**Virtual Gaming**

Juwairiah Saleem, Naveera Jamil, Mahwish Naseem and Ambreen Jahan

*Department of Computer Science*

*Jinnah University for Women*

*Karachi, Pakistan*

{juwairiah.saleem1996, naveerajamil18, mahwishnaseem17, ambreenjahan18} @gmail.com

***Abstract*-**Brain-computer interface (BCI) is a progressing area that has been adding this whole new dimension of capability to HCI. BCI has created a unique communication channel, mainly for the ones who're incapable to generate the required muscular movements in their daily life to control the common devices. The patients who suffer from Thalassemia or dialysis undergo painful treatments with time duration of 2-3 hours which is quite long. The engagement of their hands due to the canola drips makes them even more mentally disturbed. They are unable to carry out any task utilizing hands and feet except from watching the screens which can be very exhausting after some time. They need some enjoyable entertainment especially during their treatment to divert their mind from the pain they endure. Furthermore, Studies shows that the ADHD (Attention deficit hyperactivity disorder) patients are also treated by the neuro-feedback, since they tend to lose the focus easily very often. Taking these issues in consideration, we proposed a solution called Virtual Gaming, which comprises of an EEG (electroencephalogram) headset. EEG safely measures brainwave signals and monitors the concentration and attention levels of users as they interact with the system in order to play the game. The proposed solution aims to provide those patients an ease and means of entertainment during the treatment without any involvement of the hands. Also, the proposed system acts as a mind booster for normal people to increase attention, focus and concentration.

.

***Keywords:***BCI (Brain Computer Interface), EEG headset, Games, Attention Deficit Hyperactivity Disorder (ADHD), Brainwaves, Brain Exercise.

**Introduction**

Nowadays, Human Computer Interfaces (HCI)has become omnipresent. Keyboards and mouse are the best examples of HCI. But the people who are paralyzed or has any kind of physical disability cannot interact with computers as normal and enabled people can do. BCI(Brain-Computer Interface) is the solution that enables the paralyzed people to control their environment directly with their brain without any involvement of gestures or any muscular activity. Currently, BCI is using in many communications like controlling a wheelchair, games etc. Controlling a game with brain is not only used for entertainment but it is also a therapy for mentally weak people. Virtual Gaming is for all, it is not only for the people who have any kind of disability but it is an exciting experience for the healthy people as well. We have developed a car racing game on which we have implemented our idea. Such patients especially most of the young generation lose hope very soon and thinks that they have no place in society. So, the game has been developed in such a way that it encourages and motivates its users. The game aims to spread positivity and stop them from thinking negatively about themselves and to make them feel like a valuable citizen of the society. We have implemented our idea on some of the very famous and most liked games like Need for Speed, FIFA, and Asphalt etc. For Brain Control Interfaces, there is a hardware called EEG (electroencephalography) headset which is now easily available all across the world.

**Initial Research and Survey**

Before starting the project, we did research, visited and talked withthe patients of Dialysis in SIUT, Thalassemia patients in Kashif Thalassemia Clinic and to the patients of ADHD in person. Through the research and survey, we analyzed that the treatment session of both Dialysis and Thalassemia patients is more than 3 hours. We did short interview with the patients about their activities while getting treatment.They said:While undergoing dialysis treatment, they have no means of entertainment. They either get bored or just watch the TV or listen to music butafter sometime, these things start exhausting them.Instead of providing some mental ease and entertainment, it frustrates them even more. As for ADHD patients, they have lack of concentration because their brain chemicals called neurotransmitters do not work properly so, they are unable to focus and tend to forget things. They end up getting irritated and depressed.

Virtual Gaming accommodates and providesloads of joy to the patients of Dialysis and Thalassemia to control games with their brain,as during the treatment, they are unable to use their hands. The proposed idea of controlling the game through brain can also help increase the concentration and focus of ADHD patients. Virtual Gaming is not only for entertainment purposes but it also serves as a mental therapy.

**Method**

To establish a BCI connection, connect the EEG Headset Bluetooth with the Arduino Leonardo. Once the connection will establish user can play the game with his/her mind.The game called “Mind Racer”, is a Karachi-Enviornment racing car game. The racing car game with a Karachi environment may bring joy specially for the children. The user must defeat the automatic car while speeding up their own car.The goal is to save the car from being hit of destroy.To control the game user need to concentrate at a particular point. The greater the concentration, the more smoothly car will run. At the beginning of the game, there will be some difficulty experience by the user to control the car , but after few minutes, they can control the car with so much ease.

**NFS**

***Need for Speed***, also known as ***NFS***, is a [racing](https://en.wikipedia.org/wiki/Racing_video_game)[video game](https://en.wikipedia.org/wiki/Video_game) published by [Electronic Arts](https://en.wikipedia.org/wiki/Electronic_Arts) and currently [developed](https://en.wikipedia.org/wiki/Video_game_developer) by [Ghost Games](https://en.wikipedia.org/wiki/Ghost_Games). The series centers around illicit street racing and in general tasks players to complete various types of races while evading the local law enforcement in police pursuits. We will control NFS through BCI as after some time most of Brain controlled games got uninteresting. It will be a new and exciting experience for the NFS lovers.

**Hardware & Software**

**MindFlex EEG Headset**

The EEG headset is widely available in the consumer market. There are many kinds of headset like EPOC by Emotiv, Mindflex and Mindwave by NeuroSky. We use MindFlex EEG Headset in our project.The users have to connect the clips to their ear lobes, and align the metal forehead sensor just above thier left eyebrow.

**Arduino Leonardo**

The **Arduino Leonardo** is a microcontroller board based on the ATmega32u4. Similar to an Arduino UNO, can be recognized by computer as a mouse or keyboard.

