InTouch: Crossing Social Interaction with Perception

Rung-Huei Liang, Wei-Ming Chung, Hsin-Liu Kao, and Tsen-Ying Lin

Department of Industrial and Commercial Design,
National Taiwan University of Science and Technology, Taipei, Taiwan
liang@mail.ntust.edu.tw

Abstract. With visual feedback serving as a major output of current social interaction through Internet, we aim to explore how alternative sensory outputs can enrich the experience of mediated social interaction. Thoughtfully making design choices, we deliver an artifact called InTouch to address the qualities we are interested in. InTouch consists of four sections in a wooden box surfaced with elastic Lycra. Each section stands for a communication link with a friend. By pressing a link, an individual can express her consideration for a friend. When pressed, the color changes from blue to red, while raising the temperature on a friends' device. The temperature of each link is provided from a thermoelectric cooler (TEC), turning hot or cold based on the input electrical current. One movement triggers two senses, namely touch and vision, forming perceptual-crossings as perceiving while being perceived. In addition to the description of the system, we discuss the motivation and concept behind design, present a pilot test and point out directions for future work.

Keywords: Perceptual crossing, social interaction, tangible interaction design.

1 Introduction

There is an increasing amount of smart electronic devices enabling social interaction in our everyday life; we simply slide icons over screen to manipulate social information on the touch-based interface. However, the UI designer of Apple, Bret Victor [9], points out that those technology-oriented interfaces do not provide sensuous feedback, nor can they allow us to perceive inherent properties of objects. Namely, capabilities of human sensors shouldn't be ignored since everything we experience in this world, including social interaction, is perceived with sensory details: sight, sound, smell, taste, and touch..

Moreover, how we interact with devices and how devices and users mutually inform play important roles in the process of experiencing interaction. An awful user experience could make users feel frustrated if we can't provide a good dialogue in the form of awareness of others' condition or awareness of others being aware of us. Taking a terrible experience of entering through an automatic door for example, we don't have any idea why the automatic door keeps closed. Broken? Didn't sense me? Out of service? Black-out?

With these concerns, under what situation can we recreate an embodied experience to mediate social interaction through an artifact with more sensory perceptions

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Fig. 1. Scenario of using InTouch

involved? Also, how can we make perception perceivable between artifacts and people across the Internet (Figure 1)?

2 Literture Review

French phenomenologist Maurice Merleau-Ponty investigates perception in his book, Phenomenology of Perception [10], and defines phenomenology as the study of essences, especially regarding the essence of consciousness and of perception. He argues that the whole world is a field for perception, to which we can assign meaning through human consciousness. We can't separate ourselves from our perception, which is a reciprocal interplay between the perceiver and the perceived of this world. Phenomenology of perception highlights the nature of embodiment when we perceive the world through our bodies and articulates that we are essentially embodied subjects.

Of special interest to us is the term "perceptual crossing" emerging in recent studies of embodied interaction while the semantics of it however differs in different contents. Da Jaegher [2] reports that two people encountering from the opposite direction might step towards the same side for couple times and just can't walk past each other. This is how we form dynamically mutual coordination and ceaselessly adjust our movement influenced by others in the real word. We perceive while being perceived by others making dual perception at the same time, forming perceptual crossing [1]. Related experiments or projects in terms the notion of "perceptual crossing" include the following three examples.

First, Deckers et al. [3] delivered an interesting experiment to make an artifact capable of perceiving self-presence (perceive the body-image), to further, perceiving perceptive action (perceive other perceiving me), and finally, perceiving of expressivity (perceive others' mind). Second, Friendly Vending Machine (master graduation project by Guus Baggermans, 2009) [4], which behaves in coordination with customers' movements delivers an idea of human-computer interaction through perceptual

crossing. Third, being adapted to medical therapy for autistic kids, a human-robot interaction through perceptual crossing is easier to bring the kids to the crowd [4].
In short, the uses of the notion of perceptual crossing are manifold. It could refer to the situation that one perceives while being perceived as well as while knowing that she is perceived. Crossing could also indicate that a single perception encompasses two or more different sensory perceptions with intended semantics respectively. Instead of being analytical to the definition, we take a perspective of generative logic based on the inspiration of the notion of perceptual crossing and deliver design outcomes to better voice ourselves. This paper aims at designing an embodied everyday artifact informed by the notion of perceptual crossing.

