

Group Interaction Method based on Wireless Sensor Network

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Abstract

This paper presents a group interaction method based on Wireless Sensor Network which supplies new attempts and ideas for human-computer interaction. Firstly, analyze group interaction framework that is different from the monomer interaction, then integrate data language of group interaction based on user's purpose so that the Wireless Sensor Network technology and methods are applied to the system of group interaction. Finally, group interaction toys based on Wireless Sensor Network are developed. Each of toy monomers is compactly filled with sensors, wireless communication devices, LED lights. The Wireless Sensor Network which is composed of many monomers makes interface function come true in virtual. The users not only act on the physical object but also act directly on the "data" when they use the device. Currently the functions including light transmission and light color blending have been accomplished and developing.

Keywords: WSN (Wireless Sensor Network), group interaction, user's purpose

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1. Introduction

The development of new science and technology always stimulate the human-centered design concepts and design methods. In the current market, the human-computer interaction design of electronic devices has been become more harmonious, but most of them are limited to a single person-single material interaction, leading to the "distance" between people farther away. On the other side, the way that most interactive feedback stays on the screen is not suitable for the elderly people who are forgetful or young age groups who lack experience from learning. Future design will be paid more attention to harmony communication of people-people [1], people-products, and people-environment.

Hiroshi Ishii [2] who comes from MIT Media Lab proposed the idea about "Tactile Bits" that percept and manipulates digital information directly by giving the digital information to the physical form to make the data and the physical environment and real people to be connected. MIT developed interactive toys called "Siftables [3]", physical entities and the merging of digital content for one operation can achieve control of the building blocks of the everyday experience of the toy itself, such as a photo sorting. This digital kind of thinking led directly to a natural interaction [4] based on Wireless Sensor Network [5] also provide a research base for group interaction [6] as the generation and development of new interactive way.

The group interaction concept comes from the observation of the people's daily life. People usually say hello to their friends when meet them on the road or share their juice with their friends at the party. Humans always need to communicate with each other. With the development of science and technology, the rapid development of human-computer interaction technology played a significant role in product design and many other fields [7]. When the human deal with digital information or media information, such as micro blog and email, there is nothing can affect the operate ability because of the rich experience they have, but more often, person-to-person communication has been limited. The so-called the mode of the modern way of life "person-objects-objects-person" makes people much closer in geographic distance [8]. In the meanwhile, the psychological distance is extended; they prefer to talk to their friends at the front of computer screen or mobile device, rather than face to face.

As mentioned above the interactive mode, "person-objects-objects-person", can be regarded as a great deal of people-material monomers overlapped. In real lives, we advocate "return to the real world on the basis of the development of digital information products, use

science and technology to enrich human experience through Wireless Sensor Network in order to achieve seamless integration between the physical world and the digital world, to achieve group interaction of multiple objects and multi person.

In order to facilitate the following discussion, group interaction can be defined as a concept based on general understanding which is different from the "single person-single material" interaction. It refers to the "multi person-multi material" interaction based on the "single person - multi-material" interaction and the "multi-material - multi-material" interaction, promoting interaction and communication of people by products and environment. The Wireless Sensor Network is a kind of computer network composed of many spatially distributed automatic devices, which monitor the physical condition and the environmental conditions from the different positions with the help of sensors. Natural interaction means that the people will be able to interact with the real physical world by using their familiar skills, controlling the input and output of digital information through various types of sensors without button and screen interface. Putting the technology foundation of this natural interaction and principles of Wireless Sensor Network into the research of group interaction may create new interactive methods.

The framework of group interaction is proposed on the basis of natural interaction and Wireless Sensor Network. For instance, the output of feedback of the light [9] can be used to explore group interaction methods. Then the group interaction toys are developed based on Wireless Sensor Network. The toys include many monomers which are physically independent and self-powered; each of them can communicate with other monomers through a variety of sensors. Subsequently, we epitome some of the interactive language used in this design example. Finally, we design a children color teaching toys.

