Implementation of Video Games with Virtual Reality for Physical Activity and Mental Training

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Abstract

Physical activity, mental training, and emotional well-being are fundamental aspects of the proper development of a person. The main objective is to develop a recreational game application with Virtual Reality to improve users' physical and mental health. For this, the Unity video game development engine was used with Oculus glasses devices to evaluate the effectiveness of the application in promoting healthy habits and general well-being. The Scrum framework was used as a work methodology, which was applied considering its benefits and positive points. Subsequently, it was analyzed what requirements the application under development should have, as well as the visualization of the interfaces, this being the point of design and construction. For validation, the "System Usability Scale" was used to evaluate usability by users as evidence of a positive impact on the promotion of healthy habits and the general well-being of users and to serve as an example of how technology can be used to improve people's quality of life. In this way, virtual reality games offer a unique and immersive gaming experience that combines technology with physical and emotional interaction. These games provide fun, challenge, and adventure and have the potential to expand the boundaries of creativity, learning, and therapy.

Keywords

Virtual reality, unity, recreational games, oculus, scrum, usability

1. Introduction

In recent years, virtual reality has seen rapid technological advancement, providing an immersive experience that can transport users to detailed and immersive virtual environments [1]. On the other hand, playful games have been successfully used in various fields, such as education and therapy, to promote learning, motivation, and entertainment. Combining these two technologies, virtual reality and playful games, offers a promising new approach to addressing people's well-being and health.

The game also refers to a necessity for young people and adults, not just children. A subject of any age can create behaviors in the face of new and unforeseen situations, which are generated from both his structural possibilities and his personal history and his emotional dynamics, and by creating them, he makes them part of him. This is how playful behaviors lead to success; they satisfy needs according to desires. The game, also within psychoanalytic theory, is a means that enables the formation of unconscious and conscious fantasies where situations in the subject's life are repeated, allowing the creation of new circumstances that modify internal reality and

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consequently will enable the elaboration of those painful experiences, so for many, it becomes one of the vital activities for the human being as a whole [2].

The research question guiding this study is: How can the application of recreational games with virtual reality improve physical and mental health?

The study's main objective is to design and develop the "Holy Game" application, which will offer a variety of playful virtual reality games that will address aspects related to physical exercise, mental training, and emotional well-being. Playful virtual reality games have proven effective in reducing stress and anxiety. These games can transport players to calm and relaxing virtual environments, where they can practice breathing, meditation, and relaxation techniques.

Games have also been developed specifically designed to address mental health disorders, such as post-traumatic stress disorder, phobias, and depression. These games offer safe environments for patients to face and overcome their fears and emotional challenges. These games will be specifically designed to take advantage of the capabilities of Oculus devices and the Unity platform to provide users with an immersive and engaging experience.

The study design will be based on the Scrum methodology, an agile and flexible approach commonly used in software development. This methodology will allow for iterative implementation and incremental delivery of functionality, allowing for early feedback from users and adjustments as necessary. This study is expected to obtain valuable information on the effectiveness and acceptance of the "Holy Game" application in the context of virtual reality and recreational games. The results obtained may be used to improve the design and functionality of the application, as well as to support future research in the field of health and virtual reality technology.

2. Related Work

The article by Rain Epp, Dayi Lin, and Cor-Paul Bezemer [3] mentions that Virtual reality (VR) is experiencing rapid growth in the reality games market. Due to the immersive nature of said games and the use of VR headsets, gamers may have complaints about the games. The researchers conducted an empirical study to understand VR gaming trends and their complaints. We see that complaints of cybersickness are scarce and declining, indicating that players tend to worry more about other matters.

The author, Edward Probir Mondol [4], indicates that video games have become famous worldwide. World, and that these are entertainment tools where you can spend long hours without realizing it and can lead to addiction most of the time, which leads us to the main problem caused by video games, which is obesity. To solve this problem, virtual reality games require body movement and mobile apps that motivate people to do physical activities.

Kiran Ijaz, Yifan Wang, David Milne, and Rafael A. Calvo [5] present us with a virtual reality game whose objective is that older people practice physical exercise and cognitive to reduce the risk of dementia so that the player can move around real places in an environment virtual insurance, the first primary measures of these experiments will focus on older adults.

The article by Paola Ladino and Julio Caicedo [6] discusses the use of serious video games in health sciences and their application in the promotion and prevention, diagnosis, treatment, rehabilitation, and health teaching. A systematic review was carried out in several databases, and 43 articles related to VJS and CPS in different fields of application were found. The VJS is an emerging technology that leverages virtual reality to improve the user experience and has become a valuable tool to encourage lifestyle habits, educate in pathologies, and train health personnel on health.

The article by Liliana Rodríguez, Javier Sierra, and Boris Medina proposes a rehabilitation system using virtual reality techniques and commercial video games to improve postural control in people with Brain Damage Acquired (DCA). DCA is one of the most significant effects of neurological diseases today and generates great consequences that require effective intervention programs.

The proposed rehabilitation system seeks to increase the motivation in the rehabilitation process and produce changes in movement strategies of postural control. HE expects this to be reflected in a decrease in balance disturbances and an improvement in preventing falls in people with consequences of acquired brain damage.

