Gamified Rehabilitation Service Designed for Stroke Patient

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Master's Project in Product Design

CONTENTS

INTRODUCTION

In this chapter, it demonstrates the fact regarding to demographic ageing and describes the condition of health in older age. A research question is put forward based on the background, while the purpose and significance are indicated. Besides, this chapter also illustrates the role of Nornir company in the collaborative relation.
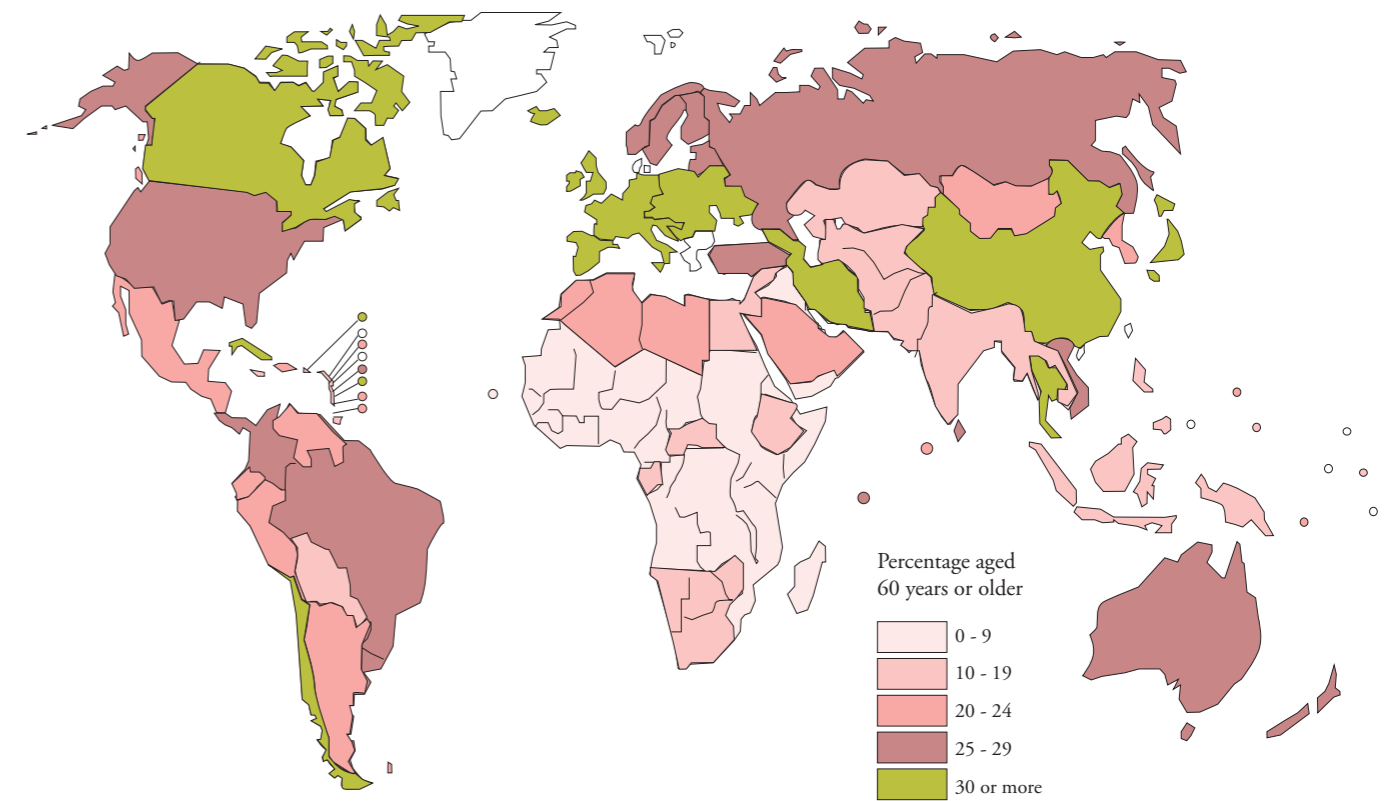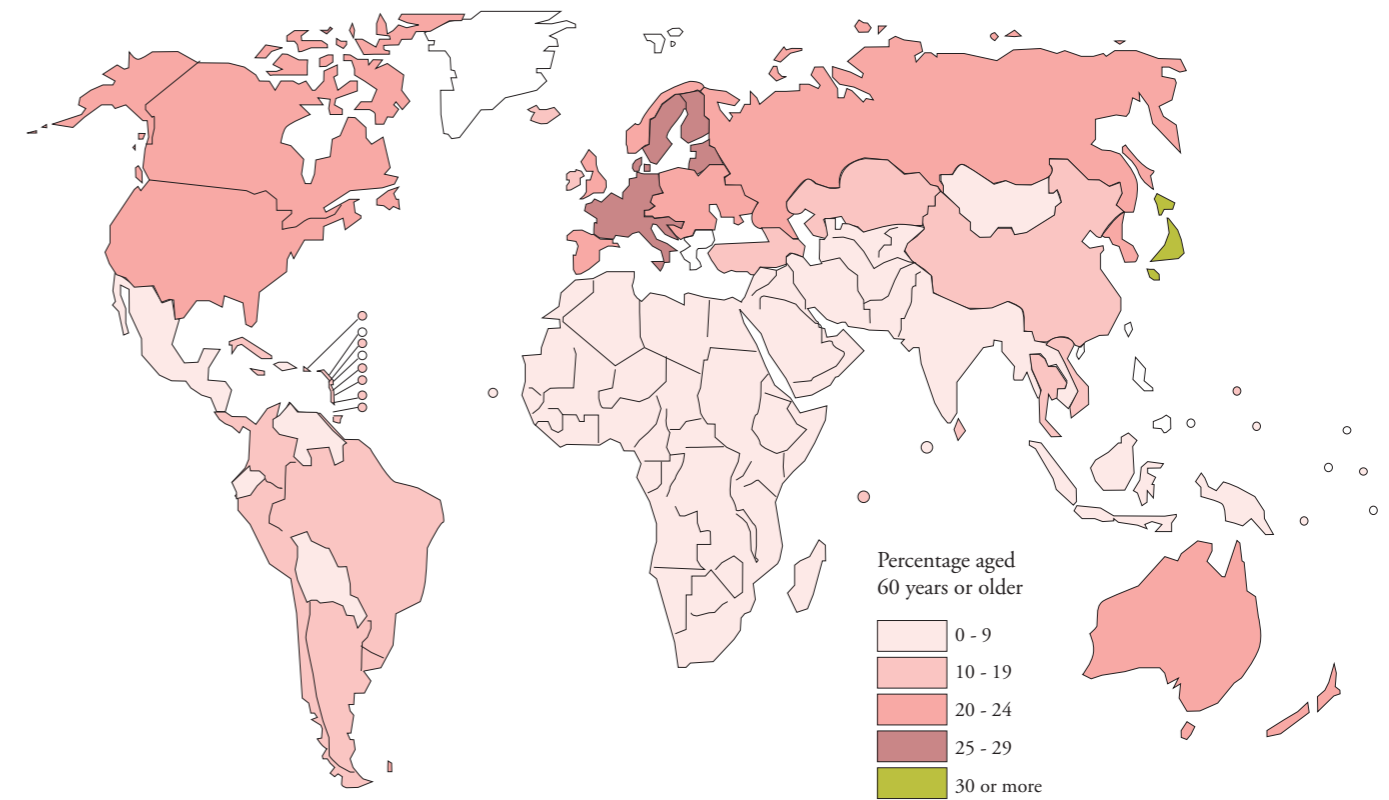
Health in Older Age

Demographic Changes

Population Ageing

One reason that ageing is emerging as a key policy issue is that both the proportion and absolute number of older people in populations around the world are increasing dramatically. Fig. 1.1 and Fig. 1.2 show the proportion of people aged 60 years or older by country in 2015 and projections for 2050. There is currently only one country where this proportion exceeds 30%: Japan. However, by the middle of the century, many countries will have a similar proportion of older people to that of Japan in 2015. These include countries in Europe and North America, but also Chile, China, the Islamic Republic of Iran, the Republic of Korea, the Russian Federation, Thailand and Viet Nam.

Percentage aged
60 years or older

0 - 9
10 - 19
20 - 24
25 - 29
30 or more

Percentage aged
60 years or older

0 - 9
10 - 19
20 - 24
25 - 29
30 or more

Above ： Fig. 1.1 Proportion of population aged 60 years or older, by country, 2015
Below ： Fig. 1.2 Proportion of population aged 60 years or older, by country, 2050 projections
Source ： World Report on Ageing and Health, WHO

The pace of population ageing in many countries is also much greater than has been the case in the past (Fig. 1.3). For example, while France had almost 150 years to adapt to a change from 10% to 20% in the proportion of the population that was older than 60 years, places such as Brazil, China and India will have slightly more than 20 years to make the same adaptation. This means that the adaptation that these countries need to go through will have to be undertaken much more quickly than was often the case in the past.
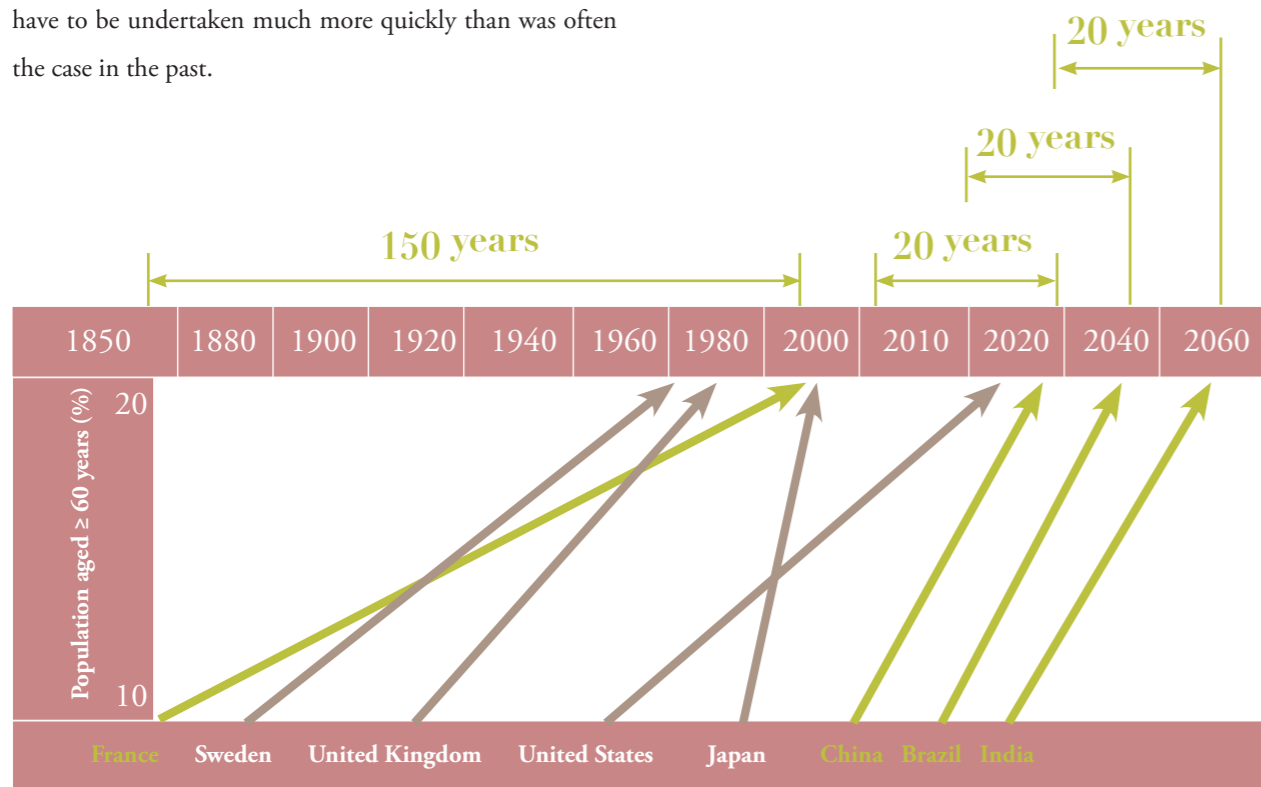

Fig. 1.3 Period required or expected for the percentage of the population aged 60 years and older to rise from 10% to 20%
Source :   World Report on Ageing and Health, WHO

Are added years in older age being experienced in good health?

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Determining whether people are living longer and healthier lives, or whether the added years of older age are lived mainly in poor health, is crucial for policy development. If the added years are lived in good health, population ageing will be associated with a similarly growing human resource that might be expected to contribute to society in many ways (for example, through a longer working life). This can be summed up in the saying "70 is the new 60". However, if people are living longer but experiencing limitations in capacity at similar or higher levels to their parents at the same ages, this means demands for health care and social care will be significantly greater, and older people will be more limited in the social contributions they can make.

Fig. 1.4 shows how strongly a country's level of socioeconomic development is associated with mortality patterns across the life course. The graphs of Fig. 1.4 shows the ages at which deaths occur in low-, middle- and high-income countries. Note that high-income countries that are members of the Organisation for Economic Co-operation and Development (OECD) are displayed separately from other high-income countries because their epidemiology is quite distinct. In lower-resource settings, death occurs most commonly in early childhood. Deaths are then evenly spread across the rest of life. As countries develop, better public health means that more people survive childhood, and the pattern of deaths changes to one in which people are more likely to die as adults. In high-income settings, the pattern of death shifts even more to old age, so that most deaths occur in people older than 70 years.
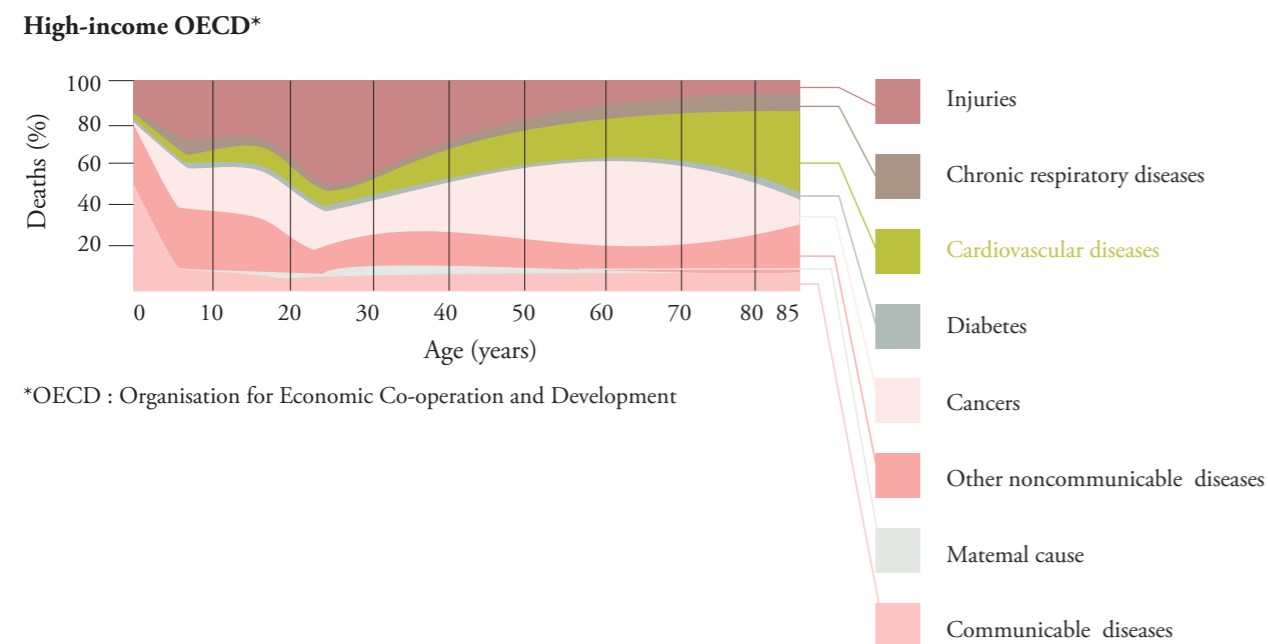
In all settings, the dominant causes of death in older age are noncommunicable diseases, such as cardiovascular diseases, although deaths from these causes tend to occur earlier in low- and middle-income countries than in high-income countries. Besides, it illustrated in fig 1.4 that the proportion of cardiovascular diseases increased by the growing age in all settings.

Moreover, in high-income countries, most studies have drawn only on relatively recent data, which are largely limited to a period when the epidemiological transition outlined in Fig. 1.4 had already taken place. Increases in life expectancy in these settings are now largely due to increasing survival in older age, and this may be the result of prolonging the end-stage of life through medical treatments rather than of the broader public-health advances that are likely to have driven earlier epidemiological changes.

Low- and middle-income countries are currently experiencing the epidemiological transition shown in Fig. 1.4. Countries such as China are nearing the end of this transition, specifically, with falls in disability related to infectious diseases and marked increases in disability related to cerebrovascular disease and arthritis (which were included in the category of physical disabilities) (Zhang, 2011).

Experiencing
the Epidemiological Transition,
It Decreases in Disability Related to
Infectious Diseases and
Marked Increases in Disability Related to
Cerebrovascular Disease and Arthritis.