2. The Framework of Group Interaction based on Wireless Sensor Network

An interactive system can be considered that several information processing apparatus cooperate through the communication to achieve a certain purpose. In the group interactive system of Wireless Sensor Network, users organically organize the function of interactive system to achieve specific goals. The Wireless Sensor Network make up a tangible user interface [10]. The input means physical operation of the entire interactive system to identify users or monomers mutual "communicate". The data can be directly acted by user purpose and these "monomers' communication" in the system. In this process, that the user's purpose is directly converted to the data is a core process. In the traditional man-computer interaction system, input and conversion are serial and one-way contact, the system perform information through the form of event sequence, while in the physical interface, the input of information is multi-threaded and parallel [11].

This multi-threaded and paralleled information not only come from the operation of multi-channel input the user operate directly but also from multi-channel input after the monomer mutual of operation. The biggest difference between group interaction and monomers interact is to achieve the multi-channel input from the monomer mutual "communication". It makes the interactive design much higher in time, semantic, logical area. So achieving much multi-group interaction is constrained by a framework to unified input from multiple channels.

It can be found, a user's purpose can be achieved by the multiple channels of data language. The same user's purpose may come from different channels, but in the end a particular purpose will be achieved. There is a integrate process that information is organized as user's purpose language. User's purpose language is integrated through a single-channel data language or multi-channel data language.

Interactive system design includes the design of the user's purpose, behavior operations design, the data language integration framework design based on group interaction data language of user's purpose. During the design process, people-oriented and customer-oriented should be obeyed. Design of user purpose is that the design of behavior operation in the design of group interaction, use the general skills which users are familiar to interact with the real physical world, divide the user's purpose into one or more acts operation, then design behavior operation to control the input and output of digital information so that the specific goal can be achieved. Design of data language integration is the design of Wireless Sensor Network. According to the results of the design of user's purpose, make sure the concrete representation of data analysis, reunion and integrate in interactive system. Of course, there is time limitation and some other important information.

3. Design Examples and Development

3.1. Design Examples

The group interactive toys we developed based on Wireless Sensor Network consists in a collection of the same toy monomer (50mm×50mm×42mm) - each monomer include: LED lights, a three-axis digital gyroscope, a wireless module, a microphone, four tongue tubes, magnets and an onboard rechargeable battery.

For a typical data manipulation task: each toy monomer has its own independent ID, receives and inputs physical information via the three-axis digital gyroscope, tongue tube, microphone. Then data information processed by the microprocessor, the output information presented to the user can directly feedback on the light, or can be transmitted to other toy monomers. Each toy monomer can achieve the switch, to change light color, flashing and other visual feedbacks, as shown in Table1. In Table2, based on Wireless Sensor Network consisting of a three-axis digital gyroscope, a wireless module, a microphone, four tongue tubes and some magnets, every toy monomer can communicate with other toy monomers.

Table 1. The Monomer Interaction Design in System

<i>If user's purpose is</i>	<i>And behavior operations is</i>	<i>Then Wireless Sensor Network consist of</i>	<i>Then the data language integration framework design is</i>
ON	Blowing	microphone	there is signal
ON	Horizontal clockwise rotation (preferred)	three-axis digital gyroscope	Clockwise 30 ° within 1 sec there is signal
OFF	Blowing	microphone	Rotation greater than 90 °
OFF	Vertical rotation	three-axis digital gyroscope	Counterclockwise 30 ° within 1 sec
OFF	Horizontal counterclockwise rotation	three-axis digital gyroscope	sec
Changes in primary colors Light flashes	Horizontal clockwise rotation	three-axis digital gyroscope	Clockwise 30 ° within 1 sec
	A slight rotation	three-axis digital gyroscope	there is signal

