King Saud University
College of Computer and Information Sciences
Department of Information Technology

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Graduation Project Proposal

Focus

Prepared by

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1 Introduction

Brain-Computer Interface (BCI) technology has, in recent years, rendered groundbreaking advancements in the domain of human-computer interaction. By facilitating direct communication between the brain and external digital systems through brainwave signals [1] ,BCI opens up new opportunities in the realms of healthcare, education, and cognitive training. One notable application is the use of BCI in serious games aimed at enhancing focus and attention. These games monitor and evaluate brain activity using non-invasive EEG devices and offer real-time feedback to help users improve and enhance their cognitive skills.

This project tackles the increasing problem of people with attention difficulties, as well as healthy individuals looking to boost their concentration [2]. Conventional treatments often fall short in terms of long-term effectiveness and user engagement[1]. Additionally, the growing global dependence on digital technologies has created a need for innovative tools that foster mental focus and cognitive health in both children and adults.

Creating a technological solution in this field is incredibly pertinent both locally and globally. Locally, many educational institutions and healthcare providers are in search of interactive and accessible solutions to assist students with learning challenges. On a global level, the increase of consumer-grade EEG devices has made BCI applications more accessible[3], paving the way for inclusive digital tools that enhance mental well-being and productivity for all age groups.

In this document, we propose the design and development of a serious BCI-based game focused on improving users' attention and concentration. We demarcate the background of the issue, the project's goals, the proposed solution and methodology, and the anticipated outcomes. The solution will combine real-time EEG signal processing with an engaging and customizable gaming environment to achieve measurable enhancements in sustained attention.

2 The Problem

In this section, we will outline the problem in detail and highlight the main challenges that we aim to address.

In our increasingly digital and fast paced world, many individuals face difficulties in maintaining focus and mental concentration during tasks that require sustained attention. This challenge becomes harder by the constant presence of digital distractions such as social media, notifications, and multitasking habits. An example of this issue is seen in individuals attempting to complete work or creative tasks but repeatedly losing focus within minutes, leading to reduced productivity and mental fatigue. Despite using timers, focus apps, or external blockers, these methods often fail to address the internal cognitive state of the user [4]. This project focuses on solving the core of the problem, which is improving the user's ability to maintain attention through direct interaction with their brain activity in real time.

3 The Solution

In this section, we will discuss the solution to the problem that was discussed previously.

To address this, we propose the development of an interactive brain-training game powered by Brain-Computer Interface (BCI) technology. The system will use non-invasive EEG sensors to monitor the user's brain activity and analyze patterns related to attention. This data will be incorporated into the game environment in a way that encourages focus and engagement. This solution promotes enhanced self-awareness and focuses through attention enhancing activities, delivering a motivating experience that blends cognitive development with entertainment. By integrating brain activity monitoring into a game format, this approach offers an innovative and accessible method to support better concentration in everyday life.

4 Product Vision

In this section, we will define the product vision of **“**Focus**”**, which outlines what we aim to achieve with the application.

Product Vision:

For individuals looking for an engaging and effective way to enhance their focus and maintain their attention

Who needs an interactive solution that goes beyond conventional methods

The Focus **is a** BCI-powered game application

That helps users train and strengthen their cognitive focus in real time

Unlike traditional therapies or generic brain-training applications

Our product delivers a personalized experience that adapts to each user’s brain activity and improves attention and performance.

5 Product Roadmap

In this section, we will present the roadmap for the ‘Focus’ application, which outlines the development and delivery stages of the product over time in Figure 1.

