PERPUSTAKAAN UMP
0000071502

INTEGRATED ENVIRONM)BACK GAME (IEPBG) USING GALVANIC SKIN RESPONSE (GSR) SENSOR

CHANG KWEE MING

A thesis submitted in partial fulfillment
of the requirements for the award of the degree of
Bachelor of Computer Science (Software Engineering) with Honours

Faculty of Computer Systems & Software Engineering
University Malaysia Pahang

MAY 2012

ABSTRAK

Tujuan projek ini adalah untuk pembanguan aplikasi yang bernama "*Integrated Environmental Protection Biofeedback Game (IEPBG) Using Galvanic Skin Response (GSR) Sensor*" yang mana projek ini merupakan satu permainanan biofeedback yang digunakan untuk memberi kesedaran tentang masalah perlindungan alam sekitar. Pada zaman sekarang, perlindungan alam persekitaran merupakan perkara yang amat hangat dalam perbiancangan. Konsep bertajuk 3R (*reduce, reuse, and recycle*) merupakan suatu pendekatan yang berhubung kait dengan ekosistem. Permainan biofeedback juga membolehkan pemain untuk mengawal emosi dari semasa ke semasa. Dengan menggunakan alat penghubung yang bernama "*Galvanic Skin Response (GSR) Sensor* ", permainan ini telah menjadi lebih menarik dan mencabar dalam pengawalan dari segi emosi dan rohani manusia. IEPBG merupakan salah satu permainan komputer yang berintegrasi dengan *GSR sensor*. *GSR sensor* digunakan bertujuan untuk mengesan pemain dengan mengukur *skin conductance level (SCL)* ketika permainan dimainkan oleh pemain tersebut. Prototaip bagi "*IEPBG using GSR sensor* " memang sesuai untuk semua manusia tanpa mengira bangsa dan umur sekiranya dia ingin mencabar diri sendiri dalam pengawalan emosi diri sendiri.. Permainan ini juga dapat menganalisis GSR data melalui laporan. Melalui permainan tersebut, ia akan menunjukkan laporan ringkas apabila kebangkitan nafsu seseorang pemain itu tinggi, ini bermaksud kesedaran tentang perlindungan alam sekitar dirinya tinggi. Sebaliknya, jika seseorang itu adalah rendahnya dalam kebangkitan nafsu, maka dia kurang mengambil tahu kesedaran tentang perlindungan alam sekitar.

ABSTRACT

The purpose of this project is to develop the application called Integrated Environmental Protection Biofeedback Game (IEPBG) Using Galvanic Skin Response (GSR) Sensor, which is a biofeedback game that gives awareness about the environmental protection issues. A biofeedback game is built due to the several approaches to environmental protection that are currently discussing. The concept of reduce, reuse, and recycle (3R) approaches is interrelated to the ecosystem approaches. The biofeedback game engage out emotion on a moment-by-moment basis, and using those emotions as an input gives games the potential for more dynamic and immersive environments. IEPBG is a game which integrated with the galvanic skin response (GSR) sensor. GSR sensor is use to detect the skin conductance level (SCL) while the players play this biofeedback game. The prototype of the IEPBG using GSR sensor is suitable for all human in order to do as an emotion application while integrates with the GSR sensor. It will help the players to view the SCL activity report. Through the development of this game, it shows the result with when the arousal is high, the awareness on environmental protection will high. While the arousal of the player is low, the weak of the awareness on environmental protection.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATION

NAME	DETAILS
IEPBG	Integrated Environmental Protection Biofeedback Game
GSR	Galvanic Skin Response
SCL	Skin Conductivity Level
UMP	University Malaysia Pahang
3 R	Reduce, Reuse, Recycle
ECG	Electroencephalographic
HRV	Hear rate variability
BVP	Blood Volume Pulse
PPG	Photoplethysmography
USB	Universal Serial Bus
EMG	Electromyography
IMBC	Institution for Medical & Biological Cybernetics
NASA	National Aeronautics and Space Administration
L.I.F.E.	Living Information Forms Energy
ANN	Artificial neural network
GA	Genetic algorithm
CBR	Case based reasoning
SNN	Semantic Neural Network
RUP	Rational Unified Process
XP	Extreme Programming
MATLAB	Matric Laboratory

CHAPTER 1

INTRODUCTION

This chapter briefly discuss about the overview of the project which related to the project that will be developed later. In this chapter, it comprises five sections. The first section is introduction, which describes the background of the project. The second section describes the problem statement of the project. Next are the third section describes the objectives of the project's goals. The fourth section describes the scopes of for the project and discuss about the limitation for project and users. Lastly is the thesis organization which briefly describes the sequences for each chapter of this thesis.

