



**Theoretical overview of playing multiplayer video game using EEG device
(Neuro Sky Mobile 2)**

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ABSTRACT

In this paper we proposed a multiplayer number picker game using brain computer interface (BCI). This game will be controlled by at least two or more people using NeuroSky MindWave Mobile 2. The users will advance through the game by choosing numbers through their brain. Our assumption is the game can be played by both able body or people with disability or both. This will be a simple game which may determine people's impression and maybe helpful to other Electroencephalography (EEG) based brain computer interface devices to perform multi computational task from multiple users. In our paper we have examined different paper on BCI process using EEG devices that enabled us to learn more about multiplayer gaming advantages in the field of brain computer interface (BCI).

1. INTRODUCTION

In brain computer interface it offers a non-invasive means of enabling a human to send messages and commands directly from his or her brain to a computer without moving or by wearing a simple scalp probe. Brain computer interface (BCI) provide the brain with the new output channels that depends on brain activity rather than on peripheral nerves and muscles. BCI can for example provide communication and control, in which the users intent is decoded from electrophysiological measures of brain activity. In this paper we represent a BCI based multiplayer "number picker game" that brain computer interface (BCI) uses NeuroSky MindWave Mobile 2 brain wave, a typical Electrophysiological response to internal and external given related potential measured using an Electroencephalography (EEG). The NeuroSky MindWave Mobile 2 wave has proven relatively easy to use variety of control

signalling purposes in much recent practical research. Brain computer interface (BCI) games can also be useful for helping a user to control his or her brain activity. Games controlled using brain wave signals have been designed to improve the power and duration of concentration, increase the speed and accuracy the brain wave. NeuroSky enables its Original Equipment Manufacturer (OEM) partners to create custom BCI headsets that are affordable, consumer-friendly and able to extend the gaming experience into new realms [1]. We formulated the following requirements for the game:

- 1) The targeted people will be healthy users of all ages and also disable person with good motor reflexes.
- 2) The system will run robustly on consumer grade Electroencephanography (EEG) hardware NeuroSky MindWave Mobile 2
- 3) The system was played by two users or at a time.
- 4) Many people with disability can not use convesional interfafces such as computers mobiles and other devices.

2. BCI VERSION OF THE GAME

In the BCI version of “number picker game,” we simply replace the manual drop of the numbers by a P300-based selection of the target column. The column selection process follows the same principle as the item selection in the well-established P300 Speller paradigm. A hided number of box is usually displayed on a computer screen for spelling [5]. The subject has to guess the hided box contained with number either Odd of Even. Since the target events are rare and unpredictable, they elicit a typical EEG evoked response, the P300 whose detection allows us to identify the target symbol. In the number picker game “Odd-Even Numbers” scenario, only the numbers are matter and need to be proposed. This yields a simpler detection task and higher information transfer rate [2]

The P300 wave is a positive EEG deflection that occurs approximately 300 ms after stimulus onset (flash onset). It is typically recorded from central and parietal sensors. This response is evoked by paying attention to rare stimuli in a random sequence of irrelevant stimuli or distracters (the so-called oddball paradigm)[6]. From a cognitive perspective, the P300 can be seen as a measure of alertness and attention orientation, thus reflecting a subject's general level of arousal [8].

Playing procedures of Number Picker (Odd-Even) games for 8 turns:

