A Fitness Game for Obesity Care Using Body Composition Data

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Contents

List of tables

List of figures

ABSTRACT

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This study proposes an exergame for personal obesity management. This project called H-Run is implemented with a focus on exercise inducement for obese people. In this study, we particularly focus on aerobic exercises among the many obesity management exercise methods and develop them for enjoyment indoors. This is designed to be enjoyed indoors so that players do not encounter situations such as difficult locations and weather. Other than games, different types of sports can be enjoyed outdoors. Therefore, based on such characteristics, this product aims to bring the reality of outdoor exercise to indoor environments.

H-Run generates an avatar in the game by using the player' s body composition data. Using the avatar reflecting his/her body type information, the player runs around the in-game spaces constructed on the basis of the actual environment. After finishing the game, the player can check the result of his/her actual exercises, and in the long term, the player can identify the body shape changes identical to those in the real environment. A pilot study showed that our H-Run game can potentially induce the

players to exercise. An analysis of H-Run was conducted on 20 participants whose BMI was higher than 25. Because the virtual reality of the game is based on the Suwon and Seongnam regions, the test subjects were limited to the residents of these areas. This was to determine whether there was a gap between the virtual reality of the game and where the participants actually exercised.

Keywords : Exergame, Obesity management, Healthcare

Ⅰ. Introduction

By the end of 2015, about 23.4% of the world population will be obese, and ten years from now, this percentage is forecasted to increase by 50% (WHO., 2014). For the obese people, the risks of high blood pressure, diabetes, and dyslipidemia are twice those of people with normal weight, and in the USA, overweight people have been paying 42% more in the form of medical expenses than normal-weight people since 2006 (Finkelstein, E. A., et al., 2009).

Most dieting methods were introduced between 1900 and 1925. Although approximately 26,000 methods have been introduced, most of them failed within two years. (WorldLinkLab., 2012) Despite such results, the proportion of the obesity prevention, diagnosis, and care industry within the global healthcare industry is expected to grow from 32% in 2010 to 43% in 2020. (Seri., 2012)

There are “Wii” and “Wii Fit” activities within Exergame, a representative program that manages obesity and health management. Although the Wii uses a remote controller, its exercise effects are only minimal. While Wii Fit uses a balance-board controller for 48 games consisting of yoga, muscular training, aerobic exercise, and balance exercises, its period of use is short.

For obesity management and other healthcare management, this study

proposes a body composition data-based game for players who are interested in obesity and health management. The reason behind suggesting a body composition data-based game is that it can create intuitive and realistic exercise effects by analyzing body elements that are difficult to identify externally. As it automatically inputs the body composition data, it is convenient in terms of intuitive health management comparing to conventional exergames requiring manual input. Further, the life of a game can be extended by adding stories and various gamification theories for continuous uses.

Our game was designed to satisfy the following three conditions as a priority to provide healthcare without harming the game's enjoyment: First, the result obtained through the game is the same as the effect of actual exercise. Second, "enjoyment," which is the inherent purpose of a game, is continuously provided. Third, the players are satisfied with the healthcare management provided by the game.

A six-week-long test was conducted based on the designed game. The test was designed based on the idea that at least 6-12 weeks of aerobic exercise must be carried out in order to expect changes in body composition, and that 20-60 min of aerobic exercise must be carried out 3-5 times per week. (American College of Sports Medicine., 1978) Based on this, male and female adults with a BMI of over 25 completed a 30-min period of exercise three times or more a week for six weeks. The participants' body changes were measured to determine the usefulness of the healthcare game.

This paper also introduced several methods related to optimizing aerobic

games, which were actually used in the process of designing the game.

