Breath Is to Be Perceived - Breathing Signal Sharing Involved in Remote Emotional Communication

Xiaotian Sun(✉) and Kiyoshi Tomimatsu

Kyushu University, Fukuoka, Japan
ginasun@foxmail.com

Abstract. In the city life with increasingly advanced technology, sociality tends to be more subtle. Although people, who have remote interpersonal intimacy, can watch or hear from each other, they cannot feel the real emotions from the other party. Especially, breath means existence in intimacy, and it is conductive to soothing emotion. This paper proposed a pair of interactive breathing sofa systems to communicate with each partner's breath tempo in real time. Also, the shared semi-virtual space and telepresence are established to enhance the emotional exchange and resonance in long-distance relationship. Each sofa can measure the user's breathing tempo and send it to the partner's sofa. In addition to strengthening emotional communication of long-distance relationship, the installation aims to design and realize the enhancement of remote emotional interaction, biosignals communication, telepresence, and telepathy of ExtraSensory Perception.

Keywords: HCI · Bio-sensing and emotional communication · Breath control · Telematic breathing · Interactive media art · Sensors

1 Introduction

Sociality is increasingly subtle in people's daily life. People receive information and even acquire the sense of presence and accompany through communication. Although people, who have remote interpersonal intimacy, can watch or hear from each other, they cannot feel the real emotions from the other party. Especially, breath means existence in intimacy, and it is conductive to soothing emotion. Hence, we intended to study the feel of simple contentment, warmth and togetherness from the other party in a long distance, and to build an emotional comfort connection for the long-distance communication. Afterwards, a pair of sofas were designed to communicate with each other's breath tempo in real time. The goal of my work is to build virtual hyper-sensory experiences through biological breaths to enhance long-range intimate emotional communication.

2 Related Work

The distance communication by biological signal to promote the empathy experience of affinity was begun to study and explore in the 1960s. Sermon Paul created media art

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"Telematic Dreaming" in 1992, it utilized the remote signal of the projector to carry out non-verbal personal communication through visual sense. The installation uses bed as a quiet and familiar place to establish a remote shared virtual space through communication so as to explore the subtle role of auditory sense, visual sense, and tactile sense in emotional communication [3]. With the continuous development of technology and the diversity of sensors, the multi-sensory digital experience is continuously explored. In the research field, masses of research deals with multiple interaction patterns at the same time under multi-modal interaction. The most typical interaction modality is gesture, voice and vision, but people generally ignore the hyper-sensory experience under the multi-sensory cooperation. "Lumitouch" is a pair of photo frames with remote interaction. When users touch one frame, the other one will light up. It takes visual stimulation as an emotional language of communication between loved ones [6]. "Mobile Feelings" is a mobile art project where users can send and receive body data over a wireless communication network. Through two wireless transmission devices that can be held in the palms, it can convey real-time heartbeat and respiratory data to users in long-distance touch [4]. The BreathingFrame is an interactive device based on the multisensory experience integrating visual sense, auditory sense, and tactile sense. Similarly, it also realizes the remote transmission of respiratory signals and communication through the physical inflatable airbag on the surface of the digital photo frame [1]. Media art 'The bed' is a bed as the carrier to provide intimate relations in the non-verbal communication installation. Bed as a familiar and safe place in the interaction through the visual vision and tactile sense to form a shared virtual space, connecting long-distance intimate relationship [5].

Except for olfaction and taste that have not yet been fully digitized for research, the sense utilized for digital interaction is still limited in the era of ubiquitous computing. At present, in addition to the full penetration of vision and hearing, touch technology interaction is the most common research point. It usually utilizes vibration, pressure, touch, stretch and other different mechanoreceptors to stimulate skin and enhance feelings. At the same time, the combination of telepresence and virtual space to enhance the hyper-sensory experience has become increasingly discussed.

