

Healthcare System Focusing on Emotional Aspect Using Augmented Reality: Control Breathing Application in Relaxation Service

Somchanok Tivatansakul¹ and Michiko Ohkura²

¹ Graduate School of Engineering, Shibaura Institute of Technology, Japan
nb12505@shibaura-it.ac.jp

² College of Engineering, Shibaura Institute of Technology, Japan
ohkura@sic.shibaura-it.ac.jp

Abstract. We proposed a new healthcare system that focuses on emotional aspects to deal with negative emotional health in daily life. Our healthcare system integrates augmented reality to display virtual objects in real environments and Kinect, which allows users to freely interact with them. We also employ biological sensors to measure and detect user emotions, and provide three services based on their expected emotions: Relaxation Service, Amusement Service and Exciting Service. To implement a small prototype of this system, we have developed one application in relaxation service: Control Breathing Application. This application applied deep breathing techniques of stress management to supports users when they experience stress. This application displays a virtual music box to assist them perform deep breathing. Virtual objects and music can increase user relaxation and decrease their stress. The experiment is performed to measure the effectiveness of the application. From the result, our application can effectively decrease users stress when they experienced our application for short time.

Keywords: Emotion, Healthcare, Augmented Reality.

1 Introduction

In recent year, the design and implementation of ubiquitous system, intelligent space system and healthcare system are very popular. The basic idea of these systems is to automatically monitor the environment including human to provide assistance and services to them. Several systems are proposed to emphasize the support of the physical aspects at the expense of emotional aspects. However, emotional health is also important as much as physical health and negative emotional health can lead to such social and mental health problem as suicide problem.

We proposed a new healthcare system that focuses on emotional aspects using augmented reality to deal with negative emotional health in daily life. Our system provides services that allow users to interact with virtual objects in real environments to get different positive emotions and decrease their negative emotions. This system is

designed to provide three services: Relaxation Service, Amusement Service and Exciting Service [1]. This paper focuses on Relaxation Service.

2 Relaxation Service Design

To implement a small prototype of this system, we have designed one application in relaxation service: Control Breathing Application.

2.1 The Design of Control Breathing Application

This application increases user relaxation with the deep breathing techniques of stress management [2]. The workflow of this application is shown in Fig. 1.

First, users can request this application in the relaxation service by web browser. Then they can start using this application by showing an AR marker to camera. The application detects the AR marker and displays a virtual music box, which slowly turns and plays music. The users inhale and exhale in harmony to the turning of the music box to control their breathing. While they are controlling their breathing, the ECG sensor on their chest records ECG signals to detect their respiration. If it isn't in harmony with the virtual music box, the application suggests that they breathe more shortly or deeply. The application continues to support users until they feel more relaxed. Our control breathing application is shown in Fig. 2.

3 Implementation of Control Breathing Application

Control breathing application synchronizes the results from augmented reality application which detect AR marker and display a virtual music box, and breathing detection which convert ECG signal to respiratory signal in order to detect inspiration and expiration. To implement control breathing application, we also need to implement augmented reality application and breathing detection as we describe below.

3.1 Augmented Reality Application

This application is implemented based on FLARManager [3] that build augmented reality applications for Flash more easily. The control breathing application will use this application to detects AR marker to render and display a virtual music box [4].

3.2 Breathing Detection

This breathing detection utilized ECG sensor to converts and analyzes ECG signal for detect respiration signal using ECG signal processing [5-6]. Our breathing detection derived the respiratory signal from estimation of the R-wave amplitude modulation [7]. This method performs low pass and notch filter to remove noise. QRS Detection is performed to detect QRS Interval. Then we remove baseline wander noise. After that,

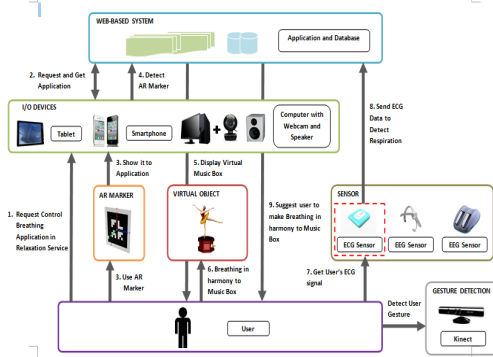


Fig. 1. The workflow of control breathing application



Fig. 2. Control breathing application

cleaned ECG signal is produced to detect peak amplitude and location of each RR-Interval in order to estimate respiratory signal. Then the interpolation is performed to smooth signal and down-sampled sampling rate in order to get respiratory signal. After that, we normalized the signal in order to easily detect inspiration and expiration signal and calculate time of inspiration and expiration. The control breathing application will use this application to detects users' respiratory signal and control their inhale and exhale in harmony with a virtual music box to increase their relaxation according to stress management technique.