Using virtual reality and commercial video games in rehabilitation has proven effective. These technologies allow you to create immersive experiences that stimulate different parts of the body and generate positive results in recovery. Although initially developed for entertainment, video games, and Commercials with high-quality graphics and settings can be helpful in rehabilitation [7].

Shaftesbury [8] presents an article exploring using a VR video game to manage stress and prevent distress. The study measures physiological signals to determine the impact of the video game on blood sugar levels. Stress. The study's findings may help develop applications, fun, and algorithms to improve the health of others through entertainment. The investigation concerns VR gamification and its potential to improve health outcomes.

The article "Acceptance and Use of Virtual Reality Games: an extension of HMSAM" [9] analyzes the potential of VR games to increase physical activity levels and improve health and well-being. Highlights the importance of designing and developing VR games focusing on fun and enjoyment since these aspects strongly affect the intention to use. The article also highlights the role of ease of use and the potential of VR games to introduce users to the benefits of playing for physical health. The report is generally related to the gamification of VR for Health and wellness.

In the article, "Formative evaluation of immersive virtual reality expedition mini-games to facilitate computational thinking" [10], the iThinkSmart VR application provides cloud resources for the game, Firebase It is used to store and manage game data, such as user profiles, game progress, and scores, and to provide timely updates accurate to the game interface.

Regarding software architecture services as Backend-as-a-Service, in Dickson Roig's article [11] on the design and development of a serious reality game virtual with editable content, Firebase is used as Backend-as-a-Service because it provides support for Unity and its NoSQL type database with a structure in the form JSON tree matches the data type needed for the project, which are questions and answers in text format. Plus, website hosting is easier to do using Firebase as an option, and it only takes 3-5 detailed steps to configure it. Firebase also allows accessible communication with the database from the server-side client using REST API and a user plugin called Rest Client for Unity.

The evidence collected in this scoping review suggests that virtual reality-based interventions present benefits for the rehabilitation of gait and balance, in addition to increasing adherence to treatment and motivation of the individual, generating better results than conventional therapy and greater satisfaction during intervention. For this reason, virtual reality has the potential to be a support tool for the processes of rehabilitation [12].

3. Methodology

Scrum is an adaptive, iterative methodology that is fast, flexible, and efficient, designed to deliver significant value quickly throughout the project. Scrum guarantees transparency in communication and creates an environment of collective responsibility and continuous progress [13]. I was chosen for the project since Scrum is compatible with all the projects. A characteristic of scrum is self-organization that focuses on the tasks distributed in the team; this, in turn, creates self-motivation, which results in efficiency in completing tasks. Another reason the scrum methodology was chosen is that if there is some modification, problem, or defect, this can be changed in the Product Backlog, being a viable option that adapts to the needs.
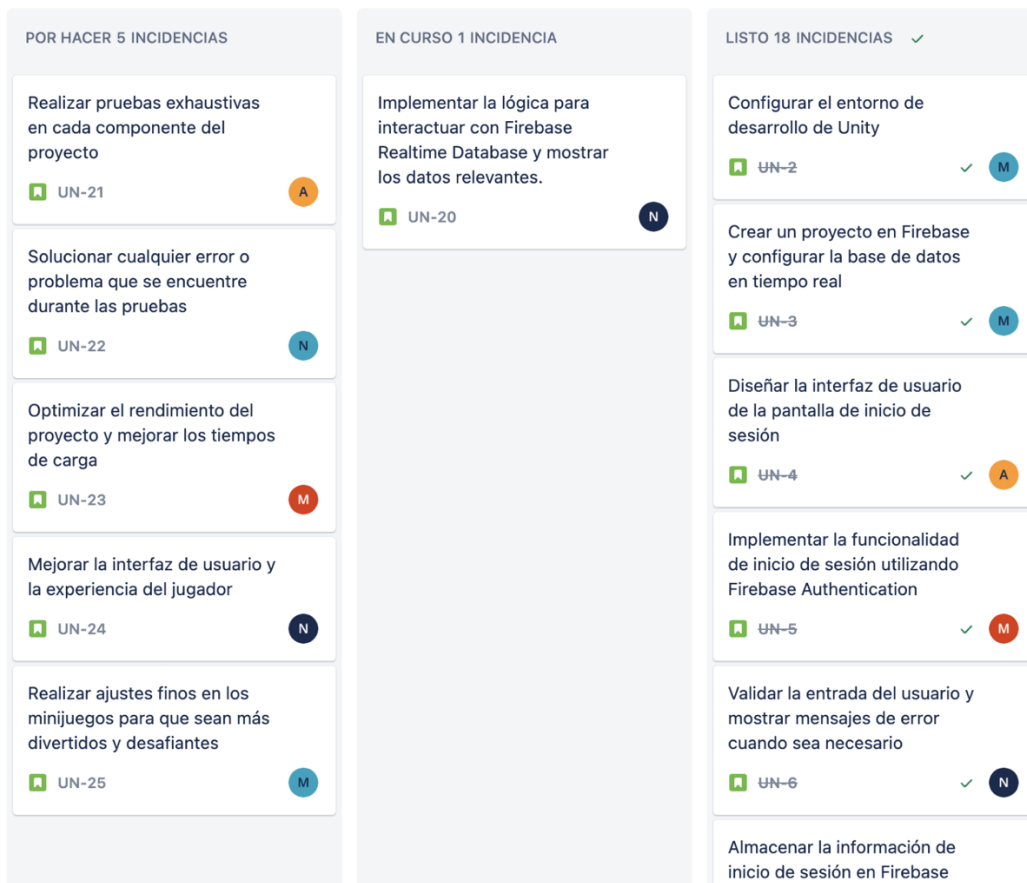
Figure 1: The Sprint of the tasks completed is shown for the development of the proposal.

