

유니티 게임 엔진과 안드로이드 플랫폼 기반의 스포츠 클라이밍 게임 설계 및 구현

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Design and Implementation of Sports Climbing Game based on Unity Game Engine and Android Platform

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[요약]

본 논문에서는 올림픽 경기중의 하나인 스포츠 클라이밍을 모바일 게임으로 설계하였으며, 유니티 게임 엔진을 이용하여 안드로이드 플랫폼 기반으로 콘텐츠를 구현하였다. 제안하는 모바일 게임의 모드 구성은 스포츠 클라이밍의 종목 중에서 스피드 종목을 적용하였으며, 3개의 모드인 무한, 하드코어 및 온라인 경쟁 모드를 추가 구성하였다. 특히, 무리한 과금 회피와 초기진입 사용자들을 위한 다양한 이벤트들을 추가하여 경험치, 코인, 보석 등과 같은 재화를 획득할 수 있도록 하였으며, 실험 결과, 제안한 스포츠 클라이밍 게임이 설계 규격대로 동작함을 확인하였다. 구현된 모바일 스포츠 클라이밍 게임은 비인기 종목이지만 올림픽 스포츠 게임의 활성화와 비인기 스포츠 종목들의 관심을 높일 수 있을 것으로 기대한다.

[Abstract]

In this paper, sports climbing, one of the Olympic games, was designed and implemented based on the Unity game engine and Android platform. The composition of the game mode applied the speed game among sports climbing events, and additionally consists of an endless, a hardcore, an online competition mode. In particular, various events for avoiding excessive charging and first-time users were added so that experience, coins, and gems could be acquired. As a result of the experiment, it was confirmed that the proposed sports climbing game operates according to the designed and implemented specification. Although the implemented mobile sports climbing game is an unpopular event, it is expected that it will activate sports games related to the Olympics, and increase interest in unpopular sports events.

색인어 : 스포츠 클라이밍, 스피드 게임, 스포츠 게임, 모바일 게임, 유니티 게임 엔진

Keyword : Sports climbing, Speed game, Sport game, Mobile game, Unity game engine

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I. Introduction

Today, the mobile game is growing rapidly due to the impact of the COVID-19 pandemic. According to App Annie’s 2021 Game Trends report, the total game market, including mobile, console, handheld, and PC, is expected to exceed \$240 billion [1, 2]. In particular, as shown in Figure 1, global mobile game sales total \$120 billion, accounting for half of the total game market [1]. According to a global consumer survey on mobile games by International Data Corporation (IDC), a global market research firm, 63% of survey respondents reported that their game play time increased after the COVID-19 pandemic [2]. It is believed that the mobile game play time has increased due to the decrease in going out and the effect of non-face-to-face work after the COVID-19 pandemic. However, the share of global consumers who use sports games in the global mobile game market is less than 10%, and accordingly, the release status of sports contents is remarkably low. Therefore, for the revitalization of sports games related to the Olympic, we proposed and implemented sports games such as basketball game and sled games including bobsled, luge, and skeleton [3, 4].

The sport game designed and implemented in this paper is also a sports climbing game. Sports climbing consists of ‘lead’, which climbs the highest rock wall within a set time, ‘speed’, which climbs the fastest, and ‘bouldering’, which counts the number of climbs among several courses [5]. The rest of the paper is organized as follows. Section 2 describes the rules for single events in sports climbing. Section 3 describes the design and implementation process of the proposed climbing game, and shows the play scenes of the climbing game. Finally, in Section 4, we present the conclusions and future research.

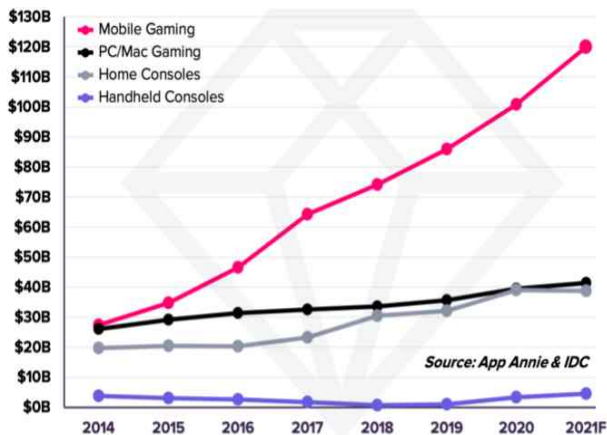


그림 1. 주요 기기별 전 세계 게임 소비 지출 현황
 Fig. 1. Worldwide game consumption spending by major device group

