

Interactive Gym Service Framework Proposal for Children and Senior

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Abstract: The quality of life improves with healthiness. However, the rate of exercise of adolescence and old age is gradually decreasing. The aim of this study is to propose a service framework of interactive gym for the old and young generation. We reviewed the literature of physical activity of the target and the concept of interactive gym. The design of the interactive gym based on the sensor-mounted smart mat, Kiosk and Controller were proposed. We also suggest the possible applications of the collected data. We proposed the plan to link the interactive gym with educational programs and community programs.

Keywords: Interactive Gym – Smart Healthcare – Quality of Life – Senior –Youth.

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Introduction

People's interest in health is growing as the 'Aging Society' approaches. However the number of people who actually exercise does not seem to increase. As the society and science develops and becomes more digital, the majority of people living in the city are being lack of exercise. The term 'hypokinetic disease' which refers to diseases arising from lack of exercise is becoming more common. It indicates that the lack of exercise is one of the biggest problems in the modern society. Lack of physical activity has been cited as the fourth cause of global deaths and non-inflammatory diseases and deterioration of health is caused by decreased physical activity in many countries and throughout the population (Korea Health Promotion Institute, 2012). In 2017, only 45.5 percent of middle school students were engaged in active physical activity for more than three days a week and 30.6 percent of high school students. The rate of cardio exercise between 19 and 64 years of age was 49.8% and that of people over 65 years of age was 29.4%. (Korea Centers for Disease Control&Prevention, 2017) Among middle school students who exercised more than three days a week, 23.8 percent and 22 percent of high school students. The rate of exercise practice between 19 and 64 years of age was found to be 22.1 percent, and 29.4 percent for those aged 65 and older. The percentage of people who exercise across all ages was less than half. Although 20s men and women performed the highest rates of cardio exercise and weights exercise, the rate of physical activity of all ages was continuously decreasing compared to the previous year (Korea Health Promotion Institute, 2017). The lack of exercise in childhood leads to chronic diseases in adulthood and in older years. It also causes difficulty to maintain the essential physical functions of the daily life. To conclude, the need for physical activity is becoming crucial among adolescence which makes the foundation for their lifelong fitness and older people who need strength for their daily lives. This study aims to propose the service and structure of interactive

gym based on ICT technology to induce active physical activity among teenagers and the elderly.

According to the WHO's Global Recommendations on Physical Activity for Health, people aged 5 to 17 are defined as children, aged 18 to 64 are "Adult" and aged 65 and older are defined as "old people" (World Health Organization, 2010). At the 2017 Korea Health Statistical Year Book 2017, Life cycle was defined as "Youth (middle school student 1st grade to high school student 3rd grade)", "19 to 64 years", "old people (over 65 years)". (Korea Health Promotion Institute, 2017). In this study, following the two standards of the definition, the youth refers to 1st grade in middle school to the 3rd grade in high school and older people are over 65 years.

In addition, 'body activity' used in this study refers to all movements of the body caused by contraction of the skeletal muscle, 'Exercise' is a type of physical activity that is planned, structured, and repeated for the purpose of improving or maintaining one or more physical strength (Ministry of Health and Welfare, 2013). Exercise is a sub-concept of physical activity and a purpose-oriented activity (Samsung Medical Center, 2019).

In order to identify the subjects of study, we examined the characteristics of adolescence and old age, the types of physical activity required for each period, and the effects of physical activity on health through theoretical considerations. In the following chapter, we studied the concepts and characteristics of interactive gym and classified the types of the gym through case studies and identified the structure and the interaction factors that are necessary for the proposal of the service.

In addition, the effect of interaction factors of interactive gym on physical activity and exercise was investigated through the previous studies on these factors. We proposed the service and structure of interactive gym for youths and the elderly based on the preceding analyses. To solve the existing problems of our society such as the rise of social costs due to lack of exercise, we emphasized the importance of exercise programs and services for

children and elderly that allows them to enjoy with ease and fun. In this study, we considered the health characteristics and physical activities of each target to induce active physical activity among children and the Senior, and based on these, we proposed the service and structure of interactive gym suitable for the aforementioned target individuals.