To develop the "Holy Game" application, consider frameworks, data persistence found in the database, and authentication users; below, it will be detailed what each is and its purpose in the project.

Framework: A framework is a structure that allows the development and organization of an application and can be composed of libraries, programs, and languages, among others [14]. Unity has a wide variety of frameworks that allow the project to be developed for virtual reality; to create the application, make use of the XR Plugin Management frameworks, a package that will enable you to define whether the application is to be run using virtual reality glasses like Oculus Rift or Oculus Quest 2 [15], the framework XR Interaction Toolkit, which is located aimed at creating virtual reality interactions and augmented reality [16].

Database persistence: These are the data or stored metadata of a program or application so that these can be used in another moment [17]. In Holy Game, a base of non-relational data was used to store users and the scores they obtained through the games. Firebase was implemented as a database, a cloud platform that allows the development of web and mobile applications [18].

Authentication: The ability to identify exclusively a user in a system or application that is running [19]. Firebase has various services, including Firebase Authentication, which allows you to determine the application's users. As you can see in Figure 2, three users can enter the system with the email and password with which they registered.

Figure 2: User authentication in Firebase.

4. Requirements

The requirements are presented in Table 1 below most important identified for the development of the proposal:

Table 1
Table Requirements

ID	Requirement	Description	Priority	Estimate
1	Register Users	The application allows users to create profiles to store all their information and have a history of their progress.	High	3
2	Activity monitoring	The application based on virtual reality manages to capture the person's movements when the user does it.	High	5
3	Variety of games	The app should offer various playful games to address physical and mental health.	Half	4
4	Content update and expansion	The application must be able to receive regular updates and add new content to maintain long-term user interest and provide new challenges and experiences.	Half	3
5	Haptic compatibility	Touch can be incorporated through haptic devices, such as gloves or Oculus-compatible controllers, to enhance immersion and user experience during gameplay.	Low	2
6	Social integration	The user and the application will provide a list of goals that must be met to achieve the user's objectives. Each time one is completed, they can be shared on social networks.	Half	2
7	Security	The application seeks to provide a secure interface that protects the users' data.	High	4
8	Compatibility with Virtual Reality Glasses	Ensure the application is compatible with virtual reality glasses available on the market, such as Oculus Quest.	High	3

9	Performance optimization	Appropriate optimization techniques are implemented to ensure efficient and smooth functioning of the games and the application in general.	High	4
10	Support for firmware and software updates	The application must have the ability to receive firmware and software updates to guarantee compatibility with new versions of Unity, Oculus, etc.	Half	2
11	Intuitive user experience	The application is intended to have an interface where the user can navigate easily and intuitively.	High	3

Priority was assigned according to the relative importance of each requirement. I am using a scale of "High," "Medium," and "Low" to set the priority. The estimate is a relative measure of the complexity or effort estimated to implement each requirement, using a scale of 1 to 5, 5 being the highest value.

Additionally, some dependencies were identified:

• Requirement 4, Content Update and Expansion, depends on requirement 10, Support for updates firmware and software. If requirement ten is not met, that is, if the application does not receive firmware and software updates, it would limit its ability to keep up with technological changes and new versions of platforms, such as Unity and Oculus, used to develop the application.

• Requirement 5, Haptic Compatibility, depends on requirement 8, Compatibility with Virtual Reality Glasses. Therefore, requirement 5, "Haptic Compatibility," depends on requirement 8, "Compatibility with Lenses." virtual reality," since, without adequate compatibility with virtual reality glasses, it would not be possible to implement touch capability using devices haptics effectively in the application. Requirement 8, Compatibility with Reality Lenses virtual, depends on requirement 10, Support for firmware and software updates lack of games playful Therefore, requirement 8 depends on requirement 10 to ensure that the application can receive the Firmware and software updates required for maintaining compatibility with reality glasses virtual. Providing support for updates ensures that the application can adapt to changes and improvements made to the lenses, giving users an optimal experience without compatibility problems.