3 Design of Breathing Sofa

Personally speaking, in psychology, people could exactly trust things or acquire the sense of presence only by strongly feeling the cognitive needs (seeing, hearing, smelling, tasting and touching) in terms of the sense of presence of both themselves and the others. Berkeley once pointed out that to be is to be perceived. The objective psychology believes that the signal we send out is proved to be real by receiving the others' response to our behaviors in the process of communication with other socialized people. Our sense of presence is based on the presence of our signal, thus helping us recognize the sense of presence and meet the needs of self identification [2]. Most kids tend to deliberately leave their footprints on the ground covered by snow. The kids identifying their movements acquire the sense of presence and prove their existence when they see their footprints on the ground. This is because the movement 'stepping' is our signal and the 'trace', in return, is the

response from the outside world. It's not the movement we send signal but the others' active response that makes us feel the sense of presence. We acquire the sense of presence when recognizing our real signal actively commented by the others. From this perspective, people are looking forward to recognizing the sense of presence in emotional exchange. The sense of presence won't be felt without the interactive relationship.

For people who want to communicate, people want telepathy, which transcends language, text, body movements, and distance, without the need to deliver media, which is an extrasensory ability to communicate. If we regard the extrasensory perception as the senses of the senses that require the combined effects of the five senses, we may also quote the association of the senses (multi-sensory collaboration) proposed in Hara Design in Design [7]. People through the sense of experience, build awareness, Therefore, we decided to transfer association of the senses in distance.

Breath, as the physiological process promoting the gas exchange between organism and the outside world, not only features the information exchange, but also represents the presence of life. It occurs spontaneously all the time, and integrates the comprehensive function of the five senses to exchange information inside and outside the body. Therefore, we employ the perception of breath to enhance the sense of presence, satisfaction perceived and emotional resonance by people in remote communication. In this way, the communication and interactive relationship based on machines can be promoted.

Many previous experiments have proved that bio-signal sharing is conductive to the remote interpersonal intimacy. At present, research on the bio-signals as a means of communication mainly focuses on breath sharing. Similarly, for users without distance barrier, breath signals can be utilized to observe the other party's emotional state and mode, and to feel the other party's responses. This fully shows the value of the communication and exchange of breath signals.

Compared with other bio-signals, the advantage of breath signals is that they can make the two parties unconsciously and willingly interact with each other. Thus the breath signals have been applied to the devices to game interface control, emotion soothing, and media art. Moreover, breath is not only a symbol of the life, but also closely related to emotional changes. However, breath signals as the remote communication media haven't been adequately studied.

3.1 Prototype

This paper proposed a pair of interactive breathing sofa system. Each sofa can measure the user's breathing tempo and then send it to the partner's sofa. Intuitive feeling of relaxed, comfortable and semi-wrapped state of the sofa serves as a "personal space" and a unique interface between people because it is a space that is shared physically with the whole bodies touch and is a common medium used by the general population and the sensory- impaired. When two sofa connected through the network remotely, they formed a semi-virtual shared space. In addition to strengthening emotional communication of remote intimacy, the goal of our study is to design and realize sense enhancement remote emotional interaction, bio-signals communication, telepresence and telepathy in extrasensory perception (Fig. 1).

Fig. 1. Users seating on breathing sofa, and interactive with each other.

3.2 Hardware

In the design process, the belt-type pressure breathing sensor was utilized to detect breath signals of the users' abdomens and connect with Arduino. The cylinder was controlled by the driver and speed controller. This cylinder repeatedly compressed a gasbag partially filled with air by the detected breathing signal rate. The sofa was composed of the other gasbag, and the two gasbags were connected by air change tube exchanged air in the process of repeated compression of stepper motor. Consequently, the expansion and contraction of the gasbags in the sofa with the breathing rate were realized. Thus users can feel the breathing rate and the gasbag in the sofa in a partially wrapped state to strength the feeling (Figs. 2 and 3).

