HIGAME: IMPROVING ELDERLY WELL-BEING THROUGH HORTICULTURAL INTERACTION

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Abstract. Family support is the key to the well-being problems of elderly. Unlike health problem, mental is often depended on the social network of elderly. How to enhance elderly well-being problems will become how to increase the interaction between elderly and their family. Horticultural interaction proves to be an effective but smooth impact on improving well-being problems of elderly. With a built-in ambient display and interaction game in mind, a Horticultural Interaction Game (HiGame) is developed, that has connection of both physical and virtual spaces. Elderly through physical watering, weeding, fertilizing to interaction with distant family. And distant family use virtual game of to support elderly.

Keywords. Horticultural interaction game; Nature display; ambient display

1. Introduction

Elderly well-being problem lies on the physical and mental well-being. Unlike health problem, mental is often through social activities. In Asia context, the close relation between elderly and their family make a strong bond among them. Due to working life of modern society, however, children and elderly often living in different places or event different cities that has differentiated the communication and family supporting pattern. Enhance elderly well-being problem will become how to increase the interaction opportunities for elderly and their family. A pilot study conducted reveals gardening or horticultural activity is among the top rank in Asia society that might invoke inter-generational interaction for the elderly because of culture context.
Therefore, this study explores a way to embed interaction into the horticultural activity for both elderly and their family.

People often use the game as entertainment, or use the game as a nature device to increase the interaction among people. Using technology can prevent and slow down the aging elderly sensory, cognitive and physiological function, increase the chance of elderly communication, entertainment, learning and service (Fozard, et al. 2000). But for elderly, because of the social isolation, elderly often cannot fully utilized their free time. Instead to a short trip or take a walk, elderly often stay at home for a whole day (Huang and Wang 2009). Game particularly could be one of these technologies that elderly can use to bridge the gap between them and society (Kappen 2013). But in this study, what we are looking for is not only physical games or virtual game, but also can set up in elderly living milieu.

1.1. BEHAVIOUR SETTING

A concept from psychology ecology proposed by Barker and Wright is called behaviour setting. They explained individual behaviour and psychological situation, have great relevance with the external environment. Especially their own environment and occasion, leads people in different environments constantly change their behaviour (Barker and Wright 1949). People have many various acts, with time, space and place, are often associated relationship in life. Behaviour settings are the combination of these people, time, land, objects and behaviours. Barker observed people' lives, found that behaviours setting maintain a dynamic balance by their own mechanism, causing some super-personal, social behaviour and activities. Moreover, the severally behaviour settings have associated with each other. Growth and decline, showing an organic relationship. These behaviour settings, constitute people behaviour ecological environment, are the basic units of ecological environment (Figure 1).

![Behavior setting (unit) and Ecological environment diagram.](image)
Put forward ecological environment, mainly on account of human behaviour and the environment are interdependent, it is a set of orderly structure. The purpose of the ecology study, is to find the most appropriate organizational elements in the environmental unit (real terms objects, environments and users can always replace). Each element is to maintain the boundary in a specific time and space, in a clear, stable relationship to linked each other in the environment units. Therefore, environmental units is recognized, describe, composition. And interpretation of these ecological environment units how to links each units. These become an important subject in the behaviour setting (Wang 1999).

1.2. SET UP NATURAL DISPLAY IN THE HOME SPACE

According to study, horticultural activity can promote society, psychological, physiological adaptation, and help spiritual health retirement, these developed horticultural therapy let elderly participates in such activity can provide auditory, tactile, olfactory stimulation, visual and gustatory. The benefits includes access to fresh fruits and vegetables, ornamental flowers, slow aging, maintain normal physiological function, treatment of chronic disease and rehabilitation, certainly self-existence value, and expansion of social contact area to prevent or combat dementia (Hilla and Relfb 1982).

The case study in 2010 by Chu, participants take once a week, each time 1.5 hours, total of eight horticultural activities. Families pointed out the concentration, finger dexterity, observation and emotional status of cases has changed better. The case aware themselves strength enhancement, increased social interaction (Chou 2010). Also, other case study in 2012 by Huang. Sowing that, after participating in horticultural activity: “self-achievement”, “interpersonal relationship”, “positive emotions”, “negative emotions” has significant differences for four levels of well-being (Huang 2012).