In order to expose more experience value, researchers adopt ambiguity as a resource for design [6]. Thus, it allows users to find their own usage and meaning instead of constraining how to use and how to work. The inconsistence that we deliberately use encourages interpretative space and imaginative privilege. In contrast to the center of technology practice, which concerns functionality, efficiency, optimality, and task focus, the intriguing design we proposed is a domestic future. We argue that, our artifact is not designed to improve intended function simply, instead, to create more space of interpretation.

Ludic design [5] aims to articulate an alternative thinking that technology should not only provide a clear, and quest oriented solution to a specific problem. Human beings are joyful, poetic, and spiritual rewarding creatures; they expect unknown thing in life world, and have their own interpretation of product usage. That is, ludic design intends to elicit the real essence of people. Ludic design is neither entertainment nor gaming. Entertainments are concerned with creating a stimulus and user oriented context, and gaming pursues user racing and competition where users are anxious about winning. Instead, Ludic design which focuses on a self-motivated form of play can initiate human kind's curiosity of all things and their pleasant nature.

To sum up, this paper's position is to research through designing [11] an aesthetic experience embodied in our everyday practice to allow ludic and ambiguous social interaction over Internet with richness of human sensors, which guide every conscious action by perceptual crossing through an artifact. The next section will discuss the process of design choice in detail, including perception, functionality, materiality, and making of form. Then we provide a prototype with sensing color and temperature properties and describe the experience of participants who lived with our artifacts over few days. Through elicited accounts from observing phenomena and semi-structure interviews, researchers illustrate what kind of social interaction we present and what kind of knowledge we learn from this design with a clear summary.

3 Design Process

3.1 Extended Perception

InTouch is inspired by the notion of McLuhan's famous book, Understanding Media: the Extensions of Man [9], which suggests that a medium, affects the society not by the content delivered through it but by the characteristics of the medium itself.

We wonder how "extensions of man" can be implemented in our daily practices across Internet connection, creating "an environment by its mere presence" as McLuhan states. If we see the Internet and the corresponding embodied artifacts as innovative media, how the concept of "the medium is the message" can be understood through embodied interaction with these media? Therefore, rather than appealing to visual cognition of UI such as semiology on the screen, we explore the extensions of man through the nature sensors of our body.

People construct this world by building on their sensation while sensing texture, lighting, odor, tasting, and sound. Our nature sensor is so exquisite and filled with abundant emotional value. We question that finger-slide-on-screen is not the only interface to connect people. Our sensation can be regarded as an interface bringing out deeper and realistic tangible feedback to a user directly. The Cryoscope is an example that outputs this idea: a haptic weather forecasting device that fetches the weather data from the Internet and a user can feel tomorrow's temperature by simply touching the cube [10]. More than functional purpose of Cryoscope, our intention is to create a new ambient interface that is implicit and expresses the new aesthetic experience embedded to our everyday life. For this goal, we open up the richness of different sensors and bring in the concept of perceptual crossing. Finally, we come up with this artifact: InTouch.

3.2 Function of InTouch

What we seek in interactive functionality of our design is a simple and intuitive mapping between a gesture and its coupling feedback. Therefore, we attempt to address this issue by answering the following questions. How can one movement (input) trigger two sensations (outputs)? How can these two sensations come across between two people with two devices?

Moreover, we intend to make people stay in touch with InTouch, which is a social network system that an individual can express her consideration for friends by pressing a link. When pressed, the color gradually changes from blue to red on InTouch, while raising the temperature on friends' device from 4 degree minus Fahrenheit (-20 c) to 113 degree Fahrenheit (45c), and vice versa. The more frequency an individual pokes, the redder the link turns to, and the higher temperature friend's InTouch is raised. It's an interesting way to mediate interaction through two artifacts than typing text via smart electronic devices.