Understanding of health and physical activity in adolescence and old age

Health and physical activity in adolescence

Adolescence is not only a period of physical rapid growth, but also a time when the changes of body shape occurs due to the hormonal effects. Additionally, the importance of health care in adolescence is emphasized in that the high level of physical strength in adolescence is the basis for supporting life and leading a healthy life in adulthood (Seoul National University college of Medicine, 2015). Physical activities in adolescence greatly affect mental health as well as physical health, such as improved physical strength and basal metabolism, reduced body fat, strengthened bone and cartilage, prevention of obesity, decreased depression and stress (Janssen, 2007). It also has a significant impact on reducing the incidence of heart and lung diseases and metabolic diseases when they become adults and older. A comprehensive study of the effects of physical activity on adolescents shows that there is a dose-response relationship that increases health benefits as the body increases. In overall, the active physical activity in adolescence has a positive effect on health.

WHO recommends intensive physical activity more than one hour a day and steady strength reinforcement activities two to three times a week (World Health Organization, 2010). In Korea, children and teenagers aged between 5 and 17 are encouraged to perform at least one hour of aerobic activity per day and High intensity exercise and strength exercise at least three days a week (Ministry of Health and Welfare, 2013).

Physical activities in adolescence include playing games, exercise, transportation, leisure, physical education classes and sports at home, school and in the community. According to the Ministry of Health and Welfare and the UK's NHS, moderate level of physical activities for teenagers include walking, playing in the playground, and biking, and medium to high-intensity physical activities are dancing, running, soccer and gymnastics, while muscle strength trainings include barbed wire, jungle gym, push-ups, sit-ups and push-pulls.

Health and physical activity in old age

Steady physical activity and exercise are essential even in old age. Performing regular physical activity supports the older people in maintaining physical functions and preventing deterioration in the quality of life. The lack of physical activity and exercise affects deterioration

in overall physical strength such as muscular strength, muscular endurance, explosive muscular strength and walking ability (DiPietro, 1996). The physical activity of the elderly improves functional health such as cardiorespiratory fitness, muscular strength and bone, and reduces non-inflammatory diseases, depression and cognitive decline (Korea Health Promotion Institute, 2012). Health appears to be the most important influential factor in the study of quality of life in old age.

A number of studies have found that older people with more physical activity levels had higher quality of life in healthiness such as physical function, role, physical pain, and overall health conditions than the ones with the less physical activity (Atlantis, Chow, Kirby, & Fiatarone Singh, 2004; Bae, et al., 2010).

Senior should conduct a total of more than 150 minutes of moderate aerobic activity per week or at least 75 minutes of strenuous aerobic exercise per week. Muscle strengthening exercises including the main muscles are recommended to be carried out more than two days a week (Korea Health Promotion Institute, 2012).

Physical activities of the senior cover exercising in the leisure time, walking and biking. To be more precise, walking, underwater aerobics, line dancing and biking are activities in the moderate level of intensity. On the other hand, jogging, running, aerobics and climbing are activities of the mid and high-intensity, and body, yoga, pilates, sit-ups and push-ups are movements for muscle strength.

A Theoretical review on Interactive gym Concepts and Features of Interactive Gym

The concept of interactive gym addressed in this study means smart gym, a space based on ICT technologies such as sensor technology, Internet of Things (IoT), cloud computing, big data and artificial intelligence (AI). The interactive gym allows people to interact with the exercise equipment unlike the aspects of existing gym where individuals exercise unilaterally. When the user starts the exercise, the exercise equipment provides immediate feedback, and relevant data is recorded during the exercise and stored in the cloud system. Using AI, exercise data can be analyzed thoroughly and the analysis is applied in the next movement so that more systematic exercise can be carried out.

Interactive gym allows users to interact with the exercising environment by collecting, storing, and analyzing accumulated data through digital devices and sensors, and leveraging the results for other services. It is a developed form of a gym from the existing gym which provided exercise data only on a one-time basis and allowing one-sided exercise.