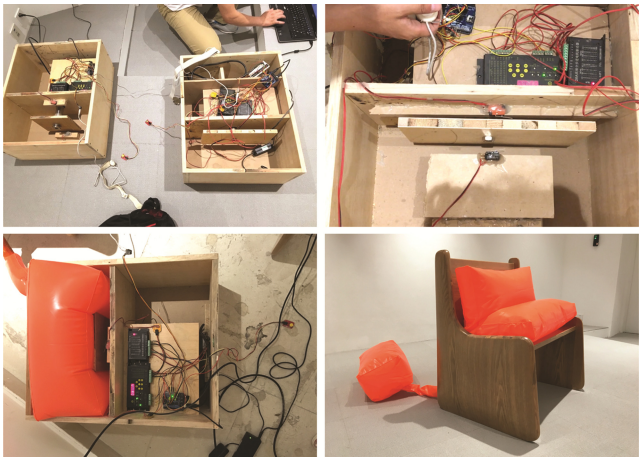

Fig. 2. Hardware

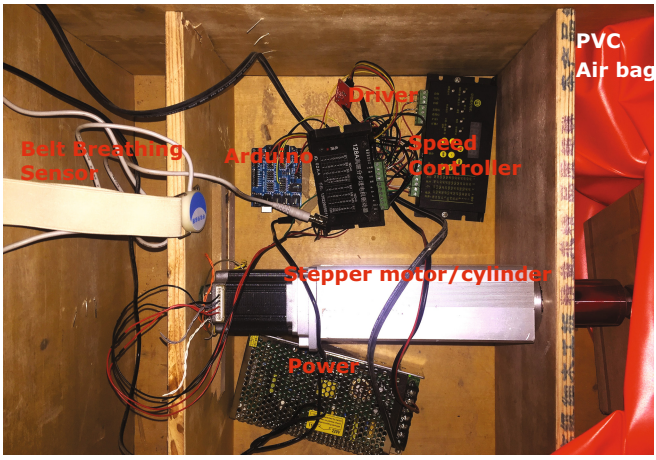

Fig. 3. Hardware

3.3 Communication

The WIFI Serial Server modules were equipped on the two sofas, respectively. The breathing sensor detected the breathing data and then realized the exchange in the cloud database by WIFI Serial Server module through the Internet. Thus one user can really feel the breath tempo of the other (Fig. 4).

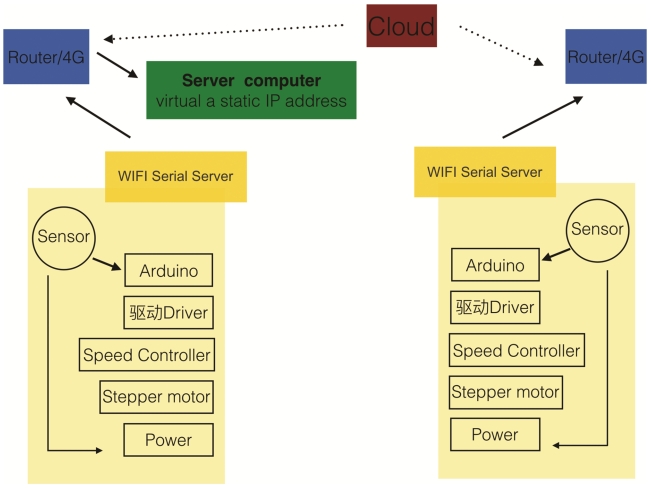

Fig. 4. Bidirectional communication diagram

4 Research Methods

4.1 User Study

We carried out an exploratory study to investigate the feasibility of Breathing Sofa for long-distance emotional experience. Our research direction is, in remote conditions, whether the emotional interaction, experience and communication can be enhanced through breath?

We selected 12 respondents in pairs, and divided them into six groups. We have chosen different genders, ages and relationships, including mother and child, couples, friends, grandchildren, and even strangers, so as to explore long-distance emotional experiences and interactions in a variety of relationships. The experiment was divided into four parts, namely, experimental information (personal information and relationship composition), emotion, experience and interaction. After recording the experimental information in the questionnaire, two people in the same group were in a separate room, sitting on the sofas with two breathing sensors(one for the installation, and the other concerted with a screen for testing breathing data) to watch a video (comedy, sensational or no emotion) in five minutes. Their emotions and breathing data were recorded. Then we began to experience the breathing dynamics of the other party, experience and guess the corresponding emotions and records. Five minutes after experiencing the other party's emotion, the result that whether one was affected by the mood of the other party was experienced and recorded. Also, whether the respiratory frequencies of both sides were gradually similar, and tended to calm? After 15 min, we had a five-minute interview. At last we compared the two results in one group to check the feasibility of Breathing Sofa, and classified the six research reports.

