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**THE DEVELOPMENT OF BIOPHYSICAL PHOTO PLETHYSMOGRAPH
(Electrocardiograph) DETECTION DEVICE AND SIMULATION
APPLICATION TO DETECT AND SIMULATE EMOTIONAL
PERFORMANCE (PERKASA 1)**

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We would like to express our eternal gratitude to University of Technology Malaysia for his support is solving complex algorithm in making biofeedback sensor running smoothly. We hope that this research can help Malaysia to be a center for advanced technology in biofeedback.



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Abstract

Biofeedback devices are used more extensively in various applications. The use of biofeedback technology is pioneered by the West. This study was undertaken to develop a biofeedback tool using technology expertise in Malaysia. This study aims to develop a biofeedback device using photoplystmograph technique that measures individual pulse rate, analyzes emotional status and displays it performance on the computer screen. This research uses a sensor that has been modified to detect the pulse of the individual, analyzing the received data to see whether the individual is in a good, medium or weak within the emotional spectrum. The status of this emotional spectrum is displayed by the computer software that has been developed to respond due to user's emotions. This research is also developed biofeedback simulation software that uses cultural background of Malaysia. The result from the hardware and software, of this study has successsfully detect the status of individual emotion either in low, mid and high coherence. This tracking system is important as a basis for developing other applications that use biofeedback techniques as a medium. This technology can be further developed and used in a variety of conditions which requires measurement of an individuals emotion.



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Abstrak

Alatan biofeedback digunakan semakin meluas dalam pelbagai aplikasi. Penggunaan teknologi biofeedback dipelopori oleh negara barat. Kajian ini dilaksanakan untuk membangunkan alatan biofeedback yang dibangunkan menggunakan kepakaran teknologi di Malaysia. Kajian ini bertujuan untuk membangunkan alat biofeedback menggunakan teknik photoplasmograph yang mengukur denyutan nadi individu, menganalisis status emosi dan memaparkannya kembali dipaparan skrin komputer. Teknik ini menggunakan sensor yang telah diubahsuai bagi mengesan denyutan nadi individu, menganalisis data yang diterima untuk melihat sama ada individu berada dalam spektrum emosi yang baik, sederhana dan lemah. Status spektrum emosi ini dipaparkan oleh perisian komputer yang telah dibangunkan sebagai bertindak balas terhadap emosi pengguna. Kajian ini juga membangunkan perisian simulasi biofeedback yang menggunakan latar belakang budaya Malaysia. Hasil daripada perkakasan, perisian yang dibangunkan, kajian ini berjaya membangunkan alatan biofeedback yang berupaya mengesan kedudukan emosi individu. Pengesanan ini penting sebagai asas untuk membangunkan aplikasi lain yang menggunakan teknik biofeedback sebagai medium. Teknologi yang dibangunkan boleh dikembangkan dan digunakan dalam pelbagai keadaan yang memerlukan proses pengukuran emosi yang lebih jelas.



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Biofeedback Pulse Monitor using CMS-50D USB.

Introduction

Heart rate Variability (HRV) signal processing has been used extensively as a biofeedback to identify a person's state. Biofeedback is the process of helping patients measure and change their biological activities by relaxing and re-educating their muscles in order to help them manage their stress and pain.

Although the biofeedback technology is relatively new, there are already numerous equipment and methods that have been used for biofeedback. These devices are used to help clients measure and change their biological activities by relaxing and re-educating their muscles in order to help them manage their own stress and pain. Here's a list of the most common biofeedback devices used by biofeedback specialists:

1. Capnometers measure the amount of carbon dioxide in the expired breath
2. Electroencephalograms (EEG) measure the amplitude and frequency of the client's brain waves
3. Electromyograms (EMG) measure the amount of tension in a client's muscle or muscle group
4. Galvanic Skin Resistance (GSR) devices measure the voltage, current and resistance of the client's skin Note: Electrodermal Resistance (EDR) devices are the same thing as GSR devices. Only the name is different.
5. Heart Rate Variability (HRV) devices measure the variability of the client's heart rate
6. Neurotherapy equipment is EEG biofeedback devices
7. Pulse Oximeters measure the oxygen content of the client's blood
8. Temperature Trainers measure the client's temperature at locations chosen by the operator

This project focuses on development of a biofeedback pulse monitor using Labview and a Contec CMS-50D USB pulse oximeter. The objective is to develop pulse monitoring software that biofeedback practitioners can use to aid them in deciding method or process to reduce

stress for a patients.

Methodology

The oximeter used was a finger pulse oximeter from Contec Medical called the CMS-50D as in Figure 1. This oximeter used Serial Port protocol to communicate with the PC through a CP2101 serial to usb converter. Data is transmitted in 5 bytes where one byte is the pulse data, one sync byte, one start byte, SpO2 byte and pulse rate byte. These data are then read through serial port before rearranging /displaying them in the GUI.

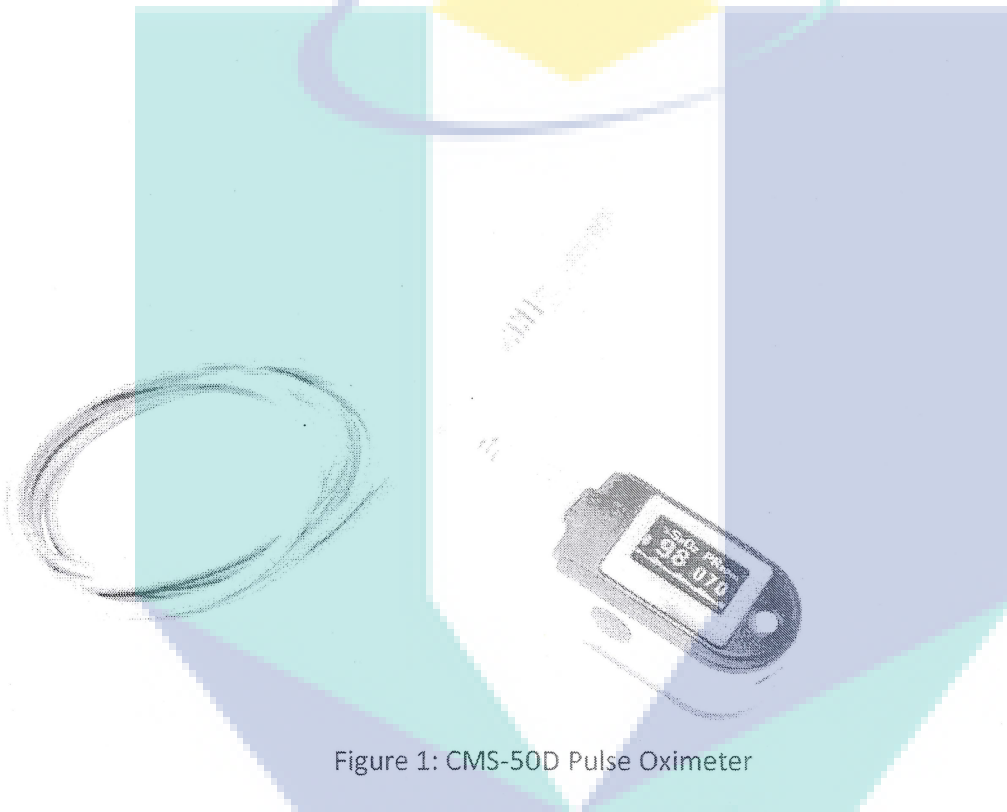


Figure 1: CMS-50D Pulse Oximeter

The GUI developed (as in Figure 2) has 4 graph that shows the SpO2 level, pulse rate, pulse signal and Heart Rate Variability(HRV). The HRF is calculated by taking two peaks and comparing the variability between peaks in time domain. The HRV graph shows the percentage of difference between the current pulse rate with the previous one. The GUI also proving two pulse rate information, one calculated from the pulse signal (pulse by pulse calculation) and the other one is a 5 second average pulse rate. *In addition, SpO2 level is also displayed with pulse rate level.*

Biofeedback Pulse Monitor

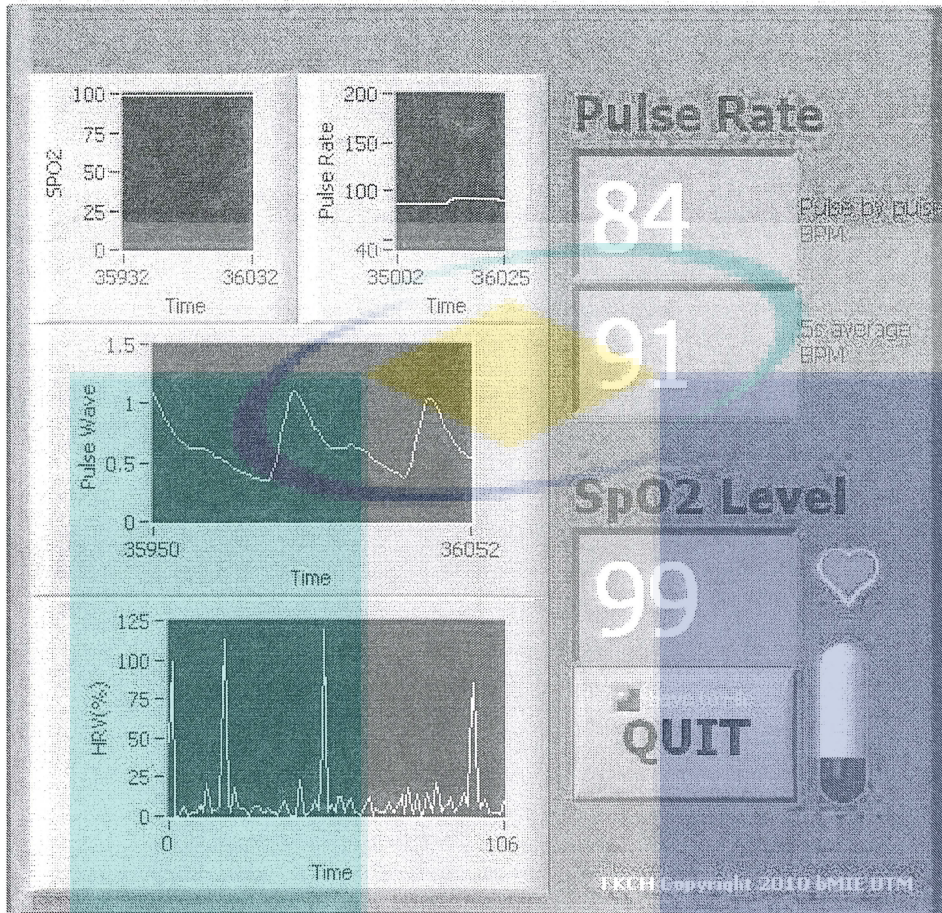


Figure 2: Biofeedback Pulse Oximetry Monitor

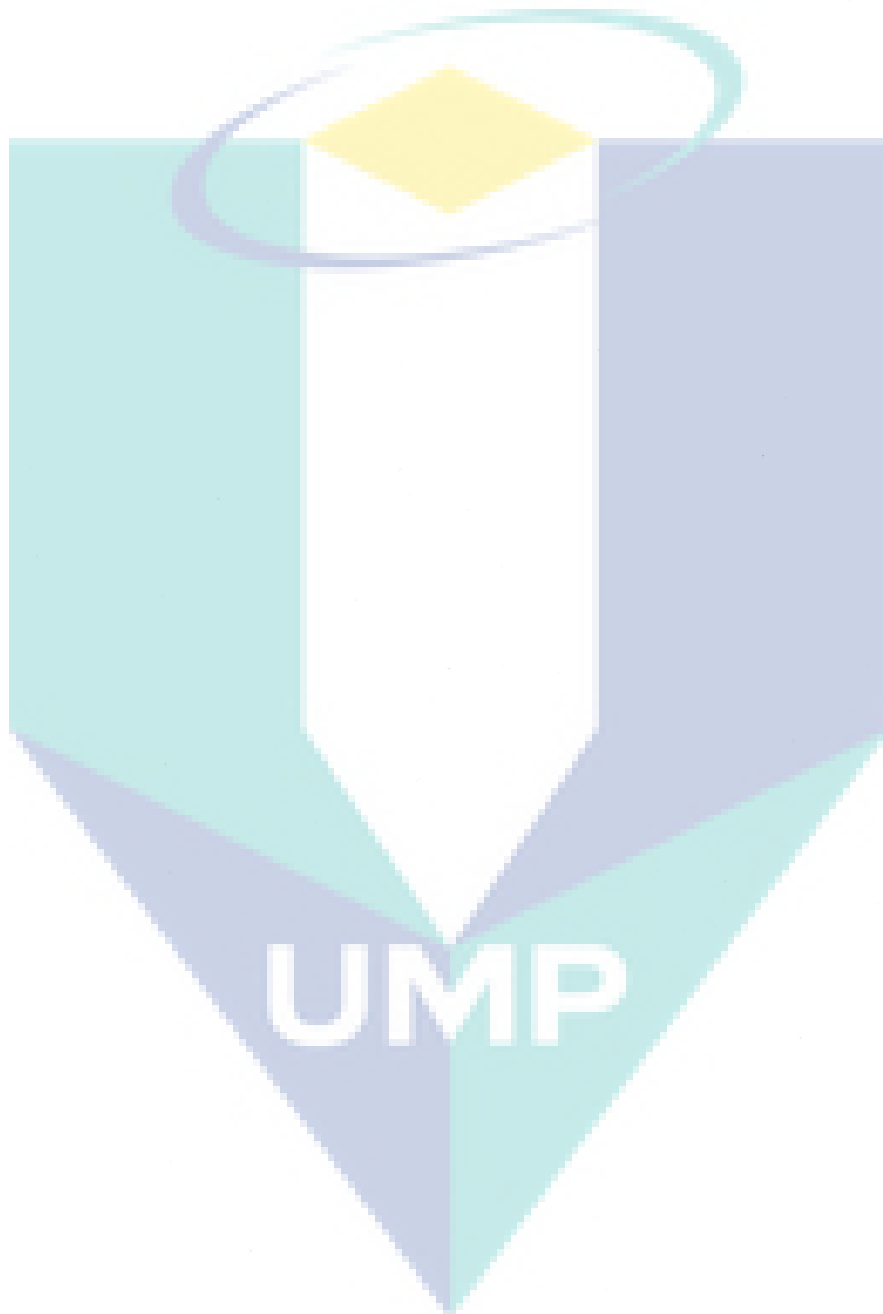
The software can also save all the information display for further processing by using the Save to File button before quitting the program.