Type classification of interactive gym

The real-world applications of interactive gym in the Korea and overseas were investigated and classified into two types: digital and physical. First of all, the digital type interactive gym uses digital game contents for education and exercise programs constructed by the exercise space with a beam projector, 3D camera, lighting/audio system,

screen, wall and more. Physical activity naturally occurs while the user is playing a game touching the screen or throwing a ball on the screen. It is mainly used in institutions for educational purpose as it has a great advantage of providing various kinds of educational and athletic content and gamification. The major product for this type of gym is 'Lü Interactive Playground' (Lü Interactive Playground, 2019).

The characteristics of the physical type of interactive gym are that from the development of the exercising space, the sensors are inserted in the floor, walls or smart mats. Usually, the design of the space partitioning floor and walls is based on exercise movements such as circuit training, interval training and cross-fit. It guides users of the contact areas of their body part and instructions for exercises by displaying numbers on the floor and walls. Therefore, the users can exercise easily with the guide. This type of interactive gym structure and form is applied to fitness centers, and products and solutions from the U.S. company 'exergame fitness' are representative examples (exergame fitness, 2015).

An advance research on the Interaction Factors in Interactive gym

The interactive gym covered in this study is based on user interaction with the exercise facility and environment. Interaction elements in the interactive gym include 'immediate feedback on exercise', 'checking and accumulating exercise records', and 'providing exercise guide'. All information about the behavior and the consequences of a user's exercise is called feedback. (Kim, 2002; Schmidt & Lee, 1999) The previous literature showed that the case which people who received feedback brought the better results than having no feedback. (Lee & Hong, 2009). Feedback also has 'information function' and 'motivation function' in the course of exercise learning. It is also found that through the feedback, people can recognize the right or wrong of the action, the current status, and acknowledge the difference between the movements and goals performed, thereby increasing their motivation. (Lee, 2005; Yoo, 2016).

Several studies have shown that using a device that can check athletic records, such as a pedometer, can create interest and motivation for walking exercises and contribute to increasing the likelihood of long-term walking exercises. (Kwon, 2019). Another study found that groups that used the exercise-recording function of smartphones had higher physical activity than those that did not. In order to increase the amount of physical activity, appropriate goals and self-checking should be used properly, which also affects the persistence of exercise. (Mcauley, Courneya, Rudolph & Lox, 1994; Kim & Kim, 2012).

Based on the prior research, we were able to draw that the interaction factors of the interactive gym: 'immediate feedback', 'identification and accumulation of exercise records', have a positive effect on the physical activity.

Interactive gym Proposal for the Children and the Senior

Interactive gym structure

The basic module of the interactive gym is a smart mat with pressure sensors.

Smart mats are made up of either rectangle or square shapes with cushion materials. The upper face of the cushion mat has a guide area made to account for various types of exercise and a display area showing the gap between the guide. Display area informs the user where to press or step during the exercise. Inside the mat is a pressure sensor to detect motion and a lighting sensor to suggest the next movement after detection. Depending on the type of exercise, the shape, combination, and installation area of the mat will vary.

The interactive gym consists of a 'kiosk' that allows the user to select the type of exercise and check the records, a 'mat kit' with various mat modules equipped with pressure sensors, and a 'controller' that transmits the data by connecting the mat kit and kiosk.

If the user adjusts the type, speed and intensity of exercise in the kiosk to search and select the appropriate exercise to perform, the kiosk and smart mat will be connected via controller and the exercise will be initiated. When a pressure sensor inside a smart mat recognizes movements by detecting 'pressure presence' and 'pressure size', the status is sent to the controller, and data is transferred to the kiosk. This series of processes is named Input.

Upon receiving input, the kiosk issues control commands to the controller and, in accordance with the control commands, the controller provides motion guides by lighting the display indicating where the user should press next. The process is named 'output through input'.

Data Collection and Analysis

The data available in the interactive gym can be largely divided into two types: personal physical health data and exercise-related data. First, personal health data can be measured using a body component meter within an interactive gym. This data includes the person's height, weight, body composition, skeletal muscle and fat, and obesity rates.