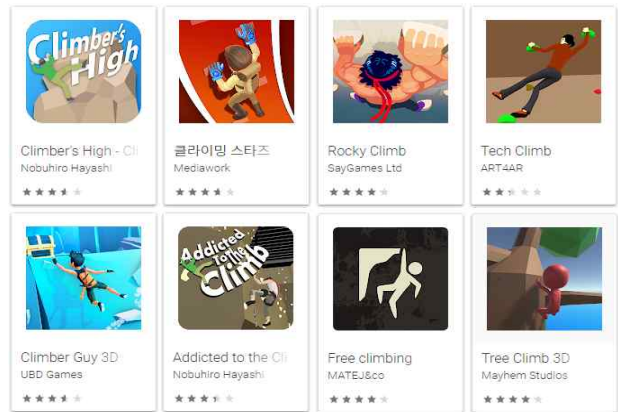


그림 2. 등반 게임 관련 애플리케이션들 (구글 플레이 스토어)
 Fig. 2. Sports climbing game related applications found in Google Play Store (last access date: 2021.10.26)

II. Types and Rules of Sports Climbing

This section explains the types and rules of sports climbing. A sports climbing event consists of three single events: lead, speed and bouldering [5, 6].

2-1 Lead Climbing

The lead climbing is an event in which one climbs an artificial structure installed on a 15-meter-high rock wall in less than 6 minutes while wearing the safety equipments. If an athlete falls while rock climbing, they will be disqualified.

2-2 Speed Climbing

The speed climbing is a competition in which two athletes compete to climb an artificial rock wall first. Here, the height of the artificial structure is 15 meters, and the slope is 95 degrees. Also, as in lead climbing, if a climber falls while climbing, it will be disqualified.

2-3 Bouldering Climbing

The bouldering climbing is an event to reach the highest point in less than 4 minutes without a rope through various artificial structures installed on a 4.5-meter-high rock wall.

2-4 Combine Climbing

The combine climbing is a new event introduced at the 2020 Tokyo Olympics, and consists of a combine (or dual) event that combines the above three events [7].

III. Climbing Game Design and Implementation

3-1 Design of Sports Climbing Game

Sports climbing game proposed in this paper applies the rules of speed climbing as a basic concept among the events described in Section 2, and the composition and flow of the proposed content is shown in Figure 3. The game modes consist of speed, endless, hardcore, and online competition, and the play point of view is implemented in a third person view. And, although the save function process is not expressed in the game flow in Figure 3, the automatic save function is performed upon screen change and stage completion. Endless mode is a game in which the character climbs to the highest point without making a mistake, and the difficulty increases as the character climbs higher. In addition, if a character falls in the middle of climbing, a rule to start over from the beginning is applied, and the ranking value is displayed in units of one day to induce a competitive spirit.

Figure 4 shows the main screens of the game flow shown in Figure 3. Figure 4(a) is the character information, and Figure 4(b) is the screen for selecting the 4 game modes presented in this paper. Figure 4(c) to (f) are screens of speed and online competition mode.

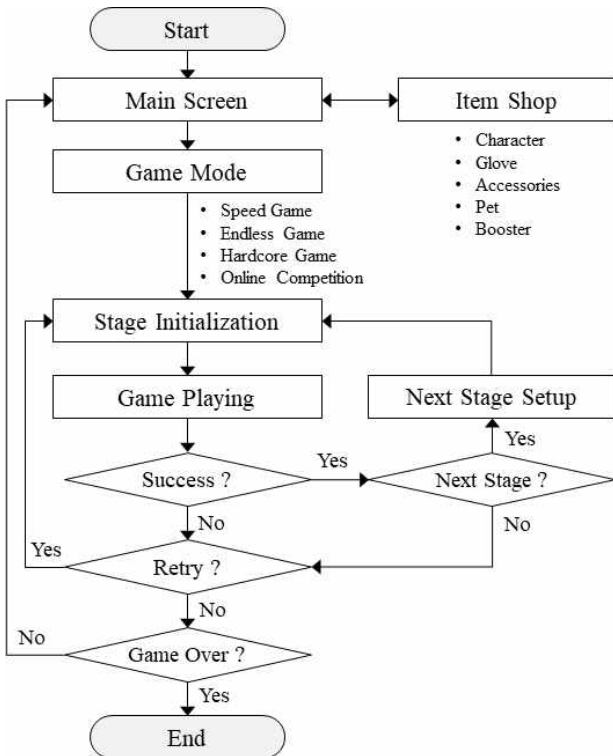


그림 3. 제안하는 스포츠 클라이밍 콘텐츠의 흐름도
 Fig. 3. Flowchart of proposed sports climbing content



그림 4. 게임 흐름의 주요 화면들
 Fig. 4. Main screens of the game flow

Figure 5 shows screens for selecting gloves, accessories, and boosters that can be found in the item shop to increase a character skill during the game. The items of gloves and accessories improve the climbing ability of character, and are designed to open the item slot according to the character level and ability.

