A Study on the Functional Silver Game Contents and Interface Technology

Hyun-Cheol Lee , Eun-Seok Kim, Im-Chul, Kang and Gi-Taek Hur

University of Dongshin , Daeho-dong, Naju, Republic of Korea

Summary
Because of the world's lowest birth rate of Korea and the development of medical technology, we expect that we'll make our way into an aging society with more than 14% of the population over 65 years old in 2018 and an super-aged society with more than 20% in 2026. As the aging population has increased, the silver generation is getting to account for the considerable percent of economic activities and becomes the main body of production and consumption. Although the economic activity of silver generation is increased, the development of silver contents for the leisure activities is still not revitalized. The serious silver contents and the easy-to-use interface are very important because the silver generation is relatively weaker than young people in perception, studying, and exercise, and is fragile in mobility and vitality.
This paper suggests methods to develop sensory bicycle, gate ball, and mole game contents having lower body exercise effects for the silver generation to utilize leisure and maintain health. Along with fun as games, functional design factors suitable to the cognitive ability and bodily activity ability of the silver generation were considered and through sensory interfaces that are easy for the silver generation to use and customized progressing methods complying with individual characteristics, it was attempted to induce continued interests and lower body exercise effects.

Key words:
Silver, Sensory bicycle, Gate ball, Mole game

1. Introduction

Recently, portion of the aged population has been increased, and aging became the biggest issue that we will be facing in the future. In 2007, people over 65 years old in the South Korea was 4,810,000, 9.9% of the total population. In 2000, Korea entered into the aging society with 7.2% of aged population, and is expected to become the aged society in 2018 with 14.3% and the super-aged society in 2026 with 20.8%[3].
This phenomenon is caused by extended average span of life due to dramatic development of medicine, increased single family, and increased number of elder orphans due to early death of spouse and extended average span of life of women compared to men. The government plans to support developing elder-friendly functional contents such as functional games like rehabilitation games that elders can both exercise and enjoy or edutainment and expand generation integrative participation programs such as the third generation family e-sports competition and family game camp. Therefore, various silver industry including elder sports will dramatically grow and Korean silver industry also is expected to grow at 12.9% annually from 2010. As aging is progressed, elders' social economic portion is expected to increase dramatically.
Especially, as we look into the IT usage rate of elders, rate of information communication usage of the 40s and 50s are gradually increasing and 65 year-old silver generation will lead IT in 10 years. As the usage of media and internet by the silver generation increases, it is possible that games will be one of the most important leisure activities that elders can enjoy[5].
However, functional game for silver contents and interface technology are underdeveloped. Until now, the elderly was the most neglected class. There was no content that they could use and high barrier to approach because they were difficult to use. Silver generation has relatively lower sense of perception, learning ability and intellectual capacity compared to young generation. Moreover, they are not good at moving and activities. Therefore, development of user interface for silver contents is necessary. This study introduces the development of functional game contents and easy-to-use interface for silver generation's leisure time utilization and health maintenance.

2. Related Work

Silver generation experiences aging process in their body as the size of each body parts decrease in proportion to the age, and ability of sense organs decrease and fall according to the level of aging. Therefore, functional games for silver generation must be easy to see, and should have easy-to-use interface. Moreover, the games also should consider physical, emotional and psychological environment of silver generation as they need to actively communicate with others and participate and contribute to the society.
The major development strategies of the functional games are to revitalize brain to prevent falling of memory, to activate physical functions and muscular power through strengthened motility, and to manage health through preventing diseases and stimulating treatment[4].

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If these functions are satisfied, the functional game contents will be revitalized as silver generation became the major content consumer with higher purchasing power.
Most of the functional games developed so far focus on brain training to prevent dementia and family participation oriented. The representative games for silver generation are FIT in “Nintento Wii” and “DS” health intention game. Nintendo, Japanese company, helped rehabilitation training for elders and patients using "Wii" which uses bodily sensation game platform.
It allows physical therapy through movement of one’s body using simple interface. In sports game, it actually receives data from remote control that has motion sensing function and calculates the quantity of motion[6].