The second exercise-related data is measured while the user is exercising on a smart mat. The exercise-related data are type, intensity, speed, duration of exercise, the calorie consumption, and posture. Personal health data and exercise-related data that is received via networks such as wireless internet will be collected in the cloud to build the big data of health and exercise. Based on the big data, the resources can be analyzed with information based on combinations of data such as 'age-specific/gender motion patterns', 'age-specific/gender exercise times', and 'age-specific/gender motor strength and speed' and information based on changes in data such as 'changes in the body by age/gender according to the type of exercise' and 'changes in weight and strength by age/gender according to the time and intensity of exercise'. Furthermore, combined with big data at the national level, various data such as "disease rates by age according to exercise

status” and “relationship between exercise and quality of life” will be able to be analyzed to create new information. Information generated in various ways is expected to be used to develop new program or contents of exercise or to develop healthcare products and social welfare policies.

Application of Interactive Gym

A method for connecting interactive gym with physical education curriculum in school

It would be the school that has the most active physical activity in consideration of the physical and health conditions of adolescence. However, standardized classes that are tailored to education courses are usually conducted rather than classes that are based on individual health status, physical ability and interest. Physical education courses should be organized to enhance physical fitness and realize students’ desire to move through various physical activities (Bang, Shin & Hong, 2015; Lee & Kim, 2007). The programs should be provided through physical education classes by organizing physical fitness programs suitable for individual health and fitness levels and allowing people to participate while enjoying (Lee, et al., 2014). In addition to the regular classes, we propose a wide range of physical education method by integrating them with other subjects such as human education, humanities, mathematics and science that can improve the physical abilities required by young people by utilizing after-school activities and the free semester system of middle schools. For example, a circuit training program, a type of combined exercise, can be used to help weight control by allowing children to work together on cardio and muscle strengthening exercises. In addition, you can set the athletic feedback sound to the piano sound so that you can play the piano while exercising, or create a program that can play music to suggest a fusion of music and physical education. Furthermore, it can be applied in basic coding training, allowing the students to experience various convergence educational activities such as adjusting the speed and intensity of exercise or changing the color of lighting.

A method of the link between interactive gym and government health promotion program

According to the 4th Health Plan 2020 (Korea Health Promotion Institute, 2017), various policies and activities are planned and implemented at the national level to improve the physical activities of the people.

The ‘Project to Support the Physical Activity Program for Living Space by Population’ stated that the existing physical activity promotion program focused on improving ‘body strength’, however, physical strength is the result of the process of physical activity, so more programs are needed to enhance physical activity rather than physical strength. A project is actively developing and distributing physical activity programs by life cycle and place of living and other programs targeting young people are conducted at schools and youth centers, and

physical activity programs for the elderly are conducted at senior leisure facilities such as Senior Citizens’ Welfare Centers (Ministry of Health and Welfare; Korea Health Promotion Institute, 2019). In line with this trend, we expect that the interactive gym can also be used as a tool to boost physical activity for youth and senior.

With the lessening opportunities for outside activities due to environmental problems and weather, it is expected that the government will be able to activate the physical activities of local residents by supplying indoor exercise programs using interactive gym while securing exercise experts. Institutions targeting young people, such as youth training centers and youth centers, suggest developing and operating physical activity programs based on youth’s needs, such as growth programs, strength enhancement programs, and basic fitness training programs, according to age groups, levels of body. It is expected to be an opportunity to experience customized physical activities that are not easily encountered in the physical education curriculum, which currently provides the same education for different grades without considering individuals’ physical condition and capabilities. When targeting the elderly, it is proposed to create and utilize programs that can increase the specific strength needed for daily life by linking the interactive gym with health centers and leisure facilities for the older people. The support for older people to maintain their physical function and improve their quality of life through simple physical exercise, yoga, and pilates, although they may have started exercising out of curiosity at first, will help older people to be aware of the changes in their physical strength to continue exercising steadily and to maintain a healthy life.