Conclusion

In conclusion, the objective of the project has been achieved with the Biofeedback Pulse Monitor GUI completed. The software can also be accessed through a web browser (with labview runtime installed) for remote monitoring. However, the hardware must still be in the server computer for the software to work. This research proves the possibility of using a pulse oximeter as an aid for biofeedback practitioners to make better decisions.

Further works

Further works include development of ear pulse oximeter for more portable and user friendly experience for patient. Development will also focus on more open source software such as Java for easier distribution. Addition of temperature and ECG are also currently being experimented for future advancement.



Artificial Intelligent Strategy to Control Heart Rate Variability

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Abstract— This research proposes a new artificial intelligence strategy to enhance software games based on heart rate variability. The model consists of two modules (visual learning and IQ test) that will conjoined with a biofeedback device connected to a computer to monitor student heart rate and record its changes in a stressful situation and generate appropriate reports. By playing these two games student will be able to improve their learning capability and control their heart rate variability.

Keywords- Artificial intelligence, biofeedback game, visual learning, IQ test

I. INTRODUCTION

Due to over stress, anxiety, over hard working student may lose their learning capability or they can't able to keep concentration for a long time if the learning capability is by born capability. This strategy will have biofeedback device integrated with it. The student will learn by using different games incorporate with their stress level/heart bit level. The level of the games will be determined based on their Heart rate variability.

Artificial intelligent games control the decision-making process for the opponents in computer games (i.e., game AI that can automatically adapt the behavior of the players to changes in the environment) can increase the challenges, result and entertainment value of computer games [1].

Currently, gaming environments are becoming more realistic. People from both the game industry [2] and academia [3] predicted an increasing importance of game intelligence (AI) in computer games. The term artificial intelligent game is used differently by game developers and academic researchers [4]. Academic researchers restrict the use of this term to refer to intelligent behaviors of game characters [5]. On the other hand, for game developers intelligent game is used in a broader sense to encompass techniques such as path finding, animation systems, level geometry, collision physics, vehicle dynamics, and even the generation of random numbers [6].

Games can provide an active, motivating way for students to review what they've learned, but their effectiveness is enhanced if the students participate in the design or construction of the game [7]. Computer-controlled games generally provide richer experiences to the participants. Such experiences can include coordinated

multi-media experience, more challenging games, extended, multi-session gaming, virtual experiences that combine reality with fantasy, faster than normal experiences, more immersive experiences [8]. Game development is becoming more and more challenging because of current exponential growth in software development Industries [9]. Heart rate variability, or (HRV), is the natural rise and fall of a person's heart rate in response to his breathing, blood pressure, hormones and even emotions. In a healthy heart rate should increase as the person inhale and decrease as he exhales [10]. HRV is reflective of the general wellness state of the organism. Human organism responds to stress by means of centralization of blood circulation. Spasm of peripheral blood vessels occurs, and blood comes mainly to the most important body parts, leaving the extremities and digestive organs. When someone warm up his hands, the blood vessels become wider. Peripheral blood circulation is enhanced, and blood pressure decreases. Another important parameter, that is heart rate, increases due to physical and psychophysical loadings. Its normalization lowers blood pressure (mainly systolic), decreases respiratory rate, and achieves muscle relaxation [11].

The aim of this paper is to create a new framework of artificial intelligence game to improve the student learning performance and control their heart based on biofeedback techniques. The proposed technique consist of two modules (visual learning, and IQ test) that will conjoined with a biofeedback device connected to a computer to monitor student heart rate and record its changes in a stressful situation. The software will take heart signal as biofeedback inputs and based on the inputs the games will behave dynamically based on games output to generate appropriate reports. The visual learning games (VL) will improve learner's visual learning capability, memorizing capability and IQ test will improve analytical ability and control their heart bits rate.

II. RELATED WORK

Attention is a visual information based process which depends on the saliency in the image itself and on prior knowledge about scenes, objects and their interrelations. Visual attention can be addressed by the both problems (1) selectively enhancing perception at the attended location (2) successively shifting the focus of attention to multiple locations [12]

The visually learning and memorizing system can improve understanding and memorization, and particularly for geographic information. The system can also be used for other non-educational applications to enable users familiar with the system to enjoy the benefits in various situations [13]. The letters "IQ" stands for "intelligence quotient" and an IQ test are widely used as a way to measure intelligence. The test most frequently used today to measure intelligence called the Stanford-Binet Intelligence test, which was developed in France in 1905. The original test has been revised several times over the years, with a major revision completed at Stanford University in 1960 [14]. The most important criterion in diagnosing a student as learning disabled is the IQ test. The aim of an IQ test is to measure the intelligence of a student, which supposedly is an indication of the student's potential [15].

The learning process may be further dissected into five component elements, which are usually deficit in persons with attention challenges.

- i. Attention stamina that sustain attention during the learning process
- ii. Visual tracking that sustains attention while following the action of the teaching method
- iii. Time on-task that maintain attention, and complete the task within a determined time
- iv. Short-term memory sequencing which process data in chunks necessary to multi-task and transfer to long-term memory
- v. Discriminatory auditory and visual processing can be able to filter data, categorize it cognitively, and process data [16].

III. THE PROPOSED STRATEGY

In this strategy first have to create visual learning and IQ test, which run on the computer system. Secondly, the device will instruct in the use of emotion-focused stress management techniques and HRV biofeedback. In addition, the biofeedback device will also provides some games to play from where it can be find some stress inputs and HRV inputs. At the end of the use of the software, Stress and HRV will be recorded. The recorded HRV and stress inputs will be saved back to database (on the computer system) via device's API. Thirdly, back to previous, the software will use the database to show the progress reports of students learning. Finally, the software will connect with the biofeedback device. When the student use the software then the software will generate proper input for the biofeedback device via COM/DCOM API (integrated with computer system and device driver) and wait for the output of the device. To collect the data, the students or group of students will use the software. Figure 1 shows the structure of proposed strategy.

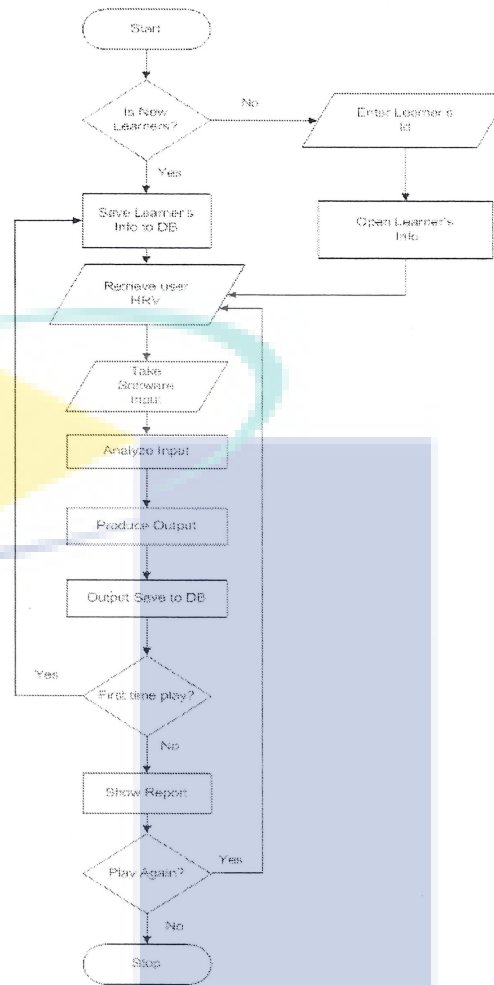


Figure1. Flow chart of the artificial intelligent strategy

IV. SOFTWARE PROCESS

The software architecture will be run as follows:

- i. User will start the game through biofeedback device that will be connected to the user. Then the user's feeling will be saved and processing it. At the same time games output send to "games output processor" for processing it. After processing games output it will be saved to "Processor" again for further processing.
- ii. The "Processor" will take biofeedback input and games output will be processed and send the data to "DB processor" for further processing.
- iii. DB processor will collect data from processor and process this and will send to database.
- iv. The "Processor" will also process the data and send it to "Games Level Processor".
- v. The "Games Level Processor" will process the data and will generate the next level of game that will be played by the user.

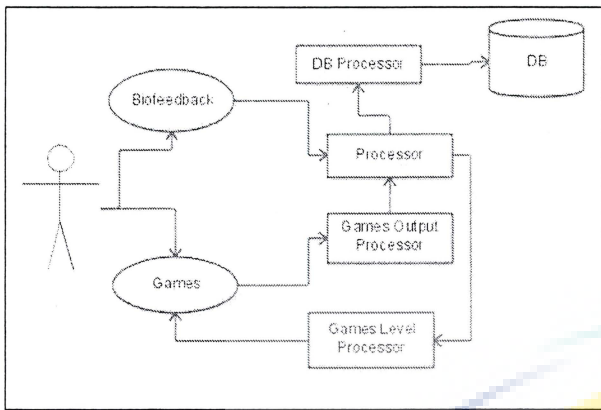


Figure2. Software Process

V. SOFTWARE ARCHITECTURE

The user interface (UI/Games) will generate output and send to the game output processor and the output processor will modify it and send to the processor. The biofeedback device will collect input and will send to the processor. The processor will process this and send it to DB processor and UI level processor. DB processor will process the data and send to database. The user interface level processor will collect data from processor, generate level, and send to user interface.

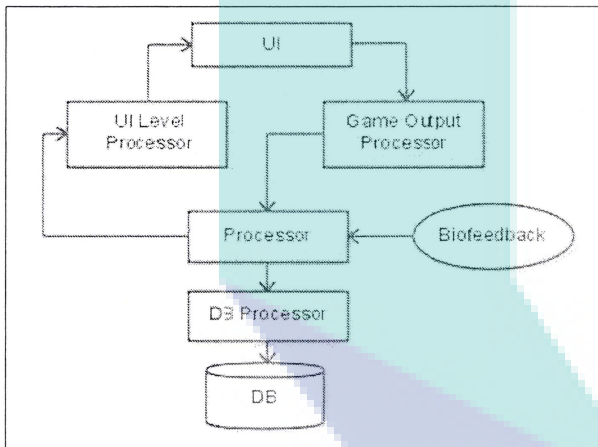


Figure3. Figure 3. Architecture of the software

VI. DISCUSSION AND RESULT

This strategy will introduce to the university students and the 30 students divided into two groups. Between the two groups; one group (G1, 7 boys and 8 girls) will play using the proposed technique and others group (G2, 7 boys and 8 girls) will play the legacy system that is available in the internet (www.amazon.com). two groups will start this game and they will be able to see the following reports based on their average heart rate variability as shown in Figure 4 and the gaming performance shown in Figure 5 and 6. From the progress report of the two groups it can be determine how this technique will help learners to improve their learning

capability than others as shown in Figure 7 and Figure 8 shows the individual student gaming performance.