Ⅱ. Related Work

1. Exergame with Kinect

In an environment where a player's motion is used for controlling an exergame, the motion capture method is connected with the experiences of the player. In a study applying mutually different body motion tracking technologies in a dance-based exergame, the player's energy expenditure and user experiences were measured through three types of video game consoles (Nintendo Wii, Sony PlayStation 3, and Microsoft Xbox 360). In their study, the players felt that the exergame was easier and more enjoyable when the whole body was freely used compared to when the limb-oriented limited motion tracking method was used through the remote controller. (Thin, A. G., et al., 2013)

In addition, Kinect has great potential in the human gesture recognition-related industry. A study that evaluated the performance of Kinect's hardware sensing component compared with the Vicon motion capture system (Fern'ndez-Baena, A., et al 2012)praised Kinect's use as a portable 3D motion capture system in workplace ergonomic assessments. Moreover, a study conducted to measure Kinect's usefulness in the rehabilitation treatments area showed that Kinect had advantages in terms of price, portability, and markerless compared with an optimal motion

capture professional system. (Dutta, T., 2012)

2. Physical activity with exergame

Exergames have been discussed as a way of promoting physical activities in people with a low absolute physical capacity compared to normal people, e.g., cardiac patients. In one study, elderly heart failure patients used an exergame for physical activities through Wii, and as a result, more than half of the patients (53%) benefited from the exergame, showing an improvement of their exercise capacity. (Klompstra, L., et al., 2014) There have been studies dealing with the interaction between exergames and the health behavior, enjoyment, energy expenditure, and health attitudes of normal users, extending beyond patients with physical abilities lower than those of normal people. In Kim et al.' s study, comparisons were made on the basis of the emotions (presence and enjoyment) felt by the users according to the user interface embodiment level and behavioral changes (energy expenditure, intention of exergame, and exercise). Their results showed that the users felt more realistic and more interesting when using a high-level user interface. (Kim, S. Y. S., et al., 2014)

3. Exergame Design

Mueller and Isbister laid out the following guidelines for movement-based game design. (Mueller, F., & Isbister, K., 2014) First, movement requires special feedback. Providing feedback on players' movement and embracing the technical ambiguity caused by sensor data error can induce player enjoyment. The game must be designed to consider an exercise input interface and to provide feedback according to the user's physical condition. Second, movement leads to bodily challenges. Games must make players experience fatigue and use dangerous situations as a means to make them feel excited. The game must be designed to lead the players' imaginations in order to induce their physical movement. Third, movement emphasizes certain kind of fun. Focusing on rhythm, the game must support the expressions used by the players. Finally, interactive movement with others can facilitate social enjoyment.

4. Exergame Development

Finkelstein presented an evaluation on the design and assessment of Astrojumper, an immersive virtual reality exergame designed to motivate players to exercise their entire bodies. (Finkelstein, S., & Suma, E., 2014) Thirty people between the ages of 6 and 50 were selected as the subjects

of the study, and they carried out a 15-minute-long exercise. After playing the exergame, the players' heartbeats increased. It was also concluded that there was a positive correlation between the recognized exercise intensity and the level of motivation. Based on this, the author stated that Astrojumper acted as motivation for both adults and children. Although Astrojumper and H-Run share the same purpose of acting as motivation and to induce exercise, players of Astrojumper must go through the inconvenience of wearing devices in order to play, and therefore many limitations can be expected. H-Run wishes to develop a program where players can move their bodies freely without wearing any devices.

5. The Effects of Aerobic Exercise

Na & Kim found that a 10-week-long walking exercise for middle-aged women reduced their body weight, body fat, and body fat ratio. (Na, S. H., & Kim, S. Y., 2003) Kim & Yang found that a 12-week-long walking exercise for obese female middle-school students reduced their body weight, body fat, and body fat ratio. (Kim, Y. H., & Yang, Y. O., 2005) Moreover, Son & Han stated that they found a 12-week-long walking exercise for the elderly brought significant changes in their body fat and body fat ratio. (Son. W. I., & Han. I. S., 2004) Various research studies helped to confirm the significant effects of aerobic exercise on one's body composition, which is H-Run's goal.

Other research studies were also in line with the research suggested by this paper in many ways, except for the fact that this research involves games.