Conclusion

As life expectancy increases, interest in living a healthy, long life is gaining more attention, however, the actual rate of physical activity and exercise practice is decreasing over time. Adolescence, which is the stage of building basic physical strength, and old age when physical strength is needed to lead a high-quality life, are particular life cycles that require more active physical activity. The theoretical review identified that the rate of physical activity in adolescence and old age was decreasing, and the types and times of exercise required for each life cycle were defined. In this study, service framework of an interactive gym was proposed as a way to improve the decrease in physical activity among youth and elderly. Interactive gym based on various sensors and ICT technologies could be classified into digital and physical types, and the interaction factors within the interactive gym were ‘immediate feedback’, ‘accumulation and verification of exercise records’ and ‘exercise guide’. In this study, with a focus on the physical type of interactive gym, we investigated the product and spatial composition, usage flow, and interaction between each device/sensor required for the construction. The research also identified the data that could be obtained using the interactive gym and suggested the data application methods.

Finally, we proposed directions and plans that could be used in conjunction with the school's physical education curriculum and the local government's national health promotion program. The study, which proposed a new exercise service and structure for youth and senior, was meaningful in that it designed an exercise service that allowed users to interact with the exercising environment, moving from the traditional aspects of the current systems in fitness center. However, the limitation of this paper is that we did not implement in real-world as it is a study that summarizes the overall services and structure. In future works, interactive gym will be developed in real-world application and evaluative user tests will be carried out to validated the proposed services and structures.

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Resumen: La calidad de vida mejora con la salud. Sin embargo, la tasa de ejercicio de la adolescencia y la vejez está disminuyendo gradualmente. El objetivo de este estudio es proponer un marco de servicio de gimnasio interactivo para la generación de mayores y jóvenes. Revisamos la bibliografía sobre la actividad física de los destinatarios y el concepto de gimnasio interactivo. Se propone el diseño de un gimnasio interactivo basado en una alfombrilla inteligente con sensores, un quiosco y un controlador. También sugerimos las posibles aplicaciones de los datos recogidos. Propusimos el plan para vincular el gimnasio interactivo con programas educativos y programas comunitarios.

Palabras clave: Gimnasio interactivo - Sanidad inteligente - Calidad de vida - Mayores - Jóvenes.

Resumo: A qualidade de vida melhora com a saúde. Entretanto, a taxa de exercício da adolescência e da velhice está diminuindo gradualmente. O objetivo deste estudo é propor uma estrutura de serviço de ginástica interativa para a geração velha e jovem. Revisamos a literatura

de atividade física do alvo e o conceito de ginástica interativa. O projeto da academia interativa baseado no tapete inteligente montado com sensores, no quiosque e no Controlador foi proposto. Também sugerimos as possíveis aplicações dos dados coletados. Propusemos o plano de ligar a academia interativa com programas educacionais e programas comunitários.

Palavras-chave: Ginásio Interativo - Saúde Inteligente - Qualidade de Vida - Senior - Youth.

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Propuesta metodológica para determinar la identidad gráfica territorial en las representaciones sociales del contexto del río Rocha en Cochabamba Bolivia. Una experiencia interacción académica y social

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Resumen: El proyecto se desarrolla en la Universidad Mayor de San Simón en Cochabamba Bolivia, involucró al instituto de Investigaciones y al Taller de Diseño III de la Carrera de Diseño Gráfico. En consenso con actores clave del contexto metropolitano del río Rocha se trabajó en ámbitos de la identidad territorial en Marca territorio como base para futuros emprendimientos en procesos de planificación. El proyecto demostró que la vinculación entre la investigación científica y la el pregrado y la sociedad civil es posible en cuanto las metodologías sean las adecuadas. Concluido el proyecto se evidencia que los beneficiarios se encuentran muy empoderados con su contexto a partir de la experiencia.

Palabras clave: Representaciones sociales – Identidad territorial – Grilla de análisis – Etnografía – Marca Territorio – Señalética.

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Desarrollo

Cochabamba en su área metropolitana contiene al río Rocha que hace algunos años atrás sufre una progresiva degradación ambiental que lo convierte paulatinamente en un foco de infección; diversos actores sociales contribuyeron en este problema por la falta de oportuna atención y utilizarlo simplemente como un receptor de

desechos. Se hace necesario averiguar las causas que llevaron al deterioro territorial con la consiguiente pérdida de valores que otrora fuera un lugar simbólico y orgullo regional. En este contexto se desarrolló un trabajo de investigación en el Instituto de Investigaciones en Ciencias del Hábitat de la UMSS, que propuso determinar la identidad territorial en las representaciones sociales, que