INTEGRATED MALAYSIAN CULTURE BIOFEEDBACK GAME USING PULSE SENSOR (IMCBG)

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ABSTRACT

Nowadays the biofeedback game is used by the practitioners, the clinician, and the patients who suffer under stress disease to control the player's heartbeats. There are several biofeedback game invented in United States and Russia. However, the Malaysian customized biofeedback game is not found in Malaysia. Therefore, this biofeedback game introduces the Malaysian culture, Wau and it can load the Malaysian player's information faster by using MyKad card reader. The purpose of this study is to develop a prototype of Integrated Malaysian Culture Biofeedback Game Using Pulse Sensor (IMCBG). IMCBG is a smart card-aware application as it can load the Malaysian player's information from MyKad automatically and saves the time to key in the data from keyboard. IMCBG is a biofeedback game that helps to control the player's heartbeats through the pulse sensor. The administrator can analyze the player's data and generate the report from the data online. The prototype is developed using spiral model as the prototype can be improved at the next spiral. The prototype will be able to introduce the Wau to the player, read the Malaysian player's information from MyKad, get the player's heartbeat data from pulse sensor, keep the data in centralized database and generate the report. It will help the user to access the data and report easily through online.

ABSTRAK

Pada masa kini, *biofeedback game* digunakan oleh pengamal, doctor dan pesakit yang menghidap penyakit yang berkaitan dengan tekanan untuk mengawal denyutan jantung pemain *biofeedback game*. Beberapa *biofeedback game* telah dicipta di Amerika Syarikat dan Rusia. Namun, yang khas untuk masyarakat Malaysia belum dijumpai di Malaysia. Jadi, *biofeedback game* ini direka untuk memperkenalkan budaya Malaysia, Wau dan *biofeedback game* ini dapat mengambil data daripada MyKad dengan menggunakan alat pembaca kad pintar. Objektif utama dalam kajian ini adalah untuk menghasilkan satu prototaip untuk *Integrated Malaysian Culture Biofeedback Game Using Pulse Sensor* (IMCBG). IMCBG merupakan satu aplikasi yang melibatkan penggunaan kad pintar. Teknologi alat pembaca kad pintar yang digunakan untuk memperoleh maklumat daripada MyKad pelawat dapat menjimat masa untuk memasukkan maklumat pemain. IMCBG merupakan *biofeedback game* yang dapat mengawal denyutan jantung dengan menggunakan alat perasa nadi. Pihak berkuasa dapat menganalisa data pemain dan menghasilkan laporan daripada data atas talian. Prototaip IMCBG dibangunkan dengan menggunakan *spiral model*. Hal ini demikian kerana prototaip yang dibangunkan dapat diubahsuaikan dengan lebih baik dalam *spiral* yang seterusnya. Prototaip ini akan dapat memperkenalkan Wau kepada pemain, mendapatkan maklumat pemain daripada MyKad, memperoleh data denyutan jantung pemain daripada alat perasa nadi, menyimpan data di pangkalan data dan menghasilkan laporan. Prototaip ini juga akan membantu pengguna mengakses data dengan mudahnya melalui talian.

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LIST OF ABBREVIATIONS

APDU - Application Protocol Data Unit

API - Application Programming Interface

ATM - Automated Teller Machine

CAD - Chip Accepting Device

CPU - Central Processing Unit

DBMS - Database Management System

ERD - Entity Relationship Diagram

GMPC - Government Multipurpose Card

HRV - Heart Rate Variability

ICC - Integrated Circuit Chip

ID – Identification

IFD - Interface Device

IMCBG – Integrated Malaysian Culture Biofeedback Game

I/O - Input Output

ISO - International Standards Organization

JPN - Jabatan Pendaftaran Negara (National Registration Department)

MSC - Multimedia Super Corridor

MyKad - Malaysia Multipurpose Smart Card

NVM - Nonvolatile Memory

OS - Operating System

PC - Personal Computer

PC/SC - Personal Computer/Smart Card

RAM - Random Access Memory

ROM - Read-Only Memory

SAM - Secure Access Module

SDK - Software Development Kit

SDLC - Software Development Life Cycle

SQL - Structured Query Language

SSP - Smartcard Service Providers

TRG - Tumor Regression Grade

USB - Universal Serial Bus

XP - Extereme Programming

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CHAPTER 1

INTRODUCTION

This chapter briefly discuss on the overview of this research. It contains five sections. The first section is introduction; follow by the problem statement. Next are the objectives where the project's goal is determined. After that are the scopes of the system and lastly is the thesis organization which briefly describes the structure of this thesis.

