

"WHAT IS A ROBOT"?

Should we continue to pursue a dream of ultimate technology, that of robot's replacing humans in the construction industry, or would a return to the idea of "craft" - skilled men and women working with robots as sophisticated tools, but not in control, ultimately prove the best approach to speed the advancement of Robotics in construction?

Melanie Richardson. AA. Dipl, RIBA, Dipl TCDHE.
and
Derek Trowell. BA. Hons, Dip. Arch, RIBA.

School of Architectural Studies
University of Sheffield
The Arts Tower
Western Bank
Sheffield, S10 2UJ
England UK

ABSTRACT

The late 1950's saw the onset of many utopian visions of automation in the fields of Architecture and Construction. Architects began to imagine how automotive technology might fuse with design ideas, and even, how technology might become the generator of form. Perhaps, for the first time, however, the possibilities that automation as a generator of form, both on a domestic scale, and on a utopian scale began to trigger creative thought, the field of Art, Architecture and Design saw a proliferation of wild fantasies, ranging from the sublime to the ridiculous. As with most of the predictions of future technology, neither vision has proved to be very close to reality. Nonetheless, automation technology has continued to advance, and there is no doubt that its continued refinement is desirable. We will discuss whether advancement of the science is hampered by a strict adherence to the notion of "full-automation", and, whether the inclusion of humans into the equation, with the Robot as tool, is a hindrance to progress, or alternatively, a more realistic and perhaps socially acceptable alternative.

INTRODUCTION

If Robotic science is to both continue to progress, and positively contribute to the Building Industry, it is probably most likely to do so if strategic direction is applied to research and development.

It is the view of the authors' that Robotic Science is currently at a pivotal stage in its development, and that there exist two clear paths to follow from here into the future. One path leads to the ultimate technological dream, that of Robots capable, through

programming, of performing all the tasks that a human can. The other path, perhaps leads to a less dramatic goal, with Robots used as programmable 'tools'.

The former is a revolution perhaps, the latter a return to the Renaissance idea of craft, with the robot skilfully used as a tool, and perhaps a counter revolution? This paper is concerned with considering which path is most likely to best serve the advancement of Robotics.

DEFINITIONS

In order to develop the discussion it is helpful to start from first principles and ask the simple question, "What is a Robot"?

There is perhaps no concise definition, although few people would disagree with the following however;

" Robot- any automatic machine that does the work, or part of the work of one or more human being " ¹

or alternatively

"Any automated machine programmed to perform specific mechanical functions in the manner of a man"²

There is a key difference between these two definitions. The first implies control by a human, the second leaves open the possibility of a machine in control of itself - replacing the human hand or mind. The two definitions would seem to crystallise the polarity of viewpoints that exist as to just what it is that scientists are up to. In lay persons' terms, are they blindly dashing up the second path in search of the ultimate technological dream, or are they heading down the first path, and en-route, developing a technology which assists humankind through the creation of machinery and which can be manipulated to assist with the performance of tasks which are dangerous, or require extraordinary precision?

Perhaps we have become accustomed to thinking of 'Robots' in the second category? The populist perception of a robot is that of a machine that will not only look and behave like a human, but will also be capable of pre-programming to 'think' as a human, not a machine.

The question to address is whether we should continue to pursue a dream of ultimate technology, that of robots *replacing* humans in the construction and other industries, or would a return to the idea of "craft-skilled" men and women working *with* 'Robots' as sophisticated tools, but not in control, ultimately prove to be the best approach to speed the advancement of Robotics in construction?

Implicit in the question, is the notion that at some point humankind decided that 'Robots' should be more powerful than humans and should also be programmed to "think" without direction. If we accept this, it is interesting to speculate why, we came to such a view.

The late 1950's saw the onset of many utopian visions of automation in the fields of Architecture and Construction. Architects began to imagine how automotive technology might fuse with design ideas, and even, how technology might become the generator of form. This was, of course, not an entirely new phenomenon, such ideas could arguably be said to have originated in "The Renaissance" with artists such as Brunelleschi and Leonardo Da Vinci. Leonardo's designs for machinery such as his proposal for a flying machine was

clearly technology inspired by natural forms, in this case a sycamore seed. Brunelleschi's acknowledged architectural masterpiece, Florence Cathedral, is another example of advanced technology, the double-skin structure of the dome being revolutionary at the time of construction.