Ⅲ. H-Run Development

1. System architecture

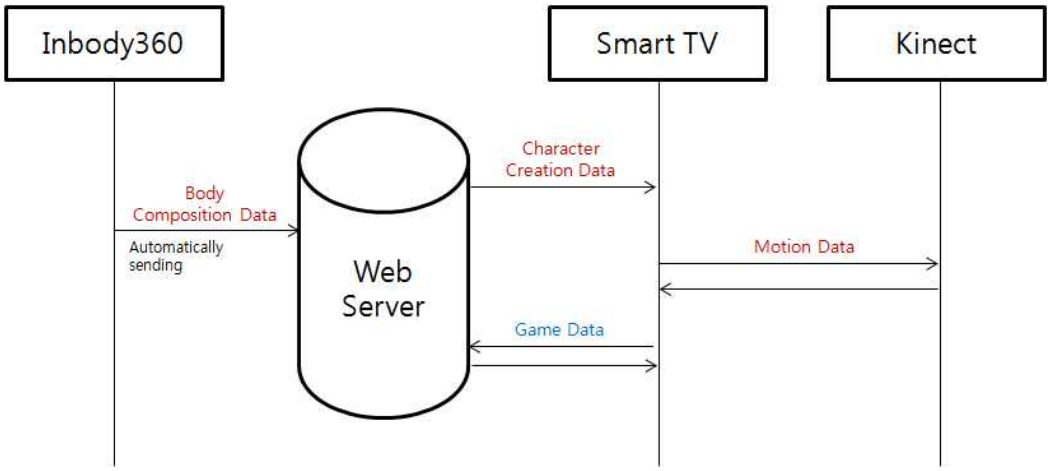

Figure 1. *System architecture*

The system consisted of three parts: a body composition measurement device, a smart TV, and a server (see Figure1).

The first component is for the measurement of the body composition, which becomes the basis of the game character creation. The body composition measurement device used was InBody230 (BioSpace, Korea). The values measured through the body composition measurement device are sent to the game and the player' s avatar reflecting these values is created. The body composition measurement device was used as it can be easily accessed at home, fitness club, or other public health centers. A

body-composition measurement device was added to provide more accurate and intuitive information in generating the player's avatar because the motion sensor used by Kinect can preserve the player's body image but cannot provide accurate detailed data related to his or her health.

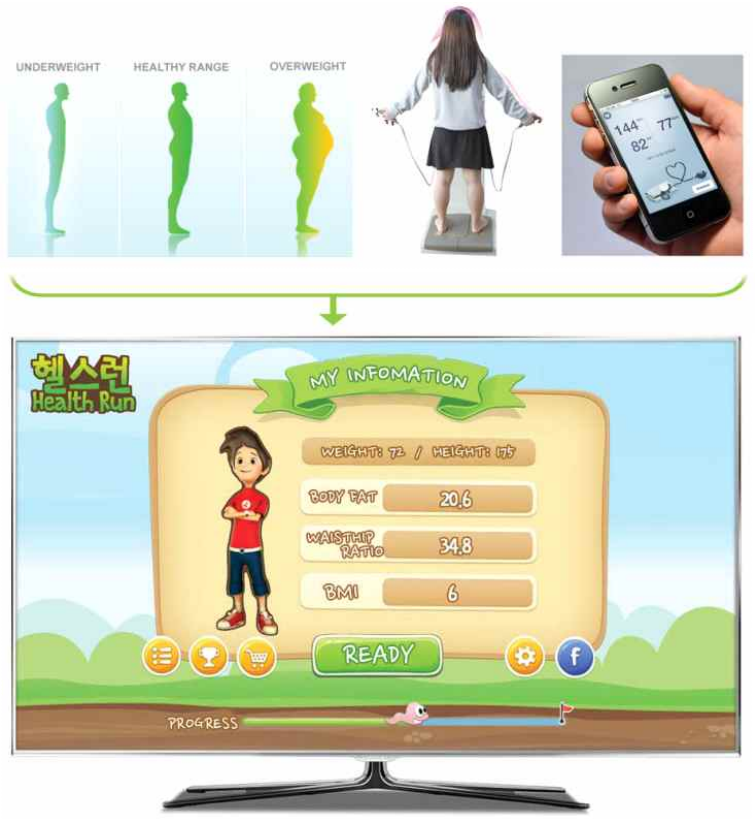

Figure 2. *Creating avatar information in the game through body composition measurement.*

The second component is a game itself, i.e., an environment in which a

player actually exercises. The game was implemented to be operable on any devices such as smart TVs, smartphones, or other displays on the basis of Unity 3D. While outputting to the screen, it continuously communicates with the body composition measurement device and the server at the same time (see Figure 2).