Fig. 1.4 Deaths at different ages in low-, middle- and high-income countries, 2012
Source : World Report on Ageing and Health, WHO

High-income OECD*

*OECD : Organisation for Economic Co-operation and Development

Injuries

Chronic respiratory diseases

Cardiovascular diseases

Diabetes

Cancers

Other noncommunicable diseases

Maternal cause

Communicable diseases

High-income non OECD
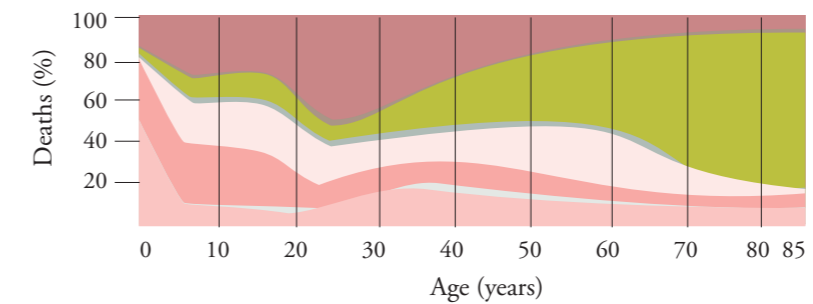
Upper-middle income
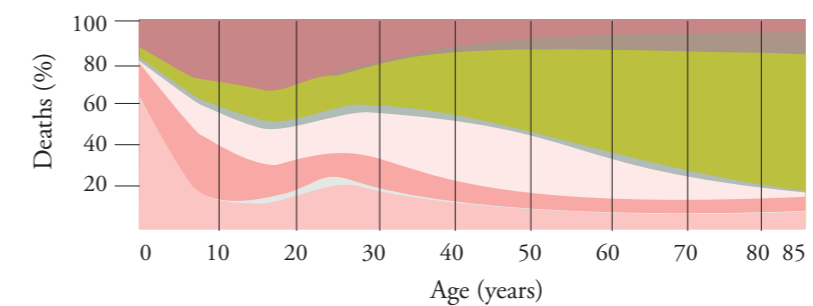
Lower-middle income

Lower income

Health Characteristics in Older Age

Underlying Changes

At a biological level, ageing is characterized by a gradual, lifelong accumulation of molecular and cellular damage that results in a progressive, generalized impairment in many body functions, an increased vulnerability to environmental challenges and a growing risk of disease and death (Kirkwood,2008).This is accompanied by a broad range of psychosocial changes.

Health Condition in Older Age

Age increases the risk of many health disorders, and these can have significant impacts on intrinsic capacity beyond the trends described in the section on Underlying changes. However, it would be wrong to think that the presence of a disease in older age means that someone is no longer healthy (Young,2009). Many older adults maintain good functional ability and experience high levels of well-being despite the presence of one or more diseases.
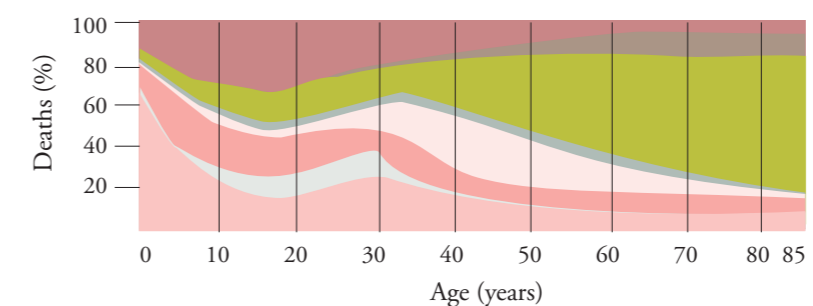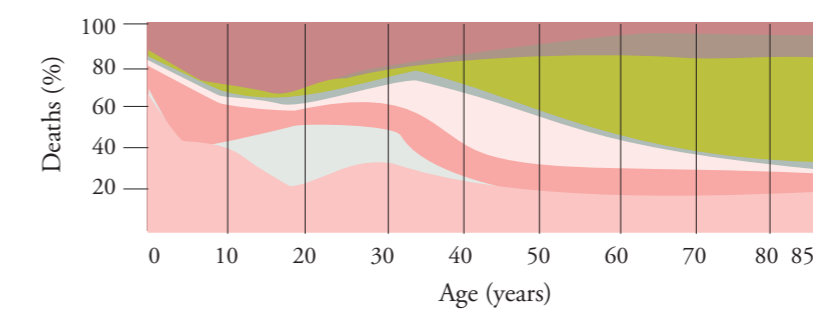
Fig 1.5 uses data from the Global Burden of Disease project to show the years of life lost among people older than 60 years with the data presented for countries grouped according to their level of economic development. This is a measure of the disorders that kill older people and the average potential years of life that they will, on average, be deprived of by these disorders. The greatest burden of mortality in older people all over the world comes from ischaemic heart disease, stroke and chronic obstructive pulmonary disease. The burden from all these conditions is far greater in low- and middle-income countries than in highincome OECD countries.

Combined, Fig. 1.5 shows that regardless of where people live, the overwhelming disease burden in older age comes from noncommunicable diseases. These are often thought of as diseases of affluence and something that poorer countries will need to give attention to as they develop. What these data show are that for older people, noncommunicable diseases ar already causing grossly inequitable burdens in low- and middle-income countries.

Fig. 1.5 Number of years of life lost to mortality per 100 000 population for the top 10 causes of lost years, in populations aged 60 years and older, 2012
Source : The Global Burden of Disease Project
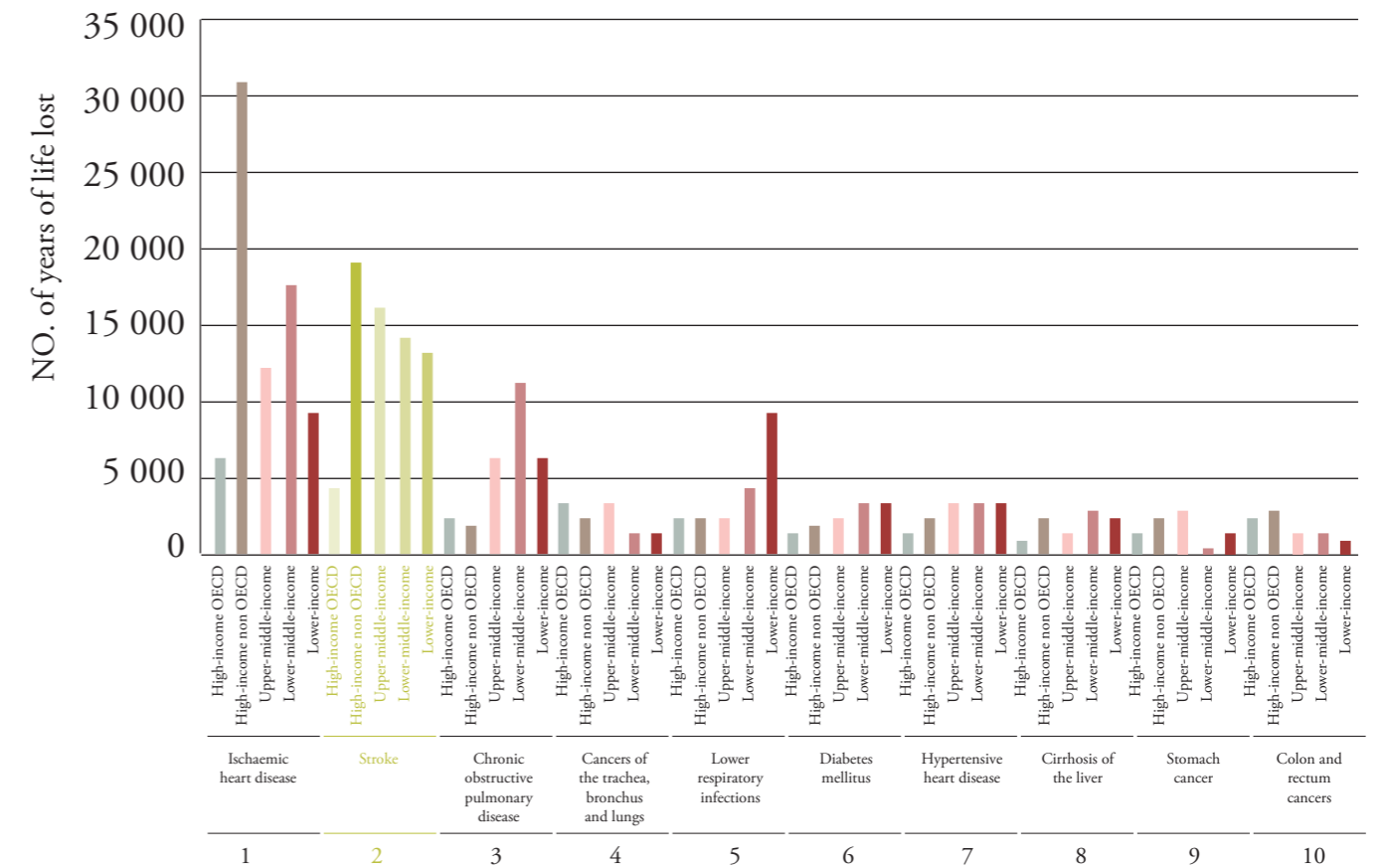
One of the Greatest Burden of Mortality in Older People All Over the World Comes From Stroke.
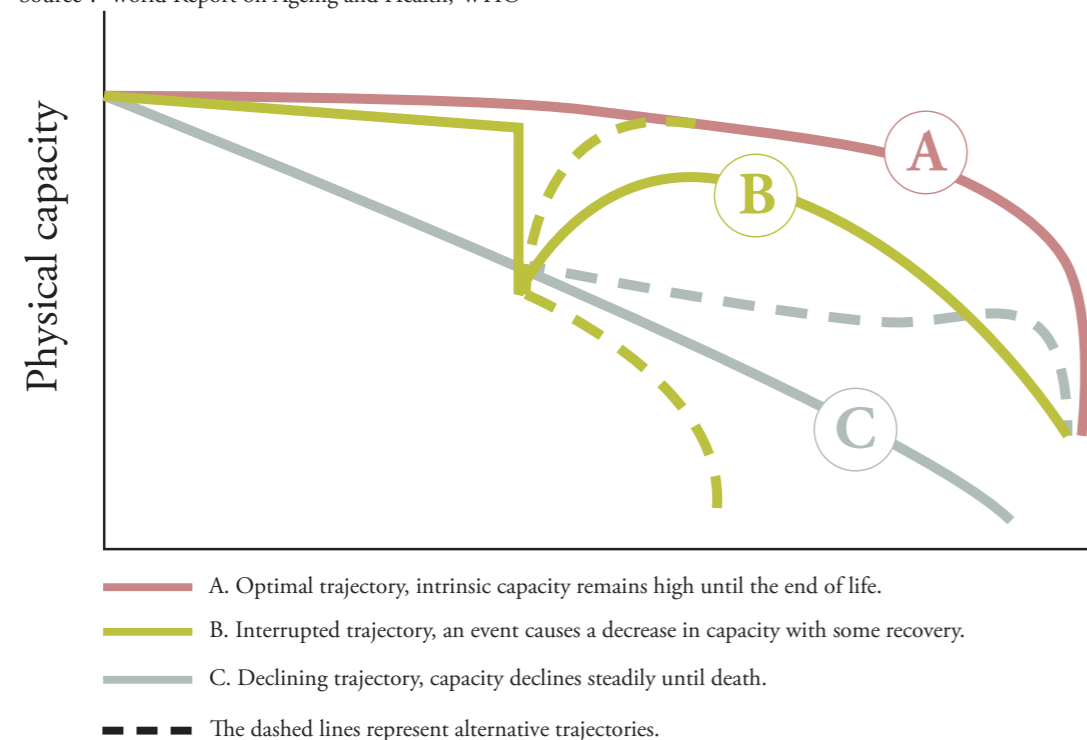
Trajectories of Healthy Ageing

Healthy Ageing reflects the ongoing interaction between individuals and the environments they inhabit. This interaction results in trajectories of both intrinsic capacity and functional ability. To illustrate how these might be conceptualized and used, Fig. 1.6 shows three hypothetical trajectories of physical capacity for individuals beginning from the same starting point in midlife.

In Fig. 1.6, individual A can be considered as having the optimal trajectory, in which intrinsic capacity remains high until the end of life. Individual B has a similar trajectory until a point when an event causes a sudden fall in capacity, followed by some amount of recovery and then a gradual deterioration. Individual C has a steady decline in function. Each trajectory sees the person die at around the same age, but the levels of physical capacity they have enjoyed in the interim are very different.

Fig. 1.6 also shows alternative trajectories for individuals B and C. For individual B, a more positive trajectory might, for example, result from access to rehabilitation, and a negative trajectory might result from a lack of access to care (perhaps through rationing in a poor community or within a socially excluded subgroup of the population). For individual C, a more positive trajectory might result from a change in a health-related behaviour or having access to medication.

Fig. 1.6   Three hypothetical trajectories of physical capacity
Source :   World Report on Ageing and Health, WHO

A. Optimal trajectory, intrinsic capacity remains high until the end of life.

B. Interrupted trajectory, an event causes a decrease in capacity with some recovery.

C. Declining trajectory, capacity declines steadily until death.

The dashed lines represent alternative trajectories.

A More Positive Trajectory Might, For Example, Result From Access to Rehabilitation, and A Negative Trajectory Might Result From A Lack of Access to Care.

Summary

Both the proportion and absolute number of older people in populations around the world are increasing dramatically. And it is a period time that experiencing the epidemiological transition, with falls in disability related to infectious diseases and marked increases in disability related to cerebrovascular disease and arthritis. Stroke is one of the typical cerebrovascular disease, with high incidence in older age.

As a result, the impact of disorders of functioning, quality of life and risk of mortality may be significantly great. Disorders are also associated with high rates of health-care utilization and high costs (Marengoni,2011). Good health in older age is closely related to high socioeconomic position.

Therefore, ensuring that systems are designed in ways that can equitably meet the needs of older people with diseases and care will be important.
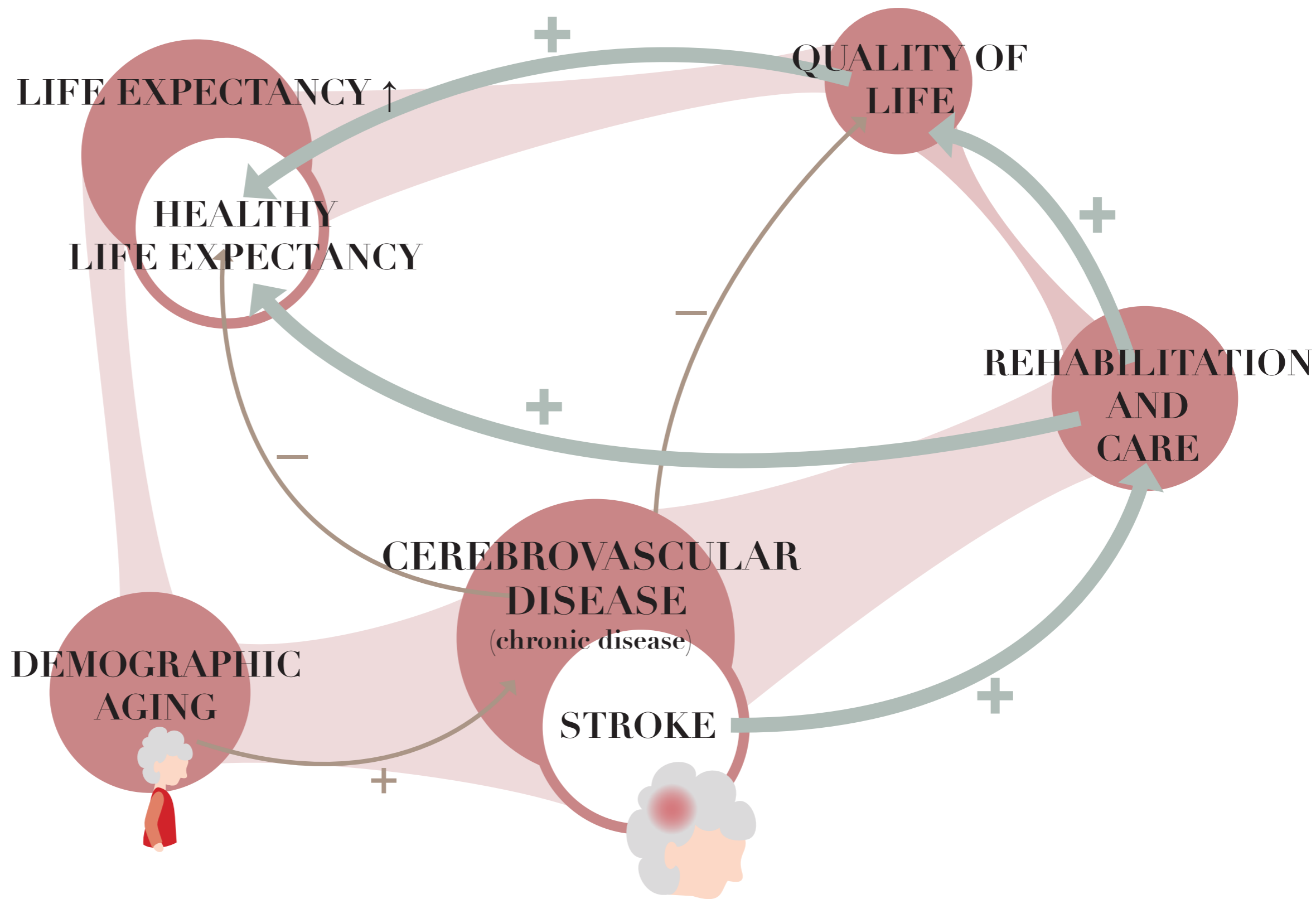
Fig. 1.7 The relation and interaction between demographic ageing, cerebrovascular(stroke), rehabilitation & care, quality of life and health expectancy life.

