

HIMS Walking — Smart Game Designed for Promotion of Health

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Abstract— This paper presents a smart walking application that helps in quantifying, motivating and persuading the physical activities specifically walking. Special considerations are made in making the system fun to use, low cost solution, easy to use and for ubiquitous applicability such as in homes. The application is targeted for elderly population in particular but can be used by general population as well.

I. INTRODUCTION

Walking is the number exercise prescribed by most of the physicians in the world. Specific advantages associated to walking include the movement of long range of muscles in the body and a very natural, easiest and among the primitive learning of a human baby.

There are various walking patterns and protocols designed by researchers for the subjects considering their age, gender, environment and the targeted muscles. Among them one protocol is walking while standing at the same position. The advantages of this protocol can be amplified by stimulating the meridian point of the foot by walking on the grass surface for better blood circulation. However the presence of grass is very much dependent on the weather and external environments. Extreme weather conditions (especially cold) make not only walking on grass impossible but also introduces a lot of problems walking due to clothing, slippery walking roads etc. Further the task is rendered difficult on the availability of walking tracks in near-by areas that the subjects should not feel psychological stress about.

Low cost, walk promotion system that can be used in homes is the proposed solution in this paper. It removes the extra-ordinary cost overhead treadmill has to offer. Further with the use of digital gaming and media technology it adds persuasiveness and hence an attractive solution for the promotion of physical activity to the general population and elderly population in specific.

Further motivation to the project, problems related to elderly population and their proposed solution are addressed in section III.

Section II details system overview, section IV deals with the proposed system: materials and methodologies involved. Finally the paper is concluded with future works in section V.

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II. SYSTEM OVERVIEW

There are two kind of Hims (Health Improvement & Management System) [1] Walking system envisioned:

A. *Hims Walking as a part of HIMS Health and Fitness Assessment System*

A fully comprehensive HIMS Walking system is envisioned as a part of training and exercise promotion system to be deployed in Ubiquitous Health Hub. The general details related to HIMS Ubiquitous Health Hub can be obtained from section II in [2].

B. *Independent HIMS Walking System for Home Health Care*

The system details written in this paper are for independent HIMS Walking system for home health care. The system envisioned consists of a computer interface with the smart mat. The system requires the internet connectivity to the proposed system for enhanced persuasiveness such as related to the social factors, storage of records, though it can fully behave as independent source for physical health promotion.

III. PERSUASIVE TECHNOLOGY

Leading researches in the field of smart games for health promotion move with the hypothesis that smart games are more persuasive because they are more fun [3]. Well true that in most of the cases; however our experience indicates very serious contradictions when it comes to the definition of fun. Children and youth are found to be attracted more in the virtual world as compared to the elderly population.

Our experience indicates that elderly population is more prone towards social factors than merely game and is also supported by authors in [3]. The health promotion games in the market are evidence to the fact that most of the games are designed keeping children and youth in focus as compared to the elderly.

There can be number of reasons for that. Primarily being:

- Elderly population don't feel attracted towards virtual world
- Elderly population is not very technology friendly so they feel lot of difficulties initializing the games.
- At the moment most of the exercise promotion games do not offer competitiveness among the elderly population located in remote locations. Rather they only focus at the site. E.g. elderly population can compete with each other located in one area (home, or elderly day care center, or in Health Hub as detailed in section II A).

- Most games designed are targeted for children and young population. Very little attention has been given keeping elderly population in mind e.g. speed of game, difficulty level of game, contents of game.
- Most of the games designed do not consider the geographical, cultural and demographic norms of the subjects. Coffee may be famous in United States and may be famous among youth all over the world, but old generation in many areas are still unaware of this term and enjoy their own traditional soups and tea.
- Elderly population lacks the will to initiate exercise and if they are subjected towards boredom and difficult games they may lose interest very soon.
- Elderly population is prone easily towards falling down. Complex dancing boards such as DDR (Dance dance revolution), complex health and fitness steps may serve as a danger for elderly population.