5. Design and Construction

Next, the design of the interfaces was developed with a vision of the Unity environment. Since we don't have the views from the Oculus headset to provide a whole VR experience, these images give an idea of what the game would look like in that context. The images will allow you to look at the graphics, lighting, 3D models, and other elements that make up the game environment. Please remember that these images are only visual representations and cannot convey the actual gaming experience that would be obtained with virtual reality.
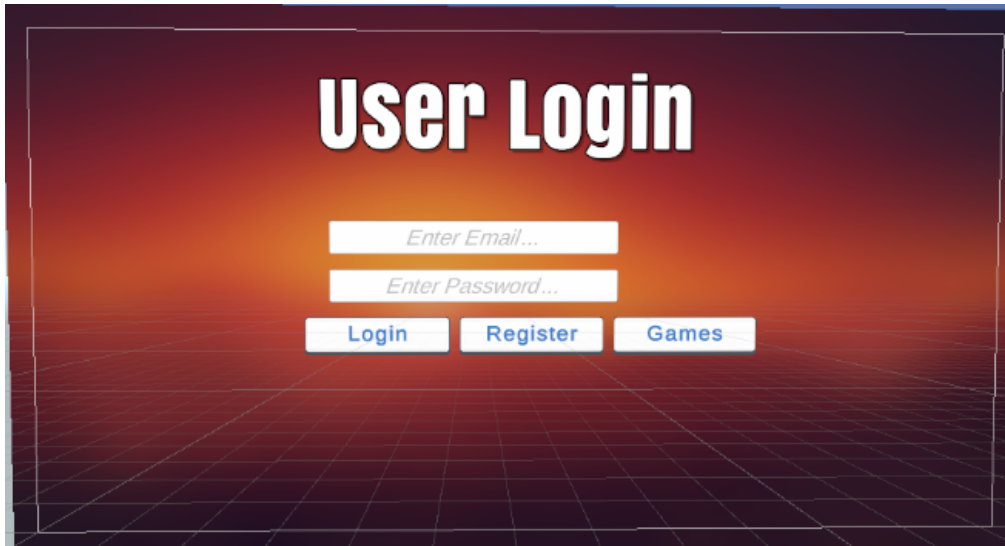
Figure 3 shows the login interface.

Figure 3. Login Screen

Figure 4 shows the interface that allows registering and validating the user.
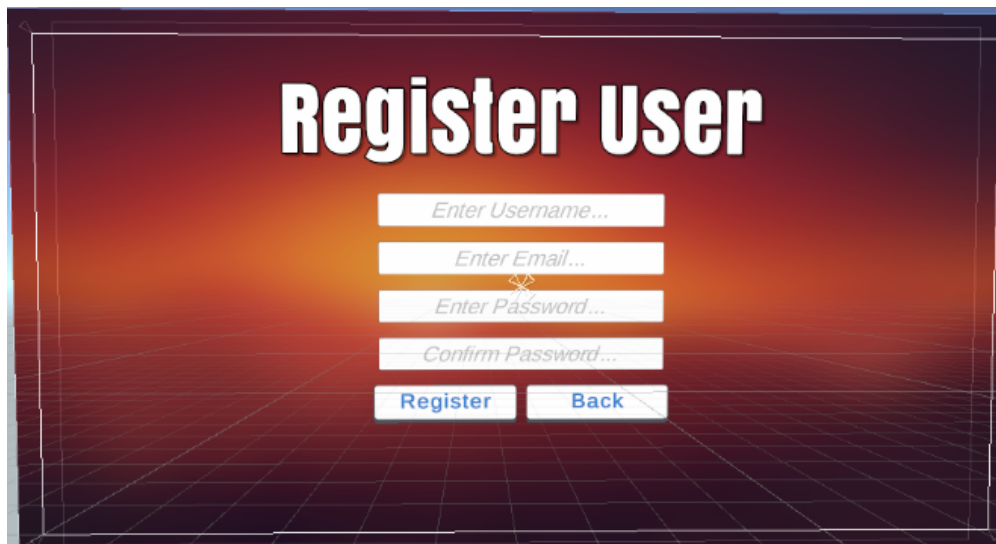

Figure 4. Register Screen

The user information is shown in Figure 5, which can be saved, along with other related options.
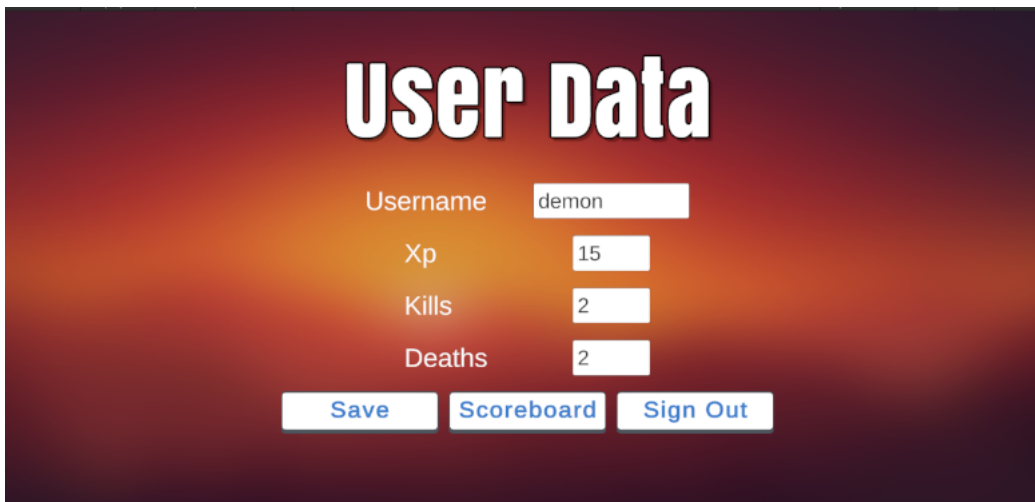
Figure 5. User Data.

