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Mutual Awareness beyond Mutual Acceptance by Sharing Information through Indirect Biofeedback

Madoka Takahara, Fangwei Huang, Ivan Tanev, Katsunori Shimohara
Graduate School of Science and Engineering, Doshisha University
1-3 Tatara-miyako-dani,Kyotanabe, Kyoto, 610-0321 Japan
E-mail:{takahara2012, fhuang2014, itanev, kshimoha}@sil.doshisha.ac.jp

Abstract

This paper proposes a model of mutual acceptance between a patient, his/her family members and medical staff by sharing information through indirect biofeedback. For upcoming a so-called super aging society, it has been becoming a serious problem how effective and high-quality care support for aged persons could be achieved in Japan. Here we focus on psychological aspect of this problem. That is, it would be a possible way to tackle the problem if an aged patient, his/her family members and medical staff could deepen their mutual understanding and mutual acceptance by sharing indirect biofeedback information of the patient. This paper describes and discusses two mechanisms; indirect biofeedback of a user's sleep state based on analysis and measurement of his/her sleep data, and sharing information of his/her indirect biofeedback with a plant-type indicator through experiments.

Introduction

The number of people with stress and mental problems containing sleep disorder has been gradually increasing in Japan. However, their situation is often not improved only by consultation with specialists in psychiatry or psychosomatic medicine.

There is a view to postulate that a patient with schizophrenia and the doctor play the "language game", a philosophical concept advocated by L. J. J. Wittgenstein, where the doctor "plays" the role of a doctor rather than understand the patient, and the patient "plays" the role of patient rather than reveal their true nature to the doctor. In the current state of psychiatric care, a patient might believe it is sufficient to visit the hospital to get some instructions and prescriptions to alleviate the symptoms. And patients can improve the situation by practicing the remedy for the disease. On the other hand, the goal of the doctor might be to just ease the symptoms and pain from which the patient is suffering and not remove the cause of the disease.

A consultation with such a specialist could not be very effective if it is a passive experience for the patient. However, if the patient is asked to approach the symptoms of their disease in a voluntary and proactive way, the treatment is more likely to succeed. To elicit proactive behavior, the patient must be made aware of their current sleep state so they can then act appropriately to maintain self-control. A device or mechanism is needed to externalize the sleep state of the patient, while the patient establishes a sense of unity with the external device.

Here, we propose an indirect biofeedback mechanism that helps the patient be aware of his/her sleep quality and condition by monitoring a device with visual features that vary according to their sleep data of the patient. We also propose a mechanism through which the patient, his/her family members and doctors and medical staff can share the information of the indirect biofeedback.

Information Sharing through Indirect Biofeedback

Concept

Figure 1 shows our proposed model of information sharing through indirect biofeedback. A patient's biological data, such as sleep, heart rate, and respiration, are sensed by a mattress sensor, sent to and stored in a server every day. Some indicators that represent his/her sleep state and quality by analyzing the data in the server. Those indicators as direct information are changed and transformed into indirect information. The indirect information is designed to be displayed in a way that anybody could understand and feel. The indirect information, and then, is not only fed back to the patient but also shared by his/her family

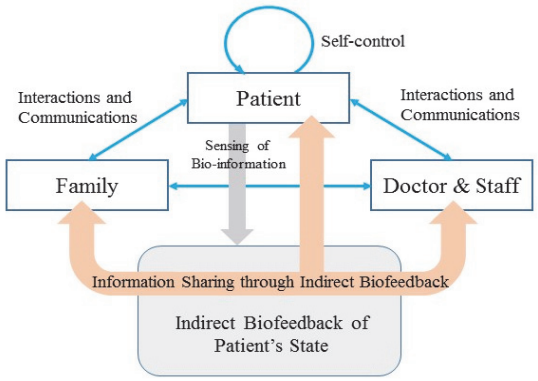

Fig. 1 Model of Information Sharing through Indirect Biofeedback.

members, doctors and medical staff. The indirect biofeedback information can be used by the patient so that he/she is easily aware of his/her sleep state and quality, and can control his/her own self. In addition, since his/her family members, doctors and staff can also easily know the patient's sleep state and quality, the patient will be able to have some feeling that other people understand and accept his/her biological state. To share some information about the patient's sleep state and quality, thus, influences other people's attitude to, interactions and/or communications with the patient. The medical staff can change their care plan for the patient, and the patient can be more relaxed and sleep more effectively.