Fig. 1 Elderly Rehabilitation Treatment(Nintendo "Wii")

"Taiko Drum Master", a dementia prevention game developed by Medical School of Kyushu University, contains various games such as dance game that requires immediate response as one needs to push the button that suddenly comes out according to music, sumo game (Japanese wrestling) that has two buttons and push opponent outside the arena by pushing two buttons in turns, and making a big drum game as one puts falling down materials into the drum.
In England, they made a training program that prevents aging of brain using computer. Veronis Greenfield of Royal Institution of Great Britain developed a training program called "Mind Fit" that prevents aging of brain using computer. It showed 15% improvement in short term memory and 19% improvement in simple reaction time for the people over 50 years old compared to the traditional brain training method. Dual Screen, a portable game player, uses easy and simple interface for silver generation and easy to operate using a pen and touch pad which allows elders to enjoy the game more easily[6].
Puffer, the first model of bodily sensational bicycle, is introduced in 1982 by Atari with an exer-cycle concept. It is an exercise game system that uses both the 8 bit computer and bodily sensational interface of bicycle[1].

3. Game Materials and Designs

3.1 Game Material

The system to be developed in this paper is purposed to analyze the characteristics of the silver generation in order to develop those motion sensing technologies, sensory game contents and wireless interface technologies that may be easily accessed and used by the silver generation with a view to the activation of the u-Silver contents industry. To relieve the emotional uneasiness of the silver generation and invigorate mental health and the vitality of living of the silver generation, this study selected those functional game contents added with those music and dances easily usable by the silver generation and amusing factors as materials for research & development so that leisure time can be actively utilized, differences between generations within a family can be maintained and mental and physical health of elderly persons can be maintained through those functional.
The material to be developed was selected from traditional play cultures that could be understood and easily accessed by the silver generation. As those sensory game contents that have been experienced in the past or easily accessible by the silver generation in surrounding environments, those game tools that could be obtained from materials in living were used.
Also, those plays and sports that could be commonly experienced were selected as easily enjoyable game contents and using Culture Technology, Information Technology and Sports Technology, those were developed into those functional contents that would help physical and mental exercises while being immersed into virtual environments and enjoying games to prevent diseases and help rehabilitations of physical functions.

3.2 Game Design

Due to the aging phenomenon of the body, the silver generation is reduced in their dimensions of various parts of the body along with changes in the skeletal structure and show the phenomenon of decline or fall of sensory organs depending on their degree of aging phenomena. Therefore, for those functional games for the silver generation, interfaces that are easy to see and easy to operate, activation of communication with others and roles and contributions as members of society are important as results of considerations of physical, mental and psychological environments of the silver generation.
To develop games for the silver generation, the developer should understand elderly persons in diverse ways and the games should be configured to be more easily

understandable and convenient compared to those games used by young people. Designs for the silver generation should be made with an approach having the design concept aiming at producing those environments and products that can be easily used by diverse users and thus should be easily usable by as many people as possible without any particular differentiation or separate device. Therefore, groping of the direction of designs corresponding to aging requires a switching of the angle of sight and the implementation of silver designs aiming at solving the problem should be accompanied with comprehensive and multi-angled approaches and design strategies. In general, the components that should be considered in silver designs include fairness, flexibility, simplicity, perceptiveness, tolerance, danger and minimal physical effort, size and the accessibility of spaces. Also, the functional game design factors in relation to sensation, perception and motion ability are as per following Table 1.

Table 1: Factors to be considered in designing functional

Division	Content
Consideration in relation to sensation and perception	simple manipulation intuitive understanding easily understandable markings
Consideration in relation to sensation	manipulation with good feeling stable sense of using comfort in using
Consideration in relation to motion ability	easy manipulation suitable form secured durability secured accessibility

4. Sensory Bicycle Game

4.1 Bicycle Game Interface

This paper analyzed the characteristics of silver generation and develop more easy-to-use motion sensing technology, bodily sensational game contents, and wireless interface technology to activate u-silver contents industry. This paper consists of three steps lower body, upper body, and brain. Each has functional contents and interface technology.

The bicycle game description under development provides natural environment and major interest points with actual 3D VR base and gives real exercise and rehabilitation effect. Signal data to actualize bodily sensational game was acquired by attaching signal sensor on the bicycle. Major data to be sensed are the speed of the bicycle and friction of the surface. In the game, angle of inclination is expressed by actual road's level land, uphill, and downhill. Using stepping motor in a damping device and based on gradient of map, physical brake was possible. RS-232C communication was the basis between the required system of 3D display and signal acquisition device of the bike.

4.2 Bicycle Game Contents

This bodily sensational bicycle game contents uses 2.6GHz CPU, 1GB main memory, Visual Studio 2005 C++ in GPU 600MHzsystem and DirectX SDK 9.0C library. It is actualized using Ogre Newton Engine and Ogre Engine 1.4.9.