2. Literature Review

In this study, we use natural pot as display interface, creating features semi-fixed elements in the space. And place a variety of environmental characteristics, to create ecological environment. In this way, will have a mutual effect between the various environmental behaviour. Enhance the atmosphere of interactive in the elderly field space.

2.1. ENVIRONMENT OBJECTS AS SYNAPOMORPHY ELEMENTS

The behaviour patterns as formed by the crowd and location substance, have identical patterns (synapomorphy) elements can be behaviour setting. By a space, time, supportive object continuing behaviour pattern organizational
relationships. People's behaviour should be considered, since it makes sense for them. And can define the timing of places or situations occur. In the environment terms of behaviour, Scenarios contain a social occasion and space scenario: who does what, where, when and how to include or exclude people.

Behaviour setting units include human and non-human components. These elements are organized in an appropriate environment, to support the inevitable activities happened. People through the environment unit provided setting modes. Adjustment their behaviour in order to meet the conditions to enter the scenarios. The contents of field, will be in the common behaviour patterns are identified. The scenarios of organizational behaviour, the main thing to through a variety of clues (fixed, semi-fixed and non-fixed). With different behaviour scenarios (a combination of people, things, times, places, objects), to significance of the environment manifested. Environment substantive objects represent clues, play a very important role. (Rapoport 1982) to existing environment clues, according to their characteristics divided into the following three categories:

- **Fixed-feature elements.** Essentially fixed, or less and slow changes. Most of the architectural elements belong to: walls, ceilings, floors, and the city's streets and buildings. Clearly, the organization of elements, size, location, order, arrangement, and so will the expression of meaning. Is especially true in the traditional culture, but in all cases other elements are needed to supplement its significance. However, some occasions still express many elements of the fixed meaning. For example, we can believe that, for any particular occasions, there are certain core elements, while other peripheral elements change, these core elements remain unchanged.

- **Semi-fixed-feature elements.** Including furniture, curtains and other furnishings in the arrangement and type, flowers, antique frames, screens, clothing and so on, which can be changed fairly quickly and easily. From the environmental context found, these elements are particularly important for environmental significance, meaning they tend to express more than the fixed characteristic elements. Most people move into the ready environment, and the characteristic elements rarely change. Therefore, semi-fixed environmental element is particularly important for the current research environment. And these elements from the earliest era had been established significance.

- **Non-fixed-feature elements.** Refers to a user or a resident in place. They transform proxemics, body for body and arm posture, facial expressions, nodding, eye contact, talking speed, volume, and non-verbal behaviour. Non-fixed-feature elements that make non-verbal research topics. The issues raised involve people in anger, disgust, and fear, or the like behaviour. These actions are embedded in the interaction what role they played.
2.2. PLANT AS AMBIENT DISPLAY INTERFACE

Plant display does not only display the information but also in an ambient style. Easterly used rubber tree with a network connection, that convert the data obtained from the network into the amount of water that plants could absorb. Using such design approach, the network data can be presented to a viewer differently. With diverse water control over a long period of time, plants growth or significant changes will reveal (Easterly and Kenyon 2004).

With the ambience, the plants interface implies the feel and emotion of people, and exhibits some characteristics of context. Kuribayashi used this concept while combining ambient display (Kuribayashi and Wakita 2006). User watch the plants display, will be touched, awaked the temporality represented by the plant interface, and also the meaning behind the interface.

The case study in 2011 by Yu, on the other hand, use planting and sensors, explore the distance between people on the couch. Choose strong phototropism indoor foliage plants as feedback interface. In a couch-sitting scenario, plants will be given different levels of irradiation of light based on the distances between sitting positions in the couch. This will lead to different shades of colour in the blade (Yu 2011).

3. Five activities-events with the pot

In the full interaction process, starting in the morning hi, continued until the end of harvest, there are eight activities respectively: morning hi, watering, weeding, fertilizing, drainage, remove weak plants, platform and harvesting. Among these activities, five of them focus, from morning hi to drainage, on the interaction between elderly and family are described in this section.

“Morning hi” provides a trigger of HiGame and allows elderly to get in touch with their family for the following activities in the future. This activity allows elderly and family to be able to communicate together to solve the issues during HiGame session. From the activity diagram shown in Figure 3, drainage is the fifth activity. This paper will focus on the activities on the right part of Figure 2. Activity diagram is divided into three circles from “Morning Hi” as centre, then activity, elderly events and to family events at the outmost circle.
Watering, weeding, fertilizing and drainage are the fundamental elements of planting and plant growth. Activity and associated events should be simple and intuitive that allow elderly to operate without additional assistance from others. Described in detail in the following session.

