though I didn't try to copy animal movement.

B. Have you always worked on things that exemplify this sort of interaction?

E. Yes, except that the Senster had motion only in its output. But the second piece I made, the Bandit - people could move a lever and interact with the computer through motion; the lever moved back at them too.

Now I'm thinking about perception in terms of physical motion being its underlying basis on which all else is mapped; we move first, and all our thinking is about how, why, when and where to move. The reason for storing anything in your head at all is to know what to do at some point.

You've got to be very sure about what you are, what you need to do, what are the boundaries of your existence, what do you have to have in order to survive, and what would make it better, before you can start looking around and saying `Isn't that pretty'. That's a luxury.

There's no justification or reason for any of the actions in the brain unless it's controlling something. Having receptors and no effectors doesn't produce anything sensible.

If you try to understand how learning has developed, or perception, you cannot do it in a system that is incapable of physical movements, because you'd never see the process of improvement. (Chess is just a dead end.)

B. Is this where you tend to diverge from conventional artificial intelligence work?

E. I think so, yes. I am firmly convinced that thinking can never be demonstrated in a computer unless that computer is a controller for some physical device. The complete cycle of perception, response and observations on the effect of the response on the thing perceived must be included. If we are receiving sensory data, it must be some aspect of reality. To check out that it's not random, or something irrelevant, you must be in a position to affect, modify, push it, and see that the data consistently changes as a function of your activity. If you can't do that, maybe you've got a headache - maybe something is happening completely unconnected with the information to your sensory system.

B. What was the Senster actually doing? Was it behaving `intelligently' at all?

E. It wasn't doing anything! This is why I was disconcerted about it. I could see the response that it produced, and people kept referring to it as an intelligent thing, but there wasn't an iota of intelligence in it: it was a completely pre-programmed responding system.

I came across the problem, then, of deciding at what point intelligence can be thought of as existing. The evolution of animals is an absolute continuum. Deciding whether an

animal has intelligence, or perception, is an arbitrary thing - you say `those animals above that line have intelligence, and those below don't. But the situation where the animal just does things, `before' intelligence, is almost as interesting, you can see the potential.

I'm trying to arrive at a description or definition of what is required, what is the method that nature used to produce us that is so sure-fire that in an extraordinarily short time we have developed out of amino acids. Something fairly simple must be in operation, something straightforward and easy to appreciate. And very tolerant of faults otherwise these things would not have happened.

I am convinced that all the component parts of it are already known to us, and once we've discovered the formula it can be applied at any level. Applying it to the most intelligent computer we have would tell us how to make a better one, and applying it to a thermostat would tell us how to make a more intelligent switch.

B. You talked earlier about things imitating life, but surely you mean `the appearance of life' not imitating the psychological and social things ... unless you get very reductionist about those things. Yet what you seem to say now is that those sorts of things can actually emerge out of the ability to get right the program in your thing that is initially behaving `below the intelligence line'. You said `you can see the potential'.

Are you saying that you can make a system `below the line' that could become or at least demonstrate the possibility, back into the world, of transcending its limitations?

E. If I could do that, I would have succeeded... if a proof were required of my theory, this would be it. I could apply it at any level, including below the level of intelligence, and show that through the process, this mechanism could acquire learning or perceptual abilities which would make it more intelligent, and still leaving the next step available. I don't know that I'd do it...

B. One of the problems at the moment is that artists and others get computers, but quickly say `yes but what can we do with them?' Have you got any advice as to what art, or experiments or whatever, what approach, they could adopt...

E. This is like someone who has a nice set of paints, and is very knowledgeable about their chemistry, the range of colours and so forth, who says `now what shall I do with them?'

It should be the other way round. You should have a burning desire to reproduce something on canvas, you find charcoal or pencil doesn't take you far enough, you want colour, so you can make the pictures come to life, the same with computers.

Artists by now, the new generation of art students, are well aware of computers as tools, in various other demonstrations, and ought to appreciate what computers can do, and what aspects of life they can reveal, in other words things that are too complex, commonly, to appreciate can be made simple by allowing the computer to churn the stuff over. Then they ought to generate the ideas for it, rather than the other way round. But the interesting things that I expect to see are in control, having the computer as part of a larger set up, with sensors responding to things.

