Architecture, interaction, systems

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> *"I go up", said the elevator, "or down."*
> *"Good," said Zaphod, "We're going up."*
> *"Or down," the elevator reminded him.*
> *"Yeah, OK, up please."*
> *There was a moment of silence.*
> *"Down's very nice," suggested the elevator hopefully.*
> *"Oh yeah?"*
> *"Super."*
> *"Good," said Zaphod, "Now will you take us up?"*
> *"May I ask you," inquired the elevator in its sweetest, most reasonable voice, "if you've considered all the possibilities that down might offer you?"*
>
> *Conversation with an elevator designed by the Sirius Cybernetics Corporation in **The Restaurant at the End of the Universe** by Douglas Adams*

The word "interactive" is found everywhere these days. It may be worth considering what "interactive" means and whether things presented to us as "interactive" actually are so, before moving on to consider why we might want our designed objects and spaces to be "interactive".

"Interactive" and "hi-tech" are not interchangeable words; one can create something interactive yet not hi-tech – likewise one can create something hi-tech yet not the slightest bit interactive. Technological advances may, however, make certain aspects of interaction easier to achieve, in part because they compress temporal, spatial or interpersonal scales.

Rather than provide at the outset a fixed definition for "interaction", I would like to discuss it from a few different angles, hoping that the sketched-in boundaries enable us to converge on a particularly useful conception of the word.

In an architectural context, a brick wall crumbles over years under the impact of rain. Is the wall "interacting" with the environment? I would argue that it is merely "reacting" – because the wall does not have an effect on the environment that it is responding to (other than, arguably, in an inconsequential way at the level of molecules). There is no circularity because the environment does not change its behaviour as a result of the wall falling down. Causality is straightforward to ascribe in this case because the transaction is occurring mostly in a single direction. Similarly, when louvres track the direction of the sun in order to direct sunlight in a building, they are merely responding to given input conditions and as such should not usually be described as "interactive" but rather "reactive".

At its fundamental, interaction concerns transactions of information between two systems (for example between two people, between two machines, or between a person and a machine). The key however is that these transactions should be in some sense circular otherwise it is merely "***re***action".

When you enter an art installation that presents you with a visual effect based on your movements in space then should this be considered “interactive”?

Consider the following example.

When I withdraw money from a cash machine, is that interactive? (I key in some numbers and currency notes are returned – closing a circle).

Before answering that question, let us step back even further for a moment and consider what occurs when we actually talk with a live person, inside a bank for the purpose of withdrawing money. We step up to the desk, provide some identification to the teller, wait a few moments and then receive from the

teller the quantity of money that we have requested. Although it is fairly basic, there has been a two-way transaction of information here: we have provided identification and a numerical amount, and we have then received what we had hoped for.

The key here is that we have *received what we expected*, both ourselves and the teller. There is an interaction, in the sense of a transmission of instruction across a boundary which has resulted in something being returned to us. However, we provided information to the teller that was expected of us (though it had to be distinguished from a large set of other pieces of fixed instruction, namely customer accounts), and we ourselves have received what we expected in the form of a sum of money.

This may be called interactive by some, but it is, to my mind, the least interesting form of interaction, because each of us operated within a predetermined set of boundaries.

The cash machine mirrors this process in that each of us selects from a fixed set of possibilities and responds directly to the other from a fixed set of possible outcomes. It is similar to a thermostat system in a building, which enables us to set a dial corresponding to our desired temperature and which returns to us (hopefully!) the spatial temperature we requested. Input and output criteria are predetermined by the designer of the system.

Similarly, in the art installation example given above, although the person entering the space may not have expected particular visual phenomena to be presented in response to particular motions in space, it is quite likely that at least the designer of the system had already determined particular outputs for particular inputs – either knowingly by filtering for only the actual visual aesthetics desired or unknowingly, but just as deterministically, through the complex but unchanging structure of the computer programme.

Let us call this a "single-loop interaction".

Much more profound, I believe, is the interaction in which we actually enter into a "conversation" with the bank teller. This might concern some news item, or a conversation about a particular financial issue that requires further interactions, or a conversation about personal matters (which may occur once we get to know a teller from repeated visits to the bank) – the key is that the domain of our interactions is open, and through conversations we are able to maintain a relationship that is productive and engaging.

