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Concept of Buddy System Adapted to the Individual Preference via User Interaction

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ABSTRACT

The "Buddy system" elevates the human consciousness state (such as concentration or relaxation) by minimizing the gap between the current and desired state while adapting the environment (light, sound and other ambient conditions) to users' preference. The concept is validated in experimental results and its potential future applications are discussed.

1 INTRODUCTION

Many devices in modern homes are installed with artificial intelligence (AI) systems that monitor human and environmental states, and adjust to user demand. For example, AI air conditioners detect the user's position and activity, and adaptively control the volume and direction of the wind to maintain the desired room temperature. Home-installed AI devices such as sweepers and washing machines improve the quality of life (QoL) of users, which is the main goal of so-called "smart homes."

QoL demands are both physical and psychological. Marketing and human-robot interactions have relied on methods that monitor biological signals and estimate human emotions [1] [2]. Various applications or devices that improve human mental conditions are also readily available. Examples are mindfulness applications and sleep-assistance devices.

However emotions and mental states are rarely monitored and are not easily controlled by devices. Humans acquire their desired emotion or mental state by different means; for example, some people relax by viewing natural landscapes and others gain positive emotions by listening to music. Therefore how humans cope with their emotions and mental states is inseparable from their preferences. The environmental effect on the emotion or state of mind is also important, as emphasized in van Praag et al.'s study of the relations among natural/artificial sounds, brain, and mind [3]. Thus, an AI system should ideally acknowledge both user preference and the environmental effect on state of mind.

We propose a system that detects and predicts the user's state of mind, and guides it into the desired state (such as concentration or relaxation) through environmental control. The proposed system adapts to the user's preference by attempting to understand and support the user, similar to a personal friend. For this reason, our system is called the "Buddy System". Whereas most of the existing AI systems aim to acquire human intelligence, our system aims to empathize with the user.

2 CONCEPT OF BUDDY SYSTEM

This section develops the concept of "Buddy System". As an example, the first subsection describes a room installed with user-controlled AI devices. The second subsection explains the learning and implementation of "Buddy System."

2.1 A Room Installed with AI Devices

Fig.1 shows a room installed with AI devices. The images on the wall display change with time and date. The air conditioner controls the wind based on the user's position and activity. The color and illumination level of the light are both adjustable. The aroma diffuser and speaker control their own volumes.

These AI devices separately monitor and control the user and the environment and are designed to be adequate for general users.

Fig. 1 Example of a room controlled by AI devices

When adapting the environment to achieve a desired state of mind, users must control each AI device separately to suit their current individual state and personal preferences. However, if these efforts distract users from their ongoing activities, the desired state of mind might not be obtained.

Ideally, the AI devices should automatically adapt to the user's mood. Such automated control would minimize the gap between the user's current and desired state of mind, enabling fast and easy acquisition of the desired state.

2.2 A Room Installed with "Buddy System" and AI Devices

Fig. 2 shows how humans control AI devices to acquire their desired state of mind. For example, if work focus is required, the desired state of mind might be concentration.

First, the human detects his/her current state of mind through sensory perception. Next the human predicts the state of mind in the controlled environment based on personal preferences, which are affected by the current state of mind. The human then decides how to control the devices to minimize the gap between the predicted and desired state of mind, and finally enacts the device control (green bold arrow in Fig. 2).

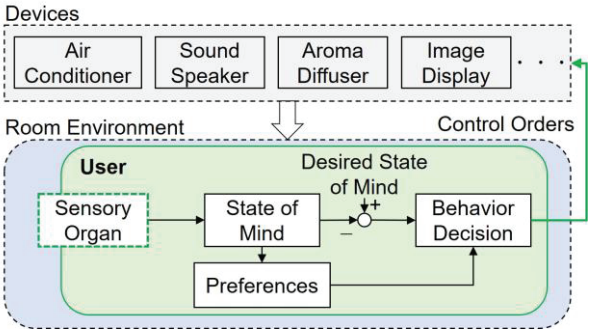

Fig. 2 Human controls of devices to achieve the desired state of mind

As shown in Fig. 3, decisions made by "Buddy System" resemble human decisions. Here, the desired state of mind is chosen and arbitrary ordered by the user because the expectation of user's desire is out of the concept of "Buddy System." The sensors monitoring the user's biological signals (red dotted square in Fig. 3) are assumed to be sufficient for detecting and predicting the target state of mind.

Before operating "Buddy System", the user must self-control the devices to teach "Buddy System" the relations between the chosen controls and the current state and user preferences. After this initial learning phase, "Buddy System" detects the user's current state and chooses a combination of device controls (indicated by bold red arrow in Fig. 3) to minimize the gap between the predicted and desired state of mind.

When desired, the user can control the devices (green arrow in Fig. 3). In response, "Buddy System" adjusts its state of mind detection / prediction, preference estimation and behavior decision parts.

After several repeats of the control and learning phases, the desired state of mind is automatically acquired, provided that "Buddy System" can estimate the user's preference. If the user's preferences change according to an altered current state of mind or environment, the user reverts to device control and "Buddy System" repeats the learning phase.

As explained above, "Buddy System" learns its behavior through user interactions, and responds as users would prefer without additional programming and data analysis.

