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INTERACTION IN TERMS OF INDIVIDUALITY AND INTELLIGIBILITY

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Abstract. This paper points out that "interaction" is not only a scientific issue but also a social-cultural issue. The relationship between the user experiences and the behaviours of the system should be emphasised. The "Individual-Intelligible" coordinate system is created to compare and evaluate the interactivity of various systems, it provides a new design space for researches or students experimenting with interactive systems. Four experiments are discussed with the new formulation of the interaction.

Keywords. Interaction; individual; intelligible.

1. Introduction

There is a great diversity of initiatives from architects, artists and students using new technologies to create their own kind of interactive systems, however, a common language for comparing, evaluating these systems is not dispensable. It is widely agreed that interaction is not equal to reaction and there is a feedback loop between the system and the user or the environment. Nevertheless, a wide-recognised formulation of interaction is still not available. To discuss the quality of "interaction", this paper addresses the significance of individuality and intelligibility as the coordinates of the interactivity of the dynamic systems, especially for researches or students in (architectural) design areas.

The "Individual-Intelligible" coordinates concern about the social-cultural aspects of the systems: the individuality emphasises the machine should attract and involve the user into a meaningful conversation; the intelligibility allows the user to associate the behaviours of the system with its "goal" according to causality. Here, the relations between the user experience and the system behaviours are highlighted. With the coordinates, various interactive systems can be compared and evaluated; furthermore, the interconnection between individuality and intelligibility defines a design space, providing a new perspective for the designers. To verify the Individual-Intelligible coordinates, four experiments have been completed and they are discussed in “Four experiments” section.

2. Interaction and isolation

What is interaction? In the domain of architecture or media design, it is acknowledged that the interaction is beyond reaction, however, there are few further researches on this topic though it is of great importance. Very roughly speaking, viewpoints on interaction lie in two main categories: cybernetics (functionalism) and biology (or sociology) motivated theories. This section reviews some of them very briefly and points out the “isolation” crux.

Cybernetic paradigm plays an important role in interaction design. One deep theory is about the design of the “Braintenberg Vehicles” (further discussion in “Four experiments” section), which reduce the error (according a predefined goal) through the feedback loop between the vehicle and its environment. It is a typical self-regulation system (also called first-order system) according to Dubberly (2009):

> The self-regulation system has a goal; the goal defines a relationship between the system and its environment, which the system seeks to attain and maintain.

Comparing to the first-order system, the second-order system is a learning system which is able to modify the goals according to the effects of the action. While, the “Braintenberg Vehicles” theory suggests an intelligent model employing artificial neural networks to connect the sensory and the motor. Both theories try to build intelligence based on feedback loops, however, neither of them take user experience into account. The relevant approaches could prevent people to understand the machines, for the underlying mechanisms are too “professional” and too “sophisticated” beyond people’s everyday knowledge. Furthermore, the “goals” of these complicated systems may represent the “false needs” according to Marcuse (1964). In short, one-sided theories about improving the control in systems could lead to the isolation of the machine and the people.

On the other hand, more and more interaction designs adopt biology concepts e.g. adaptive and metabolism. Usually the “bionic” approaches take account of the social aspects of the systems and pursue meaningful conversations between the system and the users. For example, Daan Roosegaarde’s interactive “bushes” create

> An architecture of social relations invites the visitor to spontaneously perform and thereby construct alternative physical, architectural, urban and social meanings. (Bullivant, 2007)

For a successful conversation, creating “personality” is essential for these systems. However, if these systems have no well-defined goals to achieve and maintain, then people can’t understand them very well since these machines can only be perceived by feeling, not by reasoning. So these systems are reasonable enough.

3. Individuality and intelligibility

If interaction design can not improve the user’s understanding of the meanings and the possibilities of the communication between the user and the machine, this kind of interaction could lead to the isolation of them. Under this situation, the intelligibility of the system becomes crucial. To make itself comprehensive, the system has to manifest both its goal and the way it achieves the goal. In other words, intelligibility allows people to associate the behaviours of the system with its goal. The “goal” is a function in a narrow sense. In general, it relates to the equilibrium states of the dynamical system. In fact, the notion of intelligible is consistent with one of the ideas of modern architecture: the building should express its function and manifest the rationality of its being. Applying this principle in interaction design, the system should expose its mechanism to the users rather than encapsulate its functions.