The bodily sensational bicycle game contents include various characters, background of "Nakahn Eupsung" and "Samhanji" theme part, various items(increased speed, jump, recover strength, and eliminate obstacles), UI (introduction screen, a walk/ competition mode, ranking information, mini map, and speed check), and various sound effect that is sensitive to various environment and events. There are two possible modes; a walk mode and competition mode.

A walk mode has its purpose in strengthening lower body parts. Moreover, it allows the users to experience natural environment of "Nakahn Eupsung" and events, and the user can freely navigate everywhere and select a place to give three to five minutes of experience.

In competition mode, the user is expected to hang around in a certain destination. While doing so, the user is expected to react to various events by controlling the speed and acquiring various items.

Moreover, it allows options such as straight road, slope, uphill, sharp turn, jump, and acceleration as well as various obstacle items. Figure 2. shows each information screen including the event of scattered flower paddles, speed, mini map, and items.

Fig. 2 Information screen

5. Gate Ball

5.1Gate Ball Game Interface

Gate ball is a compound word of Gate and Ball and the game field is a 25m wide 20m long rectangle, a team consists of 1 manager and 5 or more but not more than 7 players, the attacking team is determined before playing and the team attacking first uses a red ball, the other team white ball. Gate ball game contents consist of a physical engine 3-dimensionally expressing a game field installed with sensors used to play games such as emitters, detectors etc and game contents in a virtual space, a graphic engine, a DB and a display system including communication modules.

Multiple detectors are installed in the game field to detect the motion of the ball moving in the game field area so that the detectors can sense the data values necessary for the system to simulate the game and transmit the data to the display system through RS-232C communication.

The game is implemented on the display system with the direction and speed of the movement of the ball perceived and obtained by the detectors when the ball has been actually hit by a stick which are transmitted to the display system where the effects of the power of the collision of the ball and the direction, mass and friction of the movement of the ball are combined with the physical game engine of the system and applied to game contents. To enhance the sensibility of the gate ball, the sensors are configured as portable imbedded systems that may be separated from the gate ball play equipment.

The game field consists of a MCU(Micro Control Unit) that contains the emitters, detectors and A/D converters to sense signals and a characteristics compensation circuit and decides the logics necessary for detected signals, a RAM that saves and calls calculated data, a logic decoder, a ROM that contains the algorithms to perform procedures to execute orders from all input/output ports and a RS-232C port for communication with the simulator. The (a) in Figure 3. is a control box with a built-in circuit and the (b) is the appearance of the entire game field which is a virtual playground.

Fig. 3 A control box

The advantages of the game field are that the motion data of the balls can be freely detected within the space where 2-dimensional sensing meshes formed by laser beams have been formed thus sensations like those of actual games can be provided and that the sense of ball hitting can be maximized to provide the feeling of hitting the ball in an actual space. Default values of balls are established to detect the motion information of moving balls and to this end, 2-dimensional sensing meshes were configured for the spaces where the balls move using a beam point. That is, multiple detectors that can sense the laser beams emitted from the light emitter are arranged along the X-axis and Y-axis and it has been enabled to obtain 2-dimensional sensing meshes and detect sensed values using them. The sensing data perceived by the detectors are the node numbers of the detectors, the detection time and sizes of the signals detected by each detector and by computing the data, the speed, proceeding direction and the height of the hit ball that may occur can be calculated. Figure 4. shows the sensor arrangement for the detection of ball motion information.

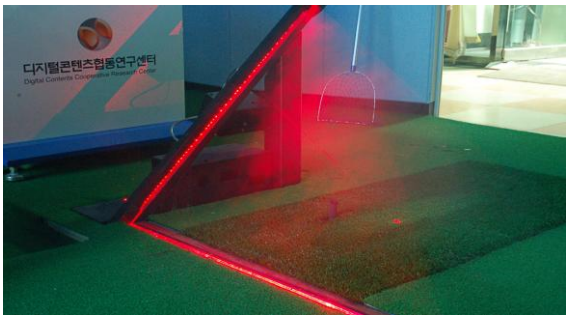

Fig. 4 The sensor arrangement for the detection of ball motion

The display system largely consists of a physical engine used to implement more realistic physical motions such as the movements and collisions of balls and a virtual gate ball game to which the gate ball game rule algorithm, a graphic engine, a DB and communication modules are applied. To enhance the sense of users to make them feel like actually playing gate ball in virtual gate ball games, the physical phenomena in the real world such as the movements and collisions of balls should be configured similarly to actual ones.

To obtain sensations similar to those of the real world, this study configured the game field with the same specification as that of actual gate ball games based on the gate ball regulations including the 25m wide and 20m long playground, the ball with the diameter of 7cm and the weight of 230g and the goal pole etc.