LIFE EXPECTANCY ↑

HEALTHY LIFE EXPECTANCY

QUALITY OF LIFE

REHABILITATION AND CARE

CEREBROVASCULAR DISEASE
(chronic disease)

DEMOGRAPHIC AGING

STROKE

Research Question

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**How to
Engage Stroke Patient in the Long-term Recovery
by Gaming
the Experience of Post-stroke Rehabilitation ?**

build societies that are cohesive, peaceful, equitable and secure, development will need to take account of this demographic transition and actions will need to both harness the contributions that older people make to development and ensure that they are not left behind (New York,2015). Older people contribute to development in numerous ways, for example through food production or the raising of future generations (Aboderin,2015). Including them in development processes not only helps build a more equitable society but is likely to reinforce

development by supporting these contributions. The third reason is the economic imperative to adapt to shifts in the age structure in ways that minimize the expenditures associated with population ageing while maximizing the many contributions that older people make. These contributions may be made by direct participation in the formal or informal workforce, through taxes and consumption, through transfers of cash and property to younger generations and through a myriad of less tangible benefits that accrue to their families and communities.

Purpose & Significance

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The aim of the project is helping stroke patient to keep up their rehabilitation exercises so that they can become as independent as possible and attain the best possible quality of life.

The ultimate goal of the project is, in narrow sense, to stretch the healthy life expectancy to enhance the happiness in late life. In broad sense, It is to relieve the negavition of demographic aging to decrease the socioeconomic burden.

More importantly, it contributes to increase the health in older age. There are many justifications for devoting public resources to improving the health of older populations. The first is the human right that older people have to the highest attainable standard of health (Baera,2016). The second key is to foster sustainable development (New York & London,2015). Today most people will live into older age, and an increasingly significant proportion of the population will be older people. If we are to

Collaboration

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I collaborate with Nornir Company in master project. Nornir is a smart city operator company, they founded the company on a visionary spirit and passion of bringing breakthrough solutions for the connected world. Their goal is to help local companies and municipalities to build communities that innovate and create new markets.

I took my internship in this company for three month before, and we are all interested in the healthcare field, with their revolutionary technology invention. Besides,

Nornir has sorts of information or project regarding to stroke, post-stroke rehabilitation and stroke unit. They can offer opportunities to contact with relevant section or person to get feedback and suggestion on conceptual solution. Moreover, they can offer technology support to achieve functional prototype in the project if need. It makes us more certain to work with the healthcare field, especially, for the stroke rehabilitation as my master project.

RESEARCH METHODS

One thing that happens in this chapter is to illustrate several different research methods. The category can be divided into traditional method and innovative method (Mattelmäki,2006). In this master project, the traditional method includes document analysis, interviews and observation . The innovative method includes giga-mapping, storytelling and usability testing. In addition, the reason of choice is explained in this chapter.

Traditional Method

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Document Analysis

Document or Documentary analysis is a social research method and is an important research tool in its own right and is an invaluable part of most schemes of triangulation. It refers to the various procedures involved in analyzing and interpreting data generated from the examination of documents and records relevant to a particular study. A document is something that we can read and which relates to some aspect of the social world. Official documents are intended to be read as objective statements of fact but they are themselves socially produced(Heffernan).

Document-based research in qualitative research, as in all areas of the social sciences, is a relatively small-scale industry(Jenkings,2010). Based on the background and the research question, the research field regards to the post-stroke rehabilitation and the need from patient in this process as well. It is a small-scale and specific study field, so it is suitable to collect and analyze the relevant literatures. Commonly, this is often relegated to the front sections of articles and reports, prior to a primary focus on interview-based talk or observations of others' interactions(Jenkings,2010). Therefore, it is the first step by applying this method of document analysis on the research phase. The documents refers to both paper-based and computer-mediated texts. In this project, it includes both the written elements of texts alongside the extra-textual elements – images, photos, graphs, and diagrams – that are routinely embedded in documents. The reason why using document analysis is to gain authoritative knowledge and correct understanding as comprehensive as possible on an unfamiliar field in a limited period of time.

Interviews & Observation

The ability to "go deep" is perhaps the strongest argument in favor of interviewing. Given a chance to talk, and questions that encourage reflection and consideration, interviewees may go on at great length, generating ideas and sharing insights(Lazar,2010). Based on the collecting and analyzing of documents, it will generate several questions which need to be asked and confirmed by the relevant individuals. So interviews are the optimal way to gain direct feedback and suggestion. Interviews are not easy to conduct, interviewing is a skill that can take significant to develop. Althought it is hard work, based on interviewee responese, interviewers can choose to re-order questions or invent completely new lines of inquiry on the fly. Opportunistic interviewing - taking an interesting idea and running with it - can be particularly useful for increasing understanding(Lazar,2010). It is much better and more suitable than surveys for the project. Participants will tell you what they know and interviewers can gain the information as much as possible during an interview. The possibility of expansion is much greater than filling in the survey form. It can bring more useful data than expectancy.

Analysis, however, is a major challenge. It need spend much time to transfer the raw notes and open-ended responses to broad questions. Moreover, deciding what is important and what is not can also be a challenge.

To avoid these potential disconnects, it might consider combining the interviews with other techniques, such as observation - possibly during the interview session. These observation will help to understand the relationship between what interviewees say and what they do. As some researchers have suggested,"look at behavior, listen to perceptions"(Miller & Crabtree,1999). Interviews is a listening process, really listening means observing, too. People may not mention things that they consider to be just another part of the natural environment—things like exactly how or exactly when something gets done. In other words, watching what people do and how they interact with their environment is part of listening(Quesenbery & Brooks,2010). Combining observing and usability tseting can also lead to greater insights as well. Discussions about usability testing are full of examples of people who say one thing and do another. Or who insist that something is easy, even as they go to greater effort to complete a task(Quesenbery & Brooks,2010). Therefore, observation likes a bridge to integral different methods in order to get maximun effect.

Innovative Method

Giga-mapping

GIGA-mapping is creating an "information cloud" from which the designer can derive innovative solutions(Sevaldson,2011).

In the background and research phase, It will collect much information with various fields, such as demographic aging data, the information of stroke rehabilitation and transmedia storytelling, and wireless sensor network knowledge. Giga-mapping is super extensive mapping across multiple layers and scales, investigating relations between seemingly separated categories.(Sevaldson,2011). Using giga-mapping method, it tries to grasp, embrace and mirror the complexity and wickedness of real life problems. Further

on it is based on design skills like visual thinking and visualisation in processes and for communication purposes(Sevaldson,2011).

The project regards to service design, focusing on gaming the experience of post-stroke rehabilitation. And the stroke is not a well-known disease for all the people. Giga-mapping is an optimal way to show the rehabilitation progress and is easy to mark the exsiting problem and discover potiental pain point. More importantly, it is a clear and effcient way to communicating with others. Giga-mapping, therefore, is a main method in the project. It looks like a bridge to link the former and later phase.

Storytelling

Stories are a powerful tool in user experience design(Quesenbery & Brooks,2010). Stories have many uses in user experience design and can be integrated into your own process.

• They can describe a context or situation, like stories that are part of personas.

• They can illustrate problems and "points of pain," explaining why a new experience is needed.

• They can be the starting point for a design discussion, explore a new design concept, or describe a new design.

In the project, in order to giving a clear understanding of what the post-stroke rehabilitation is in quick time, it is a pretty good approach to make a story to intoduce the situtaion and point out the "pain point", moreover, to give a chance for running a discussion.Storytelling is also a useful method during the interviews. It is easy to bring interviewees into the context and can leave a deep impression to them. It is benefit to gain inspiration and generate more ideas. So it is applied from research to ideas phase, wth interviews and observation method.

Usability testing

Usability testing, in general, involves representative users attempting representative tasks in representative environment, on early prototypes of computer interfaces(Lewis,2006).The world of usability testing includes:

• Testing prototypes that have only been built on paper(known as paper prototype).

• Testing prototypes that look complete bu have a human behind the scenes responding.

• Testing working versions of software before it is officially released.

• Testing software that has already been imple-mented in existing systems.

In the project, the aim of applying usability testing is to test the gaming rehabilitation experience. To be specific, it is to find the flaws during the transform which transferring the recovery exercise into games.

The interface is an application for mobile phone. While the interfaces being usability tested are typically screen layouts for desktop or laptop computers, usability testing can also take place on any type of device and usability testing is increasingly being done on hand-held devices such as smart phones(Schusteritsch,2007).Except finding flaws, usability testing is also used to discover what is working well with an interface design.

User-based testing is what most poeple mean when they refer to usability testing. This can take place very early in development or very late in development. It is better to start doing user-based testing earlier rather than later, when the result can influence the design more and when costs to make changes are much lower(Lazar,2010).In the project, therefore, the usability testing takes place at the beginning of development phase and improves the development step by step.

Summary

The above methods are utilized together basically. Document analysis is applied in the phase of background and research, giga-mapping and storytelling are used in the phase of research and idea, usability testing is mainly utilized in the phase of design and development, the interviews and observation run through the phases from research to development.

Fig. 2.1   Methods are utilized in different phases.

RESEARCH

Based on the research question, this chapter mainly focuses on collecting information of post-stroke rehabilitation, includeing the stroke patient journey, the type of recovery, the different rehabilitation place. And from the psychological view, it is to explore the real need in older age to find out a suitable way to optimize the rehabilitation experience. Besides, this chapter also includes the wireless sensor network information as a technology support part.

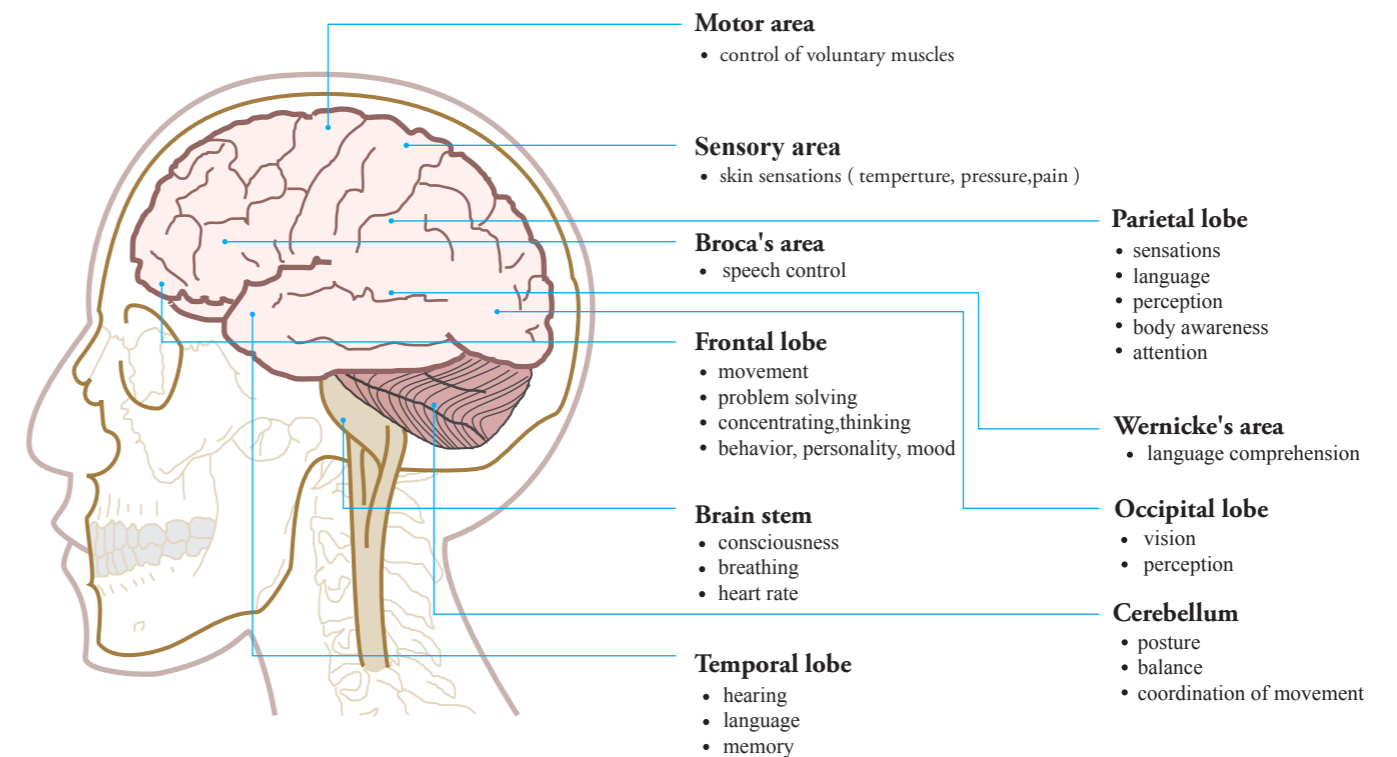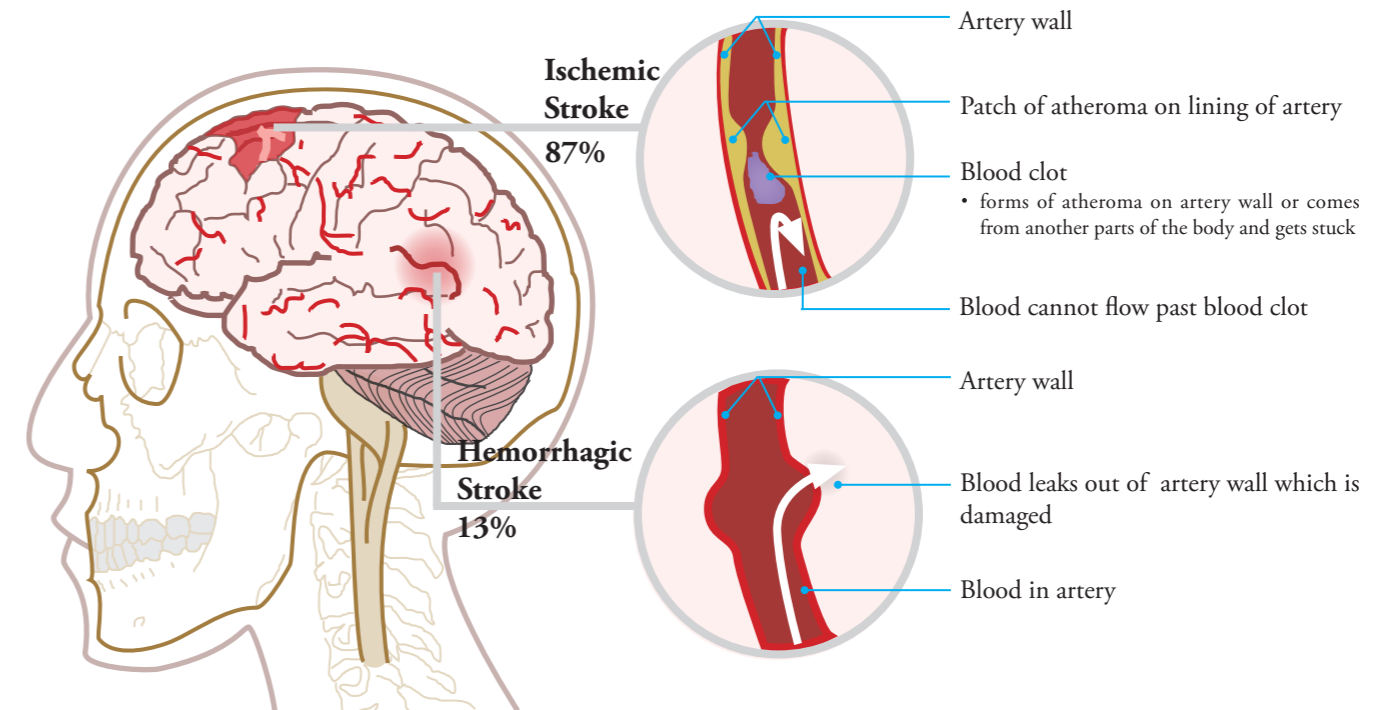# Post-stroke Rehabilitation

What is A Stroke

A stroke is a "brain attack". It occurs when blood flow to an area of brain is cut off. When this happens, brain cells are deprived of oxygen and begin to die. When brain cells die during a stroke, abilities controlled by that area of the brain are lost. Fig. 3.1 shows that stroke is divided into two type: Ischemic stroke and Hemorrhagic stroke. Ischemic strokes accounts for 87 percent. They are caused by interruption of the blood supply to the brain. Hemorrhagic Strokes accunts for 13 percent and they result from the rupture of a blood vessel or an abnormal vascular structure. Strokes are more common in older people. Almost three-fourths of all strokes occur in people 65 years of age or over. However, a person of any age can have a stroke (a).

How a person is affected by their stroke depends on where the stroke occurs in the brain and how much the brain is damaged. Fig. 3.2 shows the zone of every function of brain. For example, someone who had a small stroke on frontal lobe zone may only have minor problems such as temporary weakness of an arm or leg. People who have larger strokes may be permanently paralyzed on one side of their body or lose their ability to speak because of the damage of Broca's area. Some people recover completely from strokes, but more than 2/3 of survivors will have some type of disability.