We will probably discover new unexpected information, we may benefit from this information, or we may benefit simply from the cycles of interaction that will encourage related interactions in the future. It could be argued that it is our propensity to encourage on-going (iterative, evolving) interactions and conversations that makes us “human”. Note, however, that it isn't merely the "unexpectedness" that makes this a constructive form of interaction – if it was too unexpected (for example if the teller started yelling at us for no apparent reason) then the interaction would break down.

In such "multiple-loop" interactive systems, causality is much more difficult to ascribe than in merely reactive systems: A provokes B, but B affected A in the first place, in an ever-continuing loop. Note that complex thermostat systems such as those that take into account other environment input data are not, in their complexity, necessarily "multiple-loop" interactive systems. Multiple-loop interaction does not depend upon complexity, it depends upon the openness and continuation of cycles of response. It also depends on the ability of each system, while interacting, to have access to and to modify each other’s goals.

This is the kind of interaction that is just not present in a cash machine (or many art installations); it is not, however, an interaction that I believe is impossible to achieve with machines!

We have discussed three different scenarios: one in which I claimed there was no interaction; a second in which there was interaction, in quite unsophisticated terms; and a third in which there was a constructive and continual interaction.

It is my contention that the third scenario is most interesting and also the most productive in the context of designed spaces and architecture.

Within human-machine relationships, the second scenario (i.e. the single-loop interaction, like a cash machine) provides us with a situation where a person is at the mercy of the machine and its inherent logical constructs. [We may get unexpected results (for example the machine tells us that it is out of cash), but the fact that the machine itself was selecting from a predetermined set of responses precludes any constructive interaction]. The third relies on the creativity of the person and the machine as they negotiate across an interface, and it is this "conversational" creativity, I will argue, that makes these interactions the most desirable.

I concede that reactive or single-loop devices that satisfy our creature comforts are useful for functional goals (I am thinking here of Bill Gate's technologically-saturated mansion; or building management systems that seek to optimise sunlight distribution; or thermostats that regulate internal temperature). Such systems satisfy very particular efficiency criteria that are determined during, and limited by, the design process.

However, if one wants occupants of a building to have the sensation of agency and of contributing to the organisation of a building, then the most stimulating and potentially productive situation would be a system in which people build up their spaces through "conversations" with the environment, where the history of interactions builds new possibilities for sharing goals and sharing outcomes. In such architectural systems, inhabitants themselves would be able to determine efficiency criteria.

The cybernetician Gordon Pask, who collaborated with architects in the 1970s and 80s at the Architecture Association, London, provides us with rigorous guidance on how to develop such systems. His "Conversation Theory" gives us a clear framework for designing interactions in which systems (humans, machines or environments) may engage in the constructive exchange of information, without needing to rely on perfect communication with each other (without, for example, requiring an environment to talk to us with the emotionally-inflected yet clearly robotic voice of Star Trek's onboard computer!).

Pask's work was somewhat ahead of its time and was not fully grasped by the wider architectural community. Now that we have had certain technological developments (that alter our relationship to machines) and conceptual developments (that enable us to understand the constructive role that participants (formerly mere "users") in an open system may have), it is possible to consider how his "Conversation Theory" may help us build complex, dynamic interactive environments in the fullest senses of the words.

In such systems, there may be an environmental sensor/actuator device which monitors a space and is able to alter it. However, rather than simply doing exactly what we tell it (which relies on us knowing exactly what we want *within the terms of the machine, i.e. within the terms of the original designer*) or alternatively it telling us exactly what it thinks we need (which relies on the machine *interpreting* our desires, leading to the usual human-machine inequality, or, as some would say, mistreatment), a Paskian system would provide us with a method for comparing our conception of spatial conditions with the designed machine's conception of the space.

This enables us to converge, agree on and thereby share each others' conceptual models of the space and what alterations we decide it requires. With this shared conception we are better able to act upon the space, in conjunction with an artifact, in a constructive, engaging and ultimately satisfying manner. Such systems would operate with “underspecified” sensors; i.e. either a whole collection of them, each individual sensor of which may or may not eventually be

determined as useful in calculating its output; or better yet, it may evolve its own sensors, dependent on dynamically determined input criteria (Pask built such a system in the 1950s, which evolved its own sound receptors).