1.1 Background of the Project

The term biofeedback was reportedly coined at the first annual meeting of the Biofeedback Research Society in 1969, as shortened version of "biological feedback" (Everly, George S. Lating, Jeffrey M. , 2002). In 2008, referring to the three organization, the Association for Applied Psychophysiology and Biofeedback (AAPB), Biofeedback Certification Institution of America (BCIA), and the International Society of Neuron-feedback and Research (ISNR), biofeedback is a treatment technique that enable an individual to train their physiological activities by learning and gains control of his/her responses ((AAPB), Association for Applied Psychophysiology and Biofeedback, 2008). Environment protection is one of a practice of protecting the environment, on individual, group and human(s). Reduce, Reuse and Recycle (3R) awareness is nowadays is the most high-concerned for environment-related health and safety issues in a global trends (D. Tondeur and I. Gaballah, 2002).

Due to pressures of population and high-technologies, the biophysical environment is being degraded. With a strong society in Malaysia, a biofeedback game is reflected to many new generations (Biofeedback Lab, 2011) . One of the method requires to improve their meditations in a hypertension society is biofeedback game, which teach us relaxation and mediation techniques with modern science sensor. Biofeedback may still consider "high-technology" therapy that may be used to engender a relaxation response, thus treating the stress response itself (Everly, George S. Lating, Jeffrey M. , 2002) .

Hence, the project with title Integrated Biofeedback game Environmental Protection using Galvanic Skin Response (GSR) sensor is a biofeedback game which using a GSR. This game is based on the theme park, which one of the Malaysian environmental protection area. The player just needs to get up their awareness about environmental protection to play the game by collecting the tins, plastic, and newspapers. The GSR sensor is a measure of conductivity of human skin and provides an indication of changes in human sympathetic nervous system (SNS) (Shi, Yu; Ruiz, Natalie; Taib, Ronnie; Eric, Choi; Chen, Fang, 2007). It will monitor the overall of the player's skin conductivity between two reusable electrodes which attach to two fingers of one hand. Hence, we can analysis the skin conductivity data as well.

1.2 Problem Statement

Nowadays, biofeedback game is a powerful technology which enables us to experience and control own body blood pressure, skin conductivity and heart rate variability and so on. Because of our increasingly sophisticated computer and electronics, biofeedback is now realizing its full potential. Most of the countries peoples in this world, difficult to control their emotion no matter in a working place or home. It is because the difficulty to monitor the skin conductivity between two reusable electrodes attached to two fingers of one hand. The increasing of moisture on the skin will allow the current flow to both electrodes. The heart beat per minute data shows that the skin conductivity data of the players accuracy. Second, it is also difficult to generate a report

for the pulse rate via this biofeedback game. It is undeniably for this biofeedback game also has high education learning to the users while they are getting the 3R spirit.

1.3 Objectives

The objectives of the research are as follows:

i. To develop an environmental protection biofeedback game using GSR sensor in order to give awareness about 3 R Concept (Reduce, Reuse, Recycle).
ii. To measure the player's skin conductivity via biofeedback game.
iii. To generate a summary of the player's skin conductivity via biofeedback game.

1.4 Scopes

The scopes of this project are:

i. System Functionality

   The game give awareness about the environment protection with 3R (Reduce, Reuse, Recycle) concept.
ii. System User

   This biofeedback game can be played by all users by measure the skin conductivity using GSR sensor.
iii. Data

   Skin conductivity level (SCL) using GSR sensor
iv. System Architecture & Platform

   The game gives summary to the player's skin conductivity by using GSR sensor.