In addition to the concerns addressed above, following are the additions that should be added to add persuasion

- User Interface: The simpler it is the better it is for the elderly population. Both hardware and GUI should be very simple. Further to bring the liveliness it should be made very colorful.
- User's result over the period of time: It will clearly indicate user's progress or decline over the period of time and will make them more conscious and encouraging. Some researchers have mentioned in their research to avoid negative feedback [3].
- Social Factor: Adding competitiveness through connecting the games using internet where subjects can view their own record and also the record of others will add competitiveness. These results sharing and rankings also become the topic of their social interactions in the clubs and in telephonic conversations and hence serve as the positive motivational trigger towards healthy behavior.

IV. HIMS WALKING

HIMS Walking is the proposed Walk promotion system. Design consideration also includes a platform design for elderly cohort population studies.

The system outline is as follows:

- System input consists of Smart Mat input
- System provides a platform to understand the prevalence, incidence and risk factors for physical health decline.
- System provides a platform to understand the pattern towards physical health promotion and decline.

- System helps in establishing demographic norms for measuring physical health status
- System outputs an evaluation report based on the analysis of game.
- Special consideration is given to make system persuasive, motivational, attractive and fun to use.

A. Materials

Fig. 1, shows the overall architecture of HIMS Walking project.

Smart Mat is specially designed mat having RF interface to the computer. Mat consists of six buttons positioned as shown in the fig. 1. Special foot step protocol is designed which serves as user interface to computer.

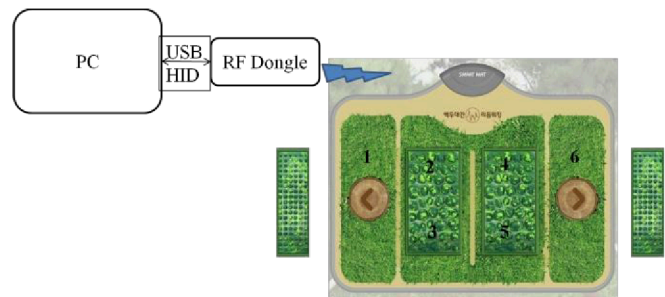


Fig. 1. A computer-aided smart walking platform

- Button 1 and 6 are referred as side kicks
- Button 2 and 3 show the current state of the left foot. If pressed they indicate left foot is present on the mat.
- Button 4 and 5 show the current state of the right foot. If pressed they indicate right foot is present on the mat.
- Communication is unidirectional from the Smart Mat to PC. USB data consists of eight bytes. First two bytes are hardwired values to ensure the data is from the Smart Mat. Third Byte contains the current state of the buttons. The state of buttons is represented in the first 6 bits of third byte. If bit value is 0 it indicates the button is not pressed. Fourth byte represents only the change in button states. If the state of button changes then it is represented in this byte. Byte 5, 6 and 7 are not used. Byte 8 contains the RF count. It is to ensure reliable RF communication between PC and Smart Mat. For each event smart mat transfers 10 times data to the PC. At the receiving end it is ensured that whenever present RF count value is different from the previous one it means a new data has arrived.
- Special timing protocol is designed for various options such as jump detection, menu selection, going to the back menu and walking etc.
- Smart Mat is provided with special additional foot mats which focus on stimulating the meridian point of foot for better blood circulation.

B. Games



Three broader categories of games are designed:










1. Sugar Reduction Games
2. Cholesterol Reduction Games
3. Dieting Games
4. Ginseng Collection Story Game

Details related to Ginseng Collection Story Game are shown in this paper. However other games with different stories share the same basic philosophy and technology.