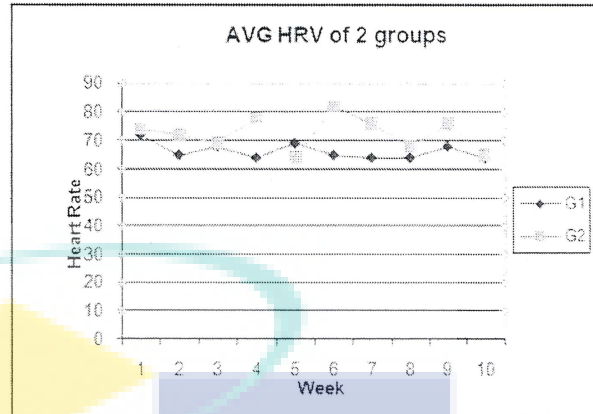


Figure4. Avg. HRV of 2 groups when they play VL+IQ

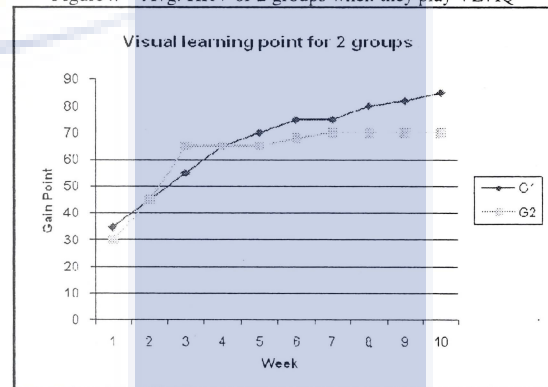


Figure5. Avg. Point of two groups when play visual learning

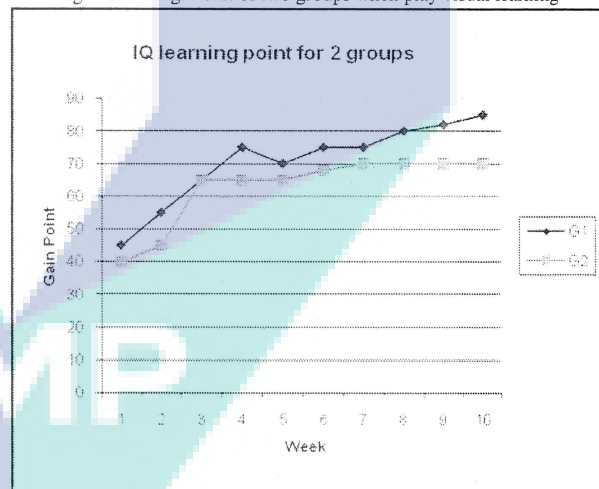


Figure6. Figure 6. Avg. Point of two groups when play IQ Test

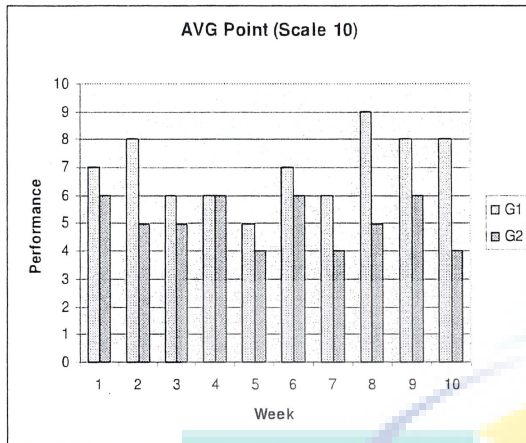


Figure7. Average point based on (VL+IQ+HRV)

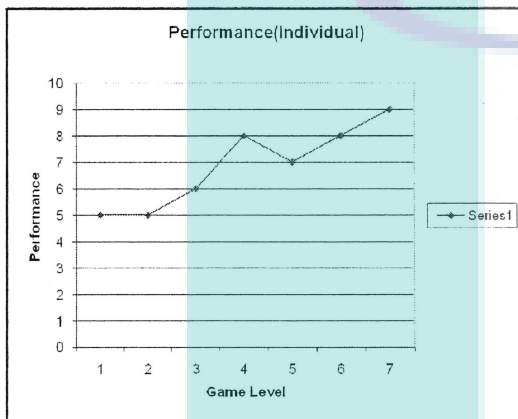


Figure8. Progress Report of individual student

VII. CONCLUSION

In the era of the internet, there are huge such games are available for learning. Those are base on different technologies with many completely new ideas to improve student's learning capability. From the review, it found that these things still do not work for all the students. In many cases, students become stress and they become worried about their study, which in terms become a great impediment to their learning capability. Here, this proposed intelligent strategy will help students to improve their learning capabilities giving them less stress within a very limited timeframe and also be able to control their heart rate variability.

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Framework of intelligent game and software for improvement of learning performance based on Heart Rate Variability

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Abstract—In many cases, students become stressed and they become worried about their study, which in terms become a great impediment to their learning capability. This paper proposes new framework of intelligent game model based on biofeedback techniques. The model consists of two modules (visual learning and IQ test) that will conjoined with a biofeedback device connected to a computer to monitor student heart rate and record its changes in a stressful situation and generate appropriate reports. The two games have different purpose to serve. Visual learning games will improve learner's visual learning capability, memorizing capability and IQ test will improve analytical ability.

Keywords—Intelligent game, biofeedback game, visual learning, IQ test.

I. INTRODUCTION

Although, learning capability is by born capability of student but due to over stress, anxiety, over hard working student may lose their learning capability or they can't able to keep concentration for a long time. This framework will have biofeedback device integrated with it. The student will learn by using different intelligent games incorporate with their stress level/heart bit level. The level of the games will be determined based on their biofeedback input.

Intelligent games control the decision-making process for the opponents in computer games (i.e., game AI that can automatically adapt the behavior of the players to changes in the environment) can increase the challenges, result and entertainment value of computer games [1].

Nowadays gaming environments are becoming more realistic. People from both the game industry [2] and academia [3] predicted an increasing importance of game intelligence (AI) in computer games. The term game intelligent (game AI) is used differently by game developers and academic researchers [4]. Academic researchers restrict the use of this term to refer to intelligent behaviors of game characters [6]. On the other hand, for game developers intelligent game is used in a broader sense to encompass techniques such as path finding, animation systems, level geometry, collision physics, vehicle dynamics, and even the generation of random numbers [7].

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participants. Such experiences can include coordinated multi-media experience, more challenging games, extended, multi-session gaming, virtual experiences that combine reality with fantasy, faster than normal experiences, more immersive experiences [9]. Game development is becoming more and more challenging because of current exponential growth in software development Industries [10]. Heart rate variability, or HRV, is the natural rise and fall of a person's heart rate in response to his breathing, blood pressure, hormones and even emotions. In a healthy heart rate should increase as the person inhale and decrease as he exhales. HRV is reflective of the general wellness state of the organism [10]. Human organism responds to stress by means of centralization of blood circulation. Spasm of peripheral blood vessels occurs, and blood comes mainly to the most important body parts, leaving the extremities and digestive organs. When someone warm up his hands, the blood vessels become wider. Peripheral blood circulation is enhanced, and blood pressure decreases. Another important parameter, that is heart rate, increases due to physical and psychophysical loadings. Its normalization lowers blood pressure (mainly systolic), decreases respiratory rate, and achieves muscle relaxation [11].

This paper proposes a new framework of intelligent game to improve the student learning performance based on biofeedback techniques. The proposed software consist of two modules (visual learning, and IQ test) that will conjoined with a biofeedback device connected to a computer to monitor student heart rate and record its changes in a stressful situation. The software will take heart signal as biofeedback inputs and based on the inputs the games will behave dynamically based on games output to generate appropriate reports. The visual learning games will improve learner's visual learning capability, memorizing capability and IQ test will improve analytical ability.

II. RELATED WORK

Attention is a visual information based process which depends on the saliency in the image itself and on prior knowledge about scenes, objects and their interrelations. Visual attention can be addressed by the both problems of one: selectively enhancing perception at the attended location, second: successively shifting the focus of attention to multiple locations [12].

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other non-educational applications to enable users familiar with the system to enjoy the benefits in various situations [13]. The letters "IQ" stands for "intelligence quotient" and an IQ test are widely used as a way to measure intelligence. The test most frequently used today to measure intelligence called the Stanford-Binet Intelligence test, which was developed in France in 1905. The original test has been revised several times over the years, with a major revision completed at Stanford University in 1960 [14]. The most important criterion in diagnosing a student as learning disabled is the IQ test. The aim of an IQ test is to measure the intelligence of a student, which supposedly is an indication of the student's potential [15].

The learning process may be further dissected into five component elements, which are usually deficit in persons with attention challenges.

- Attention stamina that sustain attention during the learning process
- Visual tracking that sustains attention while following the action of the teaching method
- Time on-task that maintain attention, and complete the task within a determined time
- Short-term memory sequencing which process data in chunks necessary to multi-task and transfer to long-term memory
- Discriminatory auditory and visual processing can be able to filter data, categorize it cognitively, and process data [16].

III. THE PROPOSED FRAMEWORK

Fig.1 Shows research activities running as follows: Firstly, create a visual learning and IQ test, which run on the computer system. Secondly, the device will instruct in the use of emotion-focused stress management techniques and HRV biofeedback. In addition, the biofeedback device will also provides some games to play from where it can be find some stress inputs and HRV inputs. At the end of the use of the software, Stress and HRV will be recorded. The recorded HRV and stress inputs will be saved back to database (on the computer system) via device's API. Thirdly, back to previous, the software will use the database to show the progress reports of students learning. Finally, the software will connect with the biofeedback device. When the student use the software then the software will generate proper input for the biofeedback device via COM/DCOM API (integrated with computer system and device driver) and wait for the output of the device. To collect the data, the students or group of students will use the software.

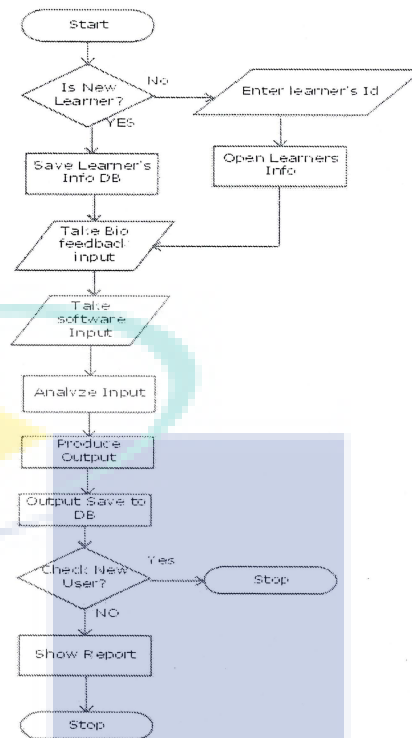


Figure 1. Research Activities

A. Software process

From the fig.2, the software architecture will be as follows:

1) User will start the game through biofeedback device that will be connected to the user. Then the user's feeling will be saved and processing it. At the same time games output send to "games output processor" for processing it. After processing games output it will be saved to "Processor" again for further processing.

2) The "Processor" will take biofeedback input and games output will be processed and send the data to "DB processor" for further processing.

3) DB processor will collect data from processor and process this and will send to database.

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5) The "Games Level Processor" will process the data and will generate the next level of game that will be played by the user.

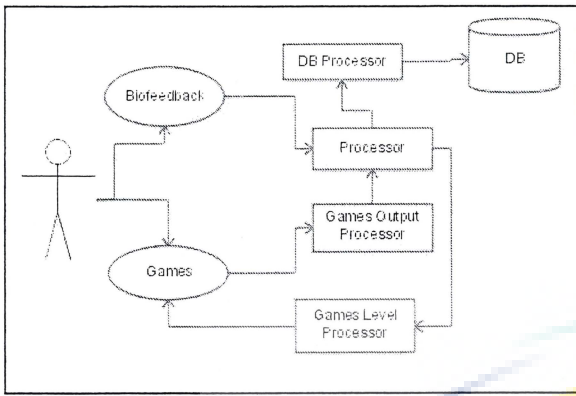


Figure 2. Software Process

B. Software Architecture

The user interface (UI/Games) will generate output and send to the game output processor and the output processor will modify it and send to the processor. The biofeedback device will collect input and will send to the processor. The processor will process this and send it to DB processor and UI level processor. DB processor will process the data and send to database. The user interface level processor will collect data from processor, generate level, and send to user interface.

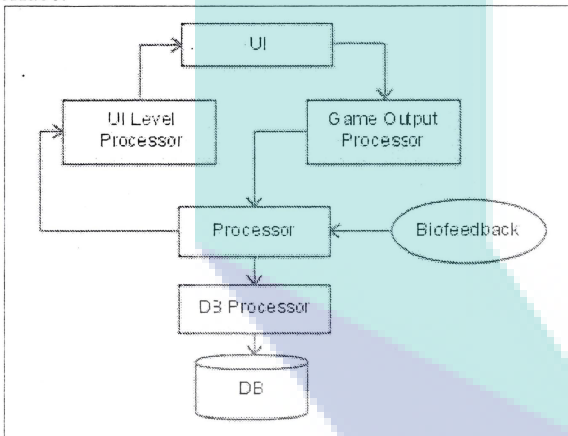


Figure 3. Architecture of the software

IV. RESULT AND DISCUSSION

This framework will introduce to our university students and the 40 students divided into two groups. Between the two groups; one group (10 boy and 10 girl) will play using the proposed framework and others group will play the legacy system that is available in the internet (www.amazon.com).

When two groups will start this game they will be able to see the following reports based on their heart rate variability and gaming performance as shown in Fig.4 and 5. From the progress report of the two groups it can be determine how the framework will help learners to improve their learning capability than others as shown in Fig.6.