Perhaps for the first time however, it was in the middle of the twentieth century that the realisation that technology, and in particular, automation, could be a generator of form. Both on a domestic scale and on a utopian scale, this realisation began to trigger creative thought. Thus, the fields of Art, Architecture, and Design saw a proliferation of wild fantasies, ranging from the sublime to the ridiculous.

These fantasies were captured by many artists, but perhaps most vividly and succinctly by the "Pop" artist, Richard Hamilton, who in 1956 completed his now legendary collage entitled "Just What is It That Makes Today's Homes so Different, so Appealing?". The answer, of course, was that new machines were for the first time becoming commonplace. Machines such as the television, the vacuum cleaner, the tape recorder, the cinema projector and so on, were to liberate us all from domestic humdrum.

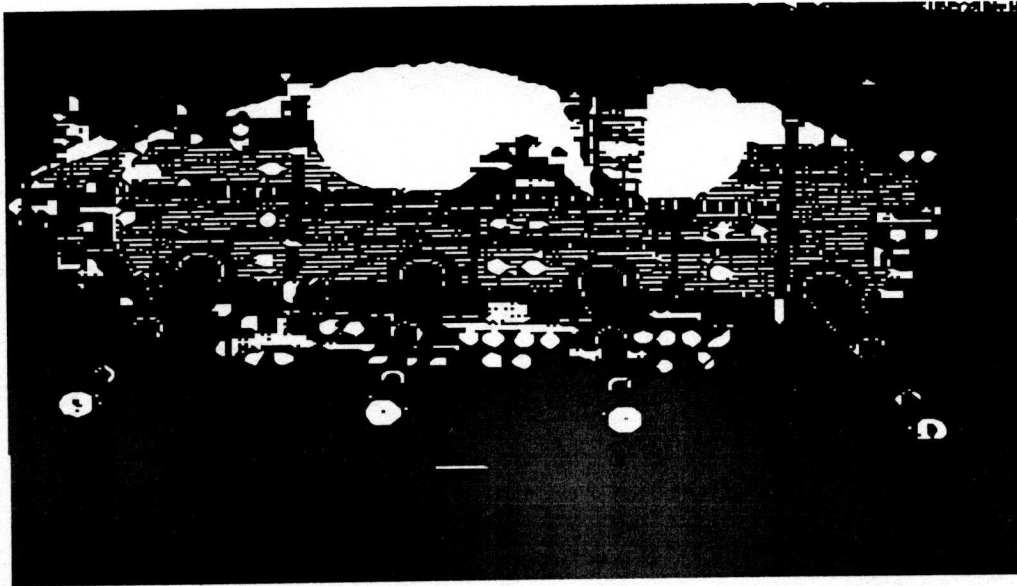


Richard Hamilton. Just what is it that makes today's homes so different, so appealing?³

At the other extreme of the scale, Archigram's "Plug-in, walking city" was put forward as a model for future living. This extraordinary vision of a future world was precipitous of a general ground swell of interest in architectural technology, and inspired Charles Jencks to write,

"The qualities of the First Machine Aesthetic are taken much further towards an extreme emphasis on logic, circulation, mechanical equipment, technology and structure. The present aesthetic is lighter than the first, and also more flexible. Previous machinery tended to produce repetitive patterns; electronic and self-regulatory machinery is more capable of

variation. Archigram, with its walking City and "robot" walls and chairs, stressed the dynamic part of this aesthetic, tying it inevitably with *Supersensualism*".⁴



Archigram. Plug in walking city.⁵

With the work of Richard Hamilton and of Archigram we continue to see two polarised views of automation, and again, because both are taken to extremes, both now seem fantastic, but also faintly ridiculous. Perhaps, because of their extremism, as with most predictions of future technology, hindsight has shown neither to be very close to reality. Nonetheless, automation technology has continued to advance and there is no doubt that its continued refinement is desirable. However, there would currently appear to be a persistence to the polarisation of views as to "what exactly is a Robot", which is not assisting progress.

MACHINES AND ROBOTS

How much direction is necessary before a "machine" becomes a "Robot"? A washing machine or dishwasher will perform a programmed task, traditionally the task of humans, but would we describe these appliances as "Robots"? Probably not, yet a machine programmed to weld part of a car, would generally be accepted as being a "Robot".