Nevertheless, intelligibility is not enough for a robust interaction because it doesn’t guarantee a successful communication. At least, the system has to attract the user into to a conversation. In the words of Bullivant (2007), the machine needs “personality”. Wolfe (2010) even thinks about a form of “embodiment” to make the system alive. Generally, the interactive system needs to be individual, to achieve its goal via alternative or interesting behaviours. In terms of dynamics, an “individual” system makes unpredictable temporary movements following predictable attractors. Thus, interaction design is to explore unique and interesting “movement-attractor” relationships.

Intelligibility and individuality could represent a new coordinate system for the interactivity of dynamic systems. If a system can catch the user into a meaningful communication (individual dimension) and enable the user to associate its behaviours with its goal (intelligible dimension), then the system is able to support a healthy interaction.

Individual-Intelligible are not two independent dimensions in Cartesian system, they can be regarded as a pair of characteristics connected to each other inherently. The Individual-Intelligible coordinates define a design space of interaction. Although there are no straight way towards high individuality and high intelligibility, here are some hints:

- Perform a task in alternative ways which are novel or interesting.
- Let the system expose its mechanism.
- “Invent” meaningful tasks for the system.

These strategies deal with interaction based on user experiences, with a social-cultural perspective rather than from a scientific background.

4. Four experiments

The motivations and the solutions of the four experiments are quite different, however, they show how Individual-Intelligible concept plays an important role in different projects.

The research commences with the “Braitenberg Vehicles”: If put a vehicle with two light sensors and two motors on the floor (Figure 1), how to make the vehicle move to the brightest location? The most difficult task for the vehicle is to “know” the brightest point, only by two light sensors each of which only outputs the light intensity in a particular direction. In fact it’s not necessary for the vehicle to know the brightest point, if its behaviour could produce the phenomenon of “moving to the brightest point”. Through this way the behaviour of the vehicle shows how it reaches the “goal” and makes itself intelligible. The experiment also implies that there are a lot of different types of behaviours which can fulfil the same task of “moving to the brightest point”. Such multiple choices on behaviours are essential for developing individual characteristic of the system.

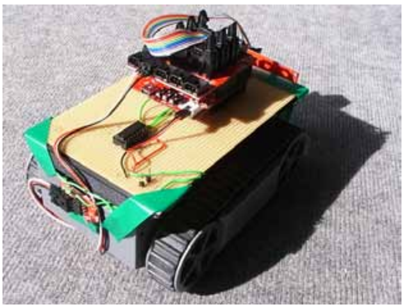

Figure 1. An implementation of Braitenberg Vehicle.

The second experiment considers two opposite solutions for dynamic facade: one solution regards the facade as a media surface, but it doesn’t make much sense for the inhabitants behind the facade. In contrast, other solution concentrates on the physical functions of the facade elements, without contributing to overall facade patterns. Actually it eliminates the individuality of the facade as a whole because all the elements work independently. So the experiment tries to integrate the display of patterns and the physical function (shading) into one system. Since shading requirements are usually locally distributed, they can be compatible with some global patterns. For example, a "wave" pattern can be constructed even if a considerable percentage of the facade elements are locally constrained by different users behind the facade (Figure 2); the amplitude and the wavelength are adapted to the constrained elements. By experiencing the facade from interior and exterior, an inhabitant can understand the system as follows: if someone regulates one element, the whole system can adjust its pattern to the change. The special mechanism by which the system maintains its pattern shapes the system's individuality, which can be perceived by the users during interaction.

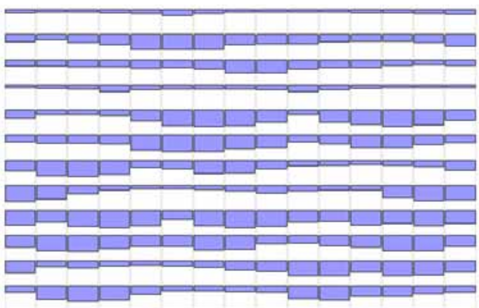

Figure 2. A "wave" pattern can be constructed though many elements are locally constrained.

In general the two approaches above are problem-solving oriented. There is another situation that the designers have to "invent" the behaviours of the system because there are no problems to solve or the problems can not be well defined. This situation has been studied deeply by Rittel (1973). During the present time, creating responsive visual and audio effects in space becomes popular, however, the interaction is weak if people don't understand what the system is doing and subsequently they don't react actively. The following two projects seek individuality and the intelligibility by inventing new behaviours.