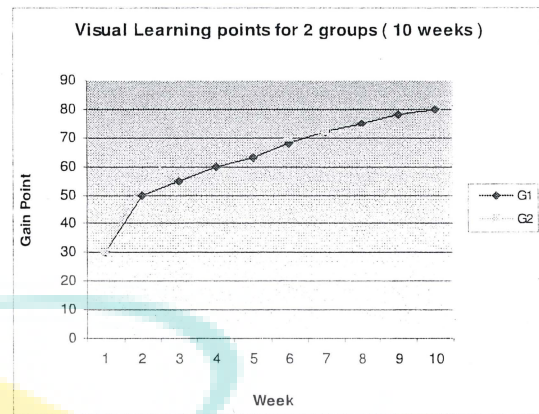


Figure 4. Two groups play visual learning

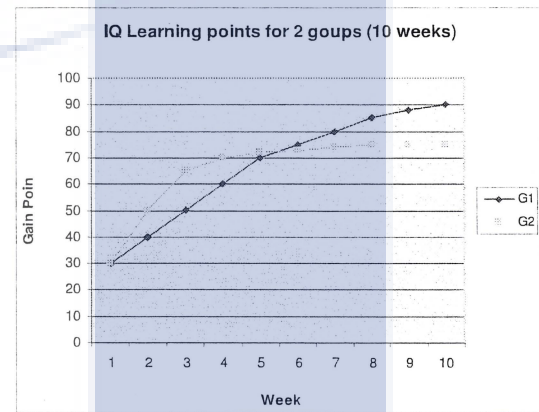


Figure 5. Two groups play IQ

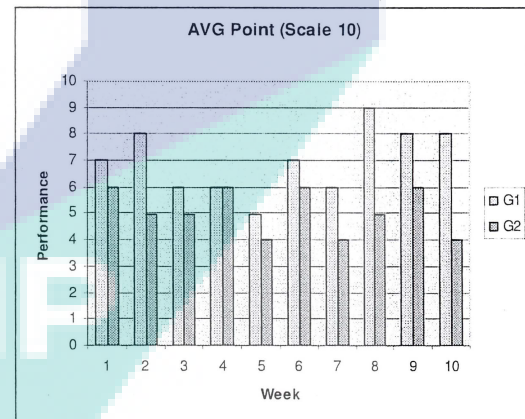


Figure 6. Average performance based on (VL+IQ+HRV)

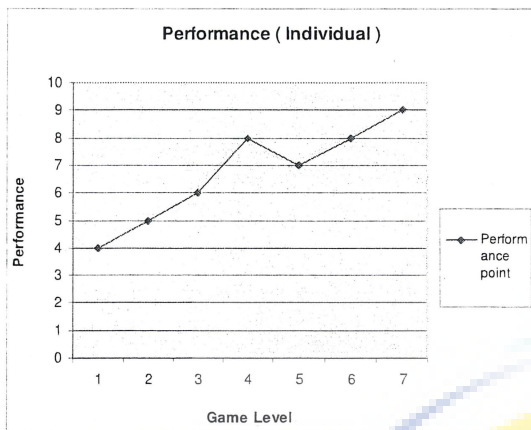


Figure 7. Progress Report of individual student

V. CONCLUSION

In the era of the internet, there are huge such games are available for learning. Those are base on different technologies with many completely new ideas to improve student's learning capability. But, there is a gap of the entire system. From the review, it found that these things still do not work for all the students. One main reason, in many cases, students becomes stress and they become worried about their study, which in terms become a great impediment to their learning capability. Here, this proposed framework of intelligent game and software will help students to improve their learning capabilities giving them less stress within a very limited timeframe.

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WAU: Malaysian Culture Biofeedback Game

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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 games invented in United States and Russia. However, the Malaysian biofeedback game is rarely founded in Malaysia. Therefore, this paper introduces a framework of biofeedback game through the Malaysian culture approach, so-called WAU. 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 analyzes the player's data and generates the report from the online data. The prototype is developed using spiral model as the prototype can be improved at the next spiral. The prototype introduces 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 help the user to access the data and report easily through online.

Keywords: Biofeedback, games, sensor, software.

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 human health and performance. It is a non-medical process that involves measuring a subject's specific and quantifiable bodily functions. Hence, this raises the patient's awareness and therefore the possibility of conscious control of those functions (Wikipedia, 2011). A biofeedback game is a match that controlled through the input from the biofeedback devices. The patient able to control the game with his or her body due to the game responds to the changes in heart rate, blood pressure, sweating, and skin temperature (Smith, 2010). In addition, the 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.

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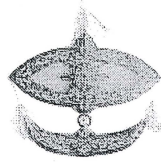


Figure 1: WAU (All World Shops Pte. Ltd, Singapore, 2010)

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 favoured 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 the player's information. There are several objectives in this research. First, develop an integrated Malaysian culture biofeedback game using the pulse sensor. Second, capture and store the player's personal information from player's MyKad using MyKad reader. Third, produce customized reports for the biofeedback game. The scopes of this project include: (1) biofeedback game developed is consider only the WAU; (2) system captures and records only one user data at one time using one pulse sensor; (3) the game displays the data in real time; the system assigns only one id for every player; (4) target users of this system are the patients, practitioners, and any individuals who wish to be trained to control their heart beats.

2. Technology

A sensor is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument. A sensor's sensitivity indicates how much the sensor's output changes when the measured quantity changes. Sensors that measure very small changes must have very high sensitivities. A variable result of sensor could be found to perform best result; these analog sensors eliminate the need for trimming, buffering, and linearization. This saves on both cost and unnecessary circuit design.

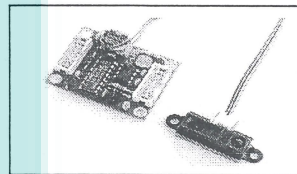


Figure 2: Sensor

Wireless communication considers the information transfer over a distance without the use of electrical conductors. The distances involved may be *short* such a few meters as in television remote control, or *long* where thousands or millions of kilometers for radio communications. It encompasses various types of fixed, mobile, and portable two way radios, cellular telephones, personal digital assistants (PDAs), and wireless networking. Example of wireless technology include the GPS units, garage door openers, keyboards and headsets, wireless computer mice, satellite television and cordless telephones. Wireless operations authorize services, such as long range communications, that are impossible or impractical to implement with the use of wires. The term is commonly used in the telecommunications industry to refer to telecommunications systems as an example the radio transmitters and receivers, remote controls, computer networks, network terminals, etc that deploys some form of energy like radio frequency (RF), infrared light, laser light, visible light, acoustic energy to transfer information without the use of wires.

3. Methodology

This section explains the development stages and the requirements of IMCBG using pulse sensor. The software development process is done by using spiral method. The main reason to choose spiral methodology for IMCBG development is because the IMCBG is a complicated system. Therefore, it requires detailed analysis to develop the system. Besides that, the emphasis on alternatives and constraints support reuse and incorporation of quality are required in this project. After develop the prototype, the customer feedbacks are required to get improve in next spiral. The development starts at the core of the spiral and will continue until the customer is satisfied with the system. During the first interaction, there might be only a paper work or just a prototype of the system. The increase of the interaction also increases of the complete system. The spiral methodology contains six main phases: Customer Communication, Planning, Risk Analysis, Engineering, Construction and Release, and Customer Evaluation.

Customer Communication is a phase in which the developer knows the demand of the customer by communicated. In developing IMCBG using pulse sensor, this phase has been conducted to gather user requirements and to increase developer's

comprehension on research area. Interviews have been done with the head of biofeedback researcher center in Universiti Malaysia Pahang (UMP).

Planning is the phase to define resource, schedule planning, and collection of related information of IMCBG using pulse sensor. Sampling of existing documentation has been done in this phase.

Risk Analysis is a critical phase that manages and control the risk might occur during the development of IMCBG using pulse sensor. The detailed risk analysis will be discussed in details later.

Engineering is where the design and prototype is carried out. This phase models user requirements of IMCBG into detailed computer-based specification. At this stage, system design, database design, interface design and storyboard are developed.

Construction and Release is the phase to do the testing, install, documentation, and training of IMCBG. After implementation, each module was tested as a unit to ensure the system fulfills business and design requirements. The integration and testing of modules of IMCBG using pulse sensor is done as a whole system. This includes documentation and training of IMCBG as well.

Customer Evaluation is the final phase of a spiral to get the feedback from the customer in order to get improve into next spiral.

3.1. The Customer Communication

Prior to planning phase, the customer communication has been conducted to gather user requirements and to increase developer's comprehension on research area. An interview was conducted with the head of biofeedback center of Universiti Malaysia Pahang (UMP). Requirements had also been derived from existing system used by the head. The existing systems used by the head are emWave Desktop Stress Relief System and The Journey to Wild Divine: The Passage, a biofeedback video game system promoting stress management and overall wellness through the use of breathing, meditation and relaxation exercises.. The comparison of emWave Desktop Stress Relief System and Vira is shown in the following Table 1. The preferable biofeedback game recommended by the head is emWave Desktop Stress Relief System. The main user requirement of the system is to design an integrated Malaysian culture biofeedback game which allows the researcher to get the player's data from pulse sensor and generate the report. He also requested other functionalities which include reading player's information from MyKad reader, searching player's information and accessing data from internet.

Table 1: Comparison between the existing systems

Existing System	emWave Desktop Stress Relief System	Journey to Wild Divine: The Passage
Advantages	Detect the HRV easily Provide different kinds of game Easy to use	Nice interface Easy to use
Disadvantages	Expensive Simple database Cannot be customized	More expensive than emWave product Cannot be customized
Biofeedback Device	USB-based ear sensor	USB-based finger sensor.

3.2. The Planning

The planning phase is the phase where the resource is defined, the schedule is planned and the related information of IMCBG is collected. Sampling of existing documentation has been done in this phase. The resources are the equipment and facilities which are required for the completion of a project activity. The equipment and facilities of IMCBG include personal computers to develop and test the prototype, USB-based finger pulse sensor as biofeedback device, and MyKad card reader to read the data from MyKad.

3.3. The Risk Analysis

The followings are the risks and the suggestions to mitigate the risks for IMCBG:

Risk #1: Integrate the game with the pulse sensor.

Suggestion: Develop the game in a platform where the pulse sensor can be integrated with the game. In order to do so, find the Software Development Kit (SDK) for the pulse sensor. If there is no any SDK available, find the way to get the data from pulse sensor through USB port. If the sensor cannot be connected with the game, use simulation data.

Risk #2: Display the data in real time.

Suggestion: Minimize the time interval to read and display the data.

Risk #3: Store the game data in centralized database.

Suggestion: Make the centralized server. Allow the user to enter Internet Protocol (IP) address of the server. Store the data in Microsoft SQL server. If the time interval of each player is different, standardize the data in table or use ad hoc database to store the data.

Risk #4: Integrate MyKad card reader to get the player's information from MyKad.

Suggestion: Allow user to edit the player's information retrieved from MyKad card reader if the information retrieved is wrong. For those who do not pose any MyKad, the birth certification number or passport number is required.

3.4. The Engineering

This is the phase where the design and prototype of IMCBG is carried out. This phase models all the user requirements into detailed computer-based specification. At this stage, system design, database design, interface design and storyboard are developed.

3.5. The Construction and Release

After develop the prototype, the next phase is to implement the prototype. To implement the prototype system, IMCBG is installed on the customer site. Then, the prototype is tested as a unit to ensure the prototype fulfils the user's requirements. The integration and testing of modules of IMCBG using pulse sensor is done as a whole system. This includes documentation and training of IMCBG as well. For unit testing process of IMCBG, the following aspects are considered:

Code

Program codes are examined by reading through it, while spotting algorithm, data and syntax faults. Codes are compared with requirement specifications and design to make sure that all relevant cases have been considered.

Interface

Interfaces are tested to ensure that information flow properly into and out of each program unit under test.

Error Handling

All error handling paths are checked to ensure all fatal errors during system execution will be detected and recovered. Routine for all error handling are tested to ensure it works properly as programmed.

Input / Output

The system is tested to determine whether it will produce expected output when input is inserted. In integration and system testing phase, individual program units are integrated and tested as a complete system to ensure that software requirements have been met. Bottom-up testing is adopted as system testing technique for IMCBG. Using bottom-up testing, lower level modules are coded and tested first and integration moves upwards. Then, higher level modules are integrated and tested together with lower level modules. This is repeated until all modules were tested.

3.6. The Customer Evaluation

The prototype which has been tested is evaluated by the customer. The feedback of the customer is taken in consideration to improve the prototype in the next spiral.

Implementation

This part will discuss about the game development. Interface development is also important for this web-based application for administration as the interface can make the system more user friendly and easier to use. The interface should be really eased to communicate with the function so that the flow of the system can be understood by the user.

Main Interface Design

The login section is placed on the left of the 3 column design. The navigation button of the web is statically also at the left of the column to make sure it is consistence with other page. The registration form is used to register the user of the system. At this form, the entire required field must be entered before the player can play the game. The details will be recorded in the database. For those who are registered to be the player, they must use their id to play the game. The player and the administrator can check the game report by login to the website. That is why this registration form provided the login name and password field so that the user can login into their own account later.

Database Development

In the database development, it will explain about the SQL statement that is used in the development of this project. The SQL statement is important to insert, delete, update, and view the table in the database. To insert the data in the database, firstly we need to declare all the text field in the form to be specify with the field in the database table. Then we connect the system to our database which has been created at the beginning. After had been connected, then the PHP and SQL statement where the statement is. The INSERT statement is commonly used to insert the data in the database. To update our data in the database, the UPDATE TABLE statement is used. DELETE statement is the SQL statement that normally used to delete the table. In this system, the ability of SELECT statement is used to retrieve the data from the database is really important as this will make this system more reliable and effective to the administrator to view again all the inserted data.

4. Results and Discussion

IMCBG using pulse sensor is a project that will get the player's information from MyKad by using MyKad card reader to register the player in the system. Then, the player will play the biofeedback game by using the pulse sensor. The data from the biofeedback game will be stored in a centralized database then the data will be used to produce report for the administrator to analyze the data. As the system will be fully developed, the system needs to be analyzed so that the objective is parallel with the project's problem. The IMCBG using pulse sensor will have to meet all the objectives of this project, which are: To develop an integrated Malaysian culture biofeedback game using pulse sensor. To capture and store the player's personal information from player's MyKad using MyKad reader. To produce customized reports for the biofeedback game.