1.1 Introduction

According to Association for Applied Psychophysiology and Biofeedback in 2008, biofeedback is a process that allows an individual to learn how to change the physiological activity for the purposes of improving the health and performance. A biofeedback game is a game which is controlled through input from biofeedback devices. The patient controls the game with his or her body, with the game responding to things like changes in heart rate, blood pressure, sweating, and skin temperature (Smith, 2010).

Malaysia is a multi-ethnic, multicultural and multilingual society. Within Malaysian society, there is a Malay culture, a Chinese culture, an Indian culture, a Eurasian culture, along with the cultures of the indigenous groups of the peninsula and north Borneo

(Advameg Inc., 2010). Malaysians' strong sense of community is reflected in many of their traditional games and pastimes (Tourism Malaysia, 2009). Wau is one of these traditional games which are still very popular till now. Flying wau is a relaxing activity that is favored by the Malaysian culture nowadays.

Integrated Malaysian Culture Biofeedback Game (IMCBG) using pulse sensor is a biofeedback game which is based on wau, which is one of the Malaysian culture. The player just has to put his/her finger on the sensor to play the game. IMCBG captures and stores the player's data by using sensor. Then, the player's data will be kept into a database which allows the administrator to keep track of the player's information.

1.2 Problem Statement

Biofeedback game is very popular at anywhere nowadays to help and train the patient to control the physiological activity. However, there is no Malaysian customized biofeedback game invented in Malaysia. This means that the user have to always key in the player's information. The costs to acquire the biofeedback game, equipment, and the system from other countries like United States of America and Russia are relatively expensive. Most of the biofeedback game that used by the practitioners related to the heart beats. It is because the heart beats data shows the condition of the player precisely. Nevertheless, it is difficult for patient to be trained to control his/her heart beats manually. Besides that, the available biofeedback game in the market does not keep large amount of the users' data and information.

1.3 Objectives

There are several objectives of this research:

i. To develop a prototype of Integrated Malaysian Culture Biofeedback Game using pulse sensor (IMCBG).

ii. To capture and store the player's personal information from player's MyKad using MyKad reader.

iii. To produce customized reports for the biofeedback game.

1.4 Scopes

The scopes of this project are:

i. The biofeedback game developed is related to wau only.
ii. The system captures and records only one user data at one time using one pulse sensor.
iii. The game displays the data in real time.
iv. The system assigns only one id for every player.
v. The system extracts and records only one player's information from MyKad at one time using MyKad reader.
vi. The system allows the users to access the data online from the centralized database.
vii. The target users of this system are the patients, practitioners, and any individuals who wish to be trained to control their heart beats.

1.5 Thesis Organization

This thesis consists of four (4) chapters. Chapter 1: Introduction briefly describes and introduces the system. This system preliminary shows the basic concept of the system, problem statements of the system, objectives, scopes, and how the report is organized. Chapter 2: Literature Review depicts the manual systems and the existing systems as the case studies of the project. This chapter also reviews the technique, method, equipment, and technology that had been used in the case studies. Chapter 3: Methodology discusses about the overall workflow in the development of the project. This chapter also discusses the method, technique or approach that has been used while designing and implementing the project. Chapter 4: Implementation describes the process involved in the development of this project. This chapter depicts the Integrated Development Environment (IDE) tools and the important source code of the system. Chapter 5: Result and Discussion discusses the results and the limitations of the system. The suggestions for further improvement of the system are discussed in this chapter too. Chapter 6: Conclusion briefly summarizes the project.

CHAPTER 2

LITERATURE REVIEW

This chapter briefly discusses about the literature review of IMCBG using pulse sensor. There are seven main sections in this chapter. The first main section is introduction of this chapter. Then, the next main section describes the concept. After that, the manual system of the project will be discussed. Next, there are two main sections which discuss several technologies and techniques separately. The next main section discusses the existing system while the last main section reviews the methodologies used to develop game.