1.5 Thesis Organization

This thesis consists of six (6) chapters. Chapter 1 Introduction will discuss the system briefly. This system will preview the problem statements of the system, objectives, scopes, and how the report is organized sequence. In Chapter 2 will explain the existing systems and different types of method that can be used as the cases studies of this project. These chapters also explain about the technique, method, equipment and technology that conducted in the case studies. Methodology, reviews about the overall of designing and implementing of the project are given in Chapter 3. This chapter also discusses the method, hardware and software needed for the project while conducting the project. Next, Chapter 4 presents the implementation, will explain about the designed project development throughout this thesis. Chapter 5 Results and Discussion will explain the results and the summarized of the project. This chapter also expected the limitation and enhancement of the project once the result analysis is parallel to the project problem statement. Finally, the conclusion and the future works are presented in Chapter 6. Appendices will be added after the last chapter of this project. There are comprises of Gantt chart, reference links and others that relevant to the project.

CHAPTER 2

LITERATURE REVIEW

In this chapter, it will briefly discuss about the literature review of the Integrated Environmental Protection Biofeedback Game using Galvanic Skin Response (GSR) sensor. There are several parts in this chapter which are existing system review, techniques, methods, equipment and technologies review while related to the concept during develop the game.

2.1 Introduction

Literature review is one if the important resources part which aim to review the critical points of the current knowledge as well as theoretical and methodological contribution to the project. Literature review divided into few parts that required getting the information about project which include the review about the methods, equipment, and technologies.

2.2 The Concept of the Project

There are concepts that need to deeply classify for this project. First of all, is the biofeedback concept, and then followed by the environment protection with recycle, reuse, and reduce (3R) concept, which related to the game of development process. Next, the concept of the game then followed by biofeedback concept which contributes physiological activity to the player. The concept of the sensor technology also briefly discuss in this section.

2.2.1 The Concept of Biofeedback

There have three organizations of biofeedback, Biofeedback Certification Institution of America (BCIA), Association for Applied Psychophysiology and Biofeedback (AAPB), and the International Society for Neurofeedback and Research (ISNR). They are research that the biofeedback techniques are early found at the 1960s which can improve our performance based on human activities (Association for Applied Psychophysiology and Biofeedback (AAPB), 2008). It is one kinds of the human process that enables a human to learn something new which is the changing of physiological activity due to the improving performance and healthy as well for their main purpose. The measurement of the physiological activity should be using the consistency instruments like the skin temperature, heart function, brainwaves, breathing, muscle activity, and the others which can evaluate our human activities as well (Bruno, 2008).

Throughout the years of research which done by the scientist, they are starting to demonstrate the whole body of the physiological activities like heart beat rate function, skin temperature, muscle control activity and the others as long as their aims to help the patient to get their self-ability control using precise instruments. (Bruno, 2008).

While the biofeedback therapist call the trainees sit on a comfortable chair, the surrounding must in a quiet place. This biofeedback training took around 20 minutes to 50 minutes to do the practices. Basically, this training will be instructing with the biofeedback device such as skin conductivity monitors like galvanic skin Response Sensor (GSR), Electroencephalographic (ECG) monitors, electromyography (EMG) monitors which accessible based on muscles reaction and heart/ pulse rate monitors (David Bray, 1998).

2.2.2 The Concept of Environmental Protection

In this century, there are many issues in the global world. Promoting of Reduce, reuse, and recycle (3R) are one of the good practice to encourage us to me more

environmentally conscious of their surroundings. According to the Mahatha Gandhi, he said that It will be the change you wish see in the world, it described the invention of managing your waste with 3R concept to the future generation which the earth do belong to them (Jufoo, 2008). One of the best practices to save and protect our environment is the environmental protection which can bring lots of benefits based on the flora and fauna natural environment or our human in different kinds of levels (Wikipedia, 2011).

The 3R concept is basically depends on the classifying of the waste management in order to avoid any kinds of pollution such as water and air pollution strategies according to the levels of importance in preventing the waste and pollution. Reduction is the first stage in 3R, is ideally waste should be avoided by optimizing the production process; manufacturers can reduce the waste or even allow it to be reused by another manufacturers. Reuse occurs when the unnecessary things that had fulfilled already its original of its functionality then convert it for another objective to use for it. For examples, the reusable bins like glass bottles or polyethylene terephthalate (PET), steel drums and others water bottles or plastic bags that are reused as liners for household waste bins (DaZhu, 2008).