In this case, unlike other traditional devices, which only perform one-way I/O function, InTouch addresses a new issue: an interface could enable two-way transmission. In each of links, InTouch allows an individual to sense two sensations at one time, sensing color (sense of vision) and temperature (sense of touch) triggered by another one, while being sensed by temperature in friends' devices. Therefore, an individual can express her concerns and receive others' at the same time in a single movement, forming a crossing of perception between two friends. We intend to stimulate participant's curiosity to explore the meaning of such a functional mapping of input and output. During the process of making design choices, a poetic expression that definitely made us go toward a clear destination came up: Can you imagine a red link feeling cold (Figure 2)? Besides the simplicity of movement, gesture, and

function, we investigate materials ranging from physical form to digital material. Making an alternative usage beyond its intended function hidden behind the computer, we employ a thermoelectric cooler as our technical implementation choice.

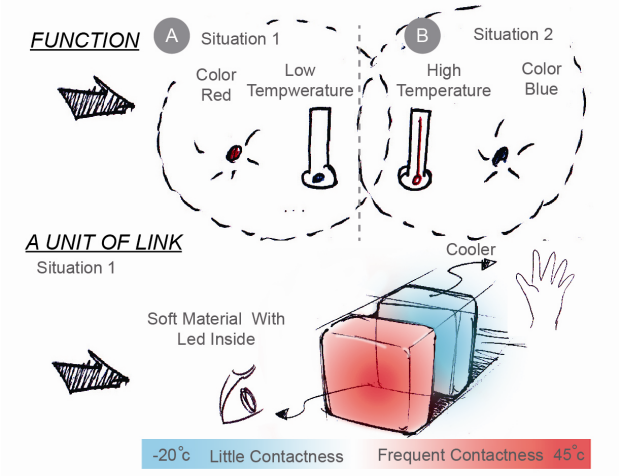

Fig. 2. Conceptual sketch of function of InTouch

3.3 Material and Form

Getting rid of solid ice-cold high-tech appearance, we try to make InTouch more domestic as a part of home furniture. InTouch is a social device contains four sections in a wooden frame. Each of the section stands for a communication link with a friend. Its window-like form plays a communicative role to allow our users at home to manage their social network in the real world. About the material choice, InTouch embeds a tactile surface: elastic Lycra. This flexible material enables people to physically poke and feel the response through the temperature and morph of surface. InTouch delivers a social aesthetic interaction through integrated material such as soft fabric instead of conventional interfaces like plastic or metal. Unlike other 2D interfaces, InTouch has a wooden-framed 3D surface unfolding possibility in making forms within the interface. We consider the material choice to make people feel more like at home (Figure 3).

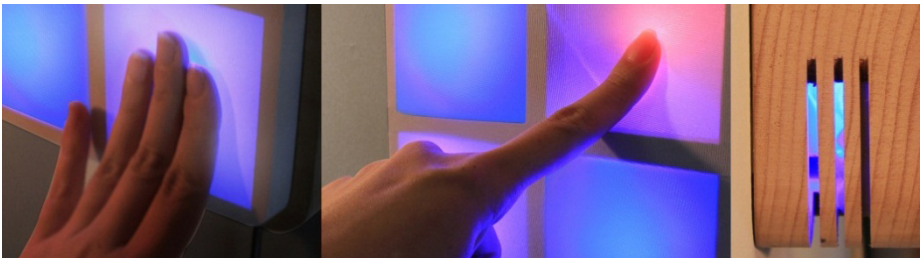

Fig. 3. Form and material choice of InTouch

3.4 Multidisciplinary Cooperation

Our multidisciplinary team iteratively discussed, widely explored in our design process, and learned to collaborate with different mindset of multiple disciplines. Designers focused on the materiality and form-making of our artifact simultaneously. They made decisions about how to construct a daily practice with domestic style and aesthetic quality. On the other hand, engineers addressed its feasibility and innovative usage of technology to provide various opportunities to its functionality. Both of them concerned establishing an embodied interaction that performs a perceptual crossing in terms of perceiving while being perceived.

4 Prototyping

The InTouch system consists of the following components, as in Figure 4:

- Input button: There is an input button beneath the lycra cloth of each compartment in InTouch. By pressing the button, a user can express consideration to a friend.
- LED lights: The LED lights change color from blue to red in a compartment based on how often the user presses it to deliver cares for a friend.
- Thermal-Electric Cooler (TEG): The TEG provides tactile feedback in the form of heat. By feeling if a compartment is warm or cold, a user can know how much a friend cares for her.
- Arduino: An Arduino Uno microcontroller board is placed in each compartment. It acts as the Central Processing Unit (CPU), i.e.: processes the incoming signals and provides tactile and color feedback based on each signal.
- Networking: A networking component transfers signals between two InTouch through the Internet.