2.1 Introduction

Literature review surveys on scholarly articles, books, journal and other literature sources relevant to the area of research for this project. The aim for literature review is to gain a clearer perceptive in developing this project. So, this chapter will explain on all information gathered from previous researches for this project. Firstly, it will include a description of the concepts for this project. The main concepts of this system are biofeedback game and Malaysian culture. This chapter will also include the description of development technology, techniques, and the methodology to develop the system in previous similar case study. The technology section explains the biofeedback devices especially the pulse sensor and other sensors as well as the smart card reader. It includes a description of smart card, components of smart card, Malaysia Multipurpose Smart Card (MyKad), smart card reader and communication process between smart card and smart

card reader. The technique section depicts the game techniques used to develop game. The methodology section in this chapter discusses the methodologies that are related to game development. Studies on the manual system and existing biofeedback game have also been done to discover the strengths and weaknesses of those systems.

2.2 The Concept of the Project

There are several concepts that need to be clearly defined for this project. First of all is the Malaysian Culture. Then, the concept of biofeedback and the concept of biofeedback game will be depicted in this section. The concept of pulse and heart rate will be described in detail in this section too.

2.2.1 The Concept of Malaysian Culture

According to The New Oxford English-English Dictionary in 2009, culture is the customs, arts, social institutions, and achievements of a particular nation, people, or other social group. Malaysia is a country in Southeast Asia, which consists of thirteen states and three federal territories (Central Intelligence Agency, 2010). So, Malaysian Culture means the customs, arts, social institutions, and achievements of Malaysian society. Within Malaysian society there is a Malay culture, a Chinese culture, an Indian culture, a Eurasian culture, along with the cultures of the indigenous groups of the peninsula and north Borneo (Advameg Inc., 2010). Culture of Malaysia is defined in the National Culture Policy of Malaysia in 1971 (Centre for Public Policy Studies (CPPS), 2008). It defines three principles as guidelines for national culture. Firstly, the national culture must be based on the indigenous Malay culture. Secondly, suitable elements from the other cultures may be accepted as part of the national culture. Thirdly, Islam is an important component in the molding of the national culture. Malaysians' strong sense of community is reflected in many of their traditional games and pastimes (Tourism Malaysia, 2009). These activities are still played by local children on cool afternoons and are also a communal activity during festivities such as before or after the rice harvest season and weddings. Wau is one of these traditional games which are still very popular till now.

2.2.1.1 The Concept of Wau

Wau is one of the favorite pastime games in Malaysia. It is called wau because its shape is similar to the Arabic letter that is pronounced as 'wow'. It is a traditional kite that is especially popular in the state of Kelantan, on the East Coast of Malaysia (Tourism Malaysia, 2009). It is a marvelous tradition inherent to the culture of the people, especially in the Eastern States of the Malayan Peninsula. Today, the kite is still widely found in the traditionally rich states of Kelantan and Terengganu, especially during harvest time. With vibrant colors and patterns based on local flora and fauna, these kites are truly splendid sights.

A wau is about 3.5 meters, measured from head to tail (Tourism Malaysia, 2009). Wau has four main parts, namely the head, wings, tail and waist. Bamboo is the main material that is used to make the frame of wau. The bamboo is split and soaked in mud for two weeks to make the frame more flexible and long lasting. Framework that has been completed will be affixed with three layers of paper thin and transparent with different colors. Normally, the wau is played by two people, one people will hold the wau and the other one will hold the rope.

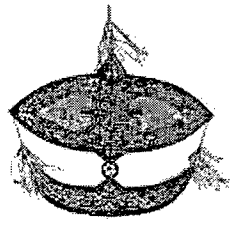

Figure 2.1 Wau (All World Shops Pte. Ltd, Singapore, 2010)

2.2.2 The Concept of Biofeedback

Biofeedback has evolved from a fascination in the 1960s and 70s to a mainstream methodology today for treating certain medical conditions and improving human performance (Association for Applied Psychophysiology and Biofeedback (AAPB), 2008). This evolution has been driven by years of scientific research demonstrating that the mind and body are connected, and that people can be taught to harness the power of this connection to change physical activity and improve health and function (Association for Applied Psychophysiology and Biofeedback (AAPB), 2008).