5.2 Gate Ball Game Contents

The playground, stick and ball in the game were expressed by modeling the specification under the gate ball regulations and applying physical quantities of the specification.
The playgrounds consist of yellow earth, artificial grass or grass and different coefficients of friction have been applied to individual game courts so that diverse games can be experienced. Playground options comprise outdoor playgrounds and indoor playgrounds. Figure 5. shows a screen of outdoor playgrounds in the game mode

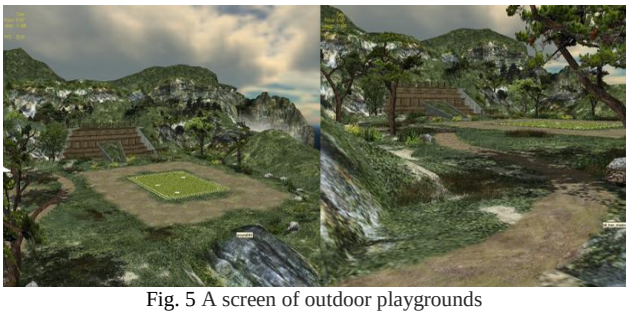

Fig. 5 A screen of outdoor playgrounds

Also, the continuity of games were given through the management of users' practice histories to enable users to experience the sense of reality. In the gate ball game, sticks and gate balls are used and a gate ball game field is implemented in a virtual space and the moving directions and speeds of the balls are expressed from values obtained from the game field and touches, gate passing, goal pole hitting etc are technologically implemented and displayed at real times on the display system. Figure 6. shows a screen in the game mode and a screen of an indoor game field for actual gate ball games.

Fig. 6 The screen of an indoor game field

6. Mole Game

6.1 Mole Game Scenario

The scenario of mole game contents was configured by adapting “Shimcheongjeon” which is familiar to the silver generation. The characters and background designs used in the game were configured in 2-dimensions considering the characteristics of the silver generation rather than 3D that requires sense or cognitive ability and the characters were designed into comic and standardized ones for fun factors of the game and so that they can be easily perceived through contrasts with backgrounds. The overall colors were made utilizing the five directional colors which are our country's traditional colors as the basic and adjusting them to modern trends.
Since simple forms of texts and graphics were not easily perceivable by the silver generation, narration texts and voices were applied simultaneously to relevant scenes to make the silver generation naturally understand thereby making the game easily enjoyable even by beginners. Considering the characteristics of visual perception of the silver generation, the display of the game screen was made large in the overall size so that the game screen can be shown on large displays or large screens using beam projectors. Also, the text used were made in colors that are more easily perceivable than those used in general game in sizes larger than those used in general games.

6.2 Mole Game Interface

The mat interface used in mole games is a game operation interface made in the form of mat for interlocking with game contents in an attempt to improve the spatial perception ability of the silver generation. The mat is a controller for the mole game consisting of a sensor part composed of a 32×32 matrix and a control part that scans and processes signals outputted from the sensor part. Figure 7. shows the skin of the mat interface and the internal design.

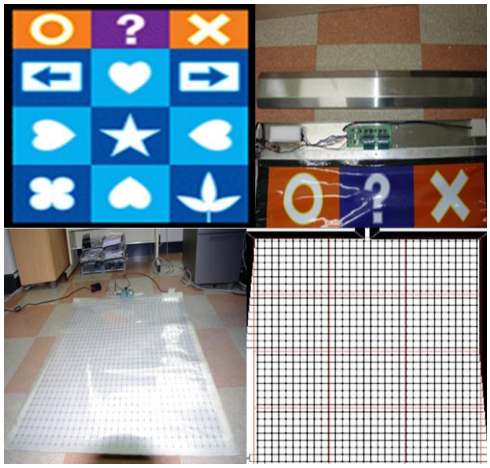

Fig. 7 The skin of the mat interface and the internal design.

Since the silver generation have difficulties in moving weight laterally and maintaining the center of gravity due to the bodily aging phenomenon, the perception range of the sensor part mat was configured to be wide so that even small impacts can be perceived when the center of sensor is not accurately trod by composing a matrix consisting of 1,024 contact points arranged in 32 lines and 32 rows made with 3 films including a film connecting the contact points crosswise, a film connecting the contact points lengthwise and a hols film to secure spaces between the aforesaid two films. The distances between the contact points were 28mm crosswise and 35mm lengthwise and thus 10 or more contact points are detected on the basis of 270mm, the size of a foot of an adult.