Gloves and accessories that can be purchased at the item shop increase the additional ability values of character that increase the health and hold distance. Acquisition of items can be purchased with coins and rechargeable gems provided in the game. And the booster serves to increase the instantaneous speed.

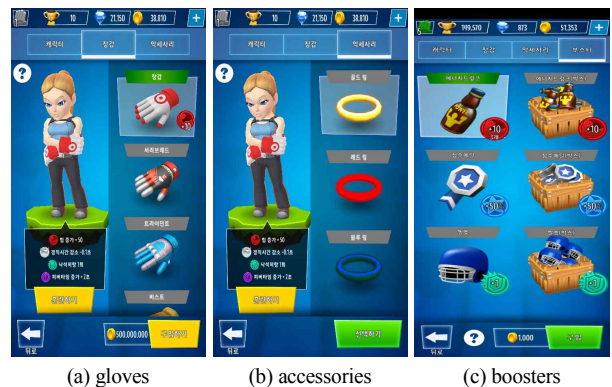


그림 5. 아이템 샵의 주요 화면들
 Fig. 5. Main screens of the Item Shop

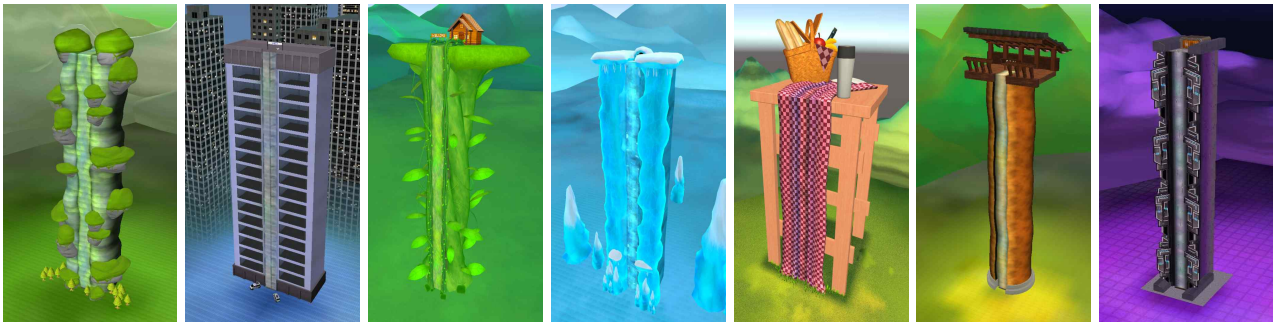


그림 6. 디자인 및 구현된 스테이지 배경들
 Fig. 6. Stage backgrounds designed and implemented

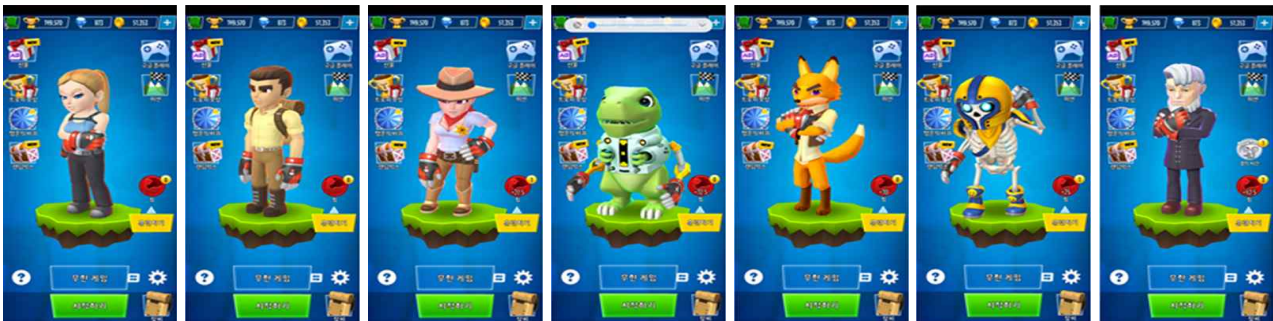


그림 7. 디자인 및 구현된 캐릭터들
 Fig. 7. Designed and implemented characters



그림 8. 디자인 및 구현된 아이템들 (장갑과 악세서리)
 Fig. 8. Designed and implemented items (gloves and accessories)

표 1. 제안하는 콘텐츠 설계 및 구현을 위한 환경
 Table 1. Environment for designing and implementing the proposed content

category	content
O/S	Window 7/10 (64bit)
S/W	Visual Studio 2019, 3ds Max 2015, Photoshop CS6
G/E	Unity 2019.4.16. (script language: C#)

3-2 Implementation of Sports Climbing Game

Table 1 shows the environment for the design and implementation of the sports climbing game proposed in this paper. 3ds Max and Photoshop were used to design objects such as backgrounds, characters, and items of the game, and Unity

game engine [8] and C# script language were used to implement the flow and functions of the game.