The "avaGarden" project creates lighting and buzzing effects in interior space and relates their patterns to the "moods" of the space. Several nodes are built and distributed in one floor. Each node is equipped with sensors (light, temperature and sound sensors), output devices (LED and Buzzer) and wireless communication devices (XBee). These nodes construct a wireless network. The “mood” of an interior space is evaluated according to the data collected from the nodes. For instance, if the current data indicates one area of the floor is good for working, then the node in that area produces a special buzzing melody and blinks the LED with special intervals to indicate the “working” mood. The mapping from physical conditions to the moods relates to the activities of the simulated agents “living” with the real-time data collected in the floor (Figure 3). People also influence these virtual agents since the real-time data are related to the people’s activities in the floor. When people experience the transition of the moods and observe their counterparts in the virtual environment, they could understand the behaviours of the whole system and perceive the individual characteristics of the system through interaction.

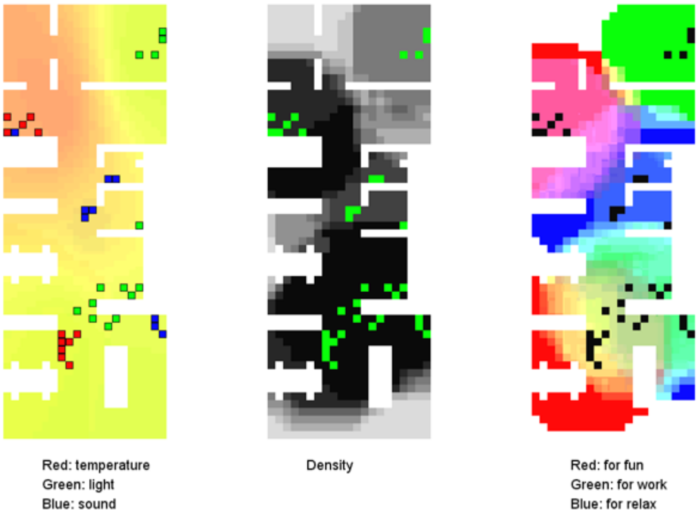

Figure 3. The visualised real-time data in one floor (left) and the moods of the space related to the activities of the virtual agents (right, the agents are represented by dots).

Last project develops a system learning the user’s body reaction to music. It’s very common that a person moves his body in response to a piece of music unconsciously or consciously. A device (the user can hold it as a baton) with two accelerometers is developed to catch the user’s hand motion. The relations between the music and the personal motion are classified (Figure 4) by a pattern recognition algorithm (Kohonen, 2001). After this learning period the user could make his personal music simply by waving his hand with the motion-catch device, for the motion can be mapped to sound immediately according to the learned motion-sound map. As a result, the device becomes a musical instrument. It's important that this map is neither random nor universal, but very personal. This system builds its individuality based on the user's personal characteristics (personal reaction to music) which are encoded via a machine learning process. By playing with the instrument, the user can find it intelligible when he realises that the instrument is to imitate his own patterns.

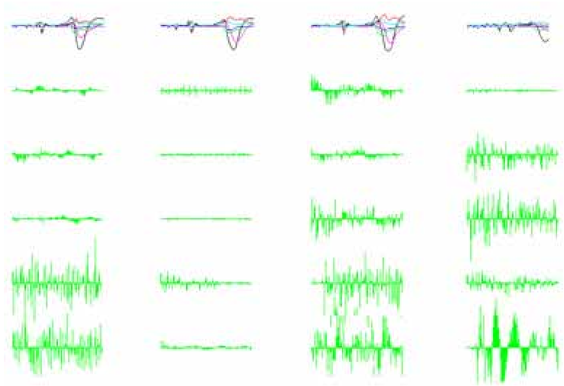

Figure 4. The classification of the motion-sound patterns (one typical motion is associated with several pieces of sound, only four of the typical motions are showed in this figure) for a personal motion-sound map.

5. Conclusions

Previous section illustrates several applications following the Individual-Intelligible formulation. It is clear that the two concepts – individuality and intelligibility are not additional requirements for interactive systems, but two intrinsic characteristics of the system which the designers always have to deal with. The Individual-Intelligible coordinate system could make the two interrelated characteristics explicit in design process.

It is always rewarding to explore the relation between the user experiences and the behaviours of the system, which can be regarded as the core of interaction especially in design areas. The new coordinate system provides a conceptual tool for designers to speculate, to evaluate and to develop this relationship towards more robust interactions.

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