In the development of this project, there are a few constraints that cause the delayed of the time-line project. For this project, the constraints are categorized into two parts which is *Development constraints* and *System constraint*. To enable player information to be read from player's MyKad, a smart card reader is required to provide the physical connectivity between the smart card's integrated circuit chip and the computer with the smart card-aware application installed. The smart card reader must be of Personal Computer/Smart Card (PC/SC) specification and conform to ISO 7816 1/2/3 standards. Development of a smart card-aware application is based on the Software Development Kit (SDK) provided by the reader manufacturer. SDK consists of existing libraries and application programming interface (API), which needed to be called by the smart card-aware application to access data from a smart card. SDK are commonly reader specific and its supported languages are limited. Some SDK are operating system platform specific where it can only support Windows platform development at most of the time. IMCBG is developed using Microsoft Visual Basic .NET. Code modification and understanding of C++ language are needed to ensure the available libraries can be used. IMCBG must be programmed where certain data reading functions can only be called by specific application in the MyKad. Three main applications in MyKad include National Registration Department, Road Transport Department and Immigration Department. Application must be called before calling data reading functions for the application, to prevent MyKad from being permanently blocked and data cannot be read from it.

IMCBG requires .NET framework to be installed on a computer before it can be executed. IMCBG is also reader specific as it is developed using the MyKad SDK. Programming for IMCBG will be written to call the functions DLL libraries in order to retrieve data from MyKad. Thus, it cannot be guaranteed that data can be retrieved from MyKad if other types of smart card reader are being used. Each client workstation must be equipped with the pulse sensor and the sensor driver has to be installed before the biofeedback game can be played. Every server must be equipped with a smart card reader with SAM and reader driver to be installed before IMCBG can be used. IMCBG can only load the Malaysian player's data with a valid MyKad using MyKad card reader. Foreigner or permanent residents who do not have a MyKad have key in data from keyboard. IMCBG generates report which is unable to redefine the layout of the report. So, it will be needed to follow the existing template used.

5. Conclusion

Integrated Malaysian Culture Biofeedback Game using pulse sensor (IMCBG) is a biofeedback game which is developed for the purpose to introduce Malaysian culture through the game and to train the player to control the heartbeats. The Malaysian culture which has been chosen is WAU. WAU is a popular traditional past time game in Malaysia. The existing biofeedback game from other country does not load the player's information automatically from MyKad and thus it is troublesome for the administrator to key in the data from keyboard for large amount of user. IMCBG will achieve the objective of this project, which is to develop a prototype of IMCBG, where the game will introduce the Malaysian Culture, WAU with the main functions to read the player's heartbeat data from pulse sensor, train the player to control the heartbeats, load the player's personal information from MyKad, and generate the report for the game. The biofeedback game for IMCBG is a standalone application and implements client-server approach. The web application for administrator application is chosen to access the data easily from anywhere at any time. IMCBG is developed using Microsoft Visual Basic .NET for interface design and programming as it provides a visual development environment for building application rapidly. Microsoft SQL Server 2008 is used as database management system placed on database server as it provides rich features in manipulating, securing and managing data.

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Full Length Research Paper

Enhancement of real-time multi-patient monitoring system based on wireless sensor networks

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Portable patient monitoring device has become increasingly important in Hospital wards to record real-time data during normal activity for better treatment. However, the current quality and reliability have not been satisfactory due to the size, weight, distance of coverage and also high power consumption. This paper provides several solutions for enhancing the reliability and improving the power management of the real-time multi-patient monitoring system (MPMS). A reliable wireless personal area networks (WPANs) based on digital signal processing (DSP) was introduced and developed, which consists of twenty remote nodes and a central node with pc-based graphic user interface. Sleep strategy and other techniques (dynamic voltage, frequency scaling) have been used to achieve low power management and assisted power control. Results indicate that, multiple WPANs approach out-performed the single one in respect of efficiency and reliability.

Key words: Multi-patient, wireless personal, power consumption.

INTRODUCTION

Diagnosing and continuous record of real-time data by the use of portable patient monitoring system during normal activity would be beneficial for medical practitioners to do proper and better treatment; also it would be useful for health care providers to improve diseases management (Otto, 1999). This challenge attracts many researchers to invent a new design and deploy comprehensive patient monitoring solutions for hospital health care system (Connor et al., 2001). Advances in wireless networking have opened up new opportunities in a variety of applications (Pierce, 2001) including healthcare systems (Lorincz et al., 2004; Lubrin et al., 2005; Dayu, 2010; Dishman, 2004; Jafari et al., 2005). Although present systems in hospitals allow continuous monitoring of patient vital signs, these systems require the sensors to be hardwired to nearby, bedside monitors or PCs, and essentially confine the patient to his hospital bed. The advents of Wi-Fi and Bluetooth have facilitated breaking the cord between the

non-invasive patient sensor and the bedside equipment (Lubrin et al., 2005). These systems do not require the patient to be confined to his bed and allows him to move around freely in his room but requires him to be within a specific distance from the bedside monitor. For example, the range of transmission for typical Bluetooth systems is about ten meters. Beyond this distance, it is not possible to acquire data. Patient mobility beyond his hospital room can be incorporated by using a network of such nodes placed at appropriate distances in order to transfer data to the monitoring station. However, network nodes that use protocols such as Bluetooth require a larger volume and higher power consumption. This indirectly indicates a higher cost per node and a fairly high burden on its power source, further increasing its size and cost. Depending on the size of the hospital, several such nodes might be required resulting in a much higher system infrastructure cost. Moreover, such protocols are meant for moderate to high bandwidth applications where relatively large packets of data need to be transmitted and received. In the case of patient vital sign monitoring, the data packet size is much smaller, which seems to suggest that networks using such protocols might seem impractical.

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Obviously, low power, low cost network nodes are required for such applications.

This paper proposed several solutions for enhancing the reliability and improving the power management of the real-time multi-patient monitoring system (MPMS). The system consists of nodes that consume very low power and are extremely small in size. These slave nodes are specifically designed for low power consumption, with minimal circuit components. They are intended for small packet, long distance range applications and typically consist of a low power processor with minimal resources and interface capabilities. They also have a conservative transceiver that is capable of transmitting 8 bytes of data at a time and has a moderate transmitting range of about 130 m. Therefore, WPANs seem to be a perfect fit for remote patient monitoring.

RELATED WORKS

Recent development in the fields of microelectronics, communication/networks, integrated optics, and other related technologies enables wireless patient monitoring sensors to sense and measure the data more efficiently, accurately, low in cost, small in size, and body-wearable. As the name suggests, this kind of devices or systems are developed to monitoring a health care environment, for prevention, diagnosis, monitoring and treatment. Design configurations of the wireless health monitoring systems for infrastructures were developed by Wag and Liao (2001). Special attention is paid to the low frequency response characteristics of the wireless transmission system. Zimu (2010) focuses on design and develops a wireless health monitoring prototype system with the initial emphasis on measuring the electrical activity of the heart. He considered two types of wireless heart monitors for indoor/outdoor use and tradeoffs between power and communication range. Hui (2007) presents integrated circuits and system design for sensor node, including analog and digital blocks in creating a RF data link. To minimize the power consumption of the sensor node, it suggested that some of the computations are performed digitally in the sensor node before the results are transmitted to the rest of the system. Priya (2009) presents a prototype of a wireless health monitoring system capable of sending SMS related to the health status of the patient. The project is divided in to three stages; data acquisition, data processing and communication.

The monitoring system automatically transmits the information to the doctor's hand phone on the mobilenetwork as a SMS message via a GSM device / SMS gateway, and at the same time, the system will

update the hospital database periodically. Figueiredo (2010) presents a low power wireless acquisition module for use within wearable health monitoring systems and ambient assisted living applications. The acquisition module provides continuous monitoring of the user's electrocardiogram (ECG) and activity, as well as the local temperature at the module. The module is placed on the chest of the user, and its wearability is achieved due to its fabrication based on a flexible PCB, by the complete absence of connecting wires, and also, as a result of the integration of flexible and dry ECG monitoring electrodes on the acquisition module, which do not require preparation with electrolyte gel.

THEORETICAL BACKGROUND

The communication link

For setting up the communication link, WPANs was introduced, where data is required to be periodically sent to the central node using time division duplex (TDD) scheme. The WPANs operates with a small network stack of three layers as illustrated in Figure 2. The Application layer (APP) is concerned with acquiring the preprocessing of the pulse rate data through the analog circuitry and the DSP processor, and it is also concerned with the development of user application program, to sample, compress, decompress, construct, display and analyze the pulse rate signal on PC. The medium access control layer (MAC) through the PIC 18F2550 microcontroller are responsible for maintaining the Network including the link establishment, changing the modes data transmission, holding the all network packet types and nodes' addresses, network management and transfer of acquired data. This involves interfacing to the application layer where the sampled data is required to be synchronized when sent, and also requires interfacing to the physical layer (PHY), which is required to interface to the XBEE module and the MAC layer. The physical layer is also responsible for obtaining 'reliable' communication between nodes. That is, the data received at each node is passed to the MAC Layer to be error-free and to be performed. The physical layer will be implemented with data whitening (DW) and CRC to minimize DC bias of the packet and to provide error detection. The WPANs specifies different packet types including connect request, disconnect request, acknowledge/poll, request settings and data transfer.

The WPANs mechanism

The initial start-up of the system is performed in the APP

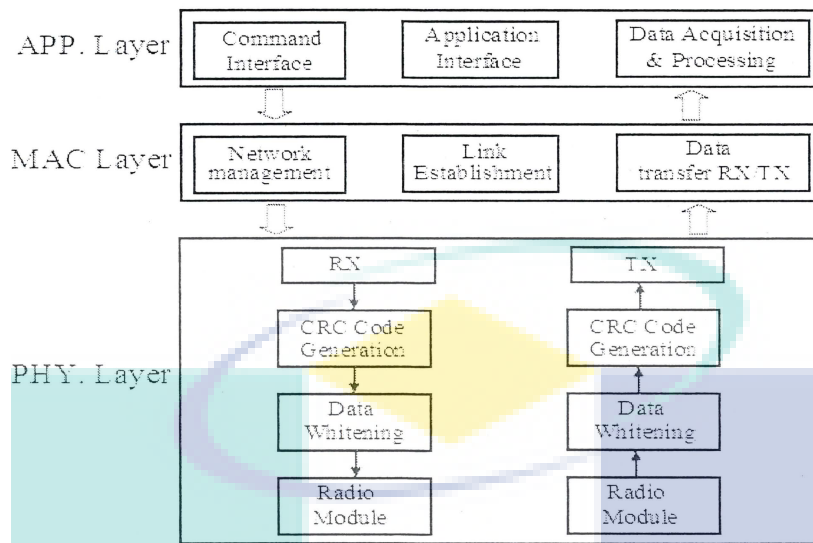


Figure 1. WSP architecture.

layer of the master node. The GUI, created in visual basic 6.0, will prompt the user on initializing the wireless connection. This will in turn pass information via a USB port to the PIC 18F2550 microcontroller communication processor which contains both the MAC layer and the PHY layer. A packet containing information on the network management is passed onto PHY layer. Here the decoding of the message and the creating of the transmission packets are executed, before the data is finally sent through the transceiver. The remote node's transceiver receives the packet and passes it onto the PIC 18F2550 microcontroller. The decoding of the message is done in the PHY layer and then the information is passed onto the MAC layer. The MAC layer first checks if it is a valid packet from the central node. If so, it will reset the clock and realize the transmission slot time. A query is then passed onto the APP layer, which begins sampling pulse rate data and storing it into PIC 18F2550 microcontroller's flash memory as shown in Figure 1.

The MAC layer, just prior to transmission time, changes the mode of the transceiver to transmit mode, and then extracts a sample of pulse rate data and passes it onto the PHY layer. This information is once again formatted and created into a packet to be sent back across to the central node. Finally, the information is received and yet again passed through the particular layers until it reaches the PHY layer. Once the PHY layer has received substantial information from the remote nodes in the network, it is then able to create the pulse rate signal on the PC. The size of time slots depends on the symbol rate of the XBEE module as well as the time required for the XBEE to switch between receiving and transmitting modes.

Power consumption

DSP systems incorporate a number of hardware or software features designed to give greater control over the system power consumption. Therefore, a number of programming techniques can be used to reduce power consumption (Verbaauwhede et al., 2000).

SYSTEM DESIGN AND IMPLEMENTATION

Hardware implementation

Central node

The right side of Figure 2 shows the functional diagram of the central node, how the XBEE-PRO module transmits the management and control packets and receives the transmitted data. The PIC 18F2550 microcontroller manages the data transfer and controls the transmission link as well as PC interfacing.

Remote slave node

The remote node can be selectively configured to provide master-slave topology, or to form Stand-Alone, that is, portable DSP-based arrhythmias monitoring system. In the left side of Figure 2, the INA326 instrumentation amplifier acts as a front-end signal acquisition system, as the OPA2335 provides the amplification. Anti alias, filters and feeds the TMS320VC5509A, which is an ever most power-efficient DSPs generation, with a roadmap as low as 0.05 mW/MIPS and speeds up to 200 MHz. Then, the PIC digitizes the signal, applies the desired preprocessing algorithms, and controls and manages the data transfer from/ to the peripherals like JTAG header, USB header, flash memory and the XBEE modem.