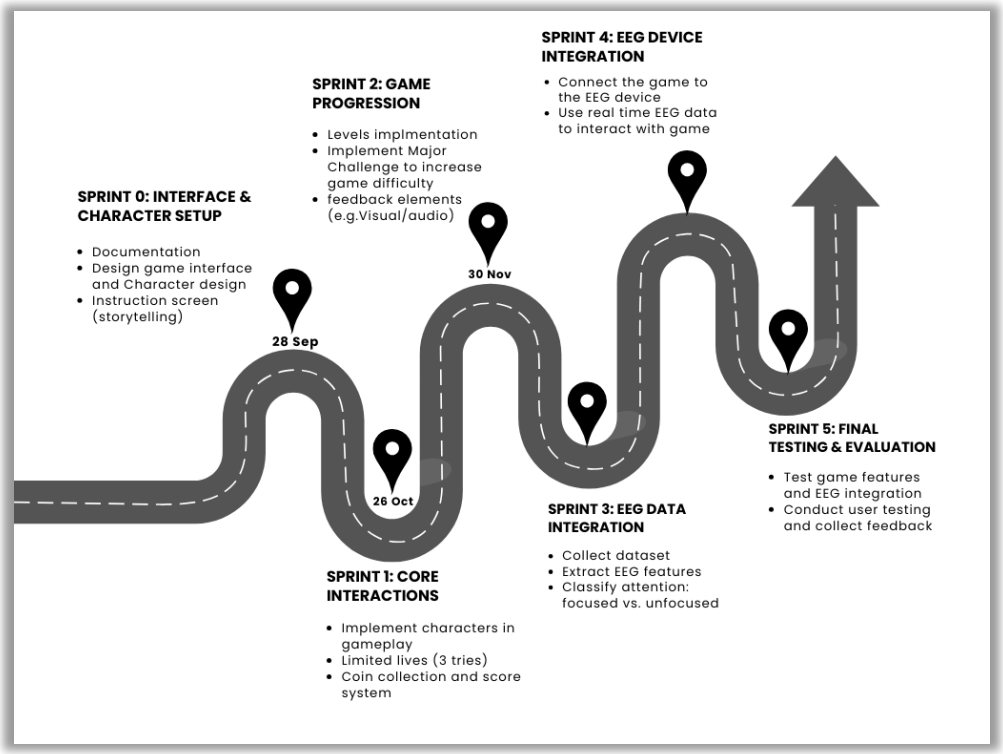

Figure 1: Project Roadmap

6 Objectives

In this section, we outline the product, project, and learning objectives for the development of "Focus", a game powered by Brain-Computer Interface (BCI) technology. These objectives define the primary goals and anticipated outcomes to be accomplished by the end of the project.

Product Objectives (customer focus-value): These objectives focus on the value and features the product delivers to end users. "Focus" aims to:

- Address the challenge of maintaining focus and attention in today's distraction-filled environments.
- Provide an interactive solution that improves users' ability to sustain concentration.
- Benefit users by offering real-time monitoring of brain activity with continuous feedback.
- Deliver an engaging game experience that combines training with entertainment.
- Include key features such as EEG-based signal detection, scoring, levels, and challenges to support motivation and progress.

Project Objectives (solution focus-plan): These objectives describe the major phases and technical activities required to build and deliver 'Focus':

- Design and implement the game interface, characters, and interaction mechanics.
- Collect and review the offline dataset.
- Preprocess and extract features from EEG data to distinguish between focused and unfocused states.
- Integrate EEG signal processing into the game for adaptive feedback and interaction.
- Connect and evaluate with a real EEG device to replace offline data with online signals.
- Conduct system testing, including usability evaluation and user feedback collection.

Learning Objectives (student focus): These objectives focus on what the team will learn from this project, including new tools, concepts, and techniques:

- Learn how to interface with EEG devices and interpret brainwave signals.
- Understand principles of EEG signals and how they can be applied in real-time systems.
- Apply knowledge of signal processing and data analysis to a practical project.
- Gain experience in game development using frameworks and libraries suitable for interactive applications with a focus on Unity integrated with BCI technology.
- Strengthen skills in Agile development, team collaboration, and iterative prototyping using Scrum methodology.

7 Scope

In this section, we outline the limitations of our application and identify what falls beyond the scope of this project, which may be considered for future development.

With captivating gameplay, “Focus” aims to develop a game powered by Brain-Computer Interface (BCI) technology that enhances users' focus and attention. The game connects to an Emotiv Epoc EEG headset (approx. $999, available through university resources) [5] to monitor brain activity and reflect the user’s attention levels through interactive gameplay. Core features include real-time EEG signal fetching, basic signal processing, and a single-player experience developed as a desktop application in English using Unity. The game will be built using the Unity IDE and the Emotiv software suite.

However, the “Focus” system will not include advanced gameplay elements such as multiplayer modes, complex storytelling, or detailed graphics. It also does not provide medical diagnosis or serve as a certified therapeutic tool. These aspects, along with features like long-term evaluation or integration with additional sensors, are considered beyond the scope and may be explored in future iterations.