Ischemic Stroke 87%
Artery wall
Patch of atheroma on lining of artery
Blood clot
• forms of atheroma on artery wall or comes from another parts of the body and gets stuck
Blood cannot flow past blood clot

Hemorrhagic Stroke 13%
Artery wall
Blood leaks out of artery wall which is damaged
Blood in artery

Motor area
• control of voluntary muscles

Sensory area
• skin sensations (temperture, pressure,pain)

Broca's area
• speech control

Frontal lobe
• movement
• problem solving
• concentrating,thinking
• behavior, personality, mood

Brain stem
• consciousness
• breathing
• heart rate

Temporal lobe
• hearing
• language
• memory

Parietal lobe
• sensations
• language
• perception
• body awareness
• attention

Wernicke's area
• language comprehension

Occipital lobe
• vision
• perception

Cerebellum
• posture
• balance
• coordination of movement

Above : Fig. 3.1 The type of stroke, individing into Ischemic stroke and Hemorrhagic stroke.
Below : Fig. 3.2 The zone of every function of brain.

What Disabilities Can Result From A Stroke ?

Paralysis or problems controlling movement (motor control)

Paralysis is one of the most common disabilities resulting from stroke. The paralysis is usually on the side of the body opposite the side of the brain damaged by stroke, and may affect the face, an arm, a leg, or the entire side of the body. This one-sided paralysis is called hemiplegia if it involves complete inability to move or hemiparesis if it is less than total weakness. Stroke patients with hemiparesis or hemiplegia may have difficulty with everyday activities such as walking or grasping objects. Some stroke patients have problems with swallowing, called dysphagia, due to damage to the part of the brain that controls the muscles for swallowing. Damage to a lower part of the brain, the cerebellum, can affect the body's ability to coordinate movement—a disability called ataxia—leading to problems with body posture, walking, and balance.

Emotional disturbances

Many people who survive a stroke feel fear, anxiety, frustration, anger, sadness, and a sense of grief for their physical and mental losses. These feelings are a natural response to the psychological trauma of stroke. Some emotional disturbances and personality changes are caused by the physical effects of brain damage. Clinical depression, which is a sense of hopelessness that disrupts an individual's ability to function, appears to be the emotional disorder most commonly experienced by stroke survivors. Signs of clinical depression include sleep disturbances, a radical change in eating patterns that may lead to sudden weight loss or gain, lethargy, social withdrawal, irritability, fatigue, selfloathing, and suicidal thoughts. Post-stroke depression can be treated with antidepressant medications and psychological counseling.

Sensory disturbances including pain

Stroke patients may lose the ability to feel touch, pain, temperature, or position. Sensory deficits also may hinder the ability to recognize objects that patients are holding and can even be severe enough to cause loss of recognition of one's own limb. Some stroke patients experience pain, numbness, or odd sensations of tingling or prickling in paralyzed or weakened limbs—a symptom known as paresthesias.Stroke survivors may lose the ability to sense the need to urinate or the ability to control bladder muscles. Some may lack enough mobility to reach a toilet in time. Loss of bowel control or constipation also may occur.Stroke survivors frequently have a variety of chronic pain syndromes resulting from stroke-induced damage to the nervous system (neuropathic pain). Patients who have a seriously weakened or paralyzed arm commonly experience moderate to severe pain that radiates outward from the shoulder. Most often, the pain results from lack of movement in a joint that has been immobilized for a prolonged period of time (such as having your arm or shoulder in a cast for weeks) and the tendons and ligaments around the joint become fixed in one position.This is commonly called a "frozen" joint; "passive" movement (the joint is gently moved or flexed by a therapist or caregiver rather than by the individual) at the joint in a paralyzed limb is essential to prevent painful "freezing" and to allow easy movement if and when voluntary motor strength returns.

Problems with thinking and memory

Stroke can cause damage to parts of the brain responsible for memory, learning, and awareness. Stroke survivors may have dramatically shortened attention spans or may experience deficits in short-term memory. Individuals also may lose their ability to make plans, comprehend meaning, learn new tasks, or engage in other complex mental activities. Two fairly common deficits resulting from stroke are anosognosia, an inability to acknowledge the reality of the physical impairments resulting from stroke, and neglect, the loss of the ability to respond to objects or sensory stimuli located on the stroke-impaired side. Stroke survivors who develop apraxia (loss of ability to carry out a learned purposeful movement) cannot plan the steps involved in a complex task and act on them in the proper sequence. Stroke survivors with apraxia also may have problems following a set of instructions. Apraxia appears to be caused by a disruption of the subtle connections that exist between thought and action.
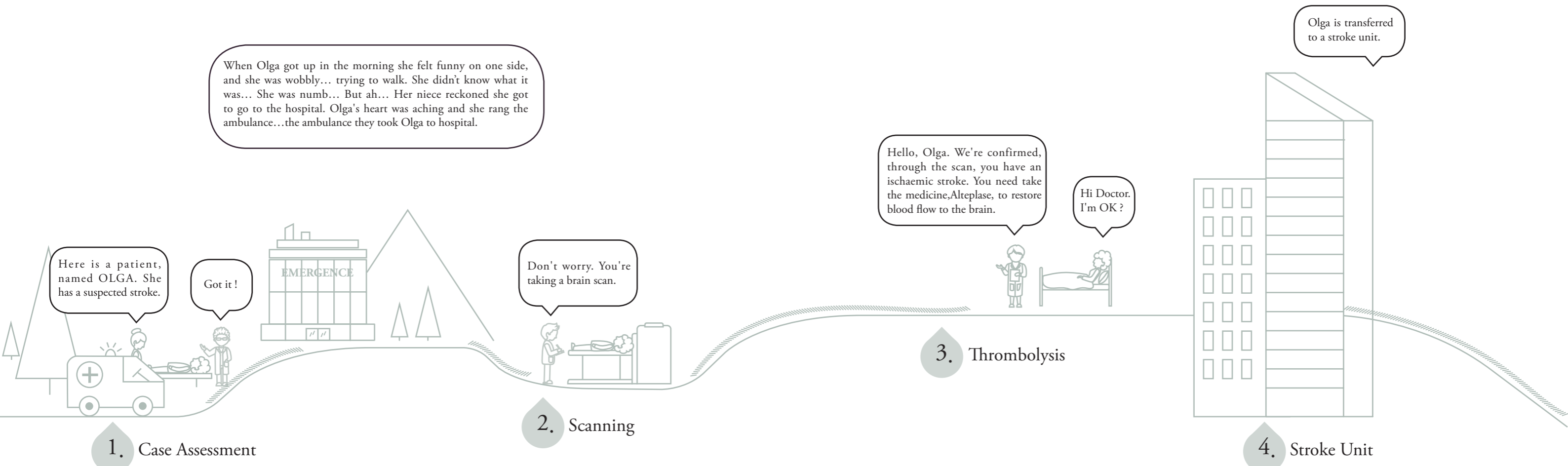
Problems using or understanding language (aphasia)

At least one-fourth of all stroke survivors experience language impairments, involving the ability to speak, write, and understand spoken and written language. A stroke-induced injury to any of the brain's language-control centers can severely impair verbal communication. The dominant centers for language are in the left side of the brain for right-handed individuals and many left-handers as well. Damage to a language center located on the dominant side of the brain, known as Broca's area, causes expressive aphasia. People with this type of aphasia have difficulty conveying their thoughts through words or writing. They lose the ability to speak the words they are thinking and to put words together in coherent, grammatically correct sentences. In contrast, damage to a language center located in a rear portion of the brain, called Wernicke's area, results in receptive aphasia. People with this condition have difficulty understanding spoken or written language and often have incoherent speech. Although they can form grammatically correct sentences, their utterances are often devoid of meaning. The most severe form of aphasia, global aphasia, is caused by extensive damage to several areas of the brain involved in language function. People with global aphasia lose nearly all their linguistic abilities; they cannot understand language or use it to convey thought.

Stroke Patient Journey:
Onset to Rehabilitation

When Olga got up in the morning she felt funny on one side, and she was wobbly… trying to walk. She didn't know what it was… She was numb… But ah… Her niece reckoned she got to go to the hospital. Olga's heart was aching and she rang the ambulance…the ambulance they took Olga to hospital.

Olga is transferred to a stroke unit.

Hello, Olga. We're confirmed, through the scan, you have an ischaemic stroke. You need take the medicine,Alteplase, to restore blood flow to the brain.

Hi Doctor. I'm OK ?

Here is a patient, named OLGA. She has a suspected stroke.

Got it !

EMERGENCE

Don't worry. You're taking a brain scan.

3. Thrombolysis

2. Scanning

1. Case Assessment

4. Stroke Unit

Olga had a suspected stroke, she was sent to an accident and emergency. Medical staff wanted to know as much as possible about her symptoms, and carried out assessments to find out whether she did have the condition and what might have caused it. Olga's blood pressure was took immediately. She had blood tests to measure her sugar and cholesterol levels, and how quickly her blood clots. Olga also had an electrocardiogram.

Olga received a brain scan within 24 hours of the appearance of symptoms. This can be a computed tomography (CT) scan and/or a magnetic resonance imaging (MRI) scan. It can help determine where in Olga's brain the stroke happened and whether this was caused by a blood clot (ischaemic stroke) or by bleeding (haemorrhagic stroke). Olga will be scanned within one hour of arrival if, for example, she is not fully conscious or is on certain medicines.

It was confirmed, through a scan, that Olga had an ischaemic stroke, sha may be gave medicine that helps break up clots, to restore blood flow to the brain. This treatment is called thrombolysis and Alteplase is the most widely used clot-busting drug. It must be administered within four-and-a-half hours from the onset of symptoms to be effective. If Olga has a haemorrhagic stroke, she will not receive thrombolysis because it can make the bleeding worse.

Following the initial assessment, Olga was transferred to a stroke unit – a centre specialised in the management of the first 72 hours of care, which are crucial to good outcomes. Transfer should occur within four hours of arriving at A&E. Research shows that patients who are looked after in a dedicated stroke unit have a reduced risk of disability and mortality, and are more likely to be living at home one year after the stroke.
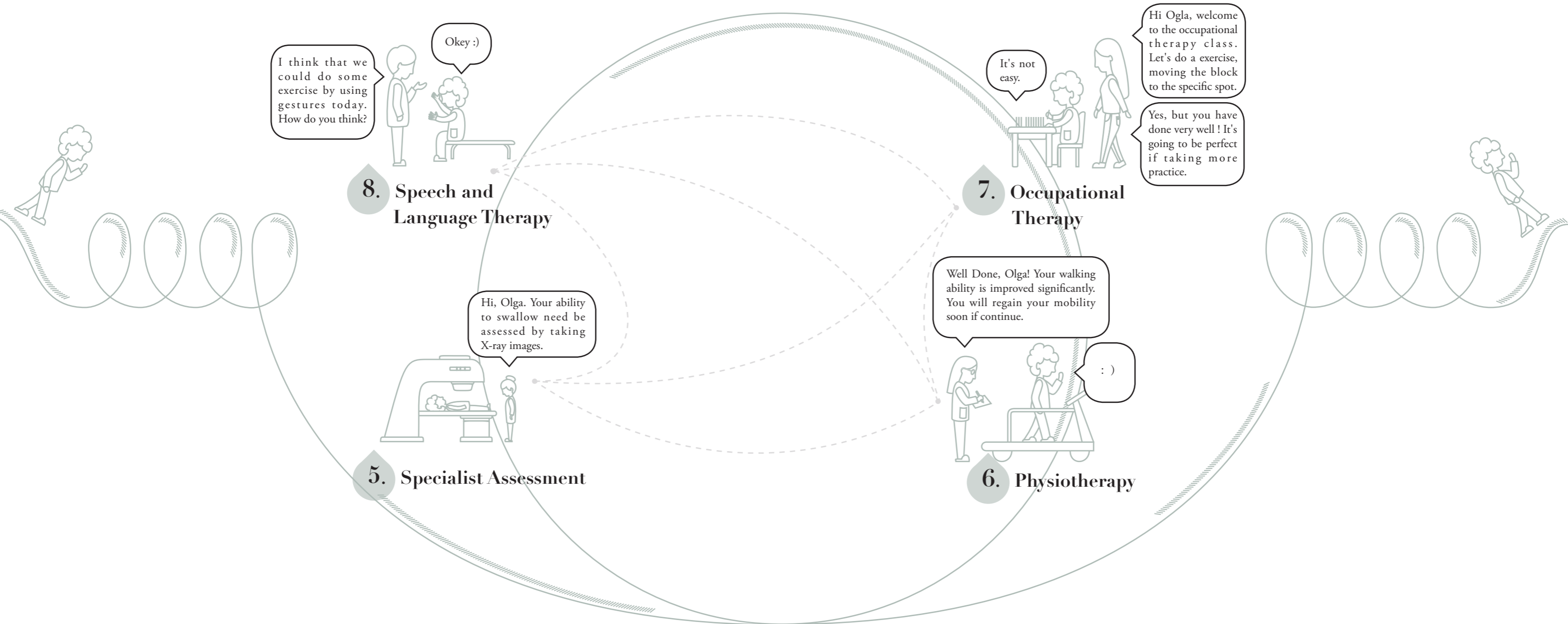
5. Specialist Assessment

In the stroke unit, Olga was seen within 24 hours by a stroke specialist team. Her ability to swallow was assessed within four hours of admission, by taking X-ray images as she swallows a bolus of barium. Most people with a stroke have difficulty swallowing, which may result in potentially life-threatening infections such as pneumonia. If the test shows her swallowing ability has been affected, she will receive specialist care to reduce her risk of developing complications.

6. Physiotherapy

Physiotherapy is an essential component of stroke rehabilitation. A stroke can damage brain regions that control movement, causing weakness or paralysis, usually on one side of the body. Olga had limited mobility, a physiotherapist may help her regain the ability to move, through exercise and other interventions. As part of Olga's physiotherapy care plan, she was encouraged to practise walking as soon as possible. Physiotherapy starts in the hospital and often needs to continue at home.

7. Occupational Therapy

Olga was seen by an occupational therapist within four days of admission to the stroke unit. Occupational therapy improves the chances of returning to independent living. It does so by helping relearn or compensate for abilities that may have been lost as a result of the stroke. In addition, an occupational therapist showed Olga strategies to make everyday activities such as dressing or washing herself easier, and can advise on special equipment and adaptations she may need.

8. Speech and Language Therapy

About half of the people who have a stroke experience difficulties with speech and language, for which they require specialist care. Olga may be unable to speak clearly (dysarthria) or to form and understand words (aphasia). Therapy may involve performing exercises to improve her ability to speak over time. A therapist can also teach Olga alternative ways to communicate, such as writing, drawing and using gestures.

9. Multidisciplinary Team Working

There is overwhelming evidence, from studies and real-life experience, that a multi-disciplinary team approach to care yields the best results, in terms of patient outcomes. For this reason, stroke units have co-ordinated teams of medical, nursing and therapy staff, who have specialist expertise in stroke rehabilitation. Compared with conventional care, multidisciplinary team working for stroke which starts in the hospital and continues in the community, increases the likelihood of regaining independence, reducing the need for institutional care.

The stroke rehabilitation, therefore, is a repeat, recycle and continuously progressive process with multidisciplinary works.

10. Discharge Process

Before Olga left hospital, the stroke team, together with social care services, prepared a discharge plan for Olga. This aims to ensure Olga continue to receive the treatment and support she need. It may include home visits to arrange for any practical help she may require. Depending on where she live, she may be assigned to an early supported discharge (ESD) team, who will treat she at home, enabling she to leave hospital earlier.

11. Therapy and Recovery

The recovery process from a stroke is rarely complete when it is time for Olga to leave hospital. It usually continues for several months, either at home or in a long-term care facility after discharge.

Rehabilitation nurse

Occupational therapist

Speech-language therapist

Physician

Physical therapist

Vocational therapist
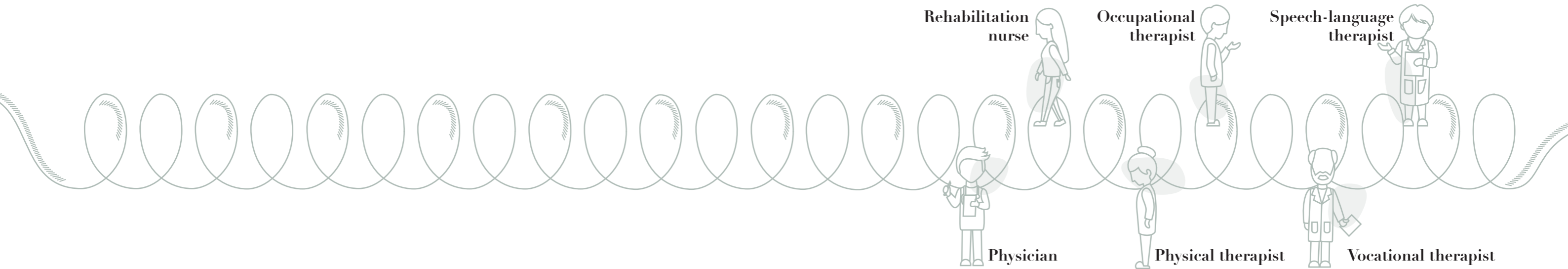
Where Can A Stroke Patient Get Rehabilitation ?