The third phase of 3R, recycle is reducing the amount that we consumed, shifting to another well-designed products and services (Team Treehugger, Worldwide, 2007).

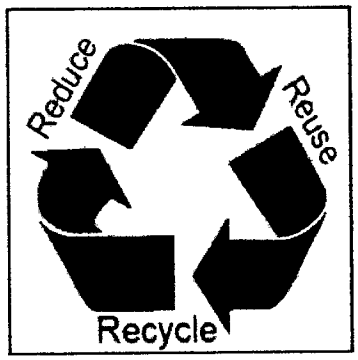

Figure 2.1 3R Logo (Self Improvement 2U, 2009)

2.2.3 The Concept of Game

While designing a game, the characters must be fit pieces into an existing field of the platform game; convention, rules and principles limit how they may move; and they

flexible, and how to arrange the rules and make it the character move in different types of situation. Comparing to the real time experiences, the game enables us to investigate how the motions of the character's game design close to the game's environment that is manipulated. (N.John Habraken, 1988). The game is used to describe the motion of the character, the response of the action, and the environments of the game. To verifying the decision of the reality model, the game is used as models for it in order to simulate the character of the function.

The more efficient way to gain the human behavior while they are in a controlling environment, games platform is one way to fact it out the reality and we can learn from it. Mostly, the most famous of the games which designing for sharpening our human minds which called the educational game. Hence, this can gain logical overview and cope with real situation with players (Schijns, 1996).

A good game with excellent concept are with an easy instruction, intuitive look design and feel, a good interaction among players, a challenging environment and optional on something to collect in-game such as coins, trophy, cards and so on (Schijns, 1996).

2.2.4 The Concept of Biofeedback Game

According to the Life Matter, an anonymous said that the biofeedback is early invented over 40 years by the specialist such as the biofeedback therapists, physical therapists, and physicians. They were found that mostly of the human are in a stress condition. Due to solve this problem the effective way is to help them to overcome the anxiety which related to the human brain's disorders. Early 1940s, all the equipment has been use and built in the house. In this 21st centuries, biofeedback equipment become an enjoyable things that allow any users to use from how relaxing their minds in a low cost effective way. The biofeedback equipment like finger temperature or skin conductance or the heart rate can directly give the users to know their physiological of humans (Why Biofeedback Games, 2008).

There is always having a combination of hardware (for monitoring the human's physiology) and software (for connecting the computer) in a biofeedback platform game

application. This will cause the uniqueness of the biofeedback game such that the developers of these games create a computerized world similar to any other computer game using biofeedback concept (S.E. Smith, 2008).

Figure 2.2 A biofeedback computer game-based using pulse detector. (Maricic, Pang Leang, Lazareva, & Bazanova, 2005)

A player needs to connect the device to the computer which will provide input for the game. Players may wear gloves, hear rate (HR) monitors, GSR sensor and so forth. The game may present on the screen with some biofeedback games instruction being towards to a virtual reality mode of play (S.E. Smith, 2008).

2.2.5 The Concept of Skin Conductance

The GSR is one of the methods that used for measuring the electrical conductance of the skin, which evaluating varies its moisture level. Galvanic Skin Response (GSR) is well known as the skin conductance or electro-dermal response (EDR), skin conductance response (SCR) or skin conductance level (SCL). This is of interest because the humans' sweat glands are controlled by the sympathetic nervous system, so the skin conductance is used as an indication of psychological or physiological arousal for the biofeedback (Wikipedia, 2011).