Figure 6 shows the interface with the Score Table.

Figure 6. Scoreboard

All the information generated from the interaction with the different interfaces of the application is stored in the Firebase Realtime database data. Figure 7 shows the user's stored data.
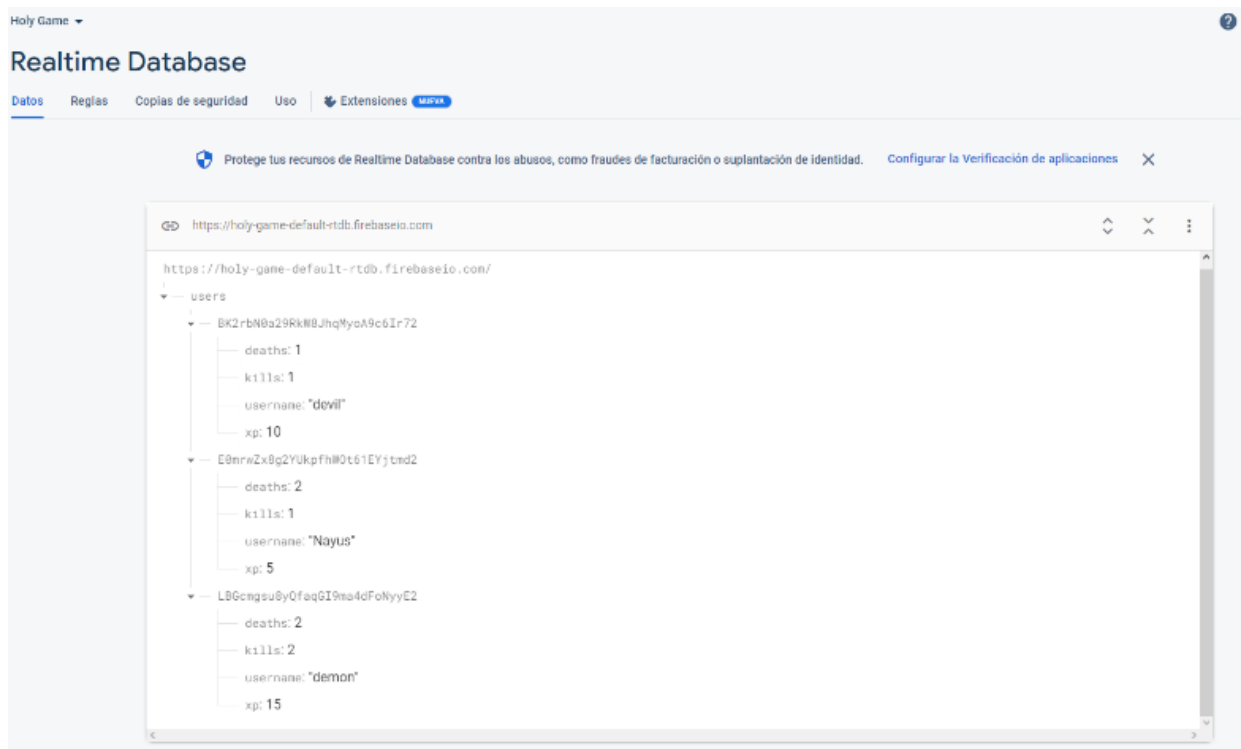
Figure 7. Real-time database

The central part of the execution of the virtual reality application is the game's option (Games), which is divided into three mini-games. Figure 8 shows the screen game options, which were based on templates existing freely for testing and adapted according to the nature of the proposal.
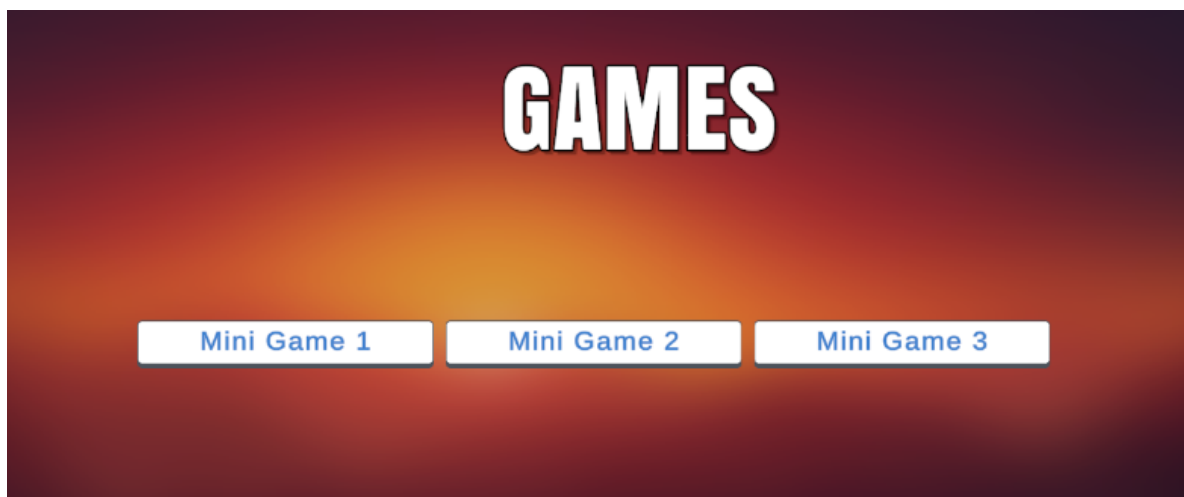