At the time of discharge
from the hospital,
many stroke survivors return home,
but some move into
some type of medical facility.

Inpatient & Outpatient rehabilitation units

Inpatient facilities may be freestanding or part of larger hospital complexes.Patients stay in the facility,usually for 2 to 3 weeks, and engage in a coordinated, intensive program of rehabilitation.Such programs often involve at least 3 hours of active therapy a day, 5 or 6 days a week. Inpatient facilities offer a comprehensive range of medical services, including full-time physician supervision and access to the full range of therapists specializing in post-stroke rehabilitation.

Outpatient facilities are often part of a larger hospital complex and provide access to physicians and the full range of therapists specializing in stroke rehabilitation. Patients typically spend several hours, often 3 days each week, at the facility taking part in coordinated therapy sessions and return home at night.

Nursing facilities

Skilled nursing facilities usually place a greater emphasis on rehabilitation, whereas traditional nursing homes emphasize residential care. In addition, fewer hours of therapy are offered compared to outpatient and inpatient rehabilitation units.

Home-based rehabilitation programs

Home rehabilitation allows for great flexibility so that patients can tailor their program of rehabilitation and follow individual schedules. Stroke survivors may participate in an intensive level of therapy several hours per week or follow a less demanding regimen. These arrangements are often best suited for people who require treatment by only one type of rehabilitation therapist. Patients dependent on Medicare coverage for their rehabilitation must meet Medicare's "homebound" requirements to qualify for such services; at this time lack of transportation is not a valid reason for home therapy. The major disadvantage of home-based rehabilitation programs is the lack of specialized equipment. However, undergoing treatment at home gives people the advantage of practicing skills and developing compensatory strategies in the context of their own living environment.In the recent stroke rehabilitation trial, intensive balance and strength rehabilitation in the home was equivalent to treadmill training at a rehabilitation facility in improving walking.

Autonomy and Dependence in Older Age

———

Stories Come From Older Age

Amanda
———

At a recent 80th-birthday party for my friend Leah, I found myself seated at a table for eight. At the main table, Leah was surrounded by her family: two sons, their wives, seven grandchildren. A photographer was taking pictures. a beautiful family, all my table-mates agreed. "While we're on the subject of families …" I began. I asked the women, named Amanda, about his own families, specifically about anything he might want to say to his own adult children. "I'd just want to say thank you," said one, "and I do say it all the time." He explained that he was sidelined by a back ailment this past year, and "my daughters, despite their busy social and professional lives, bent over backwards to do everything for their father and me."

Anna
———

At the same birthday party. "What I'd want to say to my daughters?" asked another woman, Anna, seated to my right. "I'd want to tell them, 'Buzz off.'" The daughters are both in their early fifties; their mother, widowed early in her marriage, is fiercely proud of her success as a single mother. "They're always offering to do this, do that, and do the other thing, and it just drives me crazy," she said. "It tells me that they think I'm not competent." As a result, she's stopped telling them when she really does have a problem.

Turid
———

His daughter, Brenda, had recently moved back. Almost friends thought that it was a pretty happy thing. "It must be nice to see her more often." One of friend said to Turid. "Yes, but…Whether Brenda drops by, I'm not sure whether she's come to visit or to check up on me: Dose my home meet the clean test? Is the yogurt in my refrigerator long past it's 'use by' date? I feel like I'm constantly being assessed." Turid said.

Edel
———

Her complains of "I'm being badgered by my kids about my driving. Is this a serious problem about my driving? Do I not have the capability to make my own decision?"

———

What Older People are Looking for in Indeed?

Older people express strong desire for both autonomy and connection in relations, leading to ambivalence about receiving assistance. They define themselves as independent but hope that soneone's help will be available as needed. They are annoyed by over-protectiveness but appreciate the concern it expresses. They use a variety of strategies to deal with their ambivalent feelings, such as minimizing the help they receive, ignoring or resisting children's attempts to control. "One of the scariest things to people as they age is that they don't feel in control anymore," says Steven

Zarit, a professor of human development and family studies at Pennsylvania State University. They want to be cared about, but fear being cared for.

Based on the above analysis, it is the key point need to be considered about that how to balance the need of autonomy and connection of orlder people in the relationship.

Wireless Sensor Network
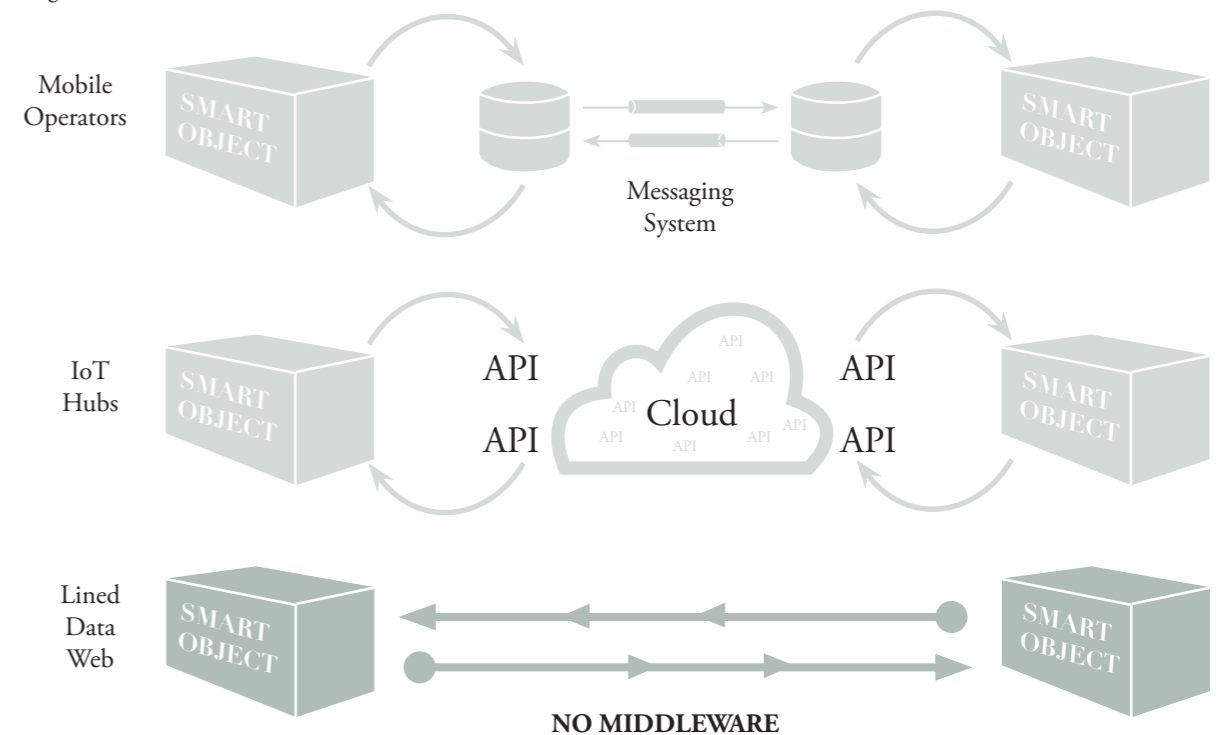
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What is Wireless Sensor Network

What is wireless sensor network

Wireless sensor networks (WSN), sometimes called wireless sensor and actuator networks (WSAN), are spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

Nornir real time web

RTW is a web of linked data in real time. Nornir offers a series of unique software tools to empower developers to create IoT solutions without API, databases and middleware. Nornir provide the easiest way to implement IoT solutions. With unique RTW technology, Nornir revolutionises software development by eliminating back end programming and middleware needs. Nornir kicks of by implementing their technology within IoT and smart cities; where it enables full interoperability between multiple IoT protocols and data sources. Unlike classical architectures of telecom operators and cloud platforms, Nornir RTW does not require any middleware (see Fig. 3.3).

Fig. 3.3 How the wireless web works.

The Type of Sensor

Light

— illuminance

— image analysis

— distance

— 3D dynamic

Touch

— pressure

— electronic skin

— surface shape

— wrinkle recognition

Biological

— food ingredient

— biosignature

Motion

— speed

— angle

— position

— height

— gravity(accelerated speed sensor)

— (external) pressure sensor

— magretic sensor

Sound

— low frequency vibration

— ultrasonic

Smell

— smell

— gas

— smog
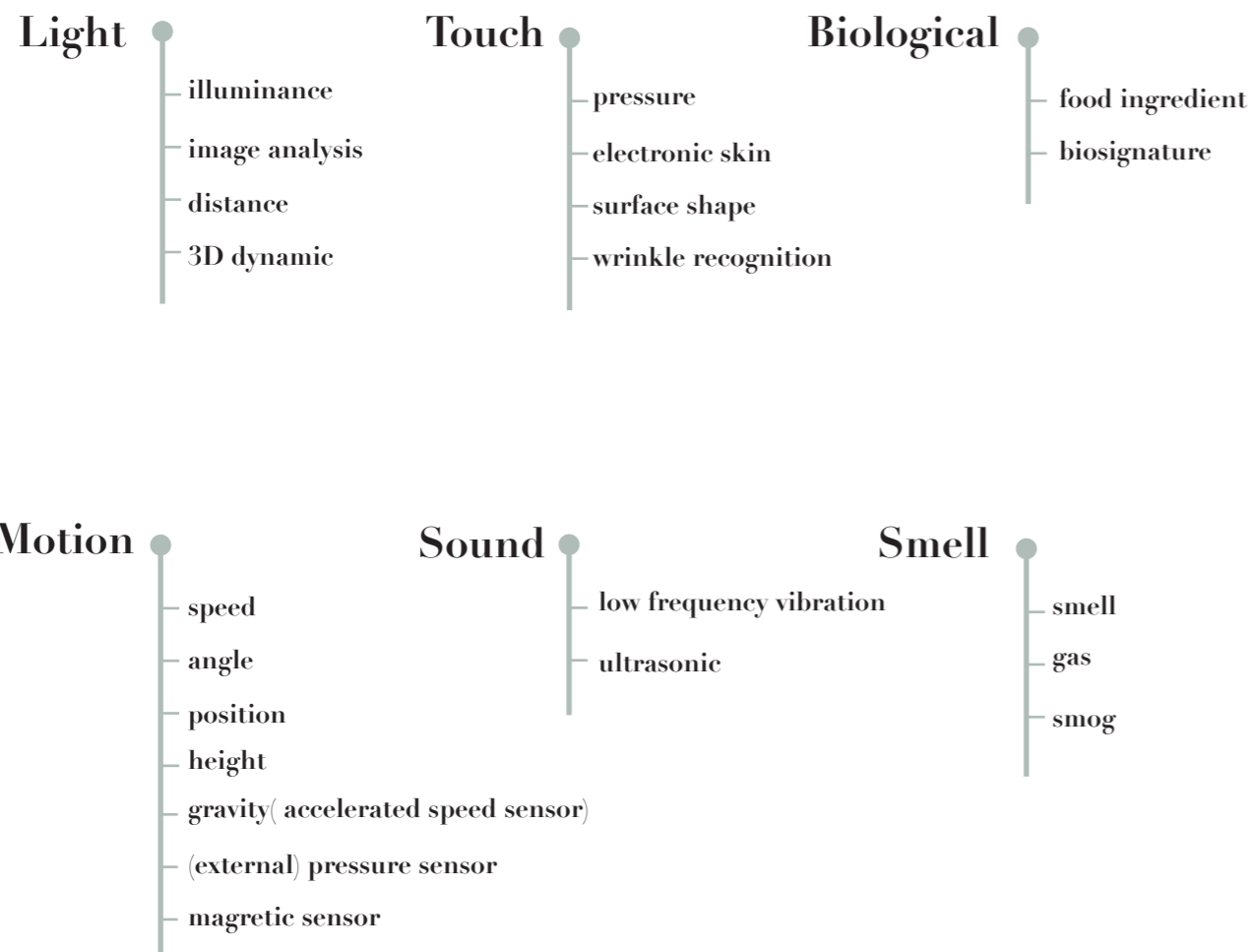
The Working Principle
of
Sensor

For Example :

Light Sensor

Turn off → Turn on

The oven is working.

The oven is working.

Gamification
&
Transmedia Storytelling
___

IDEAS

All the ideas stem from the concept of gamification. Besides, it integrates the transmedia storytelling to achieve the final gamified rehabilitation service. Gamification is just like the frame of the rehabilitation service, then the transmedia storytelling is the content which need to be filled with rich story. The aim is to achieve the best effectiveness of post-stroke rehabilitation by engaging stroke patient in those attractive stories from the game. Therefore, it presents three ideas in this chapter, these are running a farm, walking in the forest and memories never die.

Gamification
_____

The form of human activity, so called game, has been existing in human beings' lives since a long time. Game can bring much fun to human beings so that it can enrich their lives greatly. With the continuous study of human beings' behavior and psychology, game design was put forward, and summed up into relevant elements and mechanisms, such as strategies and principles. The concept of gamification was born, with the development of game design. Gamification has become a method to be applied in practice to solve problem.

Gamification is not about games people play at work place, but about using game mechanics, for achieving organization effectiveness. The above definition summarizes the application context of the gamification and point out the purpose. There are still a lot of definitions for gamification. Gamification refers to : a process of enhancing a service with affordances for gameful experiences in order to support user's overall value creation. This definition suggests that gamification is a process that enhances the gaming experience in the service so that the users or participants can more effectively exert their overall creative value. There, however, is a clear distinction between gamification and game design. The gamification is not to design a concrete game for entertainment, the main purpose is to integrate this pleasant experience into a general context or service, so as to improve the work efficiency or degree of engagement during a particular progress.

With the development of gamification, its application is more and more widely, including sports training, investment remuneration, process, data quality, teaching, entertainment, recruitment test, information system and so on. Education is a clear example, especially in young children and primary education. Younger students, their attention is easily dispersed by other things, and it is difficult to focus on learning for a longer period of time. But on the contrary, they are also pretty easy to be attracted by interesting things. The child's interest in games and play is significantly higher than that of other ages. Based on this psychological study of children, therefore, teachers try to make class become a gaming process as much as possible so that able to catch the attention of students. It is a much playful and effective way for young students to learn knowledge. In addition, for adult, the enthusiasm of entertainment is still strong. Many companies try to seize this psychology to gamify the training courses and process so that make the boring training become interesting, so as to enhance employees engagement while also improve the efficiency of training.

It is benefit a lot to both company and employee. On the one hand, employee has a playful and enjoyable learning experience, on the other hand, the company is able to gain the best learning outcome by the gamification.

The project works with the post-stroke rehabilitation. It is a difficult but necessary process for the stroke patient. The ultimate outcome of recovery directly influences their later life's quality. For many subjective and objective reasons,

however, the stroke patients lack the desire to do exercise. For example, most patients prefer to stay at home for a long-term rehabilitation, instead of stroke unit. There is an issue that they would give up easily in the long-term rehabilitation process without the supervision from nurse, therapist or others. Moreover, emotional problems due to the stroke would decrease the desire of patient for the rehabilitation also. Finally the quality of rehabilitation would cannot achieve the best. Based on the cases of education and enterprise management, it demonstrates that the good effectiveness they have as long as the good user experience they have. The gamificaiton, therefore, is able to be an optimal way to improve and optimize the recovery experience. That is the reason why integrating the concept of gamification into post-stroke rehabilitation. The better rehabilitation experience, the better effectiveness of recovery. Besides, as the previous chapter reminds, the balance between autonomy and dependence is important in older age. The gamification can be the suitable way to avoid overprotection.

Transmedia storytelling

Gamification is just like the frame of the rehabilitation service, then the transmedia storytelling is the content which need to be filled with rich story. Namely, in the design of gamified rehabilitation service, gamification is like a skeleton, and transmedia storytelling is like flesh and blood. The core of transmedia storytelling is narrative, in other words, story is the main supporting force to the frame of gamification.

Transmedia storytelling can be regarded as a strategy. One narrative (story) can be transferred into among several media, such as films, games, products, cartoons and figures(see fig. 4.1). The narrative impacts the different media, and the media also changes the narrative. The sub-story in every different media would has a little change. These sub-stories, however, would always have the same theme and related to each other. The original narrative can be enriched continuously by the new coming sub-stories.

For the participants, they are able to interact one of the media to gain information. The information embeds a distinct and related sub-story, participants are able to transfer it into own mythology and keep it in their minds for a long time. It creates the topics of conversation in daily life, participants share and communicate with each other to renew their own stories. Moreover, participants are able to get in touch with relevant story by other medias also.