4.2 Findings

Based on the research result, there is no doubt that most participators could feel the existence of the other party and their emotional interaction through the breathing sofa system. Their views on the breathing sofa experience dramatically changed from doubt to expectation. Finally, they were willing to voluntarily sit on the sofa to share their breath, emotion and the quiet accompany with the others.

In the experiment, the breathing sensors tied on the user's abdomen and one connected with partner, the other one connected with computer. The test program detects a stream of the signal value of the intensity of respiratory pressure at each time node (per second) generated from pressure intensity between expiration and inspiration. When the user recorded a set of respiratory signals in the experiment, we mark the coordinate value signal and connected into line, made them into curve chart by taking the time and pressure signal as the axis, visualized the respiratory wave. It was compared the respiratory waves of users in the same group so as to get the conclusion evidently (Fig. 5).

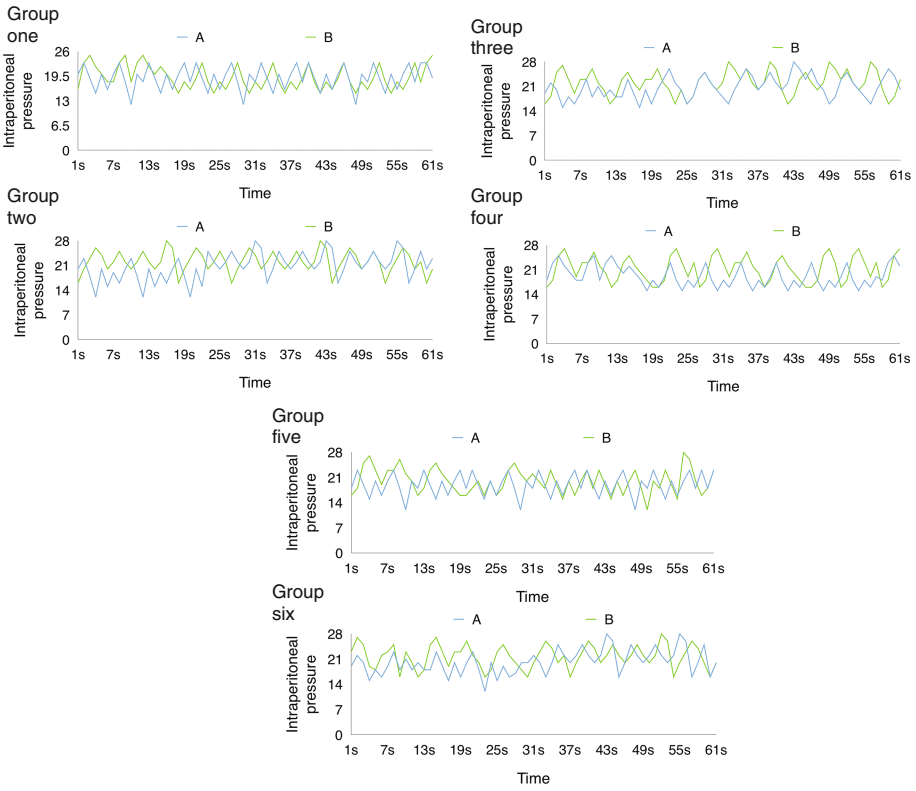

Fig. 5. Compare respiratory wave

Through experiments and interviews we divided the results into two parts. First, Emotions & Experience part: Whether the user can judge and feel the presence of the other party by breathing? Whether the user can guess through the installation and experience another user's emotions? Second, Interaction&Introspection: Whether the user can convey and communicate emotion through breathing? Whether the user can comfort the other party through this installation?

Emotions&Experience

Based on our observation of the interaction between the user and the Breathing sofa, we found that the first expectation was the immediate affective feedback. After wearing the respiratory sensor, visitors would feel the emotion and state of the other party, guess and immediately record. In the table, we compared the Emotions (user's own emotions) and the Experience (through the experience to guess the other's emotions), we found that at least eight people of experiments in the 12 people can accurately perceived the other party's emotion and state (Table 1).