Mutual Awareness by Sharing Information

Information sharing between people is useful for mutual awareness in general, as shown in Figure 2.

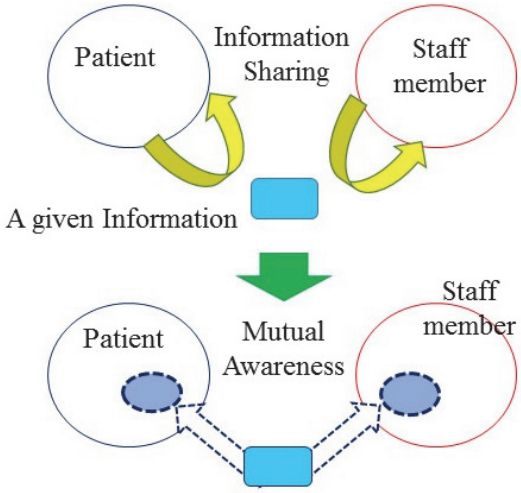

Fig.2 Image of Mutual Awareness by Sharing Information

For example, a patient's friend comes to see the patient, a staff member gets to know the fact, and the patient knows that the staff member knows the fact. That is, mutual awareness denotes that both of them know that they share a given information each other.

The case which we focus on, however, should be different from usual cases, and we have to make some consideration. While medical staff might be in strong position, a patient might be in weak one in a sense that the patient depends on medical care given by the staff. On the other hand, the patient pays to the medical care and services given by the staff. Moreover, information that should be shared by others, such as medical staff and family members is the patient's personal information.

Information sharing between a patient and medical staff, thus, should be carefully designed considering the points mentioned above. It might be quite significant, on the other hand, that a patient would be aware of being understood and accepted by others through information sharing.

From Mutual Awareness to Mutual Acceptance

Information sharing between a patient and medical staff should be carefully designed, especially, in the sense that information shared by others is a patient's extremely personal information that cannot be usually seen and known by others. In general, the patient does not want others to know his/her extremely personal information, because such information should be too direct and close to his/herself. In addition, direct numerical feedback might give a user a negative feeling by perceiving unfamiliar data which display drastic numerical changes.

Here we could find some significance in indirect representation, that is, indirect biofeedback. Information represented as indirect biofeedback and shared by others is the patient's personal one, but not too direct and close to the patient so that he/she could accept that the personal information is seen and known by others.

Figure 3 shows image of mutual acceptance that we are aiming to create between a patient and others.

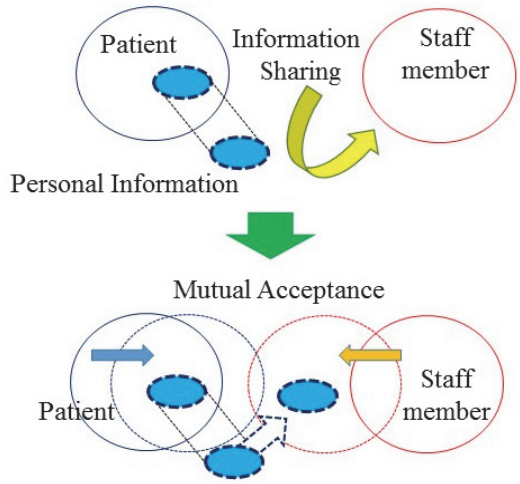

Fig.3 Image of Mutual Acceptance by Sharing Information

Once the personal information that is too direct but close to the patient could be shared, the resulting situation should be expected to be beyond mere mutual awareness, i.e., mutual acceptance.

Indirect Biofeedback

In this research, we employ virtual plants and their changes as representation of indirect biofeedback, as shown in Figure 4. We expect that such representation enables not only to externalize and objectify a patient's physiological information but also for the patient to self-control the inner state by being aware of his/her inner state.

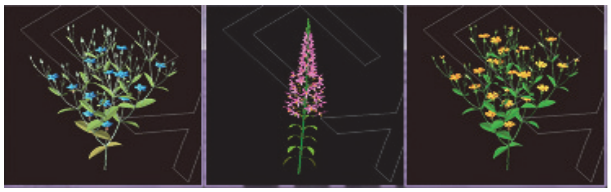

Fig. 4. Plant-Typed-Avatars.