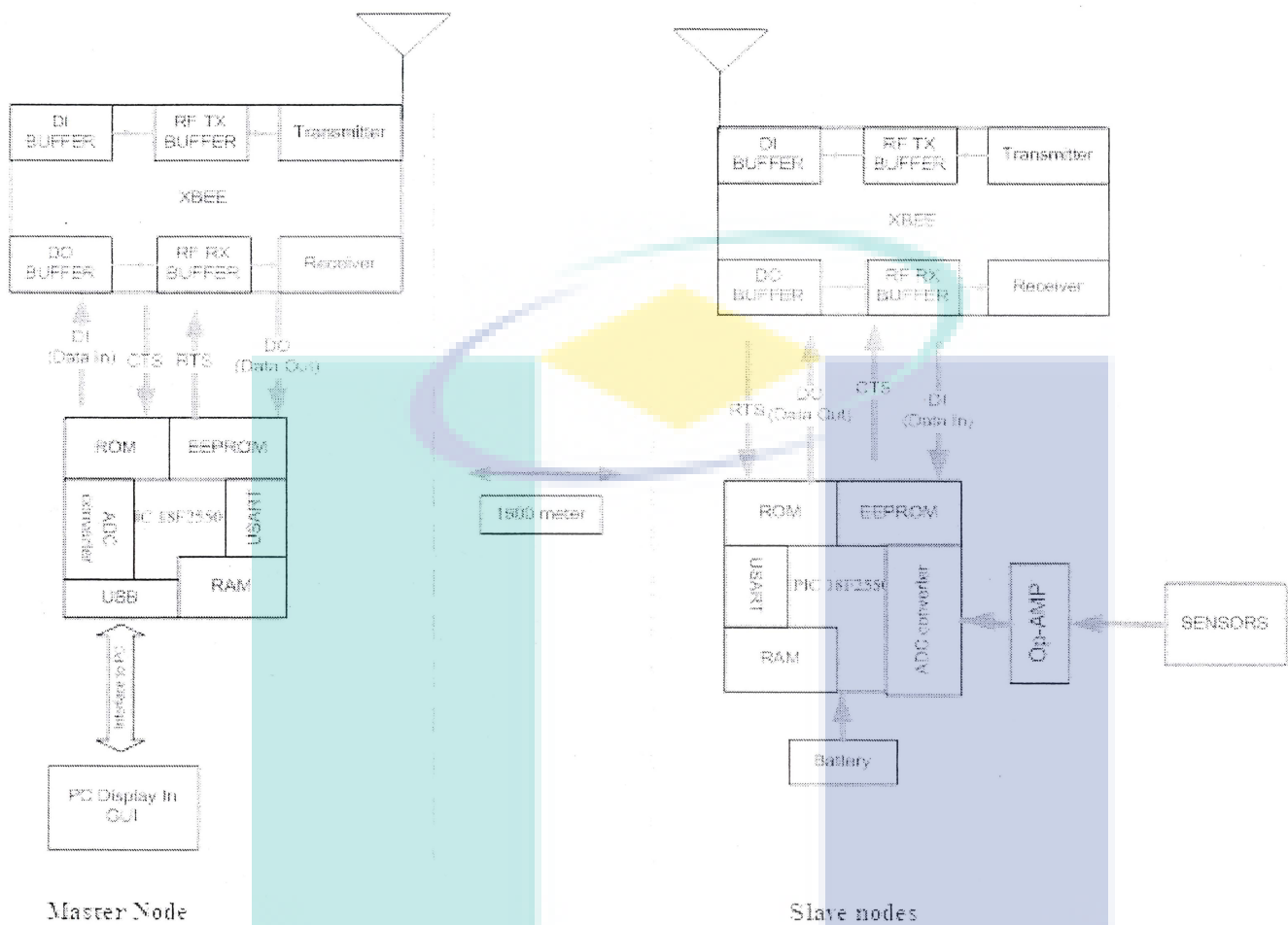


Figure 2. System block diagram.

Software design

Remote node algorithms

As introduced above, the prototyped remote node has two types of operating modes, stand-alone and slave-master. Thus, it has separate program for each mode of operation. It is apparent that both modes require certain common basic support functions, and accordingly, the software should be structured modularly. So these supporting routines can be incorporated into any of the programs as a common operational approach to allow minimal power consumption. All These algorithms are TI-DSP on-chip algorithms.

Figure 3 illustrates the remote node algorithm's flowchart. The code is written in code composer studio v. 3.1. Once power-on, the PIC chip boots up from the internal flash memory. Then the program initializes and waits user to input the mode type (if stand-alone); meanwhile a GUI window will open, which allows the user to choose the desired function. Accordingly the PIC chip starts the needed support functions like acquiring ECG signal, ADC conversion, filtering, detecting arrhythmias, displaying real ECG signal, displaying detection report, printing, sending advising /warning messages or storing data. At the same time, the PIC controls the peripherals to perform the suitable operation. But if it is a master-slave mode, the PIC, after acquiring the signal, will

convert it into ADC, filter, compress and store data until the central note establishes a new transmission link in its specific time slot. If so, the PIC will decompress and pass the data to the XBEE modem for transmitting.

Central node algorithms

These algorithms is divided into two parts, the PIC algorithms and the PC-based application algorithms. Figure 4 illustrates the PIC Program. Upon power-on, the algorithm loads and initiates the processor I/O and TDM ports, sets the modem to the active mode, configures the time slots register, initializes the connection and synchronization period assigning each (online) remote node with a particular time slot and changes into receiving mode once the entire packet is sent. Once the synchronization is accomplished, it receives data from the particular remote node at its given time slot, and sends the data to the PC. This cycle will be repeated for certain numbers of times before central either resynchronizes or disconnects. In the PC-based application program, state-of-the-art tools have been used in creation of the computer system using visual basic 6.0 to acquire, analyze, construct and display the patients ECGs periodically.

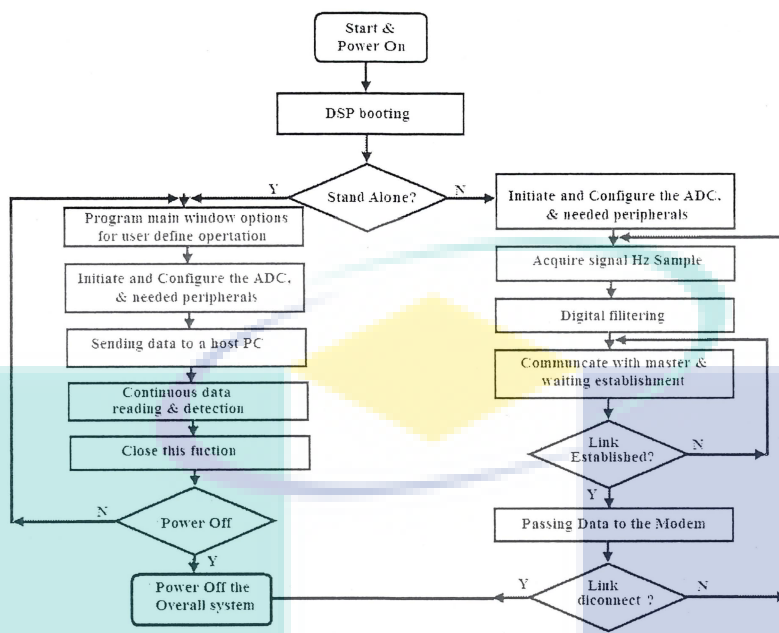


Figure 3. Remote node algorithm.

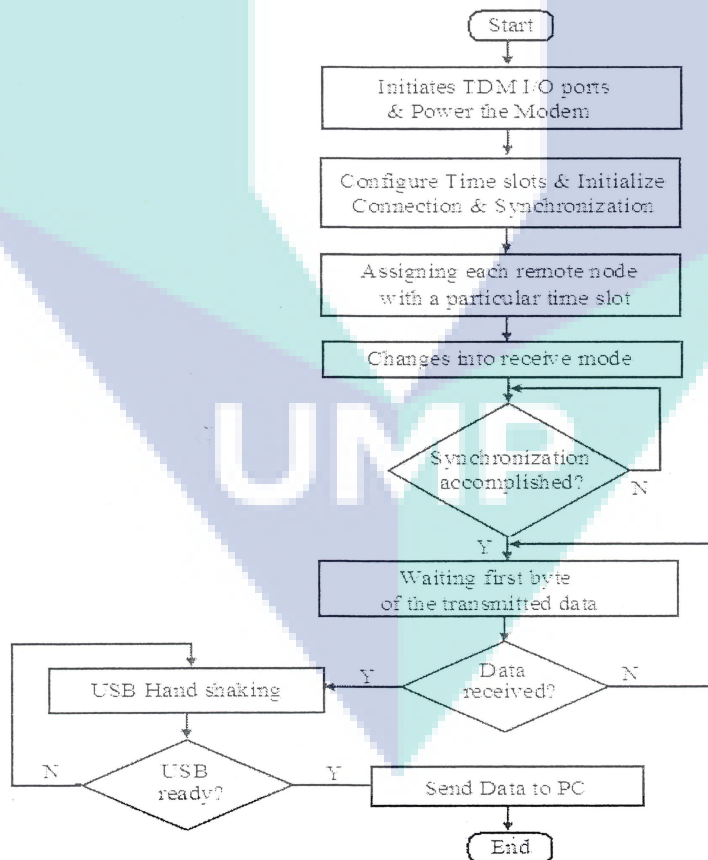


Figure 4. PIC 18F2550 microcontroller -based.

Table 1. System-based versus manual, arrhythmias detection parameters result.

Patient no.	Results method	HBR	R-R(ms)	QRS(ms)	QT/QTc (ms)	ST(mv)
1	System-based	64	165	85	393/392	0.034
	Manual	62	161	83	394/393	0.042
2	System-based	75	140	78	368/374	0.025
	Manual	72	146	76	370/372	0.031
3	System-based	82	168	83	351/369	0.017
	Manual	81	164	79	359/368	0.022
4	System-based	61	128	73	374/381	0.062
	Manual	62	130	72	375/384	0.079

Table 2. Remote node power dissipation (operating).

No	Part	Power before (mA)	Power after (mA)
1	XBee	40.00	20.00
2	ISD4004 voice	15.00	15.00
3	ECG front-end analog circuitry	03.10	0.00
4	Keypad +LCD	00.06	00.06
5	TMS320VC5509A DSP and its peripherals	46.00	36.60
	Total	104.16	71.66

RESULTS AND DISCUSSION

Through the experimentation of this implemented WPANs architecture, it was realized that relatively precise results were achieved if the network was resynchronized once every six cycles. However, with the inclusion of more nodes, this will almost certainly result in requiring more resynchronization as regular intervals. System-based results versus manual results of arrhythmia detection and ECG wave parameters values for four patients have been presented in Table 1. Power consumption forms an important characteristic of our design; so three techniques has been followed and considered to achieve low power consumption, first, because power consumption is proportional to the square of supply voltage, scaling power supply voltage, reducing the switching frequency (Jafari et al., 2005), and Data-Block processing algorithms was applied to the implementation of an Integer Filters. The total power consumption is measured using TI-VC5509A power estimation spreadsheet (Sunwoo et al., 2007). The implemented techniques achieve a reduction in energy consumption of

30.2%. Table 2 shows remote-node power dissipation before and after applying these techniques.

Conclusion

The present system provides twenty patients with real-time, low-power, low-cost, long-distance, and dual-mode monitoring, which is suitable for poor people in the Third-World countries, where there are no telephone lines, web-based systems, and GPS. The use of the PIC18F2550 and the XBEE communications processor for building blocks of the monitoring system has the benefits of intelligence, compact size and reliability. By the aid of this highly-integrated chips, external components and hence wirings are kept to a minimum. A reliable wireless personal area networks (WPANs) has been introduced and described, and also a powerful digital signal processing techniques was used to develop this DSP-based system. Further advantage of this system is its low-power consumption, which is attractive for portable applications.

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Mental and Spiritual Relaxation by Recitation of the Holy Quran

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Abstract--Nowadays, Tension or Stress is a common and serious problem in our Global Village. Stress and stress related factors contribute to tension and reduced ability to handle life's everyday challenges. This paper proposes a new method to reduce the stress and tension of our life and also proves that mentally, spiritually and physically relaxation can be achieved by the recitation of the holy Quran. In this technique of listening, reading and watching the text of the Holy Quran subject (User) can involve the whole body. The entire process will be controlled by brain, as a result during this practice the whole body will receive relaxation/refreshment, and the exhaustion, boring and tiredness will be finished. This physiological biofeedback manner provides groceries for spirit. Hence this means can be used in hospitals for mentally disturb and depression effected patients, for relaxation of the soldiers, for refreshing the students, to cool down workers in industries and for the entertainment of passengers in buses and airplanes. This approach replaces negative thoughts with positive and truthful thoughts.