The third one is a server system for storing and processing the data. It was implemented with a Webserver and PHP. The important player data such as body composition data and game result data are saved in the server, and these data can be used only in a player account-authenticated game.

2. Game Controller Phase1

Figure 3. *Configuration of controller using remote controller*

At first, the controller was implemented by a remote controller specifically used for a smart TV (see Figure 3). A gyro sensor and a three-axis acceleration sensor embedded in the remote controller were used, and this idea was based on the Wii controller. However, as time passed, it turned out as arm-oriented exercises for the arm holding the remote controller and proceeded in a direction different from the original intent, i.e., inducing exercises by moving the whole body. Thus we searched for other controllers with which the whole body could be moved. We had to figure out a way to induce exercise of the whole body because this could have led us to move away from aerobic exercise.

3. Game Controller Phase2

The controller that we finally selected was Kinect. As it was based on motion capture, the motor nerves of the player were not focused on a certain part, unlike the Phase 1 controller, which required the hand to hold something. In the end, we had the inconvenience of installing an additional device, but we succeeded in dispersing the motion nerve to different areas of the body.

4. Map Design

A map was modeled with a map of a real image-based environment based on Pangyo Techno Valley and SungKyunKwan University. It was implemented in a real image-based environment to increase player immersion by providing a perfect indirect experience environment. As the player's body information is continuously used after the creation of the avatar, we decided that the exercise environment similar to the real one it was determined that the game's reality-based exercise environment will help the players keep motivating to exercise (see Figure4).

Figure 4. *Real image-based map development: (Left) Real feature of Pangyo, Sungnam City (Right) Modeled street in Pangyo based on (Left).*

5. Map Composition_1

Figure 5. *Map Composition*

In order to provide a map according to a player's strength (or ability) like the above pictures, the maps were designed in the form of FIFO (First In First Out). A start trigger was installed at the start of the map to record the start time, and an end trigger was installed at the end of the map to decide the length of the map for the next stage in accordance with the player's strength (see Figure 5). Since the game is designed differently for each player, it was programmed to easily provide a level of difficulty for each player. Consequently, this was also helpful in ensuring technical optimization.

6. Map Composition_2

For the same reason, the Track Polygon was installed to provide maps

suitable to each player. The purpose of this is to induce more player movement while controlling the level of difficulty of the obstacles according to the player's strength (or ability). Although it is important to run the program in an environment that is exactly the same as reality, this allowed players to move their entire bodies in a more enjoyable and exciting environment (see Figure6). Since this also targeted each player, it allowed players to automatically control unnecessary graphics, and thus was helpful in ensuring technical optimization.

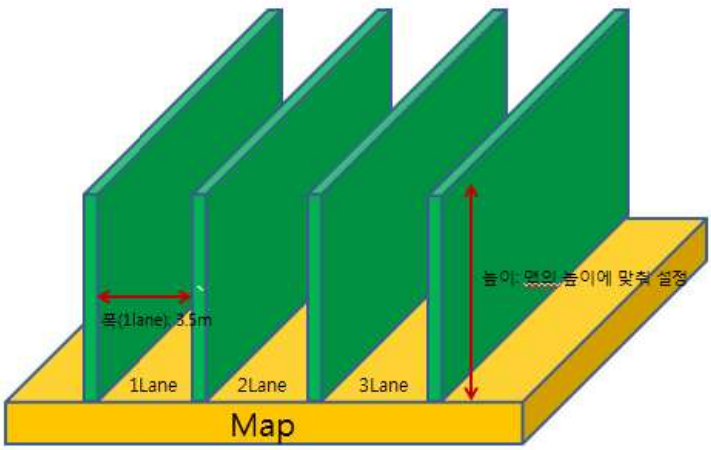

Figure 6. *Track Polygon*

7. Game manipulation

The game manipulation at current stage is made up of actions such as walking, running, evading to both sides, jumping, and sitting. Jumping and

sitting were particularly designed as they can induce more movement of the player's lower body than of his/her upper body due to the characteristics of aerobic exercises. Walking was reflected for the consideration of obese players who may want to slow down the speed of the game (see Figure 7).