Figure 8: Game Menu

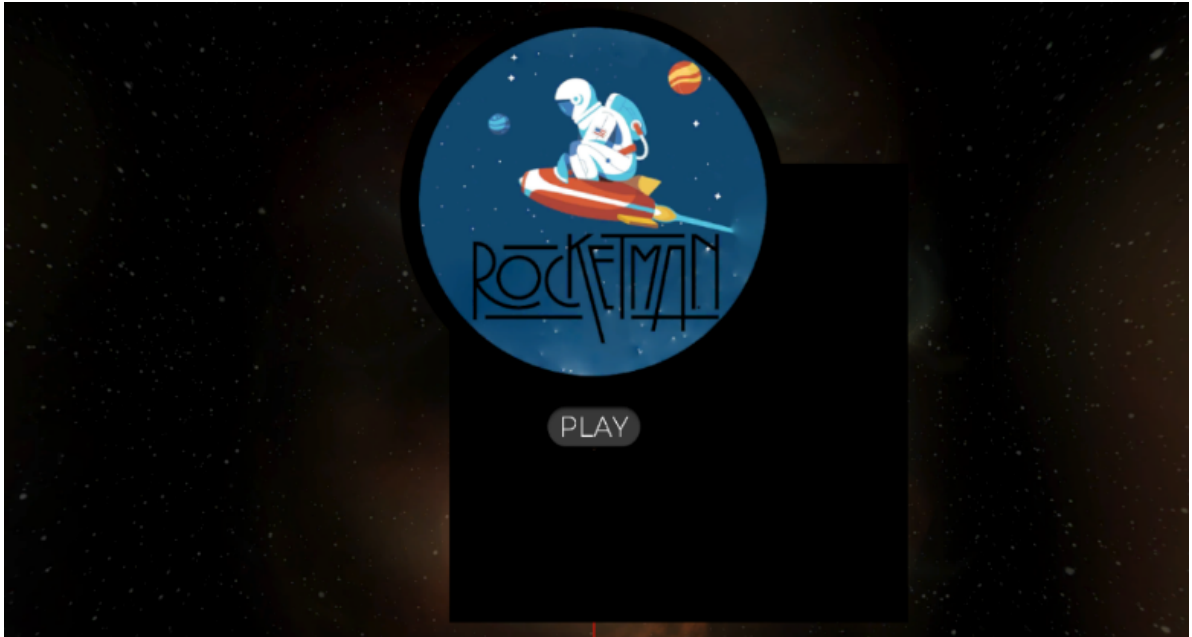Figure 9 shows the home screen of the first minigame.
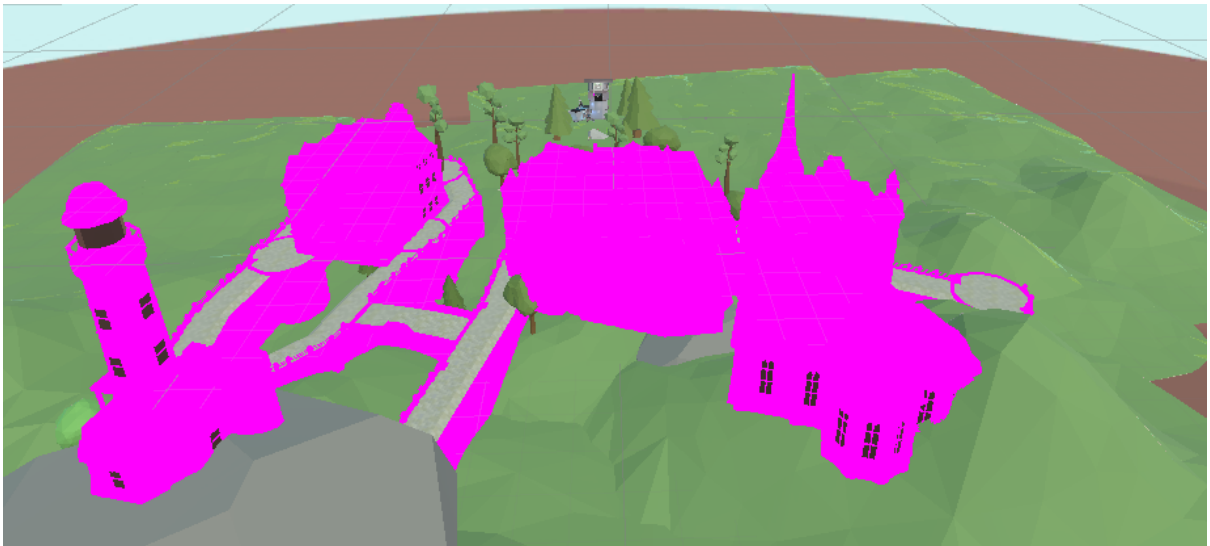
Figure 9. Menu of the first mini-game

Figure 10: First mini-game

Figure 11: Second mini-game

Figure 12: Third mini-game

6. Machine Learning

You can see some images that represent the use of Machine Learning in Unity; in this case, the service was made of speech recognition, which will help us guide the cube in saying short phrases like: "Up," "Down," and "Right" or "Left," as well as changing its color with words such as: "Purple," "Black," "Red," "Blue," among others.