Figures 6 to 8 show the backgrounds, characters, and gloves and accessories designed and implemented, respectively. In particular, the characters in Figure 7 are designed to be acquired according to level and experience from left to right. The characters in Figure 7 and the items in Figure 8 basically have the ability to increase the time they can hang on the rock wall and the ability to increase the hold distance. In addition, abilities such as stun duration, rockfall resistance, coin collection, and fever time are selectively or randomly granted to each character and item as shown in Table 2.

표 2. 캐릭터와 아이템들에 적용된 추가 능력

Table 2. Additional abilities applied to characters and items

icon	content
	increase the strength
	decrease the stun duration
	increase the number of rockfall resistances
	increase the number of booster slots
	increase the coin collection
	increase the point collection
	increase the fever time

Users who start sports climbing games for the first time often fall during rock climbing. To overcome this, users can purchase items by raising the experience points and acquiring coins (or gems) in the training mode. Figure 9 shows the methods for obtaining coins and gems in the proposed sports climbing game. The method of acquiring coins and gems can be largely obtained

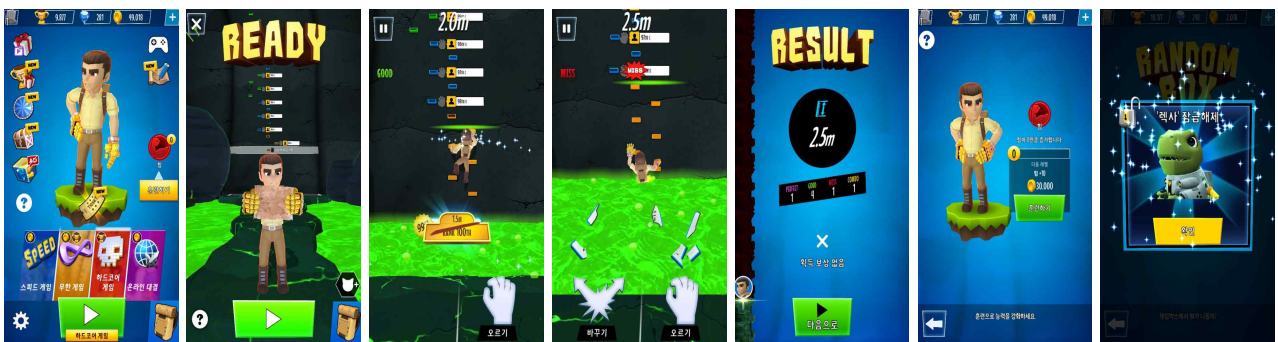
through the lucky wheel, which is opened at specific time points, watching advertisements, various missions, and random boxes. Another way to obtain gems is to purchase directly through cash, but the events shown in Figure 9 have been added in order to get out of the billing-type game as much as possible.

Figure 10 shows the playing process of the sports climbing game designed and implemented in this paper. In mobile games, most of the mission failures in the game are due to the low character level of the initial users.

