Immersive Video Game Based on Exercise Prescription

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Abstract. It is increasingly desirable to have good health. And, regular exercise is the most effective way to improve fitness. But, most people who repeat the exercise easily feel the boredom and tend to give up. This paper propose an immersive video game based on exercise prescription. The game is designed to ensure safety and effectiveness exercise. And, exercise intensity and time can be adjusted automatically with monitoring the player's physical status. We expect this kind of game will help people increase their interest and motivation.

Keywords: Health, Video Game, Exercise Prescription, Safety, Effectiveness.

1 Introduction

Advances in medicine have resulted in increase of life expectancy and it is increasingly desirable to have good health. Physical fitness is considered a measure of the body's ability to function efficiently and effectively in work and leisure activities, to be healthy, to improve the immune system, and to prevent disease. And, regular exercise is the most effective way to improve fitness. But, most people who repeat the exercise easily feel the boredom and tend to give up[1]. This paper introduces an overview of an immersive video game based on exercise prescription which provides not only entertainment but also a program of exercise[2]. We expect this game will help people increase their interest and motivation, so exercise can be a part of their daily routine.

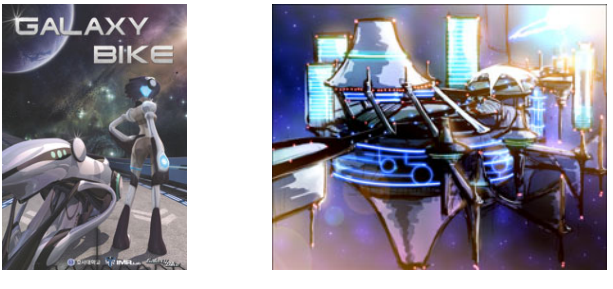

Fig. 1. Game concept design

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This game is intended to support aerobic exercise to improve heart and lung function have a strong organization, has the effect of the blood vessels. And we believe that it is important to ensure exercise safety and effectiveness. So, we apply exercise prescription to game mechanics. Then, game can adjust exercise intensity and time for a player based on heart rate.

2 Immersive Game for Exercise

This game provide a modified exercise bike and wireless heart rate monitor. We have modified exercise bike as a game controller. This bike has rotation sensors connected to the handlebar and pedals. This make it possible to exercise and play a video game at the same time with pedaling and steering. Especially, the level of resistance in the pedal can be controlled by PC connected via USB. And, wireless hear rate monitor is used to estimate calorie expenditure and exercise stress. These interface for exercise for exercise prescription

Fig. 2. Exercise bike and wireless hear rate sensor

Using exercise bike, player can control a game character's speed and direction in the track. This means that we want to use fun to encourage physical activity. This game will give exercise results along with the enjoyment of game competition. And the resistance of the pedal is adjusted dynamically depending on the slope of the track in the game. The higher slope of virtual world is, the more the pedal resistance increase. At this moment, player can experience virtually uphill and downhill while watching the game screen. Thus, the design of the track is closely related a exercise program.

3 Design and Implementation

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In this paper, we aim to propose an effective and safe exercise program by using game technology. To achieve this goal, the racing track is designed by applying the following prescription principals.

First, it would be efficient to perform aerobic exercise at least 20 minutes per session. Because, it takes at least that long for you to start burning fat. Second, warm-up and cool-down add a few minutes to exercise routine in order to reduce risk of injury and improve athletic performance. Warming up gradually revs up your cardiovascular system, increases blood flow to your muscles and raises your body temperature. And, cooling down after your workout may help gradually reduce the temperature of your muscles and regulate blood flow. Third, to get the most health benefits from aerobic activity, we should exercise at a level strenuous enough to raise heart rate to target zone. And, target heart rate zone is 50 to 75 percent of *maximum heart rate* (HR_{max}). The HR_{max} is the highest heart rate an individual can safely achieve through exercise stress, and depends on age. The most accurate way of measuring HR_{max} is via a cardiac stress test. For general purposes, people instead typically use a formula to estimate their individual maximum heart rate. The most common formula encountered, with no indication of standard deviation, is $HR_{max} = 220 - age$.

Fig. 3. Racing track based on exercise prescription principals

This game is developed based on an object oriented framework for virtual reality applications, NAVER[3, 4]. And, we have two different versions depending on 3d rendering engine, OpenScneGraph and Gamebryo. OpenSceneGraph is an open source high performance graphic toolkit. And, Gamebryo is a cross-platform 3D graphics engine and targeted at game development. This project has been executed with 5 students for a period of 9 months.

Fig. 4. Screenshots from the game

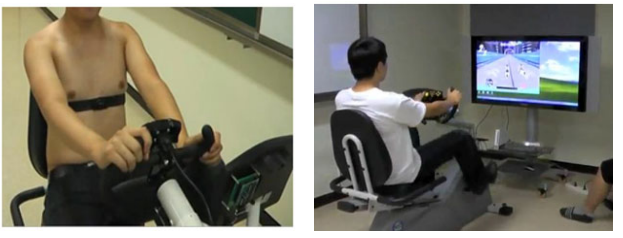

Fig. 5. User test

4 Conclusion and Future Work

In this paper, we proposed an immersive video game to provide a program of exercise as well as entertainment. This game aims to support exercise safety and effectiveness. To achieve this goal, we apply exercise prescription to game mechanics. Then, the game can adjust exercise intensity and time for a player based on his or her heart rate. We expect this game will help people increase their interest and motivation, so exercise can be a part of their daily routine.

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