**Unity 3D**

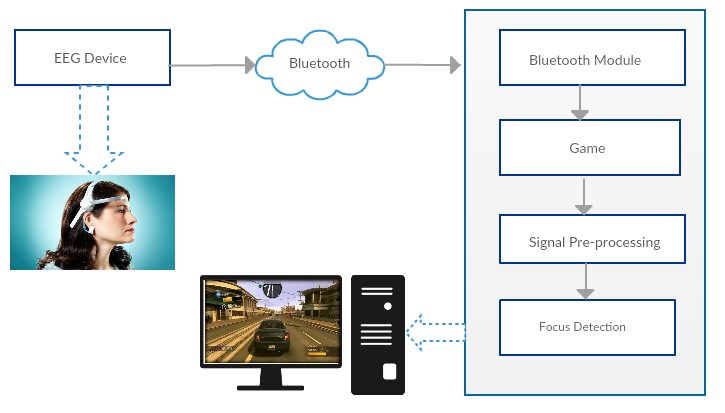
For the development of the game “Mind Racer” we used Unity 3D. Unity is a cross-platform game engine developed by Unity Technologies, which is primarily used to develop both three-dimensional and two-dimensional video games and simulations for computers, consoles, and mobile devices.

**Related Work:**

Brain-Computer Interface (BCI) technology is a rapidly growing field and publicity about this technology is increasing. Although the original aim of BCI technology was to provide a new pathway of communication for patients suffering from complete paralysis. Some researchers have focused recently on the application of BCI to games for use by healthy people, people with mental weaknesses or the people who suffer from certain diseases to divert their minds from the pains they endure especially during the treatments.

**BCI Games:**

BCI games have been developed to decrease mental weakness and to evaluate concentration in a mental task. One of the examples of BCI is “Pinball Game”. In this game the user has to concentrate at a certain point to control paddles(left or right paddles).The other game is “Mind Balance Game” that uses steady state visual potential. Checkerboards are flickering on both left and right side. The system requires user to focus on either left or right of an avatar to maintain balance.



**Engagement of Dialysis/Thalassemia Patients while getting treatment:**

At the time of the treatment, Dialysis and Thalassemia patients passes their time either by reading books, watching TV or listening to the songs.There are endless online games for passing the time, games also enhances memory and mental alertness. But, since their hands are bounded they are unable to play any games.

**The Treatment for ADHD Patients:**

The ADHD patients improve the level of memory and attention by using game. A game “The memory game” helps increases the user’s attention span and memory. The game requires the player to match their cards which are turned down face. When you turn a card face up, if your card doesn’t match, you have to take it back. The task is to remember the cards that have been take back, thus when your cards matches, you can pair them. Whoever succeeds in making the most matches wins.

**Users:**

Virtual gaming is designed for two types of users: Patients and the healthy users. It targets the patients who undergo treatments like Dialysis, Thalassemia or any other time-taking therapies and treatments. The problem that the VG isintended to solve is that such patients’ treatments are quite long with no means of entertainment since their hands are also bounded. So, our system provides them with entertainment and helps divert their minds from the pain they go through. VG has also been developed for training those who suffer from ADHD (Attention Deficit Hyperactivity Disorder) and has helped them quite a lot. The proposed system i.e. Virtual gaming also acts as a mental therapy and exercise since it requires great attention, focus and concentration for the game to run better. It is not only for the patients. The healthy people can also be entertained by the system. It is especially for those who love video games like Gamers. It’s like a new flavour in gamers’ world. It can be implemented in the gaming zones, airports or malls to spend time in a productive and fun way. Also, it can be used at homes to make free time valuable and full of entertainment.

**Conclusion and Future work:**

In a nut shell, the proposed system i.e. Virtual Gaming provides means of entertainment to those who undergo painful time-taking treatments. It is like a brain exercise as it requires user’s excellent attention and focus to play the game. VG helps improve the mental focus of those who tend to lose focus easily in a fun and interesting way. It is not only for disabled people; instead it is accessible for all. We have implemented our idea on the car racing game we have developed and also on some of the existing games like Need for Speed etc. As the time progresses in the near future, more and more advanced Brain Computer Interface (BCI) devices having more sensorswould beused to control the game through brain much more efficiently and accurately [3]. A mesmerizing environment using VR equipment likea 3D mouse and a head-mounted display will beintegrated to do a comparative study. Besides, during the learning experience, theattention and concentration levels of the user would be captured and analyzed for better understanding. The upcoming games could be designed and developed in such a way that they could be controlled by the brain and that the gaming environments and games know how toadjust according to the cognitive and motoric abilities of the gamer [4].

**References:**

1. Bram van de Laar, Hayrettin Gürkök, Danny Plass-Oude Bos, Mannes Poel, and Anton Nijholt,”       EXPERIENCING BCI CONTROL IN A POPULAR COMPUTER GAME”. 2013
2. Marijn van Vliet, Arne Robben, Nikolay Chumerin, Nikolay V. Manyakov, Adrien Combazand Marc M. Van Hulle “Designing a Brain-Computer Interface controlled video-game using consumergrade EEG hardware”.2012
3. Nijholt, A., Bos, D. P. O., &Reuderink, B. (2009). Turning shortcomings into challenges: Brain–computer interfaces for games. *Entertainment computing*, *1*(2), 85-94.
4. Vourvopoulos, A., Liarokapis, F., & Petridis, P. (2012, September). Brain-controlled serious games for cultural heritage. In *Virtual Systems and Multimedia (VSMM), 2012 18th International Conference on* (pp. 291-298). IEEE.