Table 2. The Group Interaction Design in System

<i>If user's purpose in group interaction is</i>	<i>Then Wireless Sensor Network consist of</i>	<i>Then behavior operations and the data language integration framework design are</i>
Say hello to each monomer (lighting infection)	tongue tubes and magnets	monomers are brought into close contact within 2 seconds
Dumping and mixing of colors (the monomer A 's color pour into monomer B)	three-axis digital gyroscope and wireless module	Close contact with more than 2 seconds of the two monomers and the monomer A to monomer B dumping operation

The three-axis digital gyroscope can detect the rotation information of the user's purpose in the three-dimensional surface such as the acquisition of the operation information we named "dumping". The digital gyroscope of said is sensitive to the signal of three-dimensional rotation, the information being sent to the microprocessor. The rotation information being processed in the microprocessor, output and the LED lights are controlled by LED lamp module in accordance with predetermined settings, on and off, the light intensity changing, the light color changing. The user's purpose is acquired by the microphone which can detect the signal we named "blow", and the voice signal via the microphone of said is sent to the microprocessor. The voice information being processed by microprocessor, the LED light module control LED lights on and off in accordance with predetermined settings. The tongue tubes are set for monomers' communication, one monomer saying hello to the other who is in close contact with it. Tongue tubes and magnets are set in pairs and interleaved inside of each side of toy monomer. (Overlooking a monomer, the settings structure of tongue tubes and magnets is shown in Figure 1). When two toy monomers contact, the magnet inside the toy monomer act on the tongue tubes inside the other toy monomer. The tongue tubes of said is sensitive to the signal of the magnetic field, the information being sent to the microprocessor. The magnetic field information being processed in the microprocessor, output and the LED lights are controlled on and off by LED lamp module in accordance with predetermined settings.

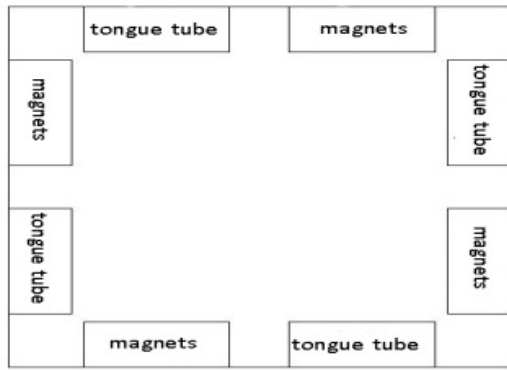


Figure 1. The Settings Structure of Tongue Tubes and Magnets from Overlooking

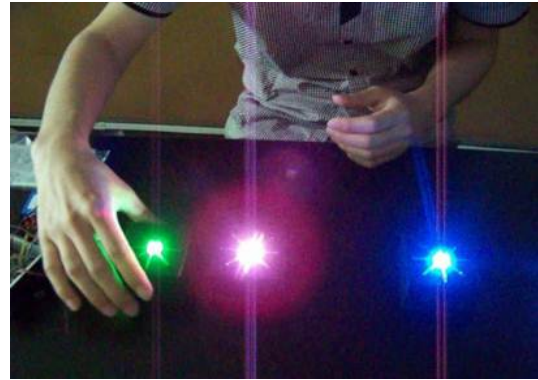


Figure 2. A Group Interaction Toy based on WSN (a color-mixing teach toy)

Perhaps the most interesting aspect of the group interactive toys is that it is a platform based on Wireless Sensor Network upon which we can develop an interaction language for WSN, starting from the user's purpose, analyzing the relationship between operation and behavior, completing framework design of integrating data language. Currently, a color-teaching light toys based on the above framework has been developed, a color-mixing teach toy, as shown in Figure 2.

When we move our hand with Lamp monomer, the light looks like candlelight flickering and a cup of water sloshing. Two monomers close contact within 2 seconds (say "hello" to each monomer) can achieve a friendly match. And dump the color as the primary color is red mixed with blue light, turn purple light.