4 Evaluation

We have performed the experiment with five young participants: four females and one male. This experiment is set to check this application that it can decrease stress effectively and to evaluate the participants' feeling when using this application [8].

4.1 Experiment

We have performed experiment to evaluate the effectiveness of the control breathing application by measuring stress of each participant using Cocoro Meter. This equipment measures the salivary amylase [KU/L] from saliva and classifies it into the stress

Table 1. Questions for evaluate user feeling

#	Questions
1	During using this application, you feel relax.
2	During using this application, you feel comfortable.
3	During using this application, you feel boring.
4	During using this application, you feel sleepy.
5	During using this application, you like it.

level. In addition, this experiment also evaluates the participants' feeling using questionnaire with the 5-point Likert scale where five is highest score (Strongly Agree) and one is lowest score (Strongly Disagree). The questions are shown in Table 1.

The experiment procedure is separated into two periods.

- *Stress Increase Period*: each participant performs English calculation exercise about addition, subtraction, multiply and division. We provided 70 questions; all participants need to answer the questions as much as they can within 20 minutes. The participants need to perform mental calculation and answer in English. Mental English calculation might be able to increase their stress.
- *Stress Decrease Period*: the participants use our control breathing application for ten minutes. They need to put ECG sensor in order to performed deep breathing and controlled their breathing. They listened to the classical music and watched the slow turning of virtual music box. The deep breathing techniques of stress management, the classical music and turning of 3D object might be able to decrease their stress.

The process to perform experiment is: firstly, the participants performed salivary amylase test to measure their current stress. Then the stress increase period is served to the participants for 20 minutes in order to increase their stress. After that, the participants performed salivary amylase test again. Then the stress decrease period is served to the participants for ten minutes in order to decrease their stress and increase their relaxation. Every five minutes past, the participant performed salivary amylase to check their stress. Finally, the participants answered the questionnaire to evaluate their feeling.

5 Result and Discussion

From the measured salivary amylase of all participants, if the measured data increases, it can indicate that the participants get more stress. If the measured data decrease, it can indicate that the participants get more relax. This experiment evaluate only the application can make user feel relax and decrease their stress. We calculate the percentage of users who got more stress after performing English calculation. We also calculate the percentage of users whose stress decreased while using our application for five and ten minutes. The percentage is shown in Table 2.

From the result in Table 2, after the participants used our application for five minutes, 80% of all participants feel more relax and their stress decreased. 40% of all

Table 2. Analysis Result of Effectiveness Aspect

	Stress Increase	Stress Decrease	Same Stress
After Stress Increase Period	60 %	20%	20%
After Stress Decrease Period 5 minutes	0 %	80 %	20%
After Stress Decrease Period 10 minutes	20%	40 %	40%

participants also feel more relax after using our application for ten minutes. However, some people didn't feel relax after using our application for five minutes but ten minutes pass, they feel more relax. Some people feel more relax after using application for five minute but they get more stress after using our application for ten minutes because they might feel tired when controlling their breathe for a long time.

From the analysis result of questionnaire, users agree that they feel relax, comfortable, boring and sleepy while using our application. However, they don't feel like or dislike when they use our application [8].

6 Conclusion

We proposed a new healthcare system that focused on emotional aspects for supporting adolescents and adults such as students and working people in daily life. The system can provide three services: relaxation, amusement and exciting service. This paper focuses on overall system design, the design, implementation and evaluation of control breathing application for relaxation service. From the experimental result, we can summarize that when users experience the application, they feel relax, comfortable and sleepy. However, they also feel boring. Moreover, we observed that our application can effectively decrease users stress when they experienced our application for short time. The improvement of relaxation service, the design and implementation of other services remains future works.

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