Related Work

Biofeedback has been used by psychologists to help treat a variety of issues including post-traumatic stress disorder, attention deficit hyperactivity disorder, headache and hypertension.

Nishino and his team said that we spend a significant part of our lives sleeping, which is essential to our physical and psychological well-being. However, sleep can easily be impaired by psychological and physical well-being. Professor Shimamoto and his team said that a decline in the quality and total duration of sleep decreases physical activity levels and increases daytime sleepiness and increases the risk of lifestyle-related disease and depression.

In recent years, Japan will be having a super aging society and the care support for elderly people is inevitable. Takadama and his team focused on the problem and proposed a concierge-based care support system to provide comfortable and healthy life with the elderly people. The system estimates a user's daily sleep stage, and stores its personal data as big data. By doing so, care workers and doctors can design personal care plans for a specific user more effectively. The system has the following characteristics:

1) Estimating the sleep stage without connecting any devices to human's body.
2) Designing the home care support which supports elderly people who live in their house, facility or hospital.

Exploring the life style improvement technology.

Information Sharing System through Indirect Biofeedback

Figure 5 shows the configuration of the proposed information sharing system through indirect biofeedback.

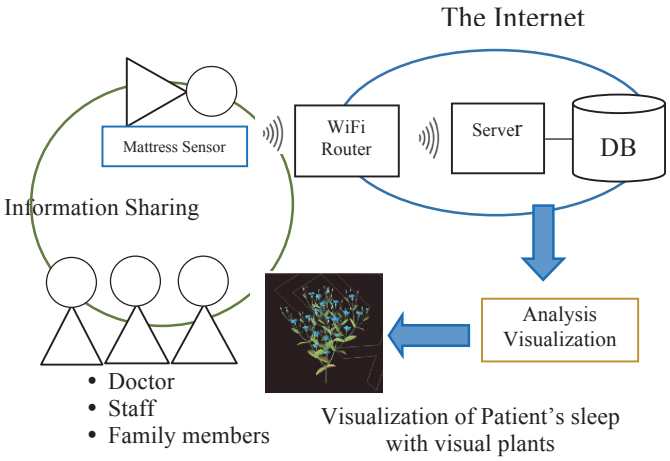

Fig. 5. Information Sharing through Indirect Biofeedback

We use the mattress sensor developed by TANITA to get a patient's sleep data, and an i-Pad as a device for display. The data are sent to a server through Wi-Fi, stored to a database, and analyzed into quality of sleep. The result is transformed and visualized as a virtual plant that is not only provided as feedback to the patient but also shared by medical staff and his/her family members.

Data on Quality of Sleep

Sleep disorder increases the risk of lifestyle-related diseases and depression. This decline has been observed in Japanese owing to changes in lifestyle. Moreover, the quality and duration of sleep vary greatly with age. Previous studies have shown that sleep disorder commonly occurs in the elderly. The quality and duration of sleep are determined by numerous factors. The following is this factor which we get with a mattress sensor and use in the proposed system;

- Sleep score

A patient's sleep state and/or quality of sleep are evaluated based on the data above. Also, we use these data as objective indicators to judge some effect by indirect biofeedback and information sharing with other people.

In addition, we will record a patient's daily events, such as taking a walk and/or bath, having a visitor, singing songs, playing a game, and so on, as well as data on his/her sleep state. Such accumulated data will allow a system to show daily, weekly, monthly and/or yearly changes of a patient's sleep state as morphing images of virtual plants. Also we can conduct correlation analysis between such events and his/her quality of sleep, and will be able to get

to know an indicator of a causal relationship between a specific event and his/her sleep.

Representation as Indirect Biofeedback

Based on the data on quality of sleep acquired by the mattress sensor, the proposed system calculates the daily average of sleep score, and compares its change day by day. We can know directly a patient's quality of sleep observing the changes and their amount of the daily average of sleep factors.

As mentioned above, however, we do not employ direct feedback but indirect biofeedback with virtual plants. Thus, depending on the difference between the pre-experiment average sleep score and the daily sleep score, we employ representation mimicking the growth of plants, for example, with the number of flowers and leaves, as shown in Figure 6.