Index Terms: *Biofeedback, Relaxation, Multimedia, Recitation, Quran.*

INTRODUCTION

Relaxation is "The return of a system to equilibrium after the displacement from its status" [1], and tension is antonym of relaxation which is "The loosening of grip on his/her body in life". There are a lot of methods, i.e. listening music, play game, watch movie, out walking, using of drugs, exercise, massage, hypnosis, self-hypnosis, crafts, hobbies, dancing, conscious mental rest, artwork chatting with friends, taking short break during stressful work for long time, taking hot bathing or shower, deep sleeping after hard and long work etc, for getting relaxation, release tension, relieve boringness and to finish stress [1, 2]. During hard and long time work some people listening music in background [2]. Because according to the research, the music stimulation is better than other stimulator [2]. Some of the above mentioned methods uses in various places i.e. in hospitals for the treatment of mentally upset patients, in army training centers to keep the soldiers away from the tension, in industries to achieve good performance from the

workers, in educational departments to keep students fresh for study and in buses or in airplanes to keep the passengers relax [1, 2]. But the effect of the above mentioned methods for tension release will be temporary and for time being, after passing that specific interval of time, automatically the effect will be finished.

Depression produced pain can radiate from the neck, back, eyes, or other muscle group in the body. Tension-type headaches account for nearly 90% of all headaches. Approximately 3% of the population has chronic tension-type headaches [6]. Tension headaches are the most common type of headaches. The pain is felt in the head but often is caused by tight muscle groups face, jaw, neck, or shoulders. These headaches account for over 80% of all headaches and they affect around 2% of the population [3, 5]. Common causes of tension headaches are Stress both mental and physical, lack of sleep and eyestrain [3].

Stress usually occurs in the afternoon after long stressful work hours or after an exam, Sleep deprivation, Uncomfortable stressful position and/or bad posture, Irregular meal time (hunger), eyestrain and, caffeine withdrawal. As a result when stress becomes too great, it begins to take a toll mentally, physically, and emotionally [7].

It seems that depression is often triggered by trauma in our lives. It could be emotional, mental, social, and physical or a combination of any of these factors [8]. The thoughts of the effected patient will be as:

- *The effected patient feels desperate and that he is losing control of his life.*
- *His thought world profoundly impacts his physical life.*
- *The effected person feels as if time is racing or he is moving in slow motion.*
- *His world and activities appear insurmountable and life can feel like a pit.*
- *There are overwhelming feelings of isolation and he feels disconnected from others.*
- *He feels trapped with no way to escape.*

- *He hates himself for feeling like this and feels tremendous shame and guilt.*
- *It is a space filled with darkness, fear, despair and panic.*

This approach presents another nice and attractive technique parallel not conflicting with the above mentioned methods of relaxation, to finish boringness, tiredness, depression, stress and produce relaxation and refreshment, which is natural music "Recitation of the Holy Quran" by using visual and multimedia systems [3]. The Holy Quran is one of the softest and lightest music in nature, which originated from pure revelation source, can be used as an emancipator tool with high experimentation value and higher authority, to prevent a great number of physical and mental sufferings [3].

In this paper, the proposed process gives the best result comparatively, because in this practice negative thoughts goes away and positive thoughts comes in mind. Best result can be achieved when user use sweet sound and attractive animation of the text. Focusing the mind on a word, phrase, or idea and letting go of other thoughts with an attitude of passive acceptance for relaxation or making positive changes [5]. The effect of recitation of the Holy Quran will be for long time, if this process keep continue with regularity for more time on daily basis, the effect will be permanent and some time for some subject (user) the effect will be forever, means for life time. Full involvement of the body for full concentration and full concentration for the best result of the process is very essential. The proposed physiological biofeedback method gives dual benefits to the mentally disturb patient, 1st the stress and depression will finish and spiritually the patient will refresh and 2nd the patient will feel decreasing in the frequency and pain level.

Relaxation is a skill. This means that relaxation is something that can be learned and practiced, it is something we are not necessarily just born knowing how to do (not everyone knows how to relax), and we often are not good at it at first [7, 8]. Each person has the ability to learn how to relax, but not everyone will relax the same way. During meditation or other relaxation techniques, the subject may not actually feel much different or notice any changes [7]. The physiological changes are occurring nonetheless. This means that whether or not you notice any changes at the time, by doing relaxation biofeedback techniques you get all of the physical and psychological benefits of the relaxation response through, and are protected against the harmful effects of stress [5, 7, 8].

Related Background

Our surrounding contains thousands of audio clips, including environmental sounds, machine noise,

music, animal sounds, speech sounds, and other non-speech utterances. The effectiveness of their deployment is greatly dependent on the quality and type of sound. Audio data is an integral part of many modern computer and multimedia applications [1, 6, 7]. Natural sounds i.e. the sound of flow of water in rivers, vibration of the leafs of trees, air on the top of mountains, bird singing etc has nice and attractive quality effect which is different and unique than the other artificial sounds [1, 7]. The Recitation of the Holy Quran is also a Natural Sound which has unique qualities and effects on the human body [3].

The own voice of the user can be particularly effective for inducing the relaxation response, because people often respond best to suggestions they provide themselves [7]. User will find that he is able to relax by listening own voice better than listening to someone else's [1, 7].

It is a commonly known fact that the performance quality and result depends upon the mode of the subject (User) during performance a task. If a user is bore, tired, depressed and stressed then the best performance and accurate result can't be expected from him. For quality work subject should be relax and fresh mentally, physically and spiritually. Hobbies and creative outlets can be excellent stress relievers [7, 8]. Managing the time effectively can significantly decrease stress. Avoid the trap of over-scheduling by prioritizing tasks and putting free time into schedule. Sensory relaxation involves the use of the senses (vision, hearing, touch, taste & smell) to bring about relaxation. This may involve imagining or experiencing different sensations [7]. Training also has an effect, when school pupils receive guidance in the form of instruction leaflets or recorded tapes, soldiers taking classes in army centers and players gain the instructions of games in playgrounds etc [7, 8].



Fig 1: Environment for getting Relaxation

Methodology

The propose process provides best effect and result, when user use multimedia for listening, reading and watching the text of the Holy Quran, he (user) can use head phone or speakers for sound of recitation, LCD Screen for display of wording of Quran and keyboard or mouse for turning of pages. Hence ears, eyes, tongue and fingers of the user will be involved and control by brain in this method.

Fig 1 shows the environment user need by using fully multimedia system. The place where a user takes the relaxation through this process should be a separate room or no noise in surrounded area. A screen or system to provide visual display of the Holy Quran text and good-looking natural sceneries, through projector the result will be better. By bearing in mind text and sceneries through eye the thoughts and dreams of the user get promotion. For the sound user need for mic to record own voice and listen by Ear loudly through headphone or speaker. By using Fingers user can change Ayah and can turn over page of the Holy Quran. By using Fig 1 environment the effect of the recitation will be nice and better.

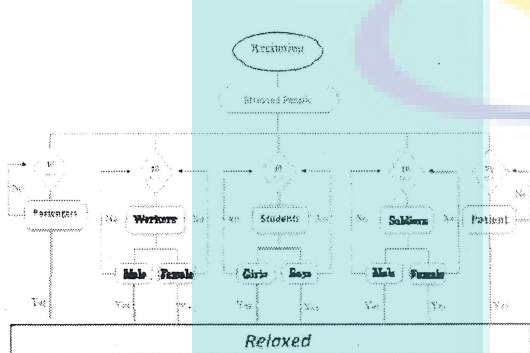


Fig 2: Relaxation Process Diagram

Results

The investigation was to prove the effect of the Holy QURAN in decreasing boringness, tiredness, depression, stress and aggressive behaviors of the human body. There were two classes of the students to participate in this research as in Fig 2. The number of students divided in two groups "A" & "B". Experimentally to one group "A" was listened the recitation of Holy Quran and to other group "B" traditional music, regular for 15 days for the same interval of time simultaneously. After 15 days there were a lot of changes in both groups. According to the result of the nursing staff the following results obtained as shown in Fig 3.

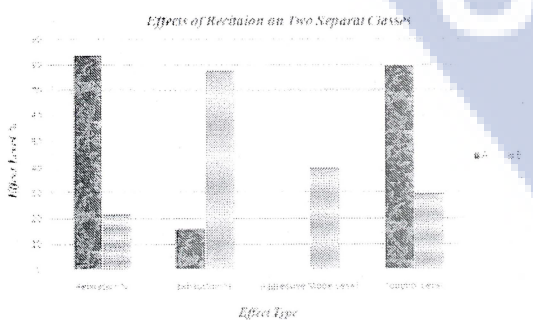


Fig 3: 5

- Relaxation Level of Group "A" was high, but low level for Group "B".
- Exhaustion Level for Group "A" was low and it was high for Group "B".
- Aggressive mode Level was Zero (Nothing) in Group "A" but for Group "B" aggressive mode was present in the form of emotionality.
- The thoughts and dreams of Group "A" were positive, high and useful, but the thoughts and dreams of Group "B" were negative, low and Useless.

It means that the effect of the music was only for that specific time, and as a result the effect of recitation of the Holy Quran (Natural music) on group "A" was permanent. Hence permanent relaxation can be achieved with the help of recitation of the Holy Quran on daily basis in daily life and especially for depression affected patients in hospitals and to decrease the aggressive mode of the person.

Our proposed system is useful comparatively in various places i.e. in army training centers to keep the soldiers away from the tension, in industries to achieve good performance from the workers, in educational departments to keep students fresh for study, in hospitals for the treatment of mentally upset patients and in buses or in airplanes to keep the passengers relax. The effect of any method of relaxation also depends upon the age of the user, in different ages there will be different effect of any practice for getting relaxation. During our research it was finalized that the best age for getting relaxation with Recitation is upto 28 years for male and 25 year for female. After this age the effect will be decrease gradually. It means that for any method of relaxation the effect can't same for 12 years child and 55 years old person.

Although any person any time can take Relaxation with the help of recitation of the Holy Quran, but for the result of research of best time, we take a mix group of different type of people i.e. male, female, young and aged. For the effect comparison we practice on this mix group, for 10 mints regular for 15 days in different time i.e. Morning before sun shine, Afternoon, before Evening, after Evening and in Night. As a result the suitable time for best result was Morning before sun shining and then Evening time after sunset as shown in Fig 4.

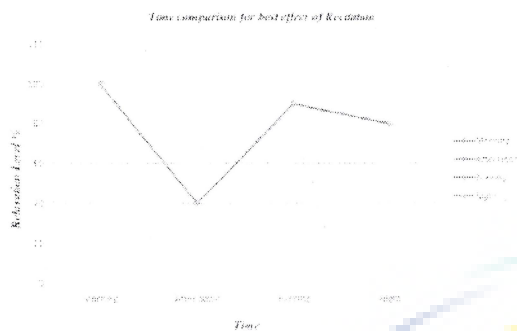


Fig: 4

According to the result of research both gender can take easily relaxation with the help of recitation. For the difference determination of the effect on male and female, we take two Groups same in number and same in age, one male group and other female. After 10 mints regular relaxation for 15 days, it was observed that female take less time than male in getting relaxation through this process, due to the sensitive factors of feminine. It means that in equal interval of time female will get more relaxation than male as shown in Fig 5.

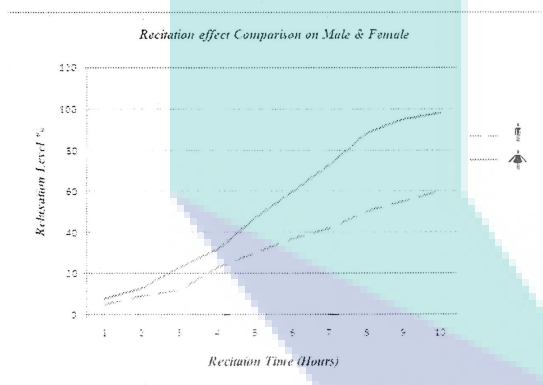


Fig: 5

Conclusion

This approach presents another nice and attractive technique parallel, not conflicting with the above already mentioned methods using for getting relaxation, to finish boringness, tiredness, depression, stress and produce relaxation and refreshment, which is natural music "Recitation of the Holy Quran" by using visual and multimedia systems. The Holy Quran is one of the softest and lightest music in nature, which originated from pure revelation source, using experimentation value and higher authority, to prevent a great number of physical and mental sufferings.

In this paper, the proposed process gives the best result comparatively, because in this practice negative thoughts goes away and positive thoughts comes in mind. Natural sounds i.e. the sound of flow of water in rivers, vibration of the leafs of trees, air on the top of mountains, bird singing etc has nice and attractive quality effect which has different and unique effect than the other artificial sounds. Rather than these sounds our surrounding contains thousands of audio clips, including environmental sounds, machine noise, music, animal sounds, speech sounds, and other non-speech utterances. The effectiveness of their deployment is greatly dependent on the quality and type of sound.

There are many methods, i.e. listening music, play game, watch movie, out walking, using of drugs, exercise, massage, crafts, hobbies, dancing, conscious mental rest, artwork chatting with friends, taking hot bathing or shower, deep sleeping after hard and long work etc, for getting relaxation, release tension, relieve boringness and to finish stress, but the effect of the Recitation of the Holy Quran will be permanent and forever, if a user uses it regular on daily basis for long time.

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Epilepsy Control by Prayer Type Yoga Exercise

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Abstract—Epilepsy is caused by sudden flurries of electrochemical activity in the brain, which interrupt the ‘conversation’ among neurons. Consciousness, memory, sense, speech, mood, movement, and motions can all be affected during the one or two minutes that the seizure lasts. Walking, jogging, running and stationary bicycling are particularly safe, but especially “Prayer type yoga exercise” clearly benefits epileptic inhabitants to control epilepsy because it often reduces seizure frequency, relieves depression, decreases social segregation, and promotes cardiac and general health. This paper proposes the study about yoga “Prayer”, which is not really an exercise but similar to yoga, helping in controlling of epilepsy and also physically, mentally, spiritually relaxation can also be achieved through this method. Spiritual religious believe and practices have an important impact on both physical and mental health.