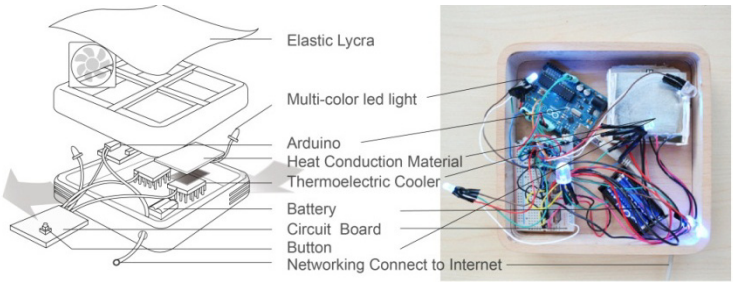

Fig. 4. Components of InTouch

4.1 Thermal-Electric Cooler (TEC)

As discussed in previous sections, we have placed a 3cm x 3cm Thermal-Electric Cooler (TEC), i.e., a Peltier heat pump device, inside each InTouch compartment. With the consumption of electrical energy, the TEC transfers heat from one side of the device to the other. This results in one side being cooled and the other side being

heated. The direction of heat transfer is based on the direction of the current. The temperature range of the TEC used in this work is from -20°C to 45°C. TECs were originally used in computer cooling to remove the waste heat produced by computer components. We exploit the flexible and configurable temperature characteristic of the TEC to provide a wide range of temperature feedback to users.

4.2 Signal Processing and Sensory Feedback

The main part of our system is the signal processing which triggers tactile and color feedback. When a user presses the input button, signals are transferred to the Arduino board. The Arduino board then sends corresponding color signals to the LED lights on the users' InTouch and heat signals to the respective friend's TEC. The flow model of the prototype is described in Figure 5.

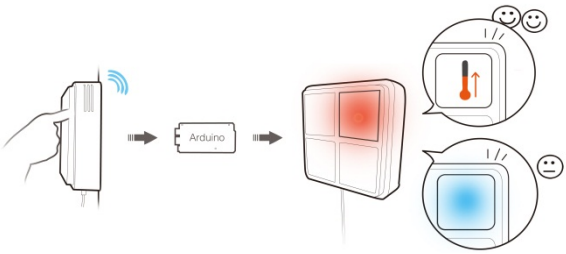

Fig. 5. InTouch flow model

If the Arduino does not receive signals over a period of time, it will send output signal to lower the temperature of the TEC and change the LED light from red to blue.

5 User Scenarios

Users can interact with InTouch in two main scenarios (Figure 6.).

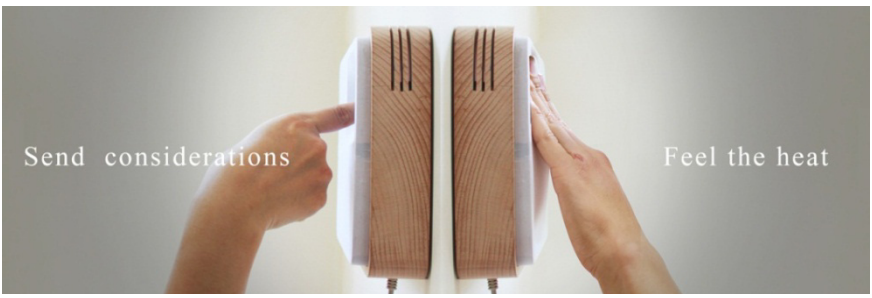

Fig. 6. Interaction with InTouch in two main scenarios

- Send your considerations: When a user thinks of a friend, he/she can press the compartment on the wooden box to send considerations. This will trigger the user's InTouch component to turn red, which is a metaphor for how much the user cares about the friend. On the other hand, the respective friend's InTouch component will turn hot.
- Feel the heat: A user can feel the temperature of her InTouch component. The temperature indicates how often a friend sends her considerations through InTouch.