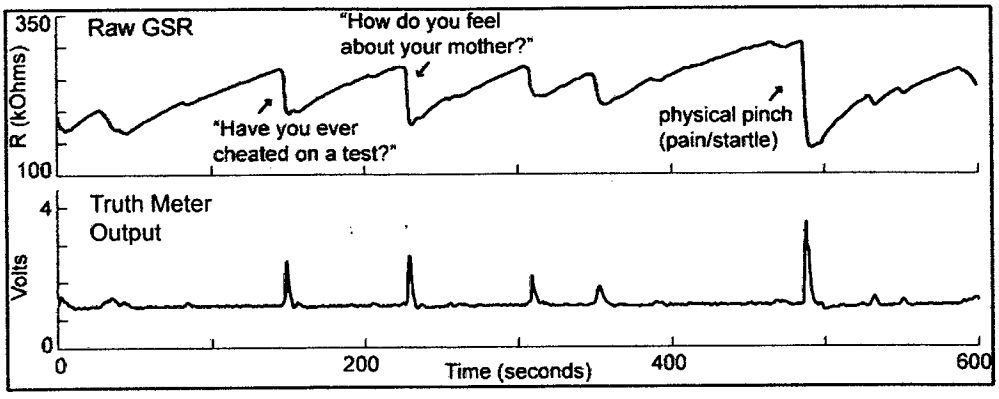

Figure 2.3 The rhythm of the skin conductivity level (SCL) between 600 seconds (Product Consumer Robot-GSR, 2011)

2.3 The Technology

Technology is one of the practical applications or method in science to the specific function in industries and commercial by overcome the problem or perform a specific function. In this project, the technology that going to be use is the sensor technology. The sensor technology brings a lot of advantages and disadvantages to the human beings.

2.3.1 The Sensor

Detector is one of the sensors; it is also called a device that measures a physical quantity and converting it into a specific signal which can be done by an instrument. Sensors are widely used in many different applications, and sensor technology has become a basic enabling technology in many instances (National Academic Press, 1995).

2.3.1.1 The Body Temperature Sensor

A body temperature sensor is a device that can be used to gather data concerning to the human's temperature from a source and converts it to specific format which can

easily for us to understand either by an observer, an specialist or another input device (What Is a Temperature Sensor, 2010)..

The body temperature sensors usually come out from different kinds of forms. It is used for a simple home to use to get an extremely accurate and precise scientific use. The powerful of the body temperature sensor is consists of handheld remote control and remote environment, which is touchscreen panel and the graphical user interface while tracking the customer capture the temperature and pressure information (What Is a Temperature Sensor, 2010).

One of the good for the temperature sensor is the mercury-in-glass thermometer. Mercury expands and contracts based on the environmental changes in the room's temperature; when these volume changes are quantified, temperature can be measured with a fair degree of accuracy (What Is a Temperature Sensor, 2010).

A more complex temperature sensor will generally be computerized for more accurate results. Mercury-in-glass thermometers are used for the nonscientific purposes because they are not extremely accurate. They only used in the high school or college chemistry labs when a very accurate measurement of temperature is not important (What Is a Temperature Sensor, 2010).

A digital temperature sensor will be calibrated to be far data and it's become more accurate. A temperature sensor will typically exist in one of two forms either in contact sensors which measure their current temperatures and then after they have to achieve the thermal's equilibrium with their suitable environments. The other form is the noncontact sensors measure heat radiation from their environments within a given area. Different level of error in their readings, as temperature is quite difficult to measure accurately if all the heart transfers together at the same time (What Is a Temperature Sensor, 2010) .