Taking the two examples above, it would seem that the speed of operation is to a degree determinate in defining our perception of the machine. A dishwasher or washing machine is arguably slower than a human alternative, the car robot welder is probably faster. Both in theory perform their task to a higher standard than their human counterpart.

Are modern robots defined by their expected ability to possess greater physical and perhaps, mental power, than humans? If so it is understandable that the advance of technology is hampered by fear amongst the uninitiated. Perhaps the reason behind this fear is concern at the implications of the combined resource of the robot and the intelligent user, the "initiated"?

HUMANS AND ROBOTS

It might be prudent to ask why there is an element in society, those perhaps, at the cutting edge of Robotics technology, with a wish to find a replacement for humans? Is the possibility of having our memory saved in perpetuity behind this quest? In fiction this is most graphically represented in Isaac Asimov's robot 'Giskard'⁶, which is pre-programmed by an Earthman to save the world, centuries after his own death.

Whether this is the case or not, one can understand the negative responses that such dreams can effect in the sceptical and this is surely a hindrance to the common cause of this conference, the advancement of technology.

An iconic example in popular fiction can be seen in the film "2001, A Space Odyssey". A space ship full of human beings is preserved for eternity in the "hands" of a computer, "Hal". Hal however, gradually forgets that he is a machine and begins to step outside his "programme". All who have watched this film, despite acknowledging it is fantasy, are doubtless disturbed by what ultimately happens when the robot/human roles become confused.

The religious believe that man was created by GOD in his image, but without his power and infinite knowledge. "Perhaps those who doubt the value of robotics are worried by a perception that what science seeks to achieve is the creation of copies of ourselves, perhaps with greater powers. Robert Owen wrote;

"Human nature in each individual is created, with its organs, faculties, and propensities, of body and mind, at birth, by the incomprehensible Creating Power of the universe; all of which qualities and powers are necessary for the continuation of the species, and the growth, health, progress, excellence, and happiness, of the individual and of society; and these results will always be attained when, in the progress of nature, men shall have acquired sufficient experience to cultivate these powers, physical and mental, in accordance with the natural laws of humanity." ⁷

The problem is, what are the Laws of Humanity? The past two centuries experience of human progress, which might reflect some of these laws has not always been positive. This has not helped the advancement of robotics, and has given weight to the views of many , such as Ruskin, who fear science.

"But in health of mind and body, men should see with their own eyes, hear and speak without trumpets, walk on their own feet, not on wheels, and work and war with their arms, ... The use of the great mechanical powers may indeed sometimes be compatible with the due exercise of our own; but the use of instruments for exaggerating the powers of sight necessarily deprives us of the best pleasures of sight". ⁸

It would be interesting to know how Ruskin would have reacted to the first unmanned undersea robot which allowed humans to see things which we would never have been able to perceive, without the help of "the use of instruments for exaggerating the powers of sight".

As might be expected from one who feared science, Ruskin did not appreciate the advances in technology which allowed cities to develop;

" But our cities, built in black air which, by its accumulated foulness, first renders all ornament invisible in distance, cities in which the object of men in not life but labour; ...

cities in which the streets are not the avenues for the passing and procession of a happy people, but the drains for the discharge of a tormented mob, in which the only object in reaching any spot is to be transferred to another; in which existence becomes mere transition, and every creature is only one atom in a drift of human dust, and current of interchanging particles, circulating here by tunnels underground, and there by tubes in the air; " ⁹

But would Ruskin, and those with similarly sceptical minds, have disapproved of the ability to fly to other parts of the world, or into space, which is now possible as pilots are helped by programmed machines?

Sant Elia and Le Corbusier in the 1930's, and the architects of the 60's and early 70's, by contrast, were generally receptive to the positive aspects of technology. Corbusier wrote;

"The machine, a modern phenomenon, is bringing about a reformation of the spirit across the world.

Nevertheless, the human factor remains intact, since the machine was invented by man to serve human needs.

The machine is conceived within the spiritual framework which man has constructed for himself and not in the realm of fantasy - a framework which forms his tangible universe; this framework, wrested element by element from the world around us, is sufficiently cogent to permit the creation of organs performing functions similar to those of the natural world.