Figure 13 and Figure 14 show the Machine Learning and Voice Recognition configuration code to mobilize objects with the video game.

```
public class ControladorPorVoz : MonoBehaviour
{

    KeywordRecognizer keywordRecognizer;

    Dictionary<string, Action> wordToAction;

    // Start is called before the first frame update
    void Start()
    {
        wordToAction = new Dictionary<string, Action>();
        wordToAction.Add("azul", Azul);
        wordToAction.Add("rojo", Rojo);
        wordToAction.Add("verde", Verde);
        wordToAction.Add("arriba", Arriba);
        wordToAction.Add("abajo", Abajo);
        wordToAction.Add("izquierda", Izquierda);
        wordToAction.Add("derecha", Derecha);
        wordToAction.Add("rosa", Rosado);
        wordToAction.Add("morat",Morado);
        wordToAction.Add("negro",Negro);
        wordToAction.Add("blanco", Blanco);

        keywordRecognizer = new KeywordRecognizer(wordToAction.Keys.ToArray());
        keywordRecognizer.OnPhraseRecognized += WordRecognized;
        keywordRecognizer.Start();
    }
```

Figure 13: Machine Learning configuration code

```
private void WordRecognized(PhraseRecognizedEventArgs word)
{
    Debug.Log(word.text);
    wordToAction[word.text].Invoke();
}

private void Arriba()
{
    transform.Translate(0, 1, 0);
}

private void Abajo()
{
    transform.Translate(0,-1,0);
}


private void Izquierda()
{
    transform.Translate(-1,0,0);
}

private void Derecha()
{
    transform.Translate(1,0,0);
}

private void Rojo()
{
    GetComponent<Renderer>().material.SetColor("_Color", Color.red);
}
```

Figure 14. Voice recognition code.

Figure 15 show the screens of interaction with the control of figures through commands voice.
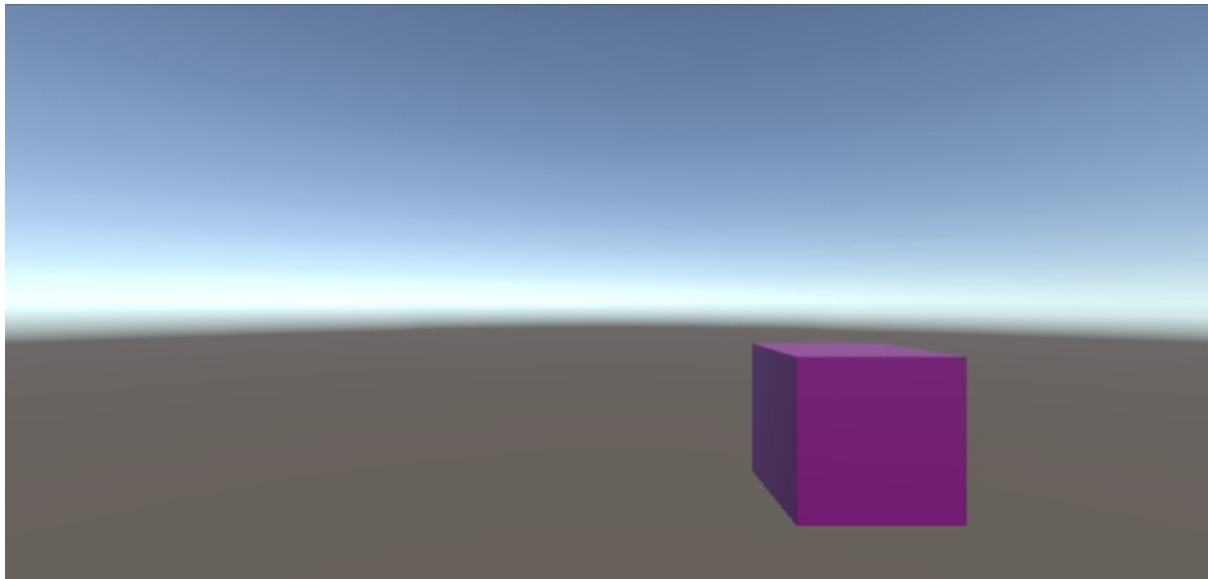

Figure 15. View of the cube saying "Down" and "Purple."

7. Results

We will use the System Usability Scale (SUS), a widely used questionnaire of 10 questions to evaluate the system's usability. The results are assessed on a five-point scale with anchors ranging from 'Strongly agree' to 'Strongly agree' disagreement' in the following way [20] as we can see continuation:

The general analysis of the usability study of the application shows that the user experience is mostly positive. The application stands out for its ease of use, design, attractiveness, functionality, and relevant and valuable content delivery. Despite these praises, there are still some options. Some users have expressed their wish to have more content related to the gameplay of "Holy Game"; in exceptional cases, there have been comments that app navigation can be confusing.