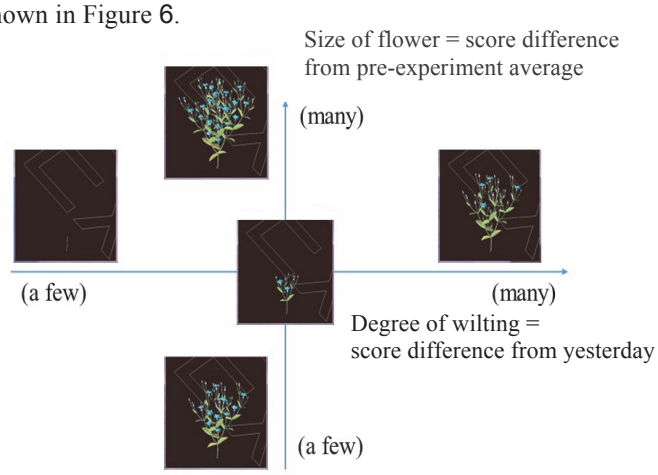

Figure 6. Mapping of Sleep Score into Visual Plant.

Design of Information Sharing Since we can get sleep patterns by evaluating overall factors on sleep, a type of plant displayed should change depending on sleep patterns. Sleep patterns change daily according to a patient's state of sleep. We tell the types to a patient, medical staff, and family members in advance, so they can recognize the patient's sleep state by looking at the types of virtual plants. We think it useful for the staff and family member to talk to the patient more effectively. By knowing such information, the patient might be able to change his/her own inner state and actions.

Figure 7 shows an example of display of the system and figure 8 shows an example of display to show relationship between sleep and event.

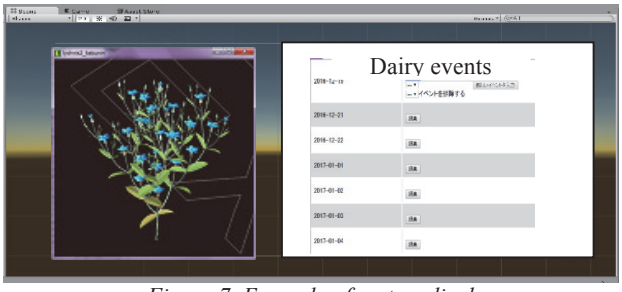

Figure 7. Example of system display

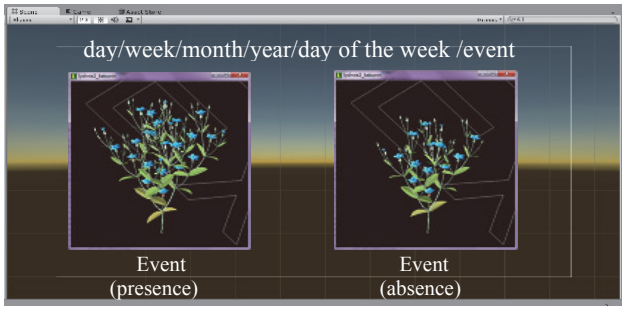

Figure 8. Example of displaying relationship between sleep (=plant) and an event

Additionally, direct numerical data is provided to the hospital staff and doctors.

Discussion

We will be conducting an experiment in a senior care home where 5 senior persons as subjects, their family members and medical staff participate in this experiment. The aims of this experiment are to verify usefulness of indirect biofeedback in improvement of a patient's sleep and to investigate whether participants including patients can deepen their mutual understanding and mutual acceptance by sharing indirect biofeedback information. In this experiment, we focus on the changes of sleep score as objective evaluation, and ask participants to answer questionnaires as subjective evaluation.

Conclusion

We have proposed an indirect biofeedback mechanism that helps a patient be aware of his/her sleep quality and condition by monitoring a device with virtual plants that vary according to their sleep data of the patient. We have also proposed a mechanism through which the patient, his/her family members and doctors and medical staff can share the information of the indirect biofeedback.

We will be conducting an experiment in a senior care home where 5 senior persons as subjects, their family members and medical staff participate in this experiment. Through the experiment, we expect to clarify usefulness of

indirect biofeedback in improvement of a patient's sleep, and to confirm that patients, their family members, and medical staff can deepen their mutual understanding and mutual acceptance by sharing indirect biofeedback information.

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