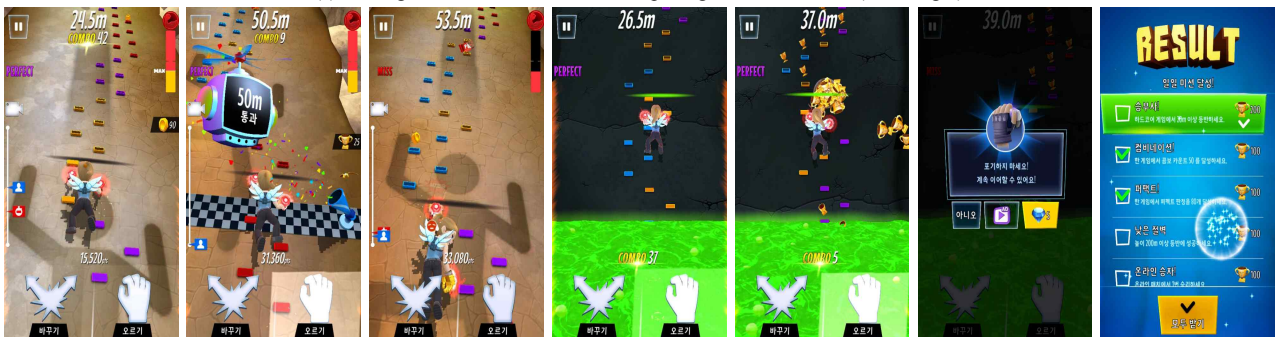


그림 9. 게임 내 재화 획득을 위한 이벤트들

Fig. 9. Events for acquiring coins and gems in the game



(a) training of low-level characters and opening of random boxes (left to right)



(b) scenes of obtaining rewards after performing endless game and mission

그림 10. 제안하는 스포츠 클라이밍 게임의 구현된 주요 화면들

Fig. 10. Main screens of the proposed sports climbing game



그림 11. 온라인 모드에서의 경쟁 화면들

Fig. 11. Competition screens in online mode

Considering these characteristics, the experience and level of character were raised through training as shown in Figure 10(a), and additional items could be acquired. And Figure 10(b) shows scenes in which rewards corresponding to experience points are obtained by performing an endless game and missions. Figure 11 shows the screens displayed when the online competition is selected in the game mode and the competition screens.

3-3 Functional Improvement and Consideration for Natural Animation Direction

This section describes major issues and functional improvements in the implementation process of the proposed sports climbing game. When a button was clicked in the process of moving a character to a nearby holder, an additional button click omission occurred due to a collision between the two functions. In addition, it was confirmed that if the animation was removed, the problem of unnatural direction such as teleportation during hold movement was confirmed.

To solve this problem, two methods were applied. In the first method, the click delay was performed by setting the animation length to within 0.2 seconds during the hold movement process. In the second method, the position weight was set by searching the position of the character's hand and holder, and a magnet effect was applied so that the character's hand was attached to the holder. And in order to prevent animation omissions, by using the animation blend provided by Unity, the character could be replaced with the corresponding motion to produce a natural animation. As a result of application, it was confirmed that even with very quick button clicks, natural animation was produced and the character moved the holder as much as the number of button clicks.

IV. Conclusions and Future Works

In this paper, sports climbing, one of the Olympic events, was designed and implemented using the Unity engine and based on the Android platform. The implemented game mode basically applied the speed game among the sports climbing events, and additionally it was composed of an endless mode, and a hardcore mode, an online mode for competition with other users. Various events were added for first-time users to acquire experience, coins, gems, and as a result of the experiment, it was confirmed that the implemented sports climbing game operates according to the design specification. Although the sports climbing game presented in this paper is an unpopular sport, it is thought to be an revitalization of mobile games based on Olympic games, and it is expected that sports climbing will actually be converted into a serious leisure activity. In the future, we plan to add events such as lead and bouldering presented in this paper.

References

- [1] App Annie. State of mobile gaming 2021 [Internet]. Available: <https://www.appannie.com/kr/go/state-of-mobile-gaming-2021/>
- [2] International Data Corporation (IDC). Worldwide Mobile and Handheld Gaming Forecast [Internet]. Available: <https://www.idc.com/getdoc.jsp?containerId=US46350120>
- [3] S. Y. Kang and K. H Park, "Design and Implementation of Basketball Game Content based on Unity Game Engine and Android Platform," *The Journal of Digital Contents Society*, Vol. 21, No. 9, pp. 1567-1573, Sep. 2020. <http://dx.doi.org/10.9728/dcs.2020.21.9.1567>
- [4] S. Y. Kang and K. H Park, "Design and Implementation of Sleigh Game Content based on Physical Force using Unity3D Game Engine," *The Journal of Digital Contents Society*, Vol. 20, No. 12, pp. 2301-2307, Dec. 2019. <http://dx.doi.org/10.9728/dcs.2019.20.12.2301>
- [5] Wikipedia. Speed climbing [Internet]. Available: https://en.wikipedia.org/wiki/Speed_climbing
- [6] Wikipedia. Sport climbing at the 2020 Summer Olympics [Internet]. Available: https://en.wikipedia.org/wiki/Sport_climbing_at_the_2020_Summer_Olympics
- [7] International Olympic Committee (IOC). IOC approves five new sports for Olympic Games Tokyo 2020 [Internet]. Available: <https://olympics.com/ioc/news/ioc-approves-five-new-sports-for-olympic-games-tokyo-2020>
- [8] Unity. Unity Game Engine 2019 [Internet]. Available: <https://unity.com/kr>.



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