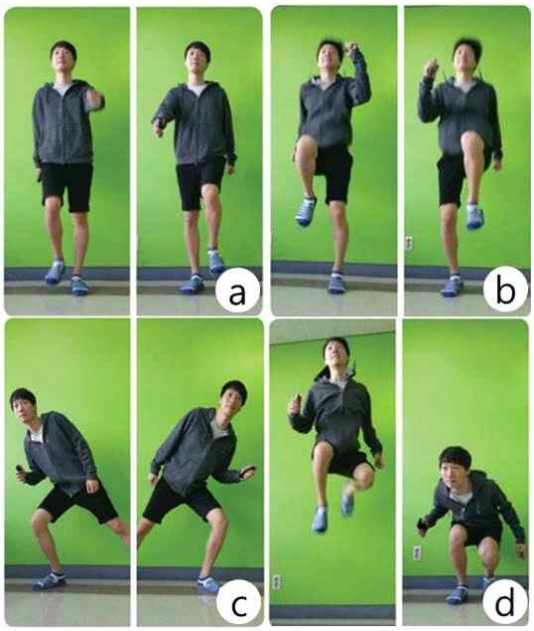

Figure 7. *Track Polygon Game Controlling (a)Walk (b)Run (c)Dodge (d)Jump/Sit.*

8. Other game elements

The game elements were configured according to the following two guidelines: (1) movement requires appropriate feedback; (2) movement leads to bodily challenges. To provide positive feedback according to the

player’ s movements, the exergame keeps complimenting the player on how well he/she is moving. Furthermore, by placing moving buses and cars here and there, we let the players enjoy their exercise activities as well as providing thrills (see Figure 8).

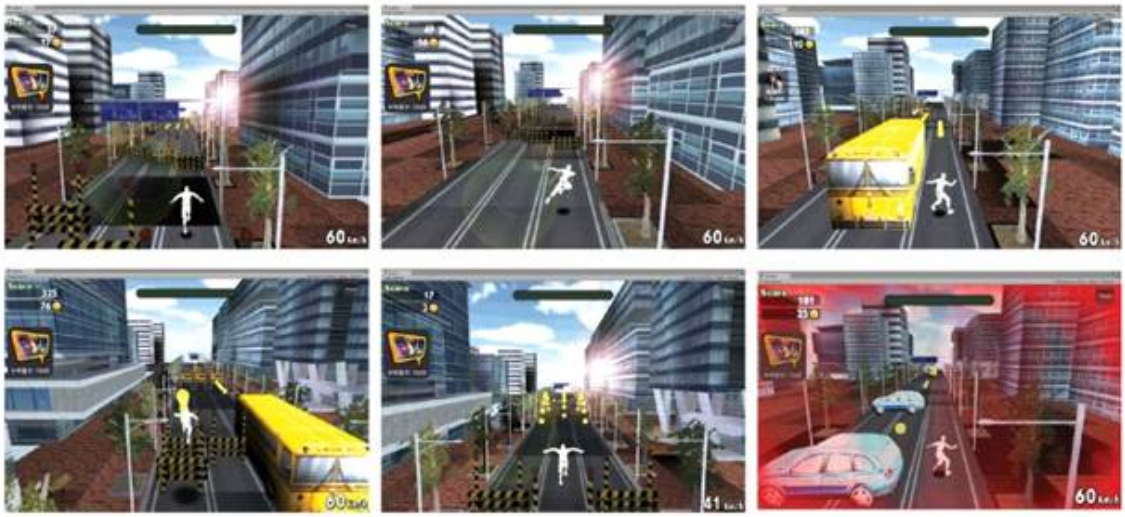

Figure 8. *Adding game elements according to obstacle placement and feedback*

9. Result Screen

On the result screen, information such as total running/walking distance, consumed calories, and acquired coins are displayed. The final score is a sum of these three parameter values (see Figure 9).

Figure 9. *Game result screen displaying the distance run and the calories consumed.*

Ⅳ. Experiment

1. Experiment 1: Pilot Study

We conducted a pilot study to check how effectively the proposed H-Run system can induce (or motivate) overweight or obese players to exercise.