It demonstrates that transmedia storytelling has the ability to motivate participants to do something by building a continues memory chain. Therefore, there is a good chance to build a gaming rehabilitation service to engage the stroke patient by transmedia storytelling.
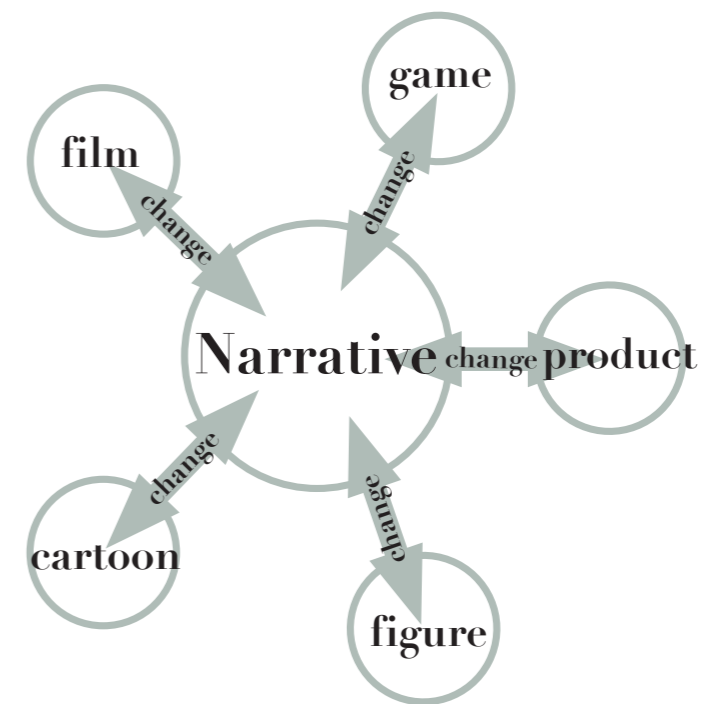

Fig. 4.1 Transmedia system.
Source : Tore Gulden 2016, Oslo and Akershus University College

The book named *Convergence Culture* provides much inspirations regarding to how to apply transmedia storytelling in practice. The fig 4.2 shows the process that how stroke patients interact among medias, patients and therapists based on rehabilitation plan.

The circle of rehabilitation includes three parts.The first part shows that different medias have related sub-stories. All kinds of therapies are embedded in these sub-stories. All of that offer a strong narrative to patient. Then it enters the second part when the narrative is accepted by the patients. The sub-story is able to become the driven force for patient to do recovery exercise, and it generates more conversations in their daily life. It strongly increases the social interaction among patient. Due to each sub-story relats to one therapy, patients would become more active to do recovery exercise in order to gain more sub-stories. It has great effect for enhancing the desire of rehabilitation. Besides, team work is another motivation point which is presented in the third part. Patients have shared goal to be achieved in the both relationships of collaboration and competition.

Whether the transmeida storytelling or the rehabilitation plan, it is a repeat and progressive process. The fig 4.2 illustrates clearly that tansmedia storytelling is able to match the rehabilitation very well. Therefore, all the following ideas stem from gamification and transmedia storytelling.
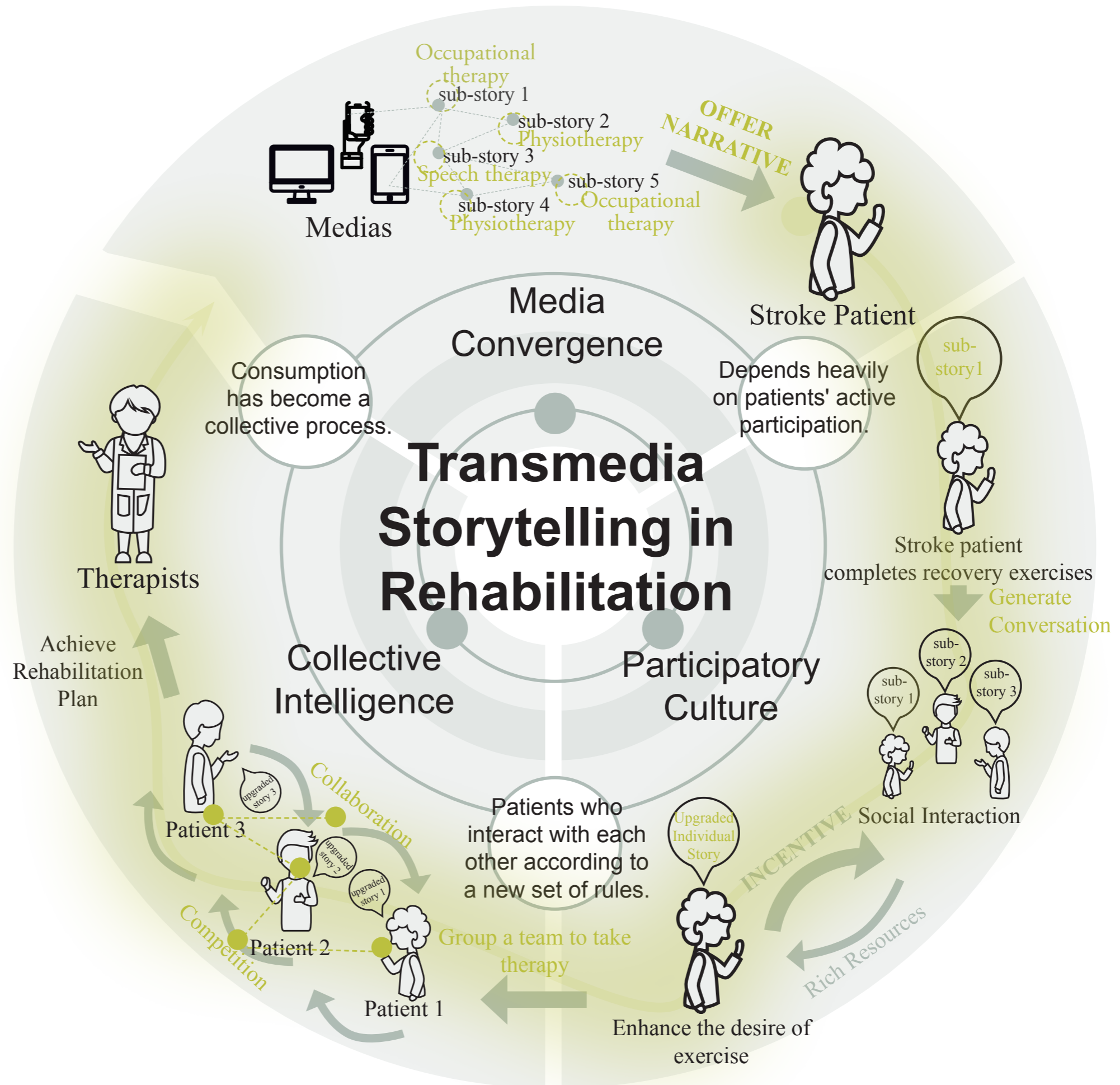
Fig. 4.2 The application of transmedia storytelling in rehabilitation process

Three Narrative Ideas

Original ideas were born in discussion on the original giga-mapping (finish in giga-mapping course) with colleagues and teachers. The followings are three narrative ideas with more development based on the gamification and transmedia storytelling.

* The original giga-mapping will be printed and hanged it on at the sensor exhibition.

Running a farm

In a village, the stroke patient plays the role of farmer and runs own farm. He need complete the farming activities in order to expand his farm. The farming activities mean all kinds of therapy. The relevant therapist or doctor is the person who decides what and how many therapies patient need do, according to individual condition. The scale of farm would be expanded a little while farming activities are completed. Besides, the farmer can get the coins also, and then his rank would also go up in friends. Moreover, the farmer is able to choose work mode of each farming activity, individual or team. Double or triple coins would be given in team mode. It means that the farmer can expand farm as quickly as possible if he invites other participants.
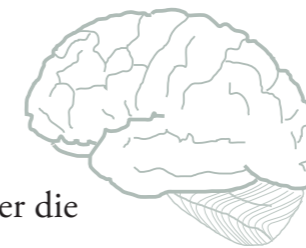
Memories never die

For the older, they own lots of memories in their minds whatever sad or happy. The memorise are the one of the most precious part in their life and they try their best to keep them forever. In this idea, therefore, it attemps to link exercise and memories together. The poor protagonist is the person who lost all the memories because of spell. These memories are scattered in different castles and guarded by a wizard. Just the knight, the role of the patient, can help the poor protagonist regain thses memories. The knight can gain a piece of memory when he won the wizard in each battle. Each battle means each exercise. The more exercise he do, the more memories he can collect, finally the poor protagonist can regain all the memories and the knight can have the highest honor.

Walking in the Forest

The story takes place in a forest. The stroke patient is the explorer, he need walk on a walking mechine with the visual reality camera. In the way of explorsion, the explorer would suffer from different challenge and bad weather, so it is important for him to find out various necessary tools, such as water, hat, glasses, tent, food and so on. Besides, there are many surprising point on the way, butterfly and amazing view, for example. Every point can encourage the patient continue walking forward. The idea more focus on the leg exercise of stroke patient, the leg exercise is an important part in the post-stroke rehabilitation.

POST-STROKE REHABILITATION SERVICE DESIGN

In this chapter, it shows one developing conceptual solution based on the previous three ideas. The developing solution regards to the idea of farm.

The Development of Idea

The Target Group

The project regards to post-stroke rehabilitation, so the target group in wide range is the stroke patient. In fact, the target group narrow down further based on the suggestions from expert. Mrs Rongrong Wang gave the professional suggestions in the master report, she is study the nerve rehabilitation in Norway as a PhD. student, and she has practical working experience in the field of stroke rehabilitation.

The followings are the more specific requirements of target group based on the professional suggestions.
1) Patient: the stroke patient who is in 5-7 recovery stage(see fig. 5.1).
2) Type of therapy: occupational therapy.
3) Place of rehabilitation: community or home-based rehabilitation.

Brunnstrom Recovery Stages

1. Flaccicity(immediately after the onset) No"voluntary"movements on the affected side can be initiated.
2. Spasticity appears. Basic synergy patterns appear. Minimal viluntary movements may be present.
3. Patient gains voluntary control over synergies. Increase in spasticity.
4. Some movement patterns out of synergy are mastered (synergy pattern still predominate). Decrease in spasticity.
5. If progress continues, more complex movement combinations are learned as the basic synergies lose their dominace over motor acts. Futher decrease in spasticity.
6. Disappearance of spasticity. Individual joint movements become possible and coordination approaches normal.
7. Normal function is restored.

Fig. 5.1 Brunnstrom recovery stages

The Function of the Gamified Service

1) Motivate patient do exercises in a long-term recovery.
2) Bridge the gap of communication between patient and therapist when in home-based rehabilitation.
3) Improve the effectiveness and quality of rehabilitation.

The developing idea

The idea of running a farm is the most suitable one among the else. because it has the better ability of expanding to the deep and rich development. The idea of farm includes various farming activities, they can be replaced and transferred into recovery exercise more easier, on the contary, the ideas of walking in the forest and memories never die are more limited. For the memories idea, it is hard to add more fresh content into the whole narrative in a long-term rehabilitation.The forest idea just mainly focus on leg exercise, even though it is an very important part in physical recovery, it is not an enough narrative to support for whole rehabilitation process. Combined with the above analysis, the idea of running a farm is chosen as the final conceptual solution.

The Platform for Display

Smartphone is chosen as the final platform to display the gamified post-stroke rehabilitation. Smartphone is an easy and quick way to engage the patient into the farm narrative, and it is an optimal way to communicate with others, such as friends and therapists. For the exercises, however, the screen size of smartphone is not enough to watch and it is not easy for patient to follow the actions in the video. However, considering the practical reason, smartphone is the most practical tool to test the conceptual solution. And it is the most convinent way to undergo the usability testing. Further consideration, it is not complicated to change and develop the size according to the future need as long as this current media platform is accepted. So there are many potential opportunities to be explored in the future. The smartphone is a tool, more important purpose is to present the gamify process which transferring the recovery exercises into all kinds of games.

The Gamified Rehabilitation Service

——

The fig.5.2 shows the process of the gamified rehabilitation service. It added the farm idea into a mobile application to display how the occupational therapy transferred into the games on the mobile media. Patient get a story from the mobile game application, and plays the role of farmer in the game. Each player's story is similiar but also distinct, it depends on individual situation. The exercises of occupational therapy were replaced by related games. Patients are not isolated anymore,the game provides a topic and create the chance to shared the game experience with each other. The passive status of doing exercise would be transferred into positive status. The mode includes individual and team. The team mode has stronger driven force for engaging patient in the gamified rehabilitation.

Fig.5.2 The gamified rehabilitation service.

The Gamified Rehabilitation Service

Rehabilitation plan 1
Farmer 1
Rehabilitation plan 2
Farmer 2
Rehabilitation plan 3
Farmer 3
game
Smartphone

OFFER NARRATIVE
Stroke Patient

All Kind of Occupational Therapies → A Set of Games

Consumption has become a collective process.

Depends heavily on patients' active participation.

Farmer 1
Running own farm
Generate Conversation

Farming Acvtivity

Individual Mode + Team Mode

Passive Status

Positive Status

Achieve Shared Goal

Individual Mode

farmer 1
farmer 2
farmer 3
Game Experience Communication

Collaboration

Patients who interact with each other according to a new set of rules.

Upgrade
INCENTIVE
Rich Resources

Farmer 3

Competition

Farmer 2

Farmer 1

Change Mode

Enhance the Interest of Game

The fig.5.3 shows the details of transfer process. It demonstrated the distinction between reality and game. There are three games, picking up apples, collecting eggs and milking, in the game.

The whole process of the game is repeat and progressive, as same as the post-stroke rehabilitation. In brief, the gamified rehabilitation service is able to provide a more pleasure experience to patients.

Reality

Friend 2

Friend 1

Friend 3

Patient

Occupational Therapy 1

Occupational Therapy 3

Occupational Therapy 2

Game

Player 2

Player 1

Player 2

Farmer

Game 3 - Picking up apples

Game 1- Collecting eggs

Game 2 - Milking

Fig.5.3   The transfer from exercise of occupational therapy to farming activity game.

| Chapter Six

USER EXPERIENCE DESIGN
OF MOBILE APP FOR
GAMIFIED POST-STROKE REHABILITATION

In this chapter, it shows the design and development process of the mobile game application by the method of usability testing.

Functional Chart

——

Based on the gamified rehabilitation service, the functional chart is the first step of game mobile application design. It decided what content of every single screen should be according to the needs of the game rehabilitation mobile app.

Fig 6.1 shows the landing and login procedure. It provides a both option of role. Patient and therapist can choose the related role, farmer or customer, according to the practical situation.
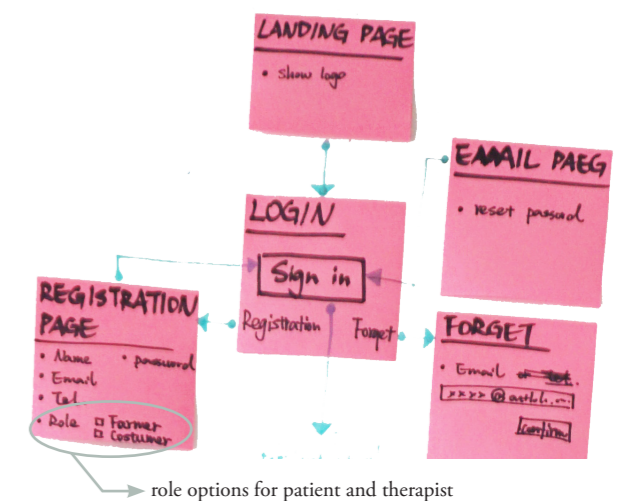

role options for patient and therapist

Fig 6.1(a) Landing page and Login page.

The role of patient
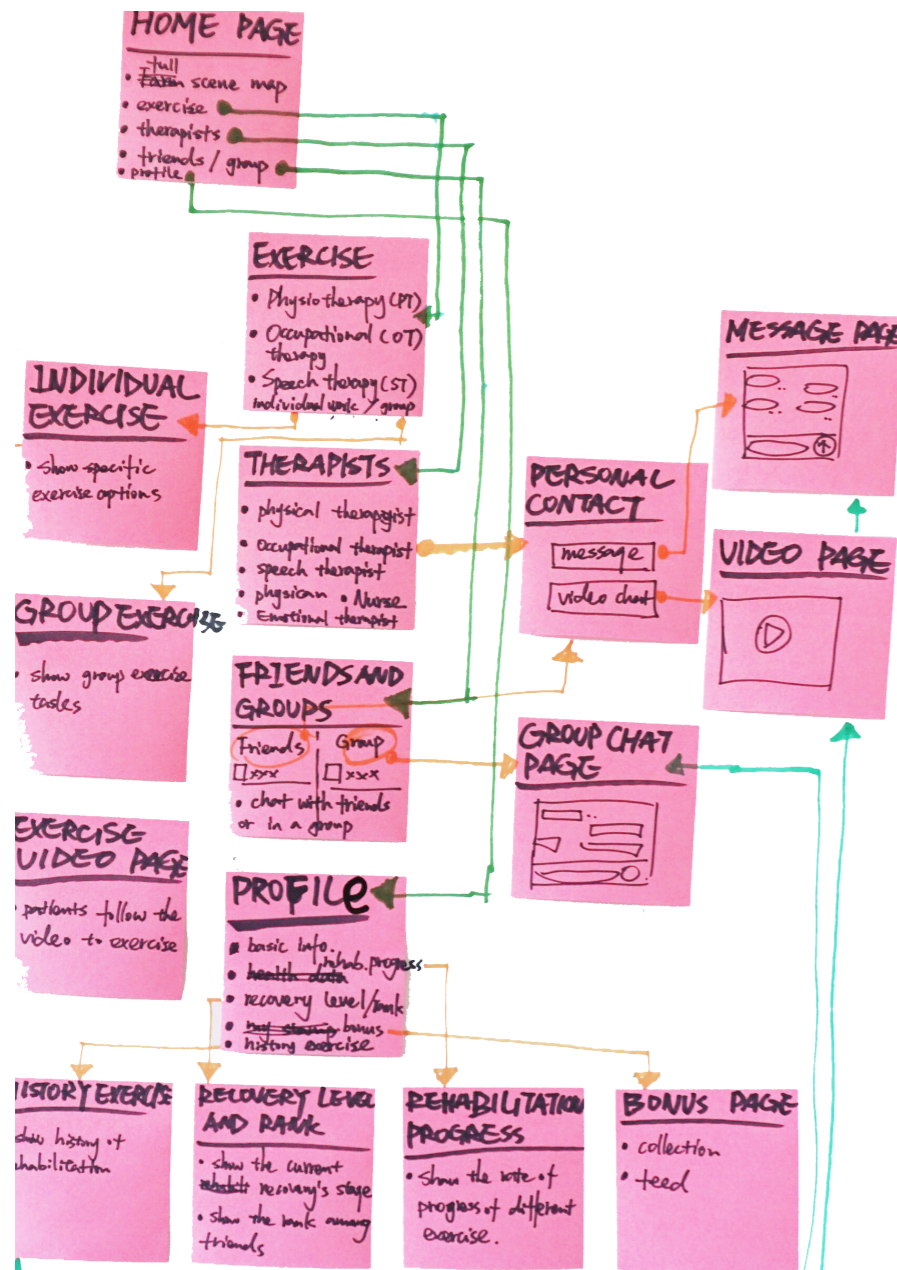
Fig 6.1(b) The content of mobile application for patient.