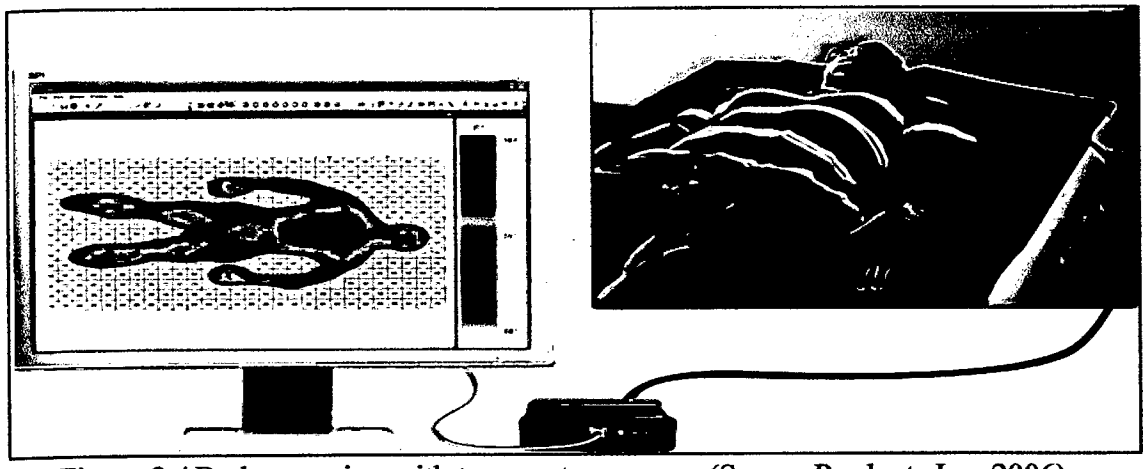

Figure 2.4 Body mapping with temperature sensor (Sensor Products Inc, 2006)

2.3.1.2 The Finger Tips Pulse Sensor

Medical device such as a finger tips pulse sensor is indirectly monitors the saturation of oxygen in patient's blood and continuously changes in their blood volume in the skin. Mostly of the finger tips pulse sensor is display the human's heart rate. This device can also be a portable device which consists of the battery-operated pulse oximetry. This can be also available for home blood-oxygen monitoring (Wikipedia, 2011). The arterial blood vessels expand and contract with each heartbeat while the signal is monitored and its bounces in time with the heartbeat. While evaluating the varying part of the absorption spectrum, another monitoring platform can ignore other tissues or nail polish and discern only the absorption caused by arterial blood. Hence, there is no function work well if the device cannot detecting a pulse is essential to the operation of a pulse oximetry (Wikipedia, 2011).

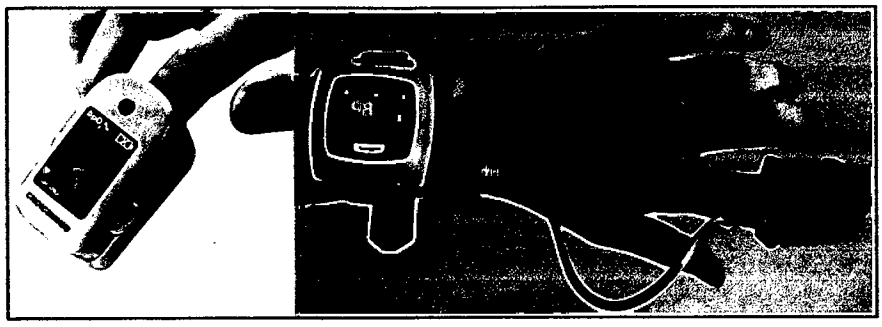

Figure 2.5 Examples of Finger Tip and Wrist Oximetry Pulse Sensor (Wikipedia, 2011)

2.3.1.3 The Galvanic Skin Response (GSR) Sensor

In 1900s, the GSR which called Galvanic Skin Response being popular and it is used for the biofeedback treatment such that caused by the degree to which a human's sweat glands are active. Psychological stress are tends to make the glands more active and this will lowers the skin's resistance while using this device. The Galvanic Skin Response GSR sensor device is very simple and easy to use for it. It will cut down the 9V LEGO motor wire and some of the aluminum foil wrapped around to our fingers with tapes. Generally, it is well-known as a lie detector or psycho-galvanometer, but it is only used in Biofeedback Physiological condition. From the theory side, it is found that; the human's more relaxing you are, the dryer of the skin will be and so the higher value of the skin's electrical resistance. When the human are under stress, then the hand will getting sweats and then the resistance of the values will decrease compare to the relaxing time (Biofeedback Products, 2001)

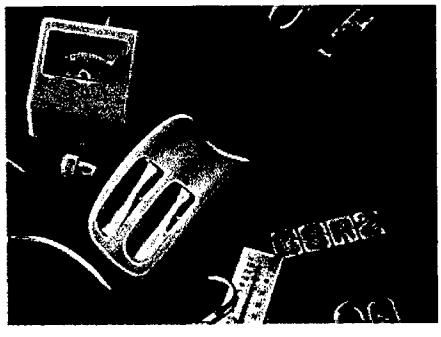

Figure 2.6 A set of Galvanic Skin Response sensors (Biofeedback Products, 2001)