A. Participants

20 students (13 males and 7 females with an average age of 25 years, ranging from 20 to 32) from SungKyunKwan University and Seongnam City, South Korea, who had a body-mass index (BMI) of 25 or higher. The study participants were limited to those who have BMI of at least 25 as people with BMI of 25 or higher are generally classified as overweight or obese in South Korea.

B. Method

We asked the participants to rank how they felt on a five-point Likert scale (1: Strongly disagree; 5: Strongly agree) after each of them experienced the system for 20 minutes in a laboratory where the H-Run

system was installed. To ensure that the study participants completely focused on the system, the test intervention, except 1-minute break, was minimized.

The questionnaire consisted of six questions regarding system enjoyment, difficulty, continual use, and feelings about the avatar, etc., as shown in Table 1.

Table 1. *Result of the pilot study: Participants' mean (and standard deviation) ratings for each question of the survey (1: Strongly disagree; 3: Neutral; 5: Strongly agree)*

Questions	Mean	Standard Deviation
I enjoyed this game.	3.75	0.64
It was hard to copy the movements of the game.	2.25	0.85
I think that playing this game is similar to actual exercise.	3.9	0.85
I think that the avatar in the game reflects my physical features.	4.05	0.51
I like the avatar of the game.	3.2	1.20
I will consistently play this game	3.75	0.85

C. Result

To the question asking whether the H-Run system was enjoyable, the

study participants answered that they generally enjoyed it, with a mean score of 3.75 (SD=0.64). Further, it was reported that it was not very difficult to follow the game movements (m=2.25, SD=0.85). To the question asking whether there was a difference compared to actual exercises, a mean score of 3.9 (SD=0.85) was given, and to the question asking whether the avatar appearing in the system reflected the player's actual physical features well, a mean score of 4.05 (SD=0.51) was given. This indicates that our system reproduces the real world appropriately. To the question about the actual intention to continually use this system, a mean score of 3.75 (SD=0.85) was given, showing that they wanted to use it consistently in general.

Interestingly, to the question "I like the avatar of the game," the most neutral result among all the survey questions of this study was obtained, with a mean score of 3.2, but the highest standard deviation (1.2), which in a sense is contradictory to the result that the participants agreed with the resemblance between them and their avatars (m=4.05; SD=0.51). We suspect that this conflicting opinions may be resulted from the player's BMI-based avatar representations. As the avatars represented the actual appearances of the players, some participants showed interest and were impressed whereas some others displayed antipathy toward their overweight or obese appearances being shown with no positive modification.

2. Experiment 2

Table 2. Experiment Results: Before/After H-Run Game Comparison_1

Gender	Age	Height	Before H-Run		After H-Run		Number of plays
			Body weight	BMI	Body weight	BMI	
Male	28	171	74	25.31	70	23.94	12
Male	23	175	95	31.02	86	28.08	34
Male	29	181	83	25.34	80	24.42	17
Male	29	173	85	28.4	73	24.39	32
Male	32	188	95	26.88	88	24.9	27
Male	27	178	85	26.83	83.5	26.35	8
Male	22	175	80	26.12	71	23.18	33
Male	23	184	90	26.58	89	26.29	5
Male	25	168	80	28.34	72	25.51	30
Male	22	177	79	25.22	74	23.62	24
Male	21	174	78	25.76	70	23.12	31
Male	28	175	78	25.47	76	24.82	6
Male	30	183	102	30.46	89	26.58	36
Female	20	163	68	25.59	59	22.21	37
Female	22	160	64	25	62	24.22	4
Female	26	168	71	25.16	62	21.97	30
Female	21	163	70	26.35	67	25.22	8
Female	29	167	70	25.1	60	21.51	34
Female	20	154	61	25.72	57	24.03	14
Female	23	157	63	25.56	60	24.34	10

The first pilot study verified that it was possible to induce obese players to work out, and therefore a six-week-long experiment was carried out to test its effectiveness.

A. Participants

Twenty Sungkyunkwan University students and Seongnam residents who participated in the pilot study were selected as the subjects of this experiment. They were thought to be the most appropriate subjects for the experiment because they were the subjects of the first pilot study, which proved that exercise can be induced.