For example, building on the rather prosaic model of the thermostat, an authentically interactive implementation would enable a person to add inputs to the temperature-regulating system as desired. These might range from “energy consumption over the last month” to “the exterior temperature for this day last year” to “the colour of my clothes today” to “the fifth letter of the second paragraph on the front page of today’s newspaper”. The system would evolve weightings for each of these input criteria in order to provide satisfactory output, again according to criteria determined dynamically with the person. Output criteria might include “increasing thermal comfort”, “keeping my energy bills down”, “keeping my neighbour’s energy bills down”, “minimising my hot chocolate drinking”, “maximising the number of friends who come to visit”. In all cases, both input and output criteria are dynamically constructed.

These systems allow us to challenge the traditional architectural model of production and consumption that places firm distinctions between designer, client, owner, and mere occupant. We can consider instead architectural systems in which the occupant takes prime role in configuring the space s/he inhabits, a bottom-up approach which would result in a more productive relationship to our spaces and to each other.

This way of thinking about interactive systems is not necessarily technological: it is not about making your online shopping experience more efficient. Nor is it about making another nice piece of hi-tech lobby art that responds to people flows through the space (which is just as representational, metaphor-encumbered and unchallenging as a polite watercolour landscape).

It is about designing tools that people themselves may use to construct (in the widest sense) their environments and thus to build their own sense of agency. It is about developing ways to make people themselves more engaged with, and ultimately responsible for, the spaces that they inhabit. It is about investing the production of architecture with the poetries of its inhabitants.

To this end, I briefly discuss below some architectural experiments by Haque Design + Research concerned with some of these ideas.

"Sky Ear" was an experiment to develop a system that responded in realtime to input from people, from the environment and from electronic devices. It consisted of a floating carbon fibre cloud of 1000 helium balloons, electromagnetic sensors and mobile phones that drifted above a park in London, in 2004 <http://www.haque.co.uk/skyear.php>. The purpose of the cloud was twofold: first, to provide a complex network of distributed sensors responding to electromagnetic fields, and second to explore how an "audience" might explicitly become a creative "participant" in the event by being encouraged collaboratively to affect the sensors that they would otherwise be merely observing. The cloud was both a sensor system, responding to electromagnetic waves generated by mobile phone calls, and an actuator, producing electromagnetic fields itself.

Next is a pair of projects undertaken to understand perception: while the first explors how we perceive space, the second explores how a space might perceive us. "Haunt" (a collaboration with anomalistic psychologist Professor Chris French) involved measuring electromagnetic patterns, infrasonic frequencies and temperature and light conditions in supposedly "haunted" spaces and then recreating these phenomena in a "neutral" space in order to determine how people constructed, psychologically, a haunted space from these given phenomena <http://www.haque.co.uk/haunt.php>.

Taking the opposite approach, in "Evolving Sonic Environment" (a collaboration with Robert Davis, specialist in artificial neural networks) we built a "spatialised" neural net into which people could actually enter, walk around and affect through their movements and occupancy patterns

<http://www.haque.co.uk/evolvingsonicenvironment.php>. The system was composed of a society of autonomous devices, functioning analagously to the neurons in our brains - not intelligent in isolation, but behaving collectively in such a way that we can begin to infer different properties in their outputs. Learning circuits in each device enabled them to adapt over the long term to different patterns of occupancy so that after a while the society of devices collectively developed their own perceptual categories of "occupancy" that were not explicitly programmed, and which therefore did not necessarily correspond to human-determined patterns of occupancy.

Finally, "Paskian Environments", a collaboration with cybernetician Dr. Paul Pangaro, will consolidate the approaches of "Haunt", "Evolving Sonic Environments" and "Sky Ear" (i.e. it will build upon what we now understand about humans perceiving environments, environments perceiving humans as well as the participative role for non-designers in designed systems) and broadly explore Gordon Pask's Conversation Theory in the context of architectural constructs. The intention in this project is to take interaction algorithms from Pask's past projects (which importantly are context-independent) and apply them to the construction of a dynamic large-scale environment. Sited in a building in London, England, the Paskian Environment will be partly multi-modal installation, partly event-oriented performance and partly interactive environmental construct, encompassing both internal and exterior spaces. We are particularly interested in working with existing systems of the building (facade, internal/external lighting, information management, wayfinding) and unused spaces (dead-end corridors, locked courtyards).

With these projects we hope to get closer to the goal of authentic multi-loop interaction in actual built architectural projects, forsaking the easier route of creating merely "reactive" works.

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