This is the most promising area as far as I am concerned, but as I say I'm just responding to an area of life

that has always been around, but we just didn't have the tools. Now computers help us to investigate it.

But of course the business of the artist is to show things that the rest of the world would never bother looking at. If he's any good, he will make these discoveries for himself. He now has a powerful tool at his command; but it would be fatal to try and advise anybody... I don't think art can be taught. Except by an atelier technique, with a Master who is really onto something, has real communication with some aspect of life, then that enthusiasm can be transmitted. But the techniques that can be learnt are not the crucial things.

The thing is to observe a person who is passionate about something; if you can see what he's trying to tell you, and observe how he's got there... you can see what psychological stages he went through, what were the tricks he played in order to get that idea across, what books he read, what connections he made between what he saw, and the things around out of which he could construct or represent.

Or there's the `doodle' syndrome a person may watch a mason chipping stone in order to make something for a gothic window, and say `well if I had a chisel I'd try to do something different' and so starts putting more decoration on, not knowing what he's trying to express, but through the activity of wanting to divert arbitrarily from the straight and narrow, he wanders into things that become, without him even knowing about it, expressions of his personality. The decisions he makes in trying to do something different are already determined by his sensitivities and life.

B. Formally, within the University here, you run an atelier, don't you? You have students who...

E. They're not artists. They've already been sorted out as engineers. They've got their vision very well blinkered. I hope I've opened their eyes a little bit, because I'm a very weird sort of person to have in a department like this. I enjoy the fact that they get quite enthusiastic about working here, and enjoy my weirdness and the fact that I don't know half the things they know from undergraduate maths or physics, yet I can open their eyes to other things they haven't thought of, that they don't get in their books.

B. When did you start in art? You did drawing and sculpture at the Ruskin, didn't you?

E. At my primary school, in Poland, I wasn't any good at art. I got better at secondary school, but it wasn't till just before the Ruskin that I carved a piece of chalk into a head, and the man who was teaching me painting said `You've got a natural gift for that, and drawing is a bit of hard work for you...'; that's why I decided to do sculpture at the Ruskin. Funny thing was, at the Ruskin, I was also very interested in electronics, I built myself an oscilloscope out of bits from an old radar set, things like this. But, at some point, feeling introspective and conscientious, I said `I've got to concentrate on my drawing and painting, throw away all my electronics, to dedicate myself to my art'. The stupidest thing I've ever done. I had to start again from scratch ten years later.

B. And now you've started up a new company producing control programs for small computers in engineering and so on.

E. This will help to make the money for some of the other things. I know there's a lot of such work about, but we're writing software that is easy

to use and apply in an industrial environment, that foremen and secretaries can use... special purpose menu driven stuff.

Eventually you find out that you can run complex operations very simply.

Generally speaking, in Britain at the moment, there's a greater need for improvement at the bottom level of automation rather than the top. People don't want to spend a hundred thousand pounds on some big system, and then have to go to school for three years to learn how to use it; so they get a little micro, and then say `what the hell do we do with it now?' this is where we come in. For a few thousand pounds we can automate something and make it easy to use.

B. Is it just as exciting as your other work? Will you still start work at 7.00?

E. I find it very satisfying if I can make someone's life easier by simply writing a program, and see the results down in the factory. I once went to a company, and saw that one of my machines was controlling maybe half the factory! One part was run by a large Digital machine, and the other was run by a PET microcomputer. I get a tremendous kick out of that.

Extract from

The Creative Computer: Machine Intelligence and Human Knowledge

By Donald Michie and Rory Johnston

Penguin Books 1984

Edward Ihnatowicz is a Polish-born sculptor living in England whose interest in the kinetic stems from his conviction that the behaviour of something tells us far more about it than its appearance. This led him to build the Senster, one of the most influential kinetic sculptures ever made. It consisted of a fifteen-foot-long steel frame articulated in six different places, with the joints all powered by hydraulics, the whole vaguely reminiscent of a giraffe made of tubular lattice. On the Senster's 'head' were carried an array of microphones and a Doppler radar system. The Honeywell mini-computer controlling the mechanism was programmed to make it react to three things: moderate and low sounds, loud sounds, and fast motion. Moderate sounds the head would move towards, loud sounds it would pull back from, and fast motion it would track. The result was an uncanny resemblance to a living thing, and the crowds at the Evoluon in Eindhoven, Holland, where it was on show reacted with enormous excitement. Children would shout and wave at it, call it names, and even throw things. Ihnatowicz explains that its movements seemed to stem from situations that people recognized.