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| i | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|----|---|---|---|---|---|---|---|---|
| X(i) | X | 2X | 2X | 4X | 4X | 8X | 8X | 16X | 16X |
| Y(i) | Y | Y | 2Y | 2Y | 4Y | 4Y | 8Y | 8Y | 16Y |
```

Here we can easily spot a pattern:

if i is even, then $X(i) = z * X$ and $Y(i) = z * Y$.

if i is odd, then $X(i) = 2*z * X$ and $Y(i) = z * Y$.

Here z is actually the power of 2. So, we can simply say –

If P is even output will be $\max(X, Y) \div \min(X, Y)$

Else output will be $\max(2*X, Y) \div \min(2*X, Y)$.

3. RESEARCH METHODOLOGY

The study will try to complete the study using the Applied Research type method. Applied research aims to develop techniques, products and procedures. This purpose of research, discovery of new knowledge, can take many directions; three of them are discussed here:

Theory Development

A theory presents interrelated concepts, definitions and propositions that provide a systematic view of phenomena and identify relationships among variables. This theory might use the following research design.[7] The study will explain how to use BCI devices in Multiplayer Video Gaming system. For this study, data will be collected from primary resources like- C++ Program, Python Program and algorithm analysis.

Practical Application

A second approach to increasing knowledge within the study involves providing evidence for the efficacy of a curriculum, a therapeutic technique, or administrative change when there may not be a theory that would predict the results. The current study will be testing all of the collected data from the primary sources. Tested result

will have been showing the effectiveness of BCI Interfaces and EEG devices using to control the game. Every player has their own choice to command the gaming options as well[7].

Development of Research Tools

A third approach to increasing knowledge within the study involves creating methods to assess behaviors. The research could develop a new standardized testing procedures and set of tasks to assess the usage of BCI devices[7].

4. CONCEPTUAL FRAMEWORK



5. BCI BASED SYSTEM:

BCI based system gaming needs several steps to perform gaming. But before gaming we need to understand how it takes user signals and convert it to commands for playing the game. In this study, we are giving a brief overview of how the BCI system takes the signals from the users and make is understandable command from the machine using NeuroSky MindWave Mobile 2. Normally BCI based systems are made of Electrode headset which is connected to a computer a wireless or wired connection. The headset records and transmits the brain signals to the computer.

The brain signals are processed in computer and respective algorithms are applied to get the desired results. These steps are briefly explained below:

Measuring EEG Signals: The aim of this step is to acquire the EEG signals. This is achieved by using Electrodes that are placed on the user's scalp (head) at respective Fig 1 shows NeuroSky headset that comfortably on one's head. It con

sists of two electrodes, one being attached at the forehead right above the left eye and other one is attached to the left ear lobe that works as a ground. It records the brain waves and transmits it to the computer via Bluetooth which is Mull in feature of Mindwave.



Fig 1:NeuroSky Headset

6. PRE-PROCESSING OF RAW DATA EEG:

Signals are very low power signals. Pre-processing and signal conditioning on EEG signal are performed in order to improve the signal quality.

FEATURE EXTRACTION:

The aim is to extract and identify the actual EEG signal from redundant signals which relates to user intention. An event is denied on the bases of some features.

In this game, both players first choose "**ODD**" or "**EVEN**" based on their lucky instincts, then choose an integer of their choice at the same time and if sum of both the numbers is even then one who chosese even wins else if number is not even then the one who chosese "**ODD**" wins. Now both wants to win the game desperately.

In this game, both players first choose "ODD" or "EVEN" based on their lucky instincts, then choose an integer of their choice at the same time and if sum of both the numbers is even then one who choses even wins else if number is not even then the one who choses "ODD" wins . Now both Player1 and Player2 decides to take this game to next level by playing game **N** number of times and whoever wins the most number of games will be titled with THE ULTIMATE CHAMPION. Now both wants to win the game desperately. It is known that Ramesh's lucky instinct tells him to go with "EVEN" always thus he always choses "EVEN". You are the judge, tell the final verdict by calling out the name of the winner[14].

INPUT FORMAT :

First line of input will contain an integer **N**. Following **N** lines will contain two integers **R** and **S** denoting number chosen by Ramesh and Suresh Respectively.

OUTPUT FORMAT :

Your output should contain one line, containing the string denoting the name of the winner, i.e., "Player1" or " Player2". (in capitals and without " ").

CONSTRAINTS :

$$1 \leq N \leq 10^4$$

$$0 \leq A, B \leq 10^{10}$$

NOTE : It is confirm that either RAMESH or SURESH wins for sure.

SAMPLE INPUT:	SAMPLE OUTPUT
3 12 21 12 12 1 1	Player1

Explanation

Since Player1 always choses "EVEN" in first game ($12+21=33$) Player2 wins. In second game ($12+12=24$) Player1 wins. In third game, ($1+1=2$) Player wins. Hence Player1 wins with 2 wins.

7. PLAYING MULTIPLAYER USING EEG (DATA SET)

The sensor Muse Headband was used for data collection. The Muse is a commercial EEG sensing device with five dry application sensors, one used as a reference point (NZ) and four (TP9, AF7, AF8, TP10) to record brain wave activity[11].

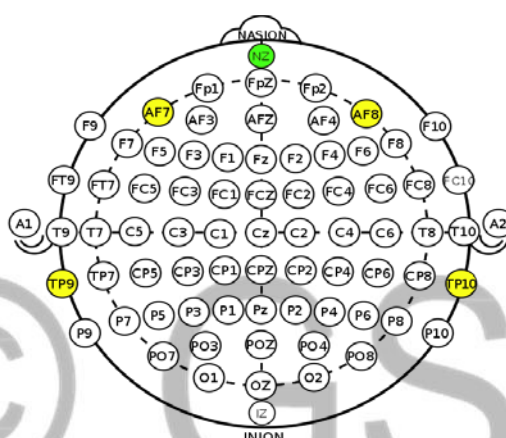


Fig. 2. The International 10-20 EEG Electrode Placement Standard [5] Highlighted in yellow are the sensors of the Muse Headband. The NZ placement (green) is used as a reference point for calibration.

The paper presents BCI based smart home control system. Non-invasive type BCI technique is used to develop this system. The simulation of brain activity for acquiring the desired EEG signals is accomplished by voluntary eye blinking. For every action, the brain emits certain signals. The EEG based sensors record these signals for various gaming activities[10].



Fig. 3. Odd-Even Number Game Interface

8. IMPORTANCE

The current study is a unique example of a multiplayer video game using EEG and BCI. Although technically we have not yet made an effort to start work, but by analyzing the research literature we understand that the analysis and programming of this video game will be able to fully evaluate the value of the research topic we have adopted.

9. Limitation

Limitations of the study are as follows:

1. Lack of enough previous research works on Multiplayer gaming using EEG Device.
2. Lack of proper high end device .
3. Budget shortage for the practical project.

10. Future Plan

To make the present study a success, we are targeted to make the proposed video game "Odd-Even Number Game". The game will show a hided box contained with a number Odd or Even. The players select their option from the list box. After that play button will be clicked and the hided box will be open in few seconds where the number will be shown odd or Even. Player who chose a right selection get win this turn. In the same way, the game will play a few more turns that players will decide in advance.

In the future, we would like to use noninvasive measurement to investigate more deeply the brain mechanism during a number picker video game.

11. Conclusion

In this BCI-based game research, we will be developing a game, Odd-Even Numbers, a option picker game using a P300 BCI to facilitate two users (a player, who controls the character in the game and does not wear an EEG cap, and a supporter, who uses his or her brain activity to communicate) working together to achieve one goal.

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