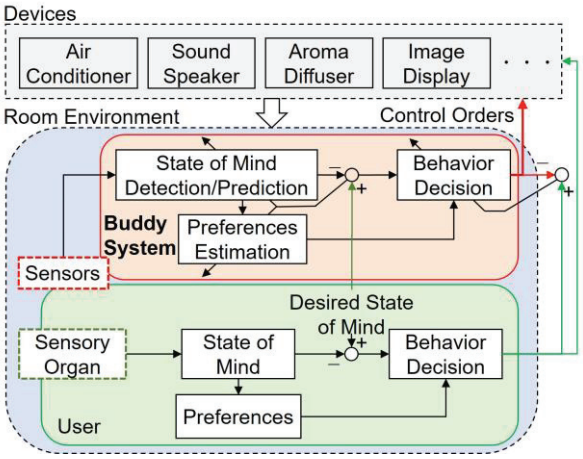

Fig. 3 Schematic of "Buddy System" controlling devices on behalf of humans

3 EXPERIMENT

This section demonstrates the application of "Buddy System" in an environment. Details of the installed "Buddy System" algorithm and structure will be described in a forthcoming paper.

3.1 Experiment Setting

In the experimental setting, the desired state of mind was assumed as concentration. The environmental devices were an aroma emitter, a natural sound generator and three light bulbs. The controllable conditions were the aroma amount, sound volume, and light color (Fig. 4). The concentration state was acquired through the user's nasal skin temperature, which is commonly utilized to estimate stress or awareness.

Nine experimental subjects (nine male, age range 18-42) played a game, involving summations and subtractions, which was manipulated using a mouse. Each game involved 25 calculations, and was executed three times under different conditions. Each time, subjects repeated the game as possible as he could for 45 minutes.

During the first eight minutes, the user played the game under the initial settings of the devices, which were set by the user based on his preferences before the test. Over the remaining time, the user played the game under one of three conditions: 1) under "Buddy System" control, 2) under random control, and 3) under user control. The order of the test conditions was randomized for each subject. Which condition was tested at each time was not revealed to the subjects.

Under all conditions, the user could control the environmental devices when desired. The user's control was always prioritized.

The results were evaluated by the game scores, which were calculated from the number of correct answers and the time elapsed per game.

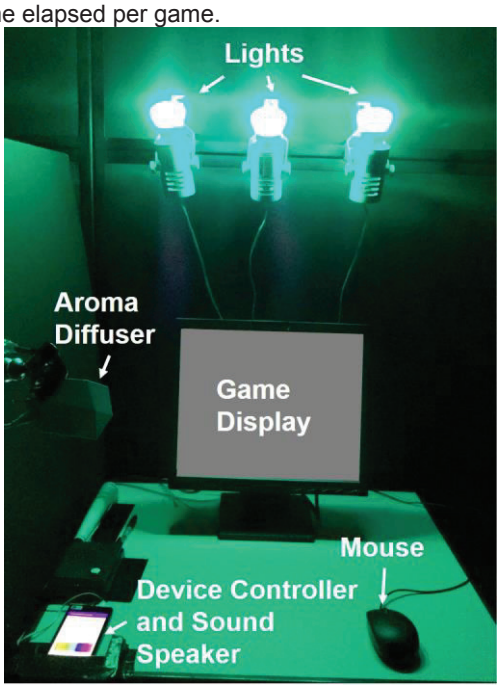

Fig. 4 Experimental setting

3.2 Results and Discussion

During the allocated 45 minutes, 7/9 of the subjects' scores increased under Buddy System control, whereas 5/9 of the scores increased under random control. Conversely, user control alone reduced the scores of 8/9 of the subjects.

Most of the users could not sustain their concentration for 45 minutes. Therefore, the score typically decreased throughout the 45 minutes of game play.

Aided by the proposed "Buddy System", 7/9 of the subjects improved their game scores. By controlling the three devices, the "Buddy System" adapted to the users' focus on the tasks.

However, the scores of 5/9 subjects were improved by random control, suggesting that auto-control itself benefits task concentration. Meanwhile, under test condition (3), the user was required to set the controls manually, which appeared to interfere with concentration.

Overall, an auto-control system, especially an adaptive auto-control system such as "Buddy System", creates an environmental state that leads the user's mind into the desired state.

4 CONCLUSION

The "Buddy System" was shown to adapt to the user's state of mind and preferences, enabling a heightened concentration state during an assigned task. Individual preferences are important for leading the user's mind into the desired state, not only of concentration as described above, but also of relaxation or another desired state of mind. Image displays can also alter a user's state of mind [4]. Users of "Buddy System" can select an image that suits their state of mind and their preference, which can be displayed on the wall display at home or on the PC screen in the office.

In this article, "Buddy System" was applied to devices installed in spaces, such as homes and offices. "Buddy System" also supports car passengers, who can work or relax by controlling various attached devices while traveling.

In the near future, autonomous home-robots are expected to support human life. The "Buddy System" can potentially control such robots to respond to users' states and individual preferences. Because it adapts to individual preferences, "Buddy System" can become a user companion. Humans who develop attachments to machines (such as Roomba) tend to endow them with personality. Home robots and other machines with "personality" can acceptably interact with humans even in home environments.

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