Of course, the development of group interaction language based on Wireless Sensor Network is still in the early stages of design. We had outlined above that monomer interaction is as an example for physical operating, there being also group interaction as an instance, and the interaction language can be used alone depth and can also be used as a whole. The language of the list is only a small portion of which we can try. Furthermore, different architectures for Wireless Sensor Network can produce thousands of group interaction methods. Group interaction based on Wireless Sensor Network can be used in the in vast different fields.

Example: dumping and mixing color

The color-mixing teach toy is suited to complete the task, dumping and mixing colors. It is closer to a physical experiment, it being completed merely with our daily dumping operation. A monomer marked A, and another monomer marked B both have independent microprocessors, wireless communication modules. After two monomers close contact and say "hello" to each other, the monomer A is dumped, its A color into the monomer B's color, then the monomer B's color changes, color B mixing color with color A. Monomers' communication relies on tongue tubes and magnets to say "hello", rotation information collected by the three-axis digital gyroscope, sharing information via wireless module. Of course, the color mixing is not only limited to two colors.

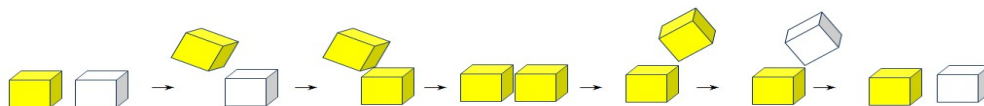


Figure 3. Dumping and Mixing Single Color

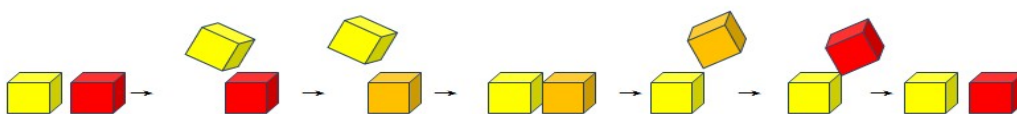


Figure 4. Dumping and Mixing Multi-color

3.2. Challenges and Future Directions

The development of group interaction design based on Wireless Sensor Network is still at a very early stage. As such there are many future challenges to address, both technological and conceptual.

Group interaction is based on Wireless Sensor Network technology. Wireless Sensor Network technology has focused a great deal of effort on the technical issues that it faces. Given the design requirements, longer battery endurance for a sensor node requires that other priorities such as battery size, the radio transmission range, or frequency of communication needs to be turned over. For the sake of efficiently realizing of the user's intention, more professional and expensive components are needed, more appropriate sensors and littler widget. And further efforts on code writing are needed to achieve the lower precision of user input and the higher recognition. Also, it is a major issue that how to correlate the design of user intent and the design of behavior operation better.

4. Conclusion

Group interaction based on Wireless Sensor Network breaks some limitations, such as the traditional separation of digital space and physical space, one-way propagation and the lack of interaction between people. Each step of the interactive system design embodies the concept of "people-oriented" in the design and technology, data the language integration through multi-channel can overcome the shortcomings in the traditional interactive, continuous input requirements, higher accuracy requirements to achieve efficient interact and natural. Design development direction, following the humane care and effective use of people's daily life experience, emphasis on physical contact to guide people to explore the significance and role in the physical world and the digital world, to promote exchanges between users, so as to create a unified experience persistent. Product use, the user will be more pro and pleasant. The use of group interaction products target user population will be more widely applicable to the low level of learning of the children [12], also applies to older users slow learning progress. Groups interact with products not only enhance and enrich the user experience of daily life, to promote exchanges, especially the emotional Lenovo also the specific use of the environment, thus demonstrating its taste.

The advantages of group interaction method based on Wireless Sensor Network provide a rich set of design principles to resolve the problem of human-computer interaction. We recommend trying to produce an entirely new way to interact with the method through the use of these design principles and Wireless Sensor Network technology, and worked out a new design framework different from the monomer interactive and design principles for the group interaction. Meanwhile, meet the challenge, further efforts on code writing being needed to achieve the lower precision of user input and the higher recognition and solving the problem that how to correlate the design of user intent and the design of behavior operation better.

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