The role of therapist

Fig 6.1(c) The content of mobile application for therapist.

The fig 6.1(b) shows the content of the patient player. The content includes exercises, therapist contacts, friend contacts and profile. And these four options' button display in the bottom of home page. More detailed and specific content can be seen at fig 6.1(b).

The fig 6.1(c) shows the content of the therapist player. There are three options in home page, they are patient list, group mode and therapist list. Therapist can check the progress and result of recovery in the patient list option. And group members can be saw at the group mode. Besides, therapist can contact with other therapist to adjust the rehabilitation plan according to individual situation. More detailed and specific content can be seen at fig 6.1(c).

Wireframe Navigation Map

Navigation Map Draft

In the section, the functional chart transferred into wireframe navigation map. Fig 6.2 is a draft of navigation map. It changes the content into simple icon and presents in a size of mobile screen. The specific detail can be found in fig 6.2.
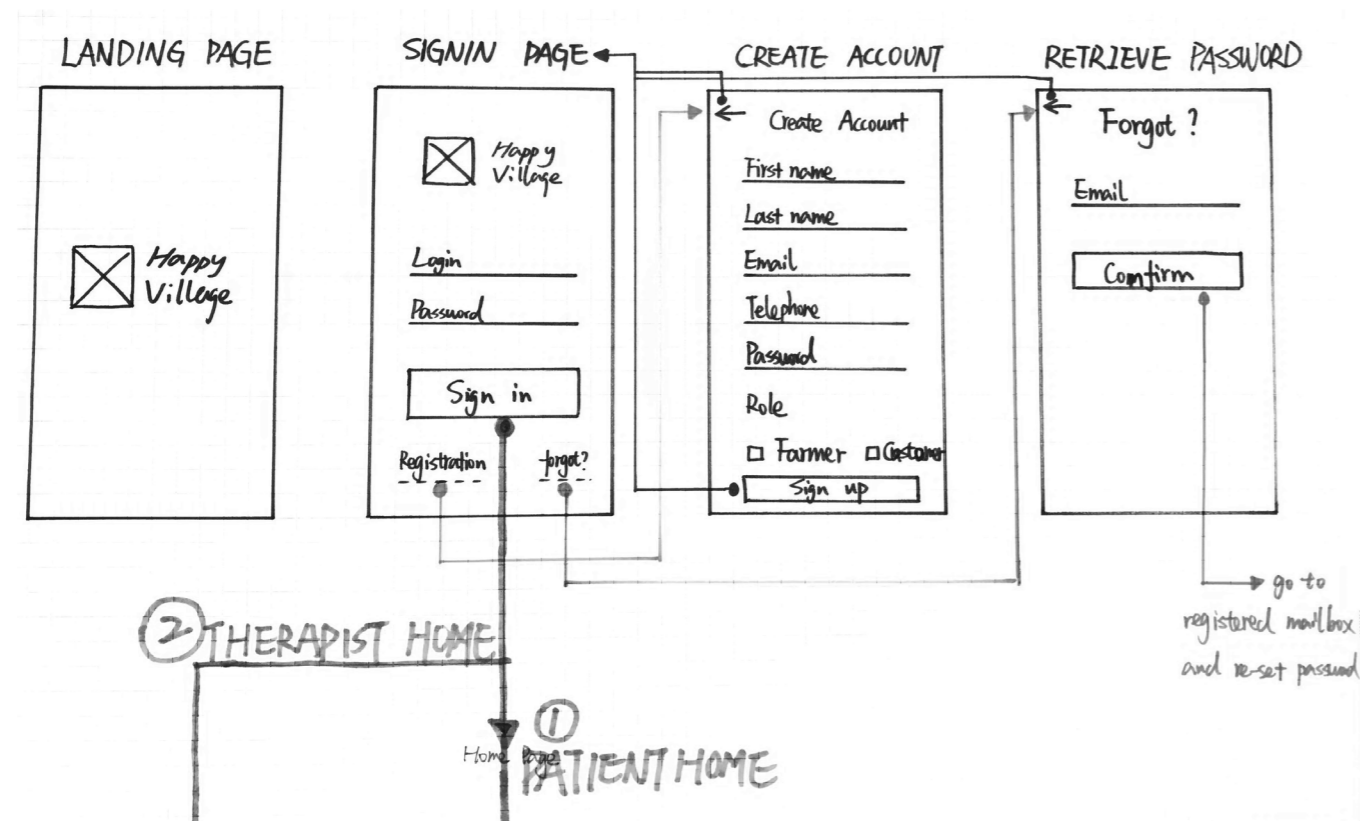
Fig 6.2(a) The user interface of landing and signin.
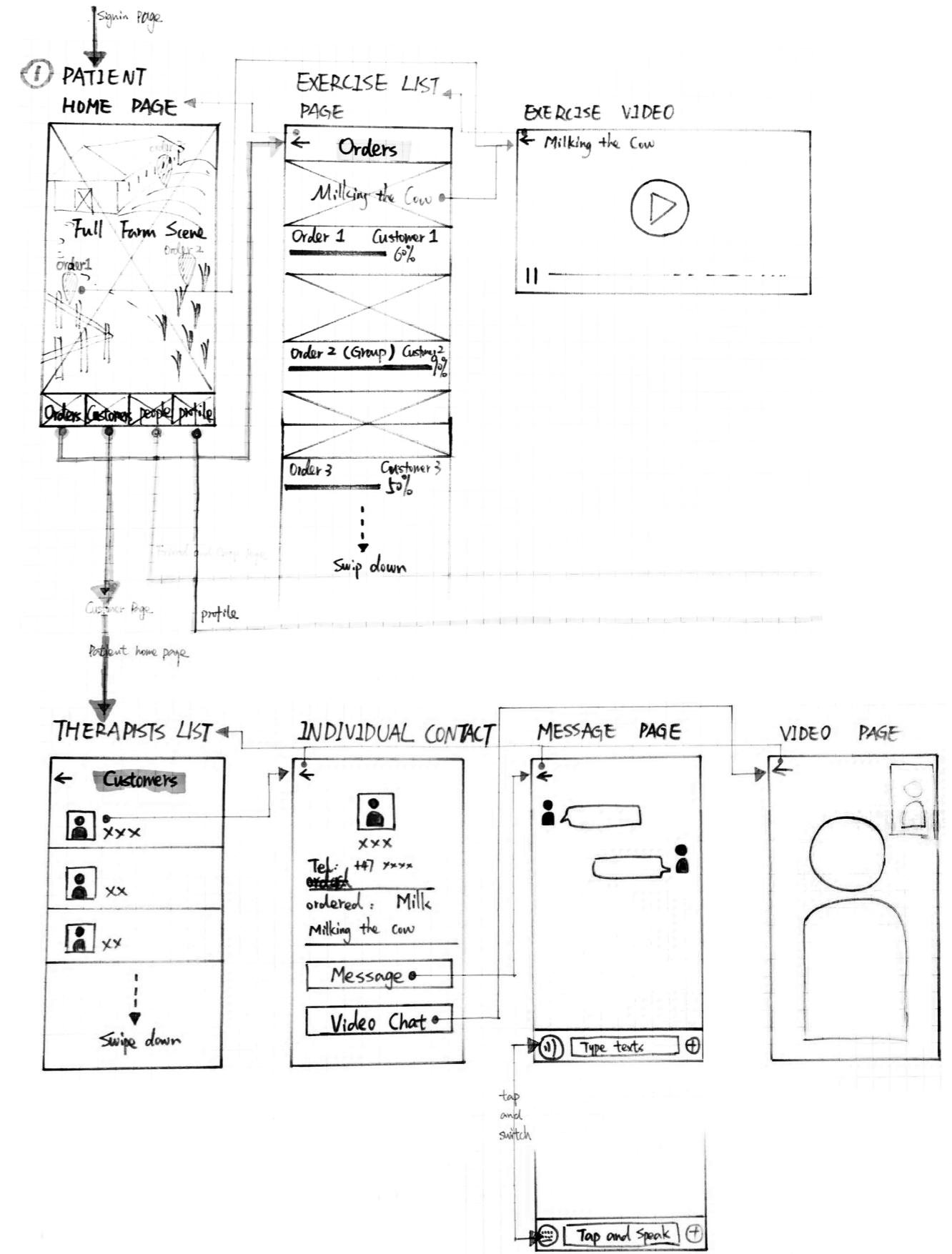
Fig 6.2(b) The user interface of home, exercise list and therapist list for patient.

Fig 6.2(c) The user interface of friends list and profile for patient.

Fig 6.2(d) The user interface of therapist.

Wireframe Navigation Map 01

The following is the first version of wireframe navigation map. The design of each user interface is based on the previous information.

1. Landing Page

LOGO **HAPPY VILLAGE**
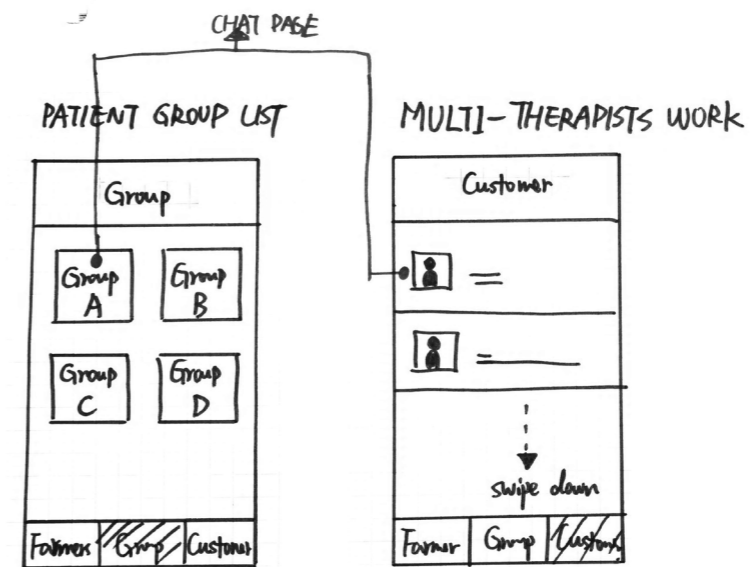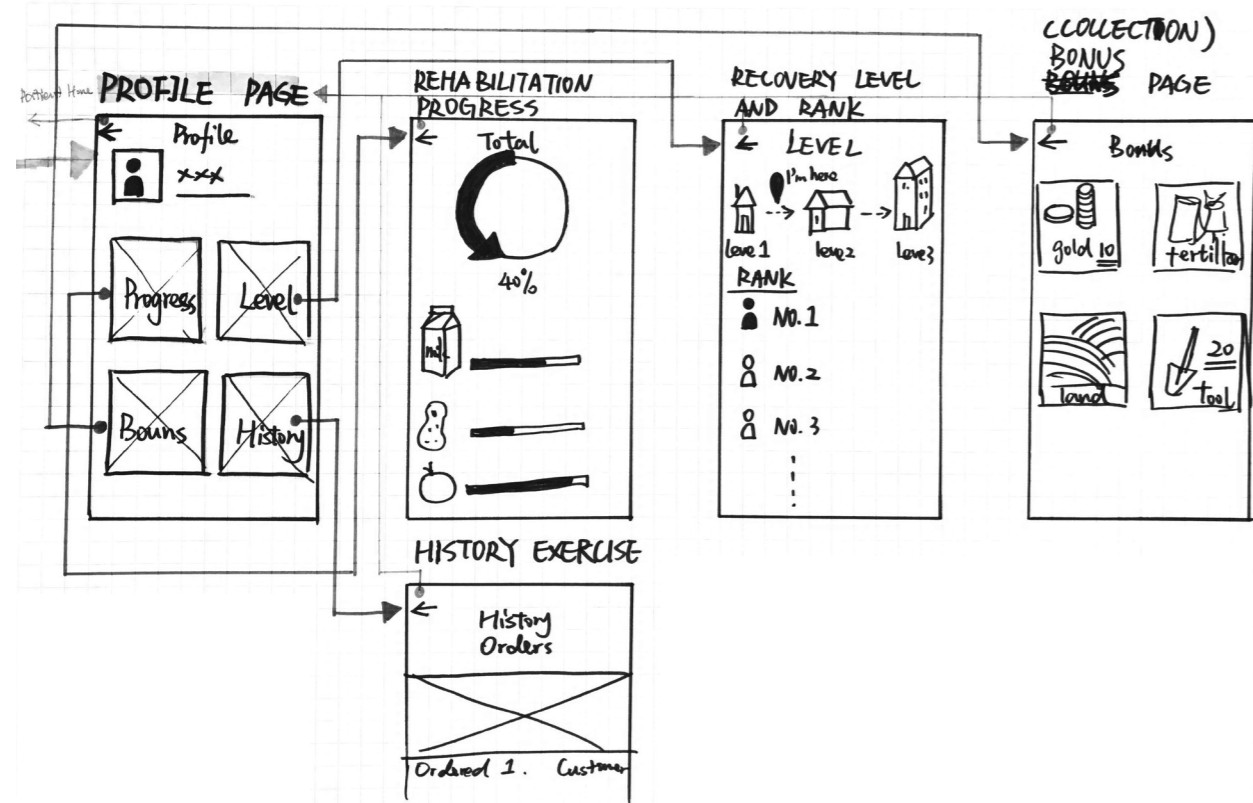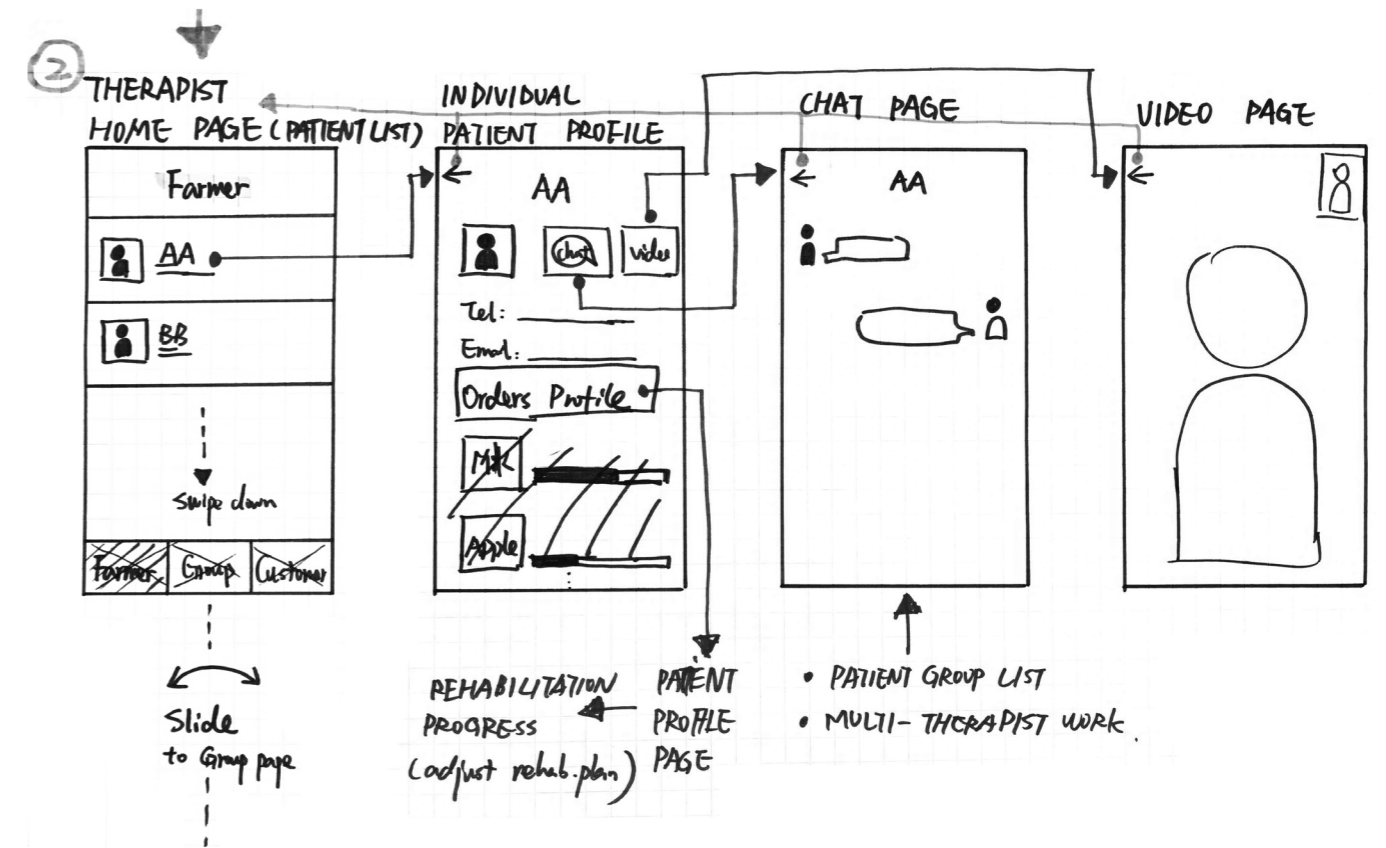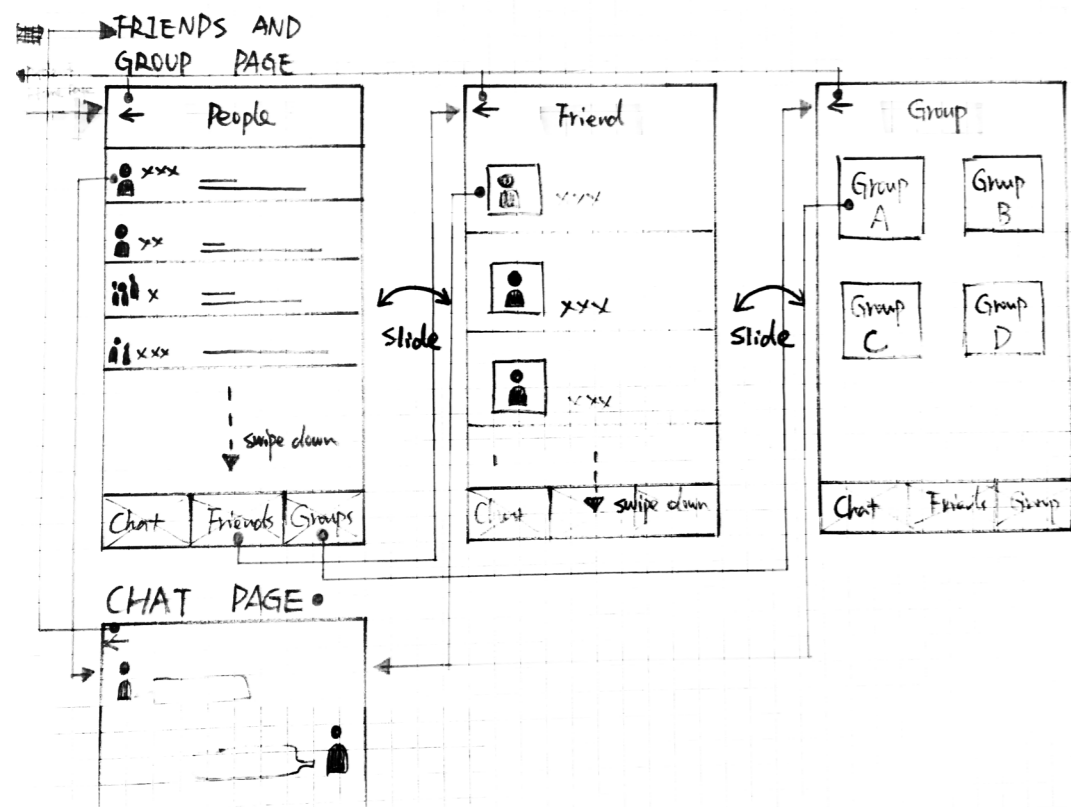Post-stroke Rehabilitation