In the quiet of the early morning the machine would be found with its head down, listening to the faint noise of its own hydraulic pumps. Then if a girl walked by the head would follow her, looking at her legs. Ihnatowicz describes his own first stomach-turning experience of the machine when he had just got it working: he unconsciously cleared his throat, and the head came right up to him as if to ask, 'Are you all right?' He also noticed a curious aspect of the effect the Senster had on people. When he was testing it he gave it various random patterns of motion to go through. Children who saw it operating in this mode found it very frightening, but no one was ever frightened when it was working in the museum with its proper software, responding to sounds and movement.

Although the Senster was dismantled some years ago, many people who saw it still remember vividly what a strong impression it made on them. Ihnatowicz has various ideas for further developments, including an investigation of how motion and perception are interdependent, an important topic for artificial intelligence. Unfortunately, the mechanisms are necessarily expensive, and the resources to build them are not easy to come by.

Extract from

Emergent Behaviours; towards computational aesthetics

By Paul Brown

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Then in 1969, with a multimillion dollar budget from Dutch electronics giant Phillips, Edward created the Senster which is arguably the first great masterwork of the computer art convergence.

The Senster was a 16 feet articulating arm based on a lobster claw and operated by a hydraulic system under the control of a Honeywell-8 computer. At the end of the arm, on the Senster's "head" was an array of sensing instruments: directional microphones; radar and sonar. It lived in a large geodesic dome in Eindhoven, Phillips headquarter city, in Holland. If you made a noise, or moved, it came over to "look" at you. If you made a loud noise or aggressive movement it backed away from you. The geodesic dome could hold about 200 people. Each one was a variable in the Senster's behaviour which, not surprisingly given that variety of "input", was amazingly complex. Behavioural scientist queued up to do experiments with the system and couldn't believe that something so simple (the Honeywell was a 12-bit computer with 4K of memory) could produce behaviour so lifelike.

Sadly the Senster was expensive to keep alive and Phillips scrapped the system in 1975.

Extract from

Origin and Development of Robotic Art

By Eduardo Kac

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While tactile participation is crucial to Squat, in Ihnatowicz's work it is the voice and the proximity of viewers that prompt responsive behavior. Working in relative isolation in England, after immigrating from his native Poland and studying at the Ruskin School of Drawing and Fine Art at Oxford, Edward Ihnatowicz (1926-1988), perhaps the least known of the three pioneers, created between 1969 and 1970 The Senster, a biomorphic computer-controlled robotic creature with shy behavior. This piece was shown at Philips' permanent showplace Evoluon, in Heindhoven, Holland, from 1970 to 1974, when it was dismantled. Built after the articulation of a lobster's claw, The Senster was about 15 feet long by 8 feet high and occupied a space of 1,000 cubic feet. Its head had sensitive microphones and motion-detectors, providing sensorial input that was processed by a digital Philips minicomputer in real time. The Senster's upper body consisted of six independent electro-hydraulic servo-mechanisms with six degrees of freedom. Responding to motions and sounds within one or two seconds, The Senster gently moved its head towards quieter and more subtle viewers. Loud and agitated viewers saw the creature shy away and protect itself from any harm. In its sensual, and apparently intelligent behavior, the piece was very engaging to a wide audience. While the debate on the use of computers in art at the time revolved around the creation of still or sequential images, and the use of static or mobile plotters to produce such images, Ihnatowicz merged software-based parametric behavior with hardware presence in a real space as he introduced the first computer-controlled robotic artwork. In other words, "The Senster" is the first physical work whose expression in space (its choices, reactions, and movements) is triggered by data processing (instead of sculptural concerns).