Bio is a word form meaning life while feedback denotes giving back (Rizk, 2006). According to Association for Applied Psychophysiology and Biofeedback (AAPB) in 2008, biofeedback is a process that allows an individual to learn how to change the physiological activity for the purposes of improving the health and performance. Thus, biofeedback means feeding back information about life responses. These physiological activities and the life responses include temperature, heart rate, brain wave activity, and/or muscle tension (Rizk, 2006). Biofeedback has helped many people combat the ill effects from involuntary muscle tension and related pain (Rizk, 2006).

2.2.3 The Concept of Game

Philosopher David Kelley (1988) defines the concept "game" as "a form of recreation constituted by a set of rules that specify an object to be attained and the permissible means of attaining it. So, a game is a recreational activity involving one or more players, defined by a goal that the players try to reach, and some set of rules that determine what the players can do (WordIQ.com, 2010). Games are played primarily for entertainment or enjoyment, but may also serve an educational or simulation role. In IMCBG using pulse sensor, the game is played for the purpose to train the player controls his/her heart beats.

2.2.4 The Concept of Biofeedback Game

A biofeedback game is a game which is controlled through input from biofeedback devices. The patient controls the game with his or her body, with the game responding to things like changes in heart rate, blood pressure, sweating, and skin temperature (Smith, 2010).

In a biofeedback game, people navigate the game by changing something about their body (Smith, 2010). This change may be conscious or unconscious. For example, changes in breath rate can be manipulated by a player, while pulse is dependent on physiological shifts in the body which the player cannot control. Such games are often designed along a reward model, with the game rewarding the player when she or he achieves a desired change.

Biofeedback games can be used in psychotherapy, to help patients work through stressful situations, and they may also be used in medical imaging studies of the brain, with the patient controlling the game while the brain is scanned to gather information about brain activity (Smith, 2010). For example, a game which is designed to help people relax and promote stress management would reward players for reductions in blood pressure, sweating, and heart rate. Someone might be able to pass through doors, build something, or engage in other activities by lowering stress, while the game would present obstacles when the player was obviously in a stressed state.

To play a biofeedback game, a player needs to be connected to biofeedback devices which will provide input for the game (Smith, 2010). Players may wear gloves, heart rate monitors, sensor, and so forth. The game may be presented on a screen or inside a visor, with some biofeedback games being geared towards a virtual reality mode of play, in which the player feels immersed inside the game. Many such games take on a storytelling or narrative form, with the player working through a series of scenes or puzzles with the game.

2.4.5 The Concept of Pulse

The pulse is the rhythmic contraction and expansion of an artery due to the surge of blood from the beat of the heart (Medicine Net, 2003). The pulse is most often measured by feeling the arteries of the wrist. There is also a pulse, although far weaker, in veins.

Figure 2.2 Pulse Wave (Saunders, 2007)

The figure 2.2 shows an example of the pulse wave. Normal jugular venous pulse A shows a positive wave due to contraction of the right atrium (Saunders, 2007). The normal jugular venous pulse C shows a positive deflection due to bulging of the tricuspid valve toward the atria at the onset of ventricular contraction while the normal jugular venous pulse

X illustrates a negative deflection due to atrial relaxation (Saunders, 2007). The normal jugular venous pulse V shows a positive deflection due to filling of the right atrium against the closed tricuspid valve during ventricular contraction, and the normal jugular venous pulse Y demonstrates a negative deflection due to emptying of the right atrium upon ventricular relaxation (Saunders, 2007).

2.2.6 The Concept of Heart Rate

Heart rate is the number of heartbeats per unit of time. It is typically expressed as beats per minute (bpm), which can vary as the body's need for oxygen changes, such as during exercise or sleep. The measurement of heart rate is used by medical professionals to assist in the diagnosis and tracking of medical conditions. It is also used by individuals, such as athletes, who are interested in monitoring their heart rate to gain maximum efficiency from their training. The R wave to R wave interval (RR interval) is the inverse of the heart rate.

Heart rate is measured by finding the pulse of the body. This pulse rate can be measured at any point on the body where an artery's pulsation is transmitted to the surface - often as it is compressed against an underlying structure like bone - by pressuring it with the index and middle finger. The thumb should not be used for measuring another person's heart rate, as its strong pulse may interfere with discriminating the site of pulsation.