B. Method

The H-Run system was distributed to the subjects, and they were asked to record their exercise data in the database log only when they exercised for at least 30 min per day. No other restrictions were given since the experiment attempted to determine the effects of the H-Run game without changing the subjects' daily lifestyles. The distributed system had a single mode where the level of difficulty changed automatically according to the player's current ability. The experiment results were saved after processing only the following data: changes in body weight, BMI changes, and the number of plays.

C. Result

The results of the experiment are shown in Table 2 and Table 3. It was found that the subjects played 21.6 times, or 3.6 times per week on average. The reduction in body weight and BMI were greater in subjects who played the game more. In addition, subjects who performed aerobic exercise for over 30 min four times or more a week on average experienced visible changes in their bodies.

Table3. Experiment Results: Before/After H-Run Game Comparison_2

Category	Mean	N	Standard deviation	t Significance level (two-tailed)
BMI Before H-Run	26.5105	20	1.74516	7.659 .000
BMI After H-Run	24.4350	20	1.64075	
Body weight Before H-Run	78.550	20	11.3020	7.420 .000
Body weight After H-Run	72.425	20	10.6614	

The collected data were analyzed using SPSS. After playing the H-Run program for six weeks, the subjects' BMI dropped from 26.5105 to 23.34, and their body weight dropped from showing statistically significant changes.

Ⅴ. Conclusion

In this paper we presented an exergame called H-Run that can generate an avatar on the basis of the player's body data. Our game intends to facilitate exercise inducement and enjoyment - particularly for obese people. H-Run is composed of three parts: a body composition measurement device, a game, and a server. The player data measured through the body component measurement device are sent to the game, and an avatar based on the player data is automatically created. The player can exercise while enjoying the game in which the virtual environment is based on real images. The player's body data and game information are stored and managed by the server.

Like the purpose of suggesting a game based on body composition data, the study showed meaningful results in finding more intuitive and realistic effects of exercise by analyzing body elements, which are difficult to identify superficially. Moreover, it is significant that the study found the technical methods used to design an aerobic exergame such as H-Run can be linked to workout effects.

A pilot study showed that H-Run can potentially induce or motivate overweight/obese people to exercise. However, as some players may have negative opinions towards the avatars reflecting their actual appearances, some psychological consideration might be necessary consistent inducement

of behavior.

One of the major problems in gathering the subjects of the experiment was the lack of an installment device. It was found that there was a slight difference in how different versions of the InBody equipment treated the data. In order to ensure uniform statistics, subjects had to bear the inconvenience of traveling a long distance to measure their body composition data at the beginning and end of the experiment. This is an area that needs improvement in future studies.

Yet we were fortunate to verify through experiments that H-Run not only induces interest simply as a game but also shows the effects of working out. The study was conducted on subjects whose BMI was over 25 and who were university students residing in Seongnam and students of Sungkyunkwan University during October 12 and November 22, 2015. We conducted an analysis of the body compositions of the experimental group that participated in the H-Run experiment. The experimental group showed a significant decrease in body weight and BMI after H-Run, and there was a significant decrease as compared with the controlled group. On average, the subjects played H-Run 21.6 times on average, or 3.6 times per week. There was a greater decrease in body weight and BMI in those who had higher numbers of plays. In addition, visible physical changes were seen in those who carried out aerobic exercise for over 30 min four times or more a week on average.

Based on these results, H-Run was found to be an appropriate program to induce obese people to exercise while simultaneously showing visible workout effects. However, broader research on more detailed body

composition data could have greater effects. Follow-up studies on motivation in addition to from intensity, dietary habits, and aerobic exercise are needed. H-Run is expected to fully play its role only when it is provided in conjunction with other elements that focus on the player.

Reference

American College of Sports Medicine. (1978). The recommended quantity and quality of exercise for developing and maintaining fitness in healthy adults (position statement). Med Sci Sports, 10.

BioSpace, Korea. InBody230. http://www.inbody.com/global/product/InBody230.aspx

Dutta, T. (2012). Evaluation of the Kinect™ sensor for 3-D kinematic measurement in the workplace. Applied ergonomics, 43(4), 645-649.