We composed a story for the collection of Ginseng in the mountains of South Korea. Story had been designed keeping the cultural association of Korean elderly population. Two kinds of mountain tracks are included in this game: real video mountain tracks; flash animated mountain tracks. While walking on the tracks of mountain elderly population gets the ginseng on the way. There are three kind of Ginseng that appears before the user for collection: 100 years, 50 years and 10 years. The appearance of Ginseng depends on the difficulty level of the game and is randomized based on the number of steps. While walking normally on the mat; ginseng appears on the left and right side of the mountain track. User collects ginseng item by pressing left and right sidekicks respectively. In order to promote balance activities among subjects various animal obstacles also appear on the left and right side of track. When an animal obstacle appears users are required not to step on the mat with that respective foot; e.g. if animal item appears on the left side the user is required to stand only on the right foot. As a matter of feedback the animal obstacle changes its state from being normal to scared. If otherwise, i.e. when the user steps over the animal obstacle the animal changes its state into angry state and a significant amount of energy for the user is lost. The states of animal as normal, angry and scared are shown in Table II. Further in order to promote jumping activities obstacles such as water puddle and wooden logs are made. When these items appear user is required to jump in order to avoid the obstacles. Failing to overcome the obstacles result in the decrement of energy level. In addition pre-cursor items are shown to the subjects for alerting them the presence of Ginseng items. At the end of one round, Ginseng collected is traded for gold coins and using those coins energy can be bought while active in the game. Fig. 2 shows the GUI interface showing speed, no of steps, energy level, number of ginseng items collected, animal obstacle item, coins, time of test, calories and ginseng items. Table I list all the items, their category and attributes.

Table I: Item category, items and attributes

Item Category	Item	Attribute
Energy Consumption Item (Balance)	Raccoon dog	Min. no. of steps:50 Max. no. of steps:55 Active Duration:6 Energy Attenuation Factor: 5
		
	Snake	Min. no. of steps:50 Max. no. of steps:55 Active Duration:6 Energy Attenuation Factor: 10
Energy Consumption Item (Balance)		

Energy Consumption Item (Balance)	Bear	Min. no. of steps:50 Max. no. of steps:55 Active Duration:6 Energy Attenuation Factor: 7
		
Energy Consumption Item (Balance)	Hedgehog	Min. no. of steps:50 Max. no. of steps:55 Active Duration:6 Energy Attenuation Factor: 3
		
Energy Consumption Item (Balance)	Wild boar	Min. no. of steps: 50 Max. no. of steps:55 Active Duration:6 Energy Attenuation Factor: 3
		
Energy Consumption Item (Jump)	Puddle	Min. no. of steps:50 Max. no. of steps:55 Active Duration:6 Energy Attenuation Factor: 12
		
Energy Consumption Item (Jump)	Wood log	Min. no. of steps:50 Max. no. of steps:55 Active Duration:6 Energy Attenuation Factor:1
		
Point Item	Ginseng 100 years	Min. no. of steps:100 Max. no. of steps:150 Active Duration:4 Coins Contribution Factor: 5
		
Point Item	Ginseng 50 years	Min. no. of steps:30 Max. no. of steps: 50 Active Duration:8 Coins Contribution Factor: 3
		
Point Item	Ginseng 10 years	Min. no. of steps:20 Max. no. of steps: 30 Active Duration:9 Coins Contribution Factor: 1
		
Pre-Cursor Item	Mountain god	Min. no. of steps:100 Max. no. of steps:150 Active Duration:4 Alert: Ginseng 100 years
		



Pre-Cursor Item	Rabbit 	Min. no. of steps:30 Max. no. of steps:50 Active Duration:4 Alert: Ginseng 50 years
Pre-Cursor Item	Mountain Squirrel 	Min. no. of steps:20 Max. no. of steps:30 Active Duration:4 Alert: Ginseng 10 years

Table II: States of energy consumption items (sample: Snake)




Item	Normal State	Angry State	Scared State
Snake (Energy Consumption) Item			

Fig. 3 shows the class diagram related to ginseng collection game and is self-evident to show the flow as well.

V. CONCLUSION AND FUTURE WORK

The prototype of HIMS Walking is ready. System is in extensive test phase. Other than the ginseng collection game, other health programs/exercise stories need to be implemented as well. We aim to deploy the system at various HIMS test sites such as in [4] for feasibility assessment.