The machine is all geometry. Geometry is our greatest creation and we are enthralled by it. The machine brings before us shining disks, spheres, and cylinders of polished steel, shaped with a theoretical precision and exactitude which can never be seen in nature itself. Our senses are moved, at the same time as our heart recalls from its stock of memories the disks and spheres of the gods of Egypt and the Congo. Geometry and gods sit side by side!

Man pauses before the machine, and the beast and the divine in him there eat their fill.

The lesson of the machine lies in the pure relationship of cause and effect. Purity, economy, the reach for wisdom. A new desire: an aesthetic of purity, of precision, of expressive relationships setting in motion the mathematical mechanisms of our spirit: a spectacle and a cosmogony. ""¹⁰

There has been an acknowledged general shift away from the views of Ruskin towards those initiated by Corbusier and St. Elia, and developed by contemporary designers such as Sir Norman Foster and Calatrava. It could nonetheless be argued that Archigram's "Plug-in Walking City" and all that went with it, in terms of a vision of technology as a liberator from meniality and a solution to overcrowding, as a consequence of an ever increasing population which ultimately, cannot continue, has been translated in the late twentieth century to a rather more sinister vision. One only needs to look at children's toys to see the difference.

This modern image of humans 'transforming' themselves into powerful beings with the help of 'robot extensions' capable of existence without contact with the external atmosphere and of venturing into territory that, as mortals, we would be afraid of, is more akin with the knight in armour than the Plug-in City. In other words, aggressive rather than enabling.

POSITIVE AND NEGATIVE USES OF TECHNOLOGY

It is a sad truism that when technology advances, it is often put to what could be argued as a counter productive or destructive use. If we look at the development of armour as a basic example, the use of suits of armour gave a frightening presence to the wearer and helped to protect him from arrows and spears in a set fight condition. It did not take long for

what was at first a 'protective' layer of armour and hence arguably passive, to become a more aggressive item by playing upon the frightening appearance it was possible to achieve. As the science of warfare 'developed', and guerrilla warfare was seen as a useful tactic, that is visual or close contact with your enemy was avoided if possible, lightweight armour was more effective. This contributed to the success of Henry the Fifth against the French, and the Moguls against the Chinese and Europeans. The use of the tank and aeroplane as extensions of human power was useful in the wars of most of this century. However, the Gulf war provided the opportunity to field test remote controlled and pre-programmed missiles to kill efficiently, while allowing the attacker to keep a safe distance, only venturing closer to view the destruction but even then only by use of remote sensing devices. This is a chilling development we have all witnessed. It is technologically breathtaking, but not, surely, how we would wish to continue.

In the civilian world we may have to go through a stage that children are now visualising with their toys, that of attaching extensions to ourselves to overcome adverse conditions in some instances. The "Transformers" are rather frightening, but almost infinitely flexible in their ability to combat hostile environments. We may need to experience these more personal or intimate benefits of robot power in order to conquer our fear that robots are a threat to human existence, rather than an aid to more comfortable living, and develop the philosophy of the Renaissance once again - that we are in control, before we can accept that a machine that we control from a distance is not necessarily threatening.

CONCLUSION

We would argue that it is not only those who do not understand technology, the "uninitiated", that hinder its development, but that there are those amongst the "initiated" who hinder it also. Our insistence on seeing robots as devices to be programmed, but not controlled, by humans is perhaps damaging our ability to advance the technology of robotics. Designers feel that they are not making progress if their machine has to be controlled by a human, even if remotely.

In *Robots and Empire* by Isaac Asimov, the relationship between robots and humans is described;

" Earthmen feared and hated robots and yet Elijah, knowing well that Daneel was a robot, treated him only as a person. Spacer, on the other hand, who loved robots and was never comfortable in their absence, would never think of them as anything but machines" ¹¹

Are Humans afraid of losing their 'humanity' in their fear of progress and technology? Perhaps when we have worked out what '*the natural laws of humanity*' are, we may be more willing to accept machines as part of our existence, without fear?

The greater integration of the Human Being into the equation with the robot as a tool, the one interdependent upon the other, is, we believe, a more socially acceptable starting point, and one which is more likely to speed development. It is apparent that there are those involved in Robotics who see this as almost regressive. Such a view, if held by larger numbers, could see the progression of 'empirical' research at the expense of intelligently 'applied' research. We would argue that there is still some room for more 'dishwashers' in the construction industry perhaps?

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