Fern'ndez-Baena, A., Susin, A., & Lligadas, X. (2012, September). Biomechanical validation of upper-body and lower-body joint movements of kinect motion capture data for rehabilitation treatments. In Intelligent Networking and Collaborative Systems (INCoS), 2012 4th International Conference on (pp. 656-661). IEEE.

Finkelstein, E. A., Trogdon, J. G., Cohen, J. W., & Dietz, W. (2009). Annual medical spending attributable to obesity: payer-and service-specific estimates. Health affairs, 28(5), w822-w831.

Finkelstein, S., & Suma, E. (2011). Astrojumper: Motivating exercise with an immersive virtual reality exergame. Presence, 20(1), 78-92.

Kim, S. Y. S., Prestopnik, N., & Biocca, F. A. (2014). Body in the interactive game: How interface embodiment affects physical activity and health behavior change. Computers in Human Behavior, 36, 376-384.

Kim, Y. H., & Yang, Y. O. (2005). [Effects of walking exercise on metabolic syndrome risk factors and body composition in obese middle school girls]. Taehan Kanho Hakhoe Chi, 35(5), 858-867.

Klompstra, L., Jaarsma, T., & Strömberg, A. (2014). Exergaming to increase the exercise capacity and daily physical activity in heart failure patients: a pilot study. BMC geriatrics, 14(1), 119.

Mueller, F., & Isbister, K. (2014, April). Movement-based game guidelines. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 2191-2200). ACM.

Na, S. H., & Kim, S. Y. (2003). Walking exercise and its influenced on body composition and blood lipid of overweight middle-aged women. Korea Sport Res, 14(4), 1037-1046.

Seri., (2012). Obesity. http://www.seri.org/db/dbReptV.html?menu=db12&submenu=&pgno=6&pubkey=db20120216001

Son. W. I., & Han. I. S. (2004). The effects of 12-week walking training on body composition, body fat area in older females. Korea Sport Res.

15(4). 2233-2245.

Thin, A. G., Brown, C., & Meenan, P. (2013). User experiences while playing dance-based exergames and the Influence of different body motion sensing technologies. International Journal of Computer Games Technology, 2013.

WHO., (2014). 10 facts on Obesity. http://www.who.int/features/factfiles/obesity/en/

WorldLinkLab., (2012). http://211.174.114.20/hint.asp?md=206&no=10543

논문요약

체성분 데이터를 활용한 비만관리 기능성 게임 개발

금정호
휴먼ict융합학과
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본고는 개인 비만관리를 위한 기능성 게임을 제안한다. 이 프로젝트는 비만인의 운동 유도에 초점을 맞춰 구현되었으며, 프로젝트의 이름을 H-Run이라 칭하였다. 특히 본고에서는 많은 비만관리 운동 방법 중 유산소 운동에 중점을 두고, 이를 실내에서 즐길 수 있는 방향으로 개발하였다. 실내에서 즐길 수 있도록 기획한 의도는 장소, 날씨 등 불가피한 상황으로부터 벗어나 운동할 수 있는 여건을 만들어 주기 위함이며, 실외에서는 게임의 형태가 아니더라도 많은 종류의 운동을 즐길 수 있기 때문에, 이런 특성을 반영하여 실외 운동의 현실감을 실내에서 표현해 보고자 하였다.

H-Run은 사용자의 체성분 데이터를 활용하여 게임 속 캐릭터를 생성한다. 자신의 체형정보가 반영된 캐릭터를 이용하여 실제 환경을 바탕으로 구성된 게임 속 공간들을 뛰어다닌다. 게임이 끝난 후에는 자신의 실제 운동량을 바탕으로 한 결과를 확인할 수 있으며, 장기적으로는 실제 환경과 동일하게 변화되는 체형의 모습을 확인할 수 있다. 우리는 BMI수치가 25를 넘는 것으로 판단되는 20여명의 참가자를 모집하여 H-Run의 유용성을 실험으로 확인해 보았으며, 실험에 참가하는 피실

험자를 수원, 성남 지역의 참가자로 한정하였다. 이는 기 구축된 게임 속 현실 공간이 성남시와 수원시를 바탕으로 제작되었기 때문이며, 실제 운동 공간과의 괴리감이 없는지 알아보기 위함이었다.

주제어 : 기능성 게임, 비만 관리, 헬스 케어, Exergame