Normal resting heart rates are variable with age, sex, size and overall cardiovascular condition. Heart rate can be determined by taking the pulse. Normal heart rate for an average sized adult is in the range of 60-85 beats/minute.

2.2.7 The Concept of MyKad

According to (National Registration Department of Malaysia , 2005)(2005), MyKad, the Government Multipurpose Smart Card is widely used in many sectors, from the Government to the Financial and Private Sectors. Under the 1959 Act, Malaysians citizens and permanent residents above the age of 12 years are eligible to apply for MyKad as it is required for many legal activities.

The word "My" spelled "M", "Y" signifies Malaysia's internet address whilst the

word "Kad" is the acronym of "Kad Akuan Diri" or translated as "Personal Identification Card" as well as "Kad Aplikasi Digital" (Digital Application Card) and also means "card" (National Registration Department of Malaysia , 2005)

The GMPC is a collaboration of five Government Agencies, which are National Registration Department as the lead agency, Road Transport Department, Royal Malaysian Police, Ministry of Health and Immigration Department. The Malaysian National Registration Department (2005) has highlighted that MyKad has eight applications and replaces the two most important official documents namely the identification card and driving license. Other applications include passport information, medical information, MEPS cash, Touch 'n Go, ATM and Public Key Infrastructure.

The anchor application of MyKad is that MyKad replaces the plastic card-based national identification cards (National Registration Department of Malaysia , 2005). The identification card number is expected to serve as the secure access key to other applications and systems. Open (non-confidential) information inside MyKad consists of original name, identification number, old identification number, gender, birth date, birth place, citizenship, race, religion, address, postcode, city and state. (National Registration Department of Malaysia , 2005)

The key technologies employed to deliver the GMPC system are the chip and biometrics technology, which is able to accommodate further expansion in the future (National Registration Department of Malaysia , 2005). MyKad has an embedded ATMEL 64K EEPROM chip in each card that carries the personal information of the holder (National Registration Department of Malaysia , 2005). The face of the card displays cardholder's identification number, full name, address, nationality, sex, and photograph. The Malaysian Government smart card employs state of the art technology that incorporates multiple layers of security features (National Registration Department of Malaysia , 2005). These features include the card authentication using symmetric key cryptography, a multi-application Operating Systems with firewalls and a secure chip platform.

2.3 The Manual System

In a typical biofeedback session, the client settles into a comfortable chair and is hooked up to the biofeedback instrument with sensors attached to the surface of the skin at various locations on the body (Wall, 2004). The sensor is usually attached on the shoulders,

fingers, back, and head. Electrical impulses from these locations are recorded and reflected on a computer monitor in the form of graphs (Wall, 2004). Additionally, the client may receive auditory feedback reflecting increases and decreases in body system activity in the form of higher and lower musical tones.

Before beginning training, the client's measures in the various modalities are recorded without feedback to give the clinician a picture of the client's overall psycho physiological state. The biofeedback modalities include temperature, electromyography (EMG), basal skin response (BSR), heart rate, respiration, and neurofeedback (EEG). This assessment, which provides a foundation for training sessions to come, is conducted during the client's first visit to BRI, which usually takes one and a half hour (1 ½ hours) to two (2) hours (Wall, 2004). The clinician then prioritizes the issues and problems exhibited by the client. The clinician focuses the training on the most appropriate physiological system. At BRI, the client may be directed to pay particular attention to one physiology, while information on the other body systems is monitored by the clinician (Wall, 2004). While the client is observing the activity of a particular system onscreen, audio feedback in the form of musical tones is also being presented, reflecting activity in the same system or a different one.

Every individual exhibits a unique set of characteristic psycho physiological patterns that reflect the various accommodations to stress that he or she has made over the years. The goal of biofeedback training is to gain self-regulatory skills with which to adjust the activity in various systems to optimal levels for the task at hand (Wall, 2004). At BRI, the clients was found to have greater success when they train toward a specific range of activity in each modality that research has found to be desirable, rather than simply training to reduce activity. These ranges are known as the goal zones.

2.4 The Technology

The technology is the application of scientific knowledge for practical purposes, especially in industry. The technology used in this project is the sensor technology and card reader technology.