8 Hardware/Software Tools and Cost

Table 1: Hardware and Software Tools and Cost

Hardware Tools	
Name and Description	**Cost**
Emotive Epoc: EEG headset used to collect brainwave signals for BCI integration	$999 Available by university resources
Laptop: Development machine, supports Unity & Python	Personal devices available
Software Tools	
Name and Description	**Cost**
C#: Programming language for Unity scripting	Free (open source)
Unity IDE: Game engine & development environment	Free (Personal plan)
Python: Used for signal processing, preprocessing, and data handling	Free (open source)
Jira: Agile project management, backlog & sprint tracking	Free (open source)
GitHub: Version control and code repository	Free (open source)
Canva: Used for design assets, UI/UX sketches, posters	Free (basic plan)
Emotiv Launcher: Main software hub to access Emotiv applications and SDK	Free with the device
Emotiv BCI: Real-time EEG visualization and performance metrics	Free with the Launcher
Emotiv SDK: Development kit for integrating EEG data with Unity/Python	Free with the Launcher
EmotivPRO: Professional tool for recording, analyzing, and exporting EEG data	$149 per month or $89 per month (annual plan)
Figma: Collaborative tool for UI/UX design and prototyping	Free (Starter Plan)

9 Scrum Team

9.1 Skill Set Requirements

To successfully design the "Focus" BCI-powered game, the Scrum Team needs the following skills:

Table 2: Technical Skills and Team Levels

Technical Skill Required	**What is the current level of the team (*beginner- intermediate- advanced*) for each skill? How will the gap be bridged? *(if necessary*) Learning plan**
C# and Unity Development,	**Beginner** – The team is new to Unity and C# and will practice by building simple game elements to gain hands-on experience.
Python	**Intermediate** – Team has prior experience; will further develop skills related to EEG integration.
EEG Device Integration (Emotiv Epoc)	**Beginner** – Will rely on Emotiv official documentation, YouTube tutorials, and sample projects to learn real-time signal streaming.
Signal Processing	**Beginner**– Team will explore fundamental signal preprocessing methods to improve EEG data quality for use in the game.
Game Design & UX	**Intermediate** – Members have background in UI/UX; game specific design elements will be refined through focused development efforts
Agile/Scrum Practices	**Intermediate** – Team has prior experience with Scrum methodologies and will apply this knowledge using tools like Jira to organize workflow and track project progress.

9.2 Roles and Responsibilities

Table 3: Scrum Team Roles and Responsibilities

Scrum Team	
Product Owner:	Dr. Mashael Aldayel
Developers:	Layan Alamri Lana Albogami Arwa Almutairi Hatoun Almogherah
Scrum Master (SM):	Dr. Mashael Aldayel
Stakeholders:	Examiners' Committee End Users

10 References

[1] J. E. Muñoz, D. S. Lopez, J. F. Lopez, and A. Lopez, “Design and Creation of a BCI Videogame to Train Sustained Attention in Children with ADHD Diseño y Creación de un Videojuego BCI para el Entrenamiento de la Atención Sostenida en Niños con TDAH”.

[2] A. E. Alchalcabi, A. N. Eddin, and S. Shirmohammadi, “More attention, less deficit: Wearable EEG-based serious game for focus improvement,” in *2017 IEEE 5th International Conference on Serious Games and Applications for Health (SeGAH)*, Perth, Australia: IEEE, Apr. 2017, pp. 1–8. doi: 10.1109/SeGAH.2017.7939288.

[3] G. A. M. Vasiljevic and L. C. De Miranda, “Brain–Computer Interface Games Based on Consumer-Grade EEG Devices: A Systematic Literature Review,” *Int. J. Human–Computer Interact.*, vol. 36, no. 2, pp. 105–142, Jan. 2020, doi: 10.1080/10447318.2019.1612213.

[4] H. H. Wilmer, L. E. Sherman, and J. M. Chein, “Smartphones and Cognition: A Review of Research Exploring the Links between Mobile Technology Habits and Cognitive Functioning,” *Front. Psychol.*, vol. 8, p. 605, Apr. 2017, doi: 10.3389/fpsyg.2017.00605.

[5] “emotiv epoc.” [Online]. Available: https://www.emotiv.com/products/epoc-x?srsltid=AfmBOorZc0GBhVZlhURrWuzS1EdCfp3A0yboYqN6CL3bLtdWOU6tznx4