Table 1. Experimental results

	Emotions (user's own emotions)	Experience (through the experience to guess the other's emotions)	Interaction (the feelings after interaction)
1A	Peaceful	Peaceful	Affected by the mood of the other party
1B	Happy	Peaceful	Affected by the mood of the other party
2A	Peaceful	Peaceful	Affected by the mood of the other party/Tend to calm
2B	Peaceful	Peaceful	Affected by the mood of the other party/Tend to calm
3A	Happy	Angry	Tend to calm
3B	Sad	Sad	Nothing to feel
4A	Peaceful	Depressed	Affected by the mood of the other party/Tend to calm
4B	Depressed	Peaceful	Affected by the mood of the other party/Tend to calm
5A	Depressed	Afraid	Nothing to feel
5B	Afraid	Peaceful	Nothing to feel
6A	Sad	Peaceful	Tend to calm
6B	Peaceful	Sad	Tend to calm

Interaction&Introspection

Also, as can be seen from the statistical data, four groups (group one, group two, group four, group six) of users could feel the convergence of their respiratory rate with the other users after interactive experience for a period of time, and both parties tended to calm. Also, as can be seen from the statistical data, four groups (group one, group two, group four, group six) of users could feel the convergence of their respiratory rate with the other users after interactive experience for a period of time, three groups (group two, group four, group six) parties tended to calm.

In the latter part of the curves of group one, group two, and group four can be clearly observed from the respiratory wave comparison chart, they are approaching the same. Indicating that their breathing frequency after a period of interaction time, respiratory frequency convergence. However, as a result of the unfamiliarity with the operation of the sensor, individuals' insensitivity to emotional breathing, and the sensor delay (such as data loss), users' accurate perception of the other party's emotion will be damaged sometimes. We believe that this dilemma can be solved by upgrading the sensor, optimizing the data processing algorithms, and the user's more practice feedback.

We obtained the positive answers, this proved that the Breathing sofa can carry out non-verbal communication and non-visual communication through unconscious breathing. First of all, the sofa as a carrier has provided the user with a relaxed semi-enclosed space. When the users experienced in relax, the can feel the actual presence and state of the other party. After a period of interaction, they can also feel the same embrace and comfort as in an intimate relationship. The respondent also said that he

enjoyed the feeling and process of slow emotional comfort. Therefore, our assumption is reasonable. The user is not only the sensor, but also the receiver. In the distance, by enhancing the experience, the users are influenced psychologically and physically, and thus they change into a new way of communication. This is our purpose. In the using process, the device is not equipped with sophisticated sensors and operating interface, and users have no opportunity to change or manipulate this process. Therefore, we come to the conclusions as follows:

- The transmission and simulation of breathing signals can promote human emotional communication
- Breathing signal can be a way to communicate human emotions
- Breathing signal may become a new way of perception and interaction
- Extrasensory interaction can provide a more convenient way for people with sensory impairments to communicate
- There is a tendency that interaction and machines will become increasingly disappear and ubiquitous (Fig. 6).

Fig. 6. Users seating on breathing sofa, and interactive with each other.

However, we also found many problems existing in the design and produce of the prototype. Firstly, the comfortableness needs to be improved or participators' comfortable experience will be affected. Secondly, in terms of the selection of materials, at the first stage we employed the wood and cloth commonly used in our daily life so as to avoid producing unfamiliar feelings to users compared to common home furnitures, thus cultivating the sense of presence and satisfaction by producing familiarity feeling and intimacy. Yet what we lack is the mystique and attraction. Therefore, we will make some changes in the selection of materials and promotion of fitness between body and sofa. Thirdly, hardware will also be improved because the cylinder presently used and the brake mode lead to its huge volume. Fourthly, the hysteresis and delay of signal won't be temporarily avoided in the process of remote transmission.

5 Conclusion

This research aims to create an installation and to study how the control of consciousness affects internal physiological process, and connects people with their own physiology through the datamation and informationization of breath. Breath information is stored and shared in remote transmission so as to explore the research and application of breath in enhanced experience of human-machine interaction. The future development will not be limited in daily communication. It can also realize remote communication between people with disabilities and realize emotional comfort and communication that are beyond life and death, time and space. Based on simple information transfer, users' emotions and feelings can be further improved so as to achieve better communication and interaction. On the one hand, users interact with the machine and the environment emotionally. On the other hand, they convey the machine to the role that coordinate and promote the emotional communication between users. In this way, the real existence and accurate transmission of biological signals will be further applied to the interactive design of affective computing.

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