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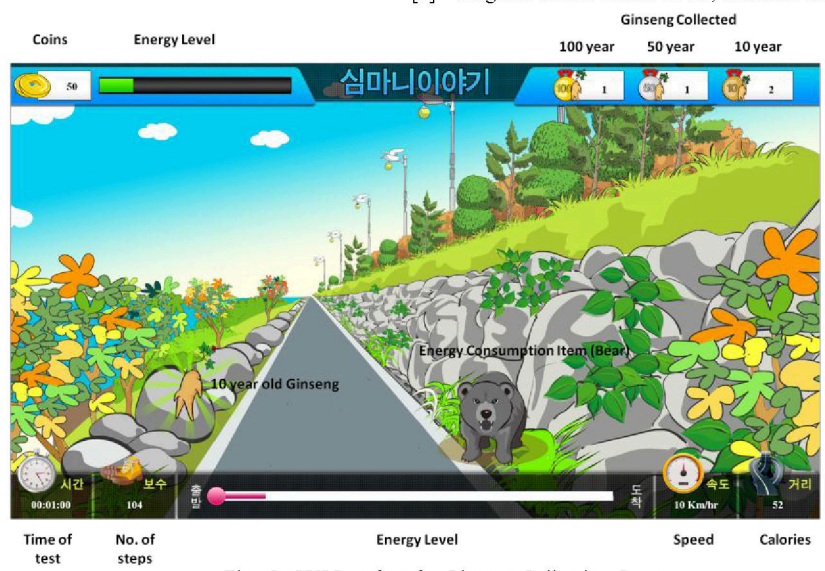


Fig. 2. GUI Interface for Ginseng Collection Game

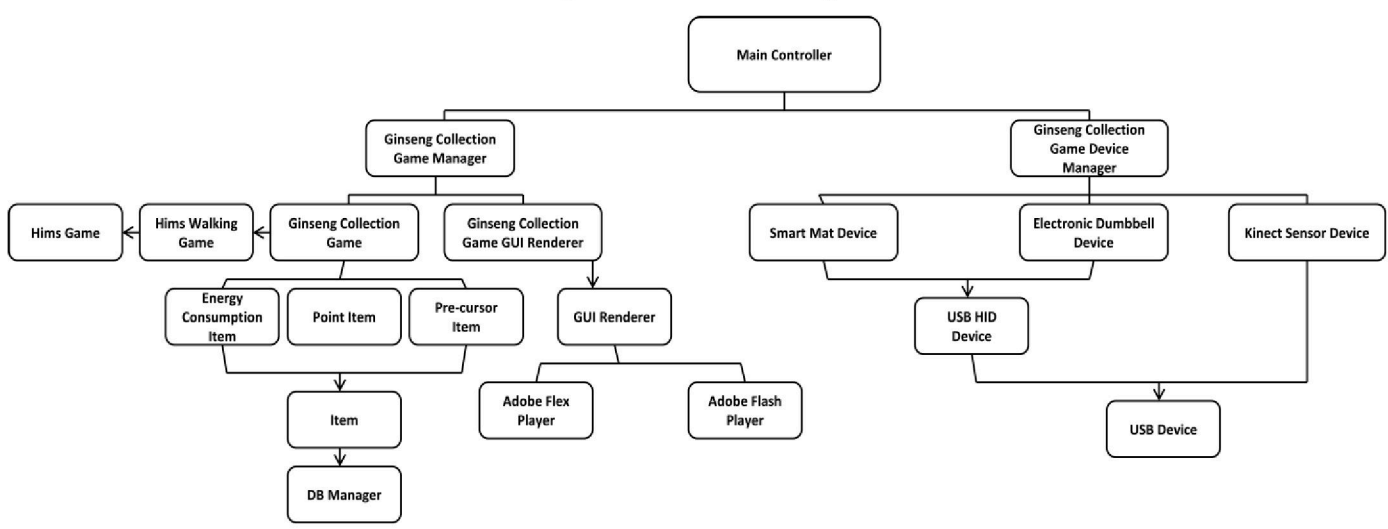


Fig. 3. Class diagram only related to Ginseng Collection Game (not included other games)