The mat was divided into 12 areas so that 12 buttons in total can be used and the buttons can be set up in diverse ways as necessary. Also, unique IDs can be given to individual mats thus maximum 256 mats can be used simultaneously and this makes possible, interlocking with game contents enjoyed by many people. [Figure 6] is a result of multi-touch perceptions interlocking a mat interface program with mat positions. The multi-touch perception is an implementation of tolerance of errors that will enable perceptions through the area of the part trod even when the silver generation do not tread accurate positions on the mats. Figure 8. Test of perceptions of mat positions(two feet).

Fig. 8 Test of perceptions of mat positions(two feet).

6.3 Mole Game Contents

Figure 9. shows the characters appeared in this paper and standardized characters were designed so that good characters and bad characters can be easily contrasted. Also, to enables games for communication between the silver generation and the grandchildren's generation, pretty appearances that may be liked by children were highlighted. The mole games have largely 3 difficulties of high, medium and low and the game time is 1 minute and 30 seconds respectively. The backgrounds of the stages are the Palace of the Sea King, the Imperial Palace and a banquet hall as per Figure 10. based on the game scenario.

Fig. 9 Game characters

To improve the perception ability of the silver generation, the number and kinds of characters appearing were set differently as the difficulty went up and characters to be trod and those not to be trod were set up in order to help the training to improve the ability of the silver generation to perceive things.

Fig. 10 The backgrounds of the stages

7. Conclusion

Different from the elders who were conservative, dependent, and insensitive to trend, they now have different idea of awareness and variety of needs. With their economic power and active participation to the society, they are changing into silver generation that can satisfy various needs and accept dramatically changing social system. Moreover, silver generation is becoming the major consumption party as they have more and more economic power. Therefore, purchasing power of silver generation will increase as their needs became more important as the number of independent elderly family is rapidly increasing. However, silver generation has relatively lower ability of perception and learning as well as capacity of locomotion due to aging, and have lower mobility and activity, development of functional silver contents and easy-to-use interface are essential.

This paper proposed gate ball, sensory bicycle and mole game contents which are functional game contents using those interface technologies that can be easily operated for

the silver generation's utilization of leisure time and maintenance of health. The game contents and interfaces of the proposed games were made considering design factors for the silver generation and simple UI and wireless interface technologies were utilized to ensure the easiness of game operation.

Also, along with strengthening of muscular power, balance and flexibility functions which are the objectives of functional games, it was enabled to induce fun and interests by adjusting the progression of games depending on the changes in the behaviors of game players.

The direction of future studies is developing methods to test the usefulness of game designs through field tests for the usefulness of design methods for the silver generation, developing those functional game contents suitable to the silver generation that can prevent declines of memories and improve physical functions such as muscular power and implementing multiple platform environments that may be applied to IPTV so that manipulations and operation would be easy.

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Hyun-Cheol Lee received his B.S, M.S and Ph.D degrees in computer science from University of Dongshin in Naju, Korea, in 1996, 1998 and 2003.
He taught digital contents at Dongshin University and researched Digital Contents Lab. He has been taught and researched as a instructor at Dongshin University. His research interests include Digital Contents, Silver Contents, 3D animation, Facial Animation, Ubiquitous Computing and Network Protocol.

Eun-Seok Kim received his B.S, M.S and Ph.D degrees in computer science from University of Chonnam, Korea, in 1995, 1997 and 2001. He taught digital contents at Dongshin University and researched Digital Contents Lab. He has been taught and researched as a professor at Dongshin University. His research interests include Digital Contents, 3D animation, Image Processing, Fluid Animation and Implicit Modeling

Im-Chul Kang received his B.S. degree in computer science from Chonnam National University in Gwangju, Korea in 1991, M.S. degree in Management Information System from Chonnam National University in 1997, and Ph.D. in e-business system from Chonnam University. He worked as software engineer at Asiana Airlines for ten years and visiting professor at Honam University, Gwangju, Korea for one and a half years. He is manager of R&D department at the DCRC of Dongshin University in Naju, Korea. His research interests include e-business of digital contents, 3D animation, and virtual reality.

Gi-Taek Hur received his B.S, M.S at Chonnam Univ, and Ph.D degrees in computer science from University of Kwangwoon, Seoul, Korea, in 1984, 1986 and 1994.
He taught digital contents at Dongshin University and researched Digital Contents Lab. He has been taught and researched as a full professor at Dongshin University. His research interests include Digital Contents, 3D animation, Network Protocol, Silver Contents, Image Processing, Fluid Animation, Ubiquitous Computing.