Keywords- Epilepsy; Yoga; Prayer; Relaxation.

I. INTRODUCTION

The effect of exercise on seizure frequency and harshness [1, 2] has been demonstrated, and exercise may confer a protective effect on epileptic patients [3, 4]. Patients who contribute in physical activity present fewer seizures than inactive patients, but neither the cause nor the effect are established [1]. However, the changes in the electroencephalogram created by exercise and the reduced response to hyperventilation after exercise are associated to nerve cell acidosis [5], indicating that physical exercise suppresses activity and raises the seizure threshold. In addition, effects of physical exercise in human being with epilepsy has been demonstrated [6, 7] and physical training during the chronic period reduces the frequency of seizures [7]. Brain metabolism during seizures and interictal periods provides a signal of the central nervous system structures responsible for the generation, propagation, and control of the epileptic activity.

Epilepsy is a general term used for a group of disorders that cause instability in electrical signaling in the brain. Such as such an office building or a computer, the brain is a highly complex electrical organism, powered by roughly 80 pulses of energy per second. There are many sorts of seizure i.e. Partial or focal seizures, complex partial seizure, simple partial seizures, absence seizures, tonic-clonic seizures, myoclonic seizures, infantile spasms, atonic or a kinetic seizures and febrile seizures. Before a seizure, many people experience a warning sign called an aura, which may involve a particular smell, feeling or visual effect. Additionally after a seizure, a person may be confused, tired, or sleepy, experience muscle aches or soreness, and may not remember what happened.

Participating in physical activity and exercise has important benefits, including preventing, treating and reducing risk factors for conditions such as coronary heart disease, diabetes, hypertension and osteoarthritis. Physical activity can also positively impact severe conditions, such as cancer, and support lifestyle changes, such as smoking cessation [11, 12]. Moreover, people with epilepsy face additional barriers to exercise, as epilepsy substantially impacts their health and lifestyle [13, 14]. Many patients with epilepsy are physically inactive owing to fears of exercise-induced seizures or guidance given by family members and health experts [15, 16]. Patients with epilepsy who overcome these barriers and concerns, however, stand to benefit from physical activity in a number of ways, with improved cardiovascular health among the most prominent [17].

A study in Scandinavia reported that, where 10% of the population with epilepsy is prone to having seizures induced by strenuous exercise, another 30% to 40% of the survey population experienced moderately reduced seizures following regular physical exercise [18]. Patients with epilepsy can generally be confident to engage in physical activity, yet because of the particularities of each individual’s epilepsy, consultation with a physician must precede activity [18].

Epileptic uses different ways of aerobic exercise i.e. Dancing, Swimming, Pilates and yoga, Team sports, Weight training, Golf, Tennis, Squash, Racket sports, Rowing, kayaking, Cycling, Aerobics classes, Walking and jogging, but this paper present another YOGA prayer type exercise, which is very nice as compare to another exercises, suitable and easy for any one, any time and also can perform anywhere.

II. RELATED BACKGROUND

Yoga physical exercise is generally accepted to contribute to general health and well-being superior mood, life quality and reduction in symptoms of anxiety, sadness and depression [8, 9]. Positive physiologic effects, including improved cardiovascular fitness are well standard [8]. However, during physical activity (involuntary hyperventilation), the increased respiratory rate is a creation of the greater metabolic and respiratory demand. This compensatory mechanism is completely different from the process of non-physiological hyperventilation [10].

Many people with epilepsy do not participate in physical exercise courses and live a sedentary life [24, 26]. Overprotection, isolation, low self-esteem, depression, and anxiety [27, 29] are considerable barriers to an active life. Furthermore, obstacles for some persons with epilepsy who desire to live an active life are the notion that physical activity provokes seizures and also make them prone to injuries [24]. Several studies have shown a low degree of participation in physical activities among people with epilepsy [25, 26]. Although the main concern with regard to physical exercise by persons with epilepsy has been exercise-induced seizures, other factors such as lack of training facilities, problems with transportation, low motivation, and fear of qualified instructors who know how to handle such problems are noted [25]. Various studies have been designed to study this subject comparing physical and social activities among patients with epilepsy based on questionnaires and/or clinical studies [24, 30]. They also assess physical fitness by using standardized tests of physical endurance [30, 31] and physical training programs [32]. Epidemiological data in the literature shows the relationship between epilepsy and physical exercise based on different populations from various countries [25]. Observed that patients with epilepsy from a Norwegian population were half as active physically as the normal population and their physical fitness corresponded to their sedentary lifestyle. Other studies have confirmed these findings showing that people with epilepsy have a low degree of participation in physical activities [24, 33]. The real benefits of physical activities and aerobic exercise are achieved by increasing heart rate and breathing hard for an extended period of time. During this aerobic activity the body produces more energy and delivers more oxygen to

muscles. Heart beats faster and increases the blood flow to muscles and then back to lungs.

Prayer is generally understood as a communicative act between humans and the divine. Yet as a communicative act it is somewhat peculiar in that God's (the addressee's) presence and action is often quite uncertain. Anthropologist Webb Keane notes, "In contrast to face-to-face encounters of conversation analysis, the presence, engagement, and identity of spiritual participants in the speech event cannot always be presupposed or guaranteed [34]. Prayer often seeks to bring about interaction between human beings and other kinds of beings that would (or should) not otherwise occur. Even belief in the omnipresence of divinity does not assure that one can interact with it" [34]. In contrast to interactions between humans, prayer generally involves uncertainty about whether and how the divine listens and responds, making these relations unusually complex [35].

Prayers are also speech acts, governed by particular kinds of speech genres. As Keane's quote suggests, the fact that prayers can be distinguished as acts of communication with a divine actor (presence or agent) organizes the certainties and uncertainties within these speech acts in different ways [36].

Recent psychological literature focusing on prayer and religion pays comparatively little attention to non-agentic, immanent conceptions of divinity. Building on psychobiological evolutionary models of religion's emergence as a response to particular biological and psychological conundrums, gods are interpreted and posited as conjectures that play certain functions [37].

Increasing evidence suggests that spiritual and religious beliefs and practices have an important impact on both physical and mental health [19]. Data suggest that religion and spirituality may be protective against physical and psychological illness as well as important tools for coping with life stressors [19]. More specifically, spirituality has been shown to increase resilience to depression in individuals suffering from terminal illnesses religiosity has been correlated with improved psychosocial adjustment in cancer patients [20, 21]. In addition, spiritual practices, such as mindfulness meditation, have been associated with stress reduction and improved coping among several populations, including chronic pain patients, individuals with panic disorder [22] and overworked medical students [23].

III. METHODOLOGY AND RESULTS

Yoga consists of a number of "Asnas" or body positions, which one retains for a desired length of time while either reciting "Mantras" or breathing in a rhythmic manner. Its benefits have been researched by many doctors who now recommend it to their patients, by many medical schools such as Harvard, and by many foundations such as the Menninger Foundation.

The Muslim prayer has five positions, and they all (as well as the recitations we make while performing the prayer) have a corresponding relationship with our spiritual and mental well being, according to modern scientific research. Muslims pray five times a day, which each prayer made of a series of postures and movements, each set of which is called a *rak'ah*. The benefits of performing specific movements and recitations each day come from the correct rendition of the position or action itself, the length of time the position is held, and from careful and correct recitation techniques. Each of the five prayer positions has a corresponding yoga position, and the positions together "activate" all seven "chakras" (energy fields) in the body.

The TAKBIR and AL-QIYYAM together are very similar to the "MOUNTAIN POSE" in yoga, which has been found to improve posture, balance, and self-awareness. This position also normalizes blood pressure and breathing, thus providing many benefits to asthma and heart patients. Fig 1.

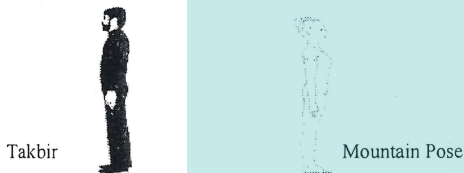


Figure 1. Takbir in prayer and Mountain Pose in yoga.

The placement of the hands on the chest during the Qiyyam position are said to activate the "SOLAR PLEXUS" chakra or nerve pathway, which directs our awareness of self in the world and controls the health of the muscular system, skin, intestines, liver, pancreas, gallbladder and eyes. When the hands are held open for du'a, they activate the heart "chakra," said to be the center of the feelings of love, harmony and peace to control love and compassion. It also governs the health of the heart, lungs, thymus, immune system, and circulatory system.

Fig 2.

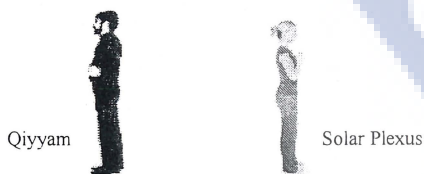


Figure 2. Qiyyam in prayer and Solar Plexus Pose in yoga.

The position of RUKU is very similar to the "FORWARD BEND" Position in yoga. Ruku stretches the muscles of the lower back, thighs, legs and calves, and allows blood to be pumped down into the upper torso. It tones the muscles of the stomach, abdomen, and kidneys.

Forming a right angle allows the stomach muscles to develop and prevents flabbiness in the mid-section. This position also promotes a greater flow of blood into the upper regions of body – particularly to the head, eyes, ears, nose, brain, and lungs – allowing mental toxins to be released. Over time, this improves brain function and ones personality. This is an excellent stance to maintain the proper position of the fetus in pregnant women. Fig 3.



Figure 3. Ruku in prayer and Forward Bend Pose in yoga.

The SUJUD is said to activate the "CROWN CHAKRA" which is related to a person's spiritual connection with the universe around them and their enthusiasm for spiritual pursuits. This nerve pathway is also correlated to the health of the brain, nervous system, and pineal gland. Its healthy function balances ones interior and exterior energies. In Sujud, we also bend knees. Thus activating the "BASE CHAKRA", this controls basic human survival instincts and provides essential grounding. Sujud helps to develop levelheaded and positive thinking along with a highly motivated view of life, and maintains the health of the lymph and skeletal systems, the prostate, bladder, and the adrenal glands. We also bend the "sacral chakra" during Sujud. Thus benefiting and toning the reproductive organs. Fig 4.



Figure 4. Sujud in pray and Crown Pose in yoga.

The position of AL-QAADAH, (Julus) is similar to the "THUNDERBOLT POSE" in yoga, which firms the toes, knees, thighs and legs. It is said to be good for those prone to excessive sleep, and those who like to keep long hours. Furthermore, this position assists in speedy digestion, aids the detoxification of the liver, and stimulates peristaltic action in the large intestine. Fig 5.



Figure 5. Tashahhud in prayer and Thunderbolt Pose in yoga.

Last, but not least, the SALAM as “THROAT CHAKRA” in yoga is activated by turning the head towards first the right and then the left shoulder in the closing of the prayer. This nerve path is linked to the throat, neck, arms, hands, bronchial, and hearing – effecting individual creativity and communication.

It is believed that a person who activates all nerve pathways at least once a day can remain well balanced emotionally, physically and spiritually. The doctors and medical practitioners suggest for the epileptic YOGA, but in this paper we proved that pray has very close similarities with PRAYER. Since this is the goal of all sincere Muslims, we all should strive to attain the perfection of stance, recitation and breathing recommended in the Hadith while performing our prayers the very same techniques of perfection taught in popular yoga, Tai Chi, and many other exercise classes.

IV. CONCLUSION

Interestingly, for the millions of people enrolled in yoga classes, the Islamic form of prayer has provided Muslims for fourteen centuries with some of yoga’s same (and even superior) benefits. This simple form of “YOGA” offers physical, mental, and spiritual benefits five times a day. "Prayer is one of the greatest and most excellent means of nourishing the new nature, and of causing the soul to flourish and prosper." These were some very meaningful words spoken by Jonathan Edwards over 200 years ago in his famous sermon on prayer. Times have changed and so his society, but Edward's message remains timeless. Prayer has not changed nor has its amazing benefits.

This paper shows that those who pray are physically, mentally, emotionally, spiritually healthier than those who do not pray. Those who suffer depression, anxiety, and even terminal illnesses often have a quicker healing time, and more successful survival rate. Perhaps it is this meditative process that gives prayer one of its most outstanding benefits. "Prayer that is constantly and diligently attended to be one of the best means of leading not only an amiable and pleasant life; but also a life of much sweet fellowship with Christ, and of abundant enjoyment of the light of his countenance", says Edwards in his speech. To put it quite simply, when we pray, we are growing closer to the Lord we love. We are easing the struggles in our lives and improving our relationships, all the while getting to know Him by learning His word, and applying it to our lives in many meaningful ways.

However, this is fact that not every prayer will get all those beneficial substances and hormones. If you are interrupted in the middle of the prayer, you can't obtain the full benefit. In sum, prayer is a kind of still meditation, yet moving meditation gives better result. When you pray, it involves three functions - the mouth when you chant, ear as you hear the chanting, and eyes are closed. But in

moving meditation, you will have to control more of your functions. The more you can control them, the better you can balance your mind and body.

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