Figure 16 shows the statistics and detailed usability survey of the three minigames of the proposal application.

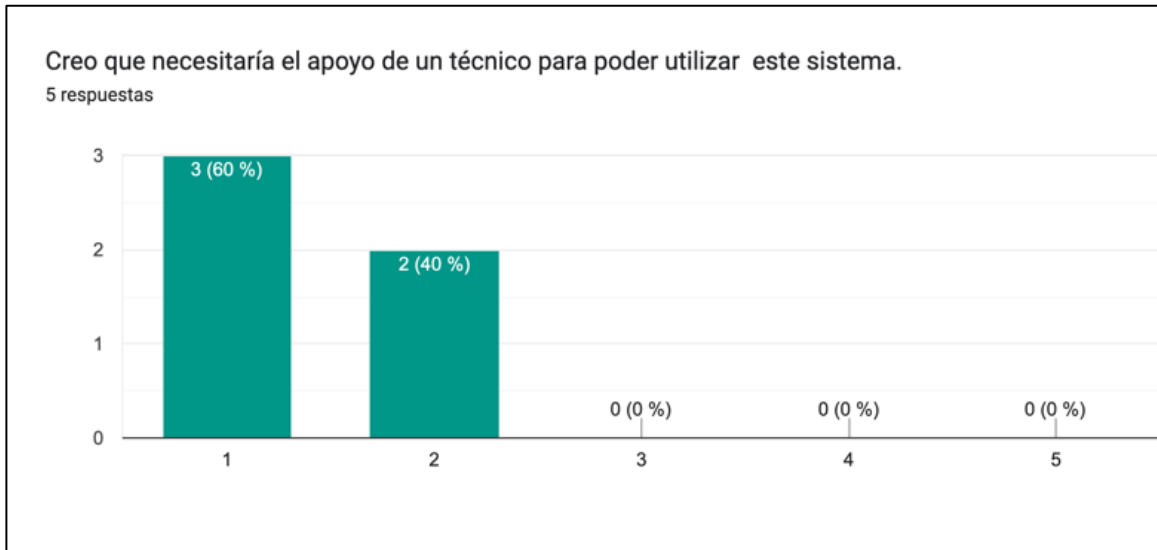**Figure 16.** Statistics of the first mini-game.

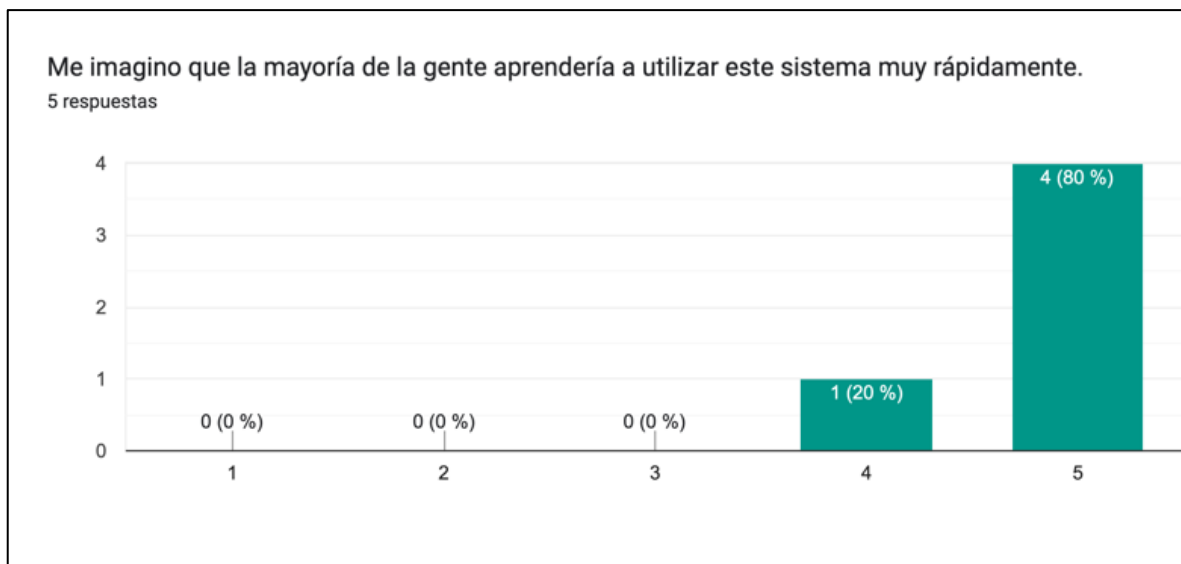**Figure 17.** Second mini-game statistics.

Figure 18. Third mini-game statistics.

8. Conclusions

Playful games with virtual reality can improve users' physical and mental health, addressing aspects related to physical exercise, mental training, and emotional well-being.

Machine learning techniques and voice recognition to improve interaction with activities carried out by users.

It was concluded that the developed application seeks to take advantage of the capabilities of virtual reality to provide an immersive and engaging user experience, addressing aspects related to exercise, physical and mental training, and emotional well-being.

According to the System Usability Scale test, it was shown that usability has good acceptance by the evaluated stakeholders regarding the mini-games developed for the benefit of people's physical activity and mental training.

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