3.1. MORNING HI

From the persona we conducted, elderly often keeps regular routines. When family has breakfast or on the way to the workplace before, elderly has already awakened for a while. “Morning Hi” starts with a light on the planting placed in the elderly residence when family open HiGame. The lights will be dimming slowly like a burst of deep breathing when waking up in the morning. When elderly notice the planting change, they can spread out their hands palm on the both sides, then wait 3 seconds, and the lights to ease and calm down as shown in Figure 3.

The pot of HiGame is the media for communicating between elderly and family. From the view of elderly, the pot represents the family, and vice versa. As elderly and family continuously react and interact through HiGame, the physical and virtual presentation of the pot will provide the reflection needed up to their expectations.

Figure 2. Activities-events diagram.
3.2. WATERING

In watering activity, elderly often used to watering and fertilizing in garden that is part of their daily routine as well as the watering activity in HiGame. Once elderly does not do watering for a period of pre-defined time that is recorded by soil moisture sensor, planting will then switch to the responsibility of the family. Family should press the potted button remotely that can trigger the watering mechanism in the pot. At this time planting blinks breathing lights resonance, and gives elderly with lack of watering warning.

As the pot represents the family, the dimming light is used for the physical presentation. The brightest, ordinary light, normal, slightly dark, very dark, and darkest are the lighting scale and controlled by the arduino. HiGame will change the light scale based on the activity and associated events. Additionally, these lighting scales and the speed are analogy responsive effects for communicating with elderly. For example, while elderly saw the rapid light scale changing (as a sign of shortness of breath), they would know state of water shortage, and response accordingly.

3.3. WEEDING

Weeding is a routine activity that will occasionally be reminded via interaction between family and elderly. HiGame in this activity acts as a reminder and social activity presentation for increasing the frequency of interaction.

Weeding activity is in a random manner with playful operation design in mind. When the family received a weeding time reminder, family blow to the app softly (as shown in Figure 4) to send the message back to the elderly. The concept of “blowing” is to use a soft reaction like a whisper in the ear as a gentle gesture in the East that said: If you cut the weeds without digging up their roots, they will grow again when the spring breeze blows.
3.4. FERTILIZATION AND DRAINAGE

While considering the fertilization and drainage issues, different plants will need different consideration. This study use of small tomatoes as the exemplary planting: Tomatoes grown for about 98 days, from the first 3 days after planting to 21 days. According to growth state of the tomato, HiGame will calculate the duration time of fertilization and drainage that are described as follows:

- **After 3-4 days planting.** Small tomatoes are in germination that needs a lot of fertilizer; elderly will need to fertilize the pot every 20-30 days.

- **After 14 days planting.** Tomatoes will grow about 5-7 cm high, and cultivate a second layer of leaves.

- **After 21 days planting.** Tomatoes grow about 13-19 cm high. Draining might be a problem. Watering when the soil is slightly dry.

When twenty days period of fertilization is approaching, family will receive the fertilization prompts on the app. Illustrated by the reminder, family will shake the phone up and down as a gesture “to shake off the fertilizer” (Figure 5). On the pot, lights will cue the messages received from family. After 21 days of planting, the drainage problems should be noticed. When the soil moisture sensor detects the drainage problems, the wave lights automatically flash, and remind elderly to check, and pay attention to drainage problems.
5. Conclusion

HiGame uses pot as a behaviour setting in elderly residence, makes it be semi-fixed-feature elements. Such element creates an interactive field for elderly with family (Figure 6). With persona and evaluation on site, such semi-flexed-feature provides a significant impact and ease the difficulty to integrate digital technology in the environment. With plants and pots, elderly have become accustomed to interact with HiGame that increase the communication as expected along with increase on horticultural activities that can both provide comfort and physical relaxation to the well-being of elderly.

HiGame is not only limited on the pot but also embedded the display in the environment. By using characteristics of ambient displays, HiGame provides a further development as a spatial interaction than just a reminder of plants for the daily life of elderly. Further media such as moving graphics, sounds and pictures are explored and will be tested in HiGame as well.
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