6 User Evaluation

The InTouch system was demonstrated and played by 5 students coming from design and 5 from computer science backgrounds, respectively. For each play session, we briefly introduced the system and then let users interact with the system. All players found the system to be "fun" and "very interesting". The system was able to engage users to explore for an enough span of time to report their accounts.

We found the tactile and color feedback of InTouch to be the most intriguing aspects of the system. User A1 said: "…if I keep on pressing it, it gets hotter visually, but actually the temperature is so cold…this is so contradicting…like I care a lot for her, but she doesn't feel the same for me." A Chinese proverb "placing one's hot face on another's cool behind" was mentioned to describe this experience. The device also triggered another user to think more about a friend; user A3 reported: "It feels so hot, he thinks a lot about me. I should really press this more often." The perceptual crossing phenomenon also generated feedback; user A4 described: "Temperature is passive, you need to touch it to feel the heat…this makes me want to touch it more often." That is, the implicit characteristic of temperature triggered users to interact with the device more often. The use of the TEC also raised discussion. User A4, a student from the computer science department expressed: "The TEC is a device for cooling down CPUs…it is very interesting to see it used for other purposes…such as interaction design."

7 Discussion

The observation of InTouch in daily use and in-depth interview with participants gave us some lessons. These can be summarized as follows:

- The ambiguity of InTouch allows users to explore its ludic value

The inconsistence of sensing color and temperature inspires participant's engagement, and the ambiguity of social connection provokes their curiosity. Unlike the traditional GUIs (Graphical User Interfaces) that are designed to fix specific problems through modeling what people behave accurately, the tangible interaction focuses on what situated activities people are engaged and what's going on around ambiguous features. The embodiment of our artifact encourages participant to keep in touch with his/her friends with perception of touch.

- The perceptual crossing evokes implicit social meanings

InTouch allows multiple users to sense temperature triggered by each other in a remotes side. As a result, the perceptual crossing engages people to expect responding more than ordinary functions of social network. It is not an explicit signal that alerts someone concerning you or messaging you, but implicitly informs you through self-motivated touch. It is expected in the future that the moment of coincidentally two-way sensing will create more experience of serendipity.

- Users find their own appropriation over time

We don't cater to user's need; otherwise, our design is a catalyst to provoke the communication of participants and their social groups. Users would explore alternative ways to use. Furthermore, it might allow user to share the using experience with their friends and create a conversation in social groups. The purpose of our design is to raise topics for provoking users' point of view instead to force target users to persuade.

We argue that, human beings interact with each other in various ways and the reaction of everyone is very different, in other words, it would be meaningless to constrain or measure the behavior of human kinds. On the contrary, we see the interaction as an embodied phenomenon that could inspire future innovation. Therefore, the intentionality of InTouch is not a physical form only but a participative situation manifesting artifact in the domestic context. Furthermore, our design instantiates a form of interaction that is embodied, open, and ambiguous.

8 Conclusion and Future Work

From our empirical user study, we have found that users concerned how many friends they can interact with through the system. User A7 wondered, "So I only get to choose four friends? This is weird. Can I change these four people? Or to make it even more fun, can it randomly select for me?" Certain users found the four compartments within a wooden box to be limited; user A5 commented: "this is an emotional design, nice, I like how it is covered with fabric, but the form is sort of limited…the wooden box limits my interaction." There were also suggestions to increase the sense of coincidence; user A9 explained: "if my friend happens to be using this at the exact same time as I do, will anything happen? How about making a sound or something? This would be a nice surprise to know my friend's presence." Serendipity in terms of human senses was also discussed; user A10 described: "can the system stimulate more senses in a random sort of way? I would like it to be even more complicated and unpredictable." To embody InTouch into everyday lives, user A10 asked, "Can it become even more intimately integrated into our lives? Or on the other way, just make it an obvious art installation." In conclusion, through the designing and prototyping of InTouch, we have explored how the inspiring notion of perceptual crossing can be crafted into embodied experience as well as how the Thermal-Electric Cooler can be alternatively used to lead to advancement in terms of technology.

Moreover, this paper stresses a design artifact as outcome that can transfer the world from visual feedback as a major output of networked social interaction to a preferred future where all sensory outputs can become significant feedback ready for meaning-making in terms of social interaction. How this work adopts and uses technology as material for crafting embodied experience has made a solid contribution, which can also be leveraged by the interaction design community.

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