2. Sign-in Page

LOGO **HAPPY VILLAGE**
Post-stroke Rehabilitation

First name or Email

Password

Sign In

Registration   Forgot ?

2.1 Create Account Page

Create Account

icon   or   icon
Farmer   **Storekeeper**

First name
Last name
Telephone
Email
Password

Sign Up

2.2 Forgot Page

Forgot ?

Email

Confirm

3. Patient Home Page

Full Farm Scene

icon   icon   icon   icon
Order Storekeeper People   Me

3.1 Order Page

Order

Milk
Completed 30%
ordered by Trey Taylor

Fish
Completed 60%
ordered by Rachel Holzman

Carrot
Completed 50%
16 participanted   ordered by Jessica Gray

Yarn
Completed 20%
6 participanted   ordered by Eden Dawn

Banana
Completed 90%
34 participanted   ordered by Amy Sall

Apple
Completed 50%
ordered by Lasse Fløde

Egg
Completed 70%
ordered by Boe Marion

Chicken
Completed 40%
45 participanted   ordered by Martin Margiela

Balloon
Completed 70%
ordered by Chidy Wayne

Song
Completed 20%
ordered by Kelsey Burrow

3.1(d) Group Occuptional Tharepy Page

Chicken Done 10 times
Completed 40%   45

Introduction

Welcome to the team work :)

Martin Margiela ordered 5000kg chicken. Please take care of chicks and feed them three times a day. You need deliver the order in 15 days.

Good Luck！

▶ **Start 11st Times**

3.1(e) Individual Speech Tharepy Page

Balloon Done 8 times
Completed 70%

Introduction

Chidy Wayne will visit your farm soon. Please blow up 15 balloons to welcome him. You need finish in 5 days.

Good Luck！

▶ **Start 9th Times**

3.1(a) Individual Physical Tharepy Page

Milk Done 7 times
Completed 30%

Action list   3 actions

Basic level
Make a Fist
10 times

Intermediate level
Five Finger Spread
10 times

Advanced level
Tip to Tip

▶ **Start 8th Times**

3.1(b) Individual Occuptional Tharepy Page

Egg Done 21 times
Completed 70%

Introduction

Boe Marion ordered 30 boxes of eggs. Please put eggs into the refered place of egg box by using one hand. You need deliver the order in 7 days.

Good Luck！

▶ **Start 22nd Times**

* The navigation map 01 will be printed in 1:1 and presented at sensor exhibition.

3.3(a) Social Page
Current Chatting Page

MyCall 13:01 70%
People

icon **Daniel Swift**
Hi, how are you? Let's group a team.

icon **Milk Group**
Hi Guys. How was your farms?

icon **Willian Blake**
I expanded my farm business :)

icon **Lord Byron**
I've collected 6 tools. How about you?

icon People icon Contact icon Group

3.3(b) Contact Page

MyCall 13:01 70%
Contact

🔍

icon Daniel Swift
icon Willian Blake
icon Lord Byron
icon Jane Austen
icon Denis Manning

icon People icon Contact icon Group

3.3(c) Group Chatting Page

MyCall 13:01 70%
Group

🔍

icon Milk Group
icon Yarn Group
icon Fish Group
icon Egg Group
icon Balloon Group

icon People icon Contact icon Group

3.3.1 Message Page

MyCall 13:01 70%
Daniel Swift

icon

icon

—— Yesterday ——

icon

icon

Type a message ⬆

3.2 Therapist Contacts Page

MyCall 13:01 70%
Storekeeper

🔍

icon Trey Taylor
icon Rachel Holzman
icon Jessica Gray
icon Eden Dawn
icon Amy Sall
icon Lasse Fløde
icon Boe Marion
icon Martin Margiela
icon Chidy Wayne
icon Kelsey Burrow

3.1.1 Video Exercise Page

Basic level
Make a Fist
10 times
⏸ 3:01

Basic level Make a Fist
▶ 3:01

3.4 Patient Profile Page

MyCall 13:01 70%
Me

icon

Jacob Smith

Order | Rank
Bonus | History

3.4(a) Patient
Rehabilitation Progress

MyCall 13:01 70%
Order

Milk
Egg
Apple
Yarn

Total
55%
70%
30%
50% 65%

3.4(b) Rank Page

MyCall 13:01 70%
Rank

icon **18** / 30
Jacob Smith current rank / total

icon Erin McCarthy 🥇
icon Micheal Prince 🥈
icon Ginger Ring NO. 3
icon Tina Susedik NO. 4
icon Even Grace NO. 5

3.4(c) Bonus Page

MyCall 13:01 70%
Bonus

35 Gold | **5** Fertilizer
2 Land | **17** Tool

3.4(d) History Page

MyCall 13:01 70%
History

Milk
Completed
ordered by Trey Taylor

Fish
Completed
ordered by Rachel Holzman

Carrot
Completed
16 participated ordered by Jessica Gray

Paper Mock-up

——

The paper mock-ups is an effective way to experience the game app before the first round testing by the digital prototype. The paper mock-up is a fake mobile frame(see fig 6.3. It can be slided on the printed navigation map to experience the interaction between human and user interface in order to find out better user ecperience. For example, the length of user interface is longer than the screen size because of its content, it is able to slide the interface to go down and go up to experience the interaction if it is the real application in the mobile device. For this phase,however, it is a better effetive way to experience the interaction by sliding the paper mock-ups on the printed navigation map (see fig 6.4).

Fig 6.3 Paper muck-ups.

Fig 6.4 Sliding interaction between user and interface by the paper mock-up

Digital Prototype and Testing

——

Digital prototype is a key section. It would much close to the real situation and get directly feedback from the testing. So it is the best way to experience the interaction of user and interface. The digital prototype is a simulated app made by Invision program and it can be tested on mobile.

I tried my best to contact with a hospital named Oslo Universitetssykehus, and the assistant helped me to look for voluntary testers by sending email. The result is that most of stroke patients more prefer to communicate in Norwegian instead of English. However, I cannot understanding Norwegian. So it is huge challenge for me to find the testers who are stroke patient.

One of the therapist suggested that the tester can be the adult persons who do not suffer stroke also. As the previously mentioned,the target group is the stroke patient who is at 5-7 recovery stay, The ability of this kind of patient has already much close to a "normal" adult person. Therefore, the testers include colleagues, relevant therapist and other adult person in the project.

All the following testings took place at the mobile device. The testing process is recorded by photo. The feedback and suggestions of the application come from post-testing discussion.

Testing 01

The **first** round testing is going to test :

1) The function and setting of the game.

2) The gamified process which transferred the exercises of occupational therapy into the farming activity games.

3) The information of game page.

4) The motivation point.

The following is the **feedback & suggestions** :

1) There is not necessary to set two role in the game. The only player of the mobile app can be the patient. The therapist more tend to login by website, according to their working condition.

2) The content of homepage need more simple to avoid complicated operation. The lands element can be the main picture of homepage(see fig 6.5(a)).

3) Classifying the 'order'page into 'day mode' and 'week mode'(see fig 6.5(b)).

4) Enriching the 'game' page. For example, adding a short introduction and displaying the participant list of the game (see fig 6.5(c)). Patients would be more clear before start the game.

5) The way of playing video need to be considered more, especially the way of recording the result of exercise process. It depends on the duration or times of exercise (see fig 6.5(d))?

5) The motivation need be more stronger. Highlighting the 'rank' element or adding more interactive operation, for example.

Fig 6.5(a) shows one of key suggestion gained from the post-testing discussion. In the homepage, it is better to change the four options on the bottom into three or two options. The storekeeper, the second option, is not necessary to set. In the main area of homepage, the suggestion is to show farming lands, each piece of land links one kind of game. User can enter a game by tap the related land.

* The digital prototype of first version will be displayed by mobile phone at the censor exhibition.
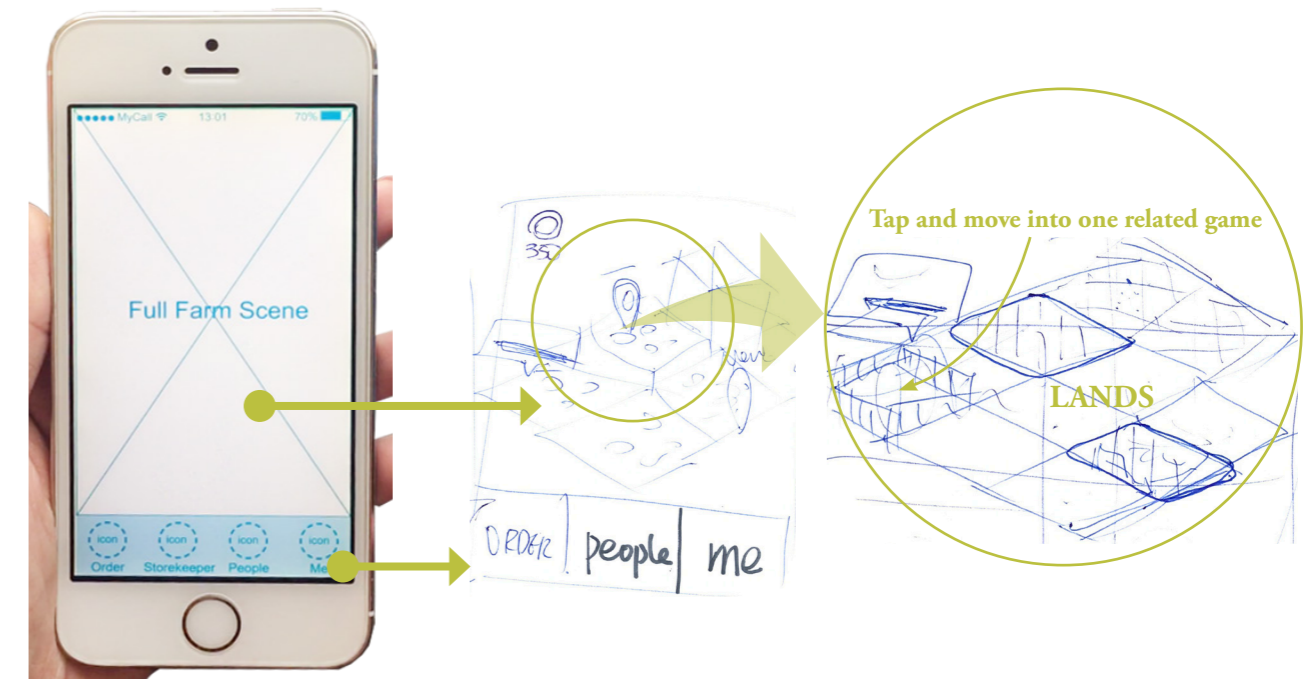
Fig 6.5(a) Suggestion on homepage.

Fig 6.5(b) shows another important suggestion on 'order' page. The 'order' page displayed all the games, these games stand for the exercises of occupational therapy. The suggestion is to classify the exercises into 'day mode' exercise and 'week mode' exercises. It is more clear and simple to know the rehabilitation plan.
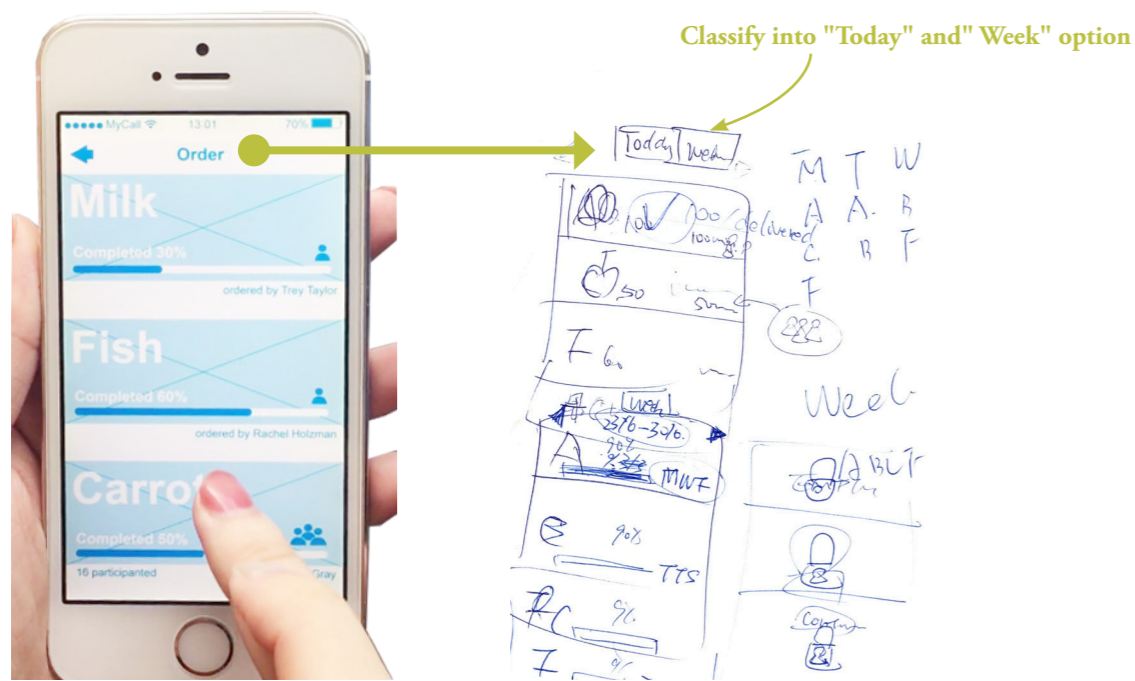
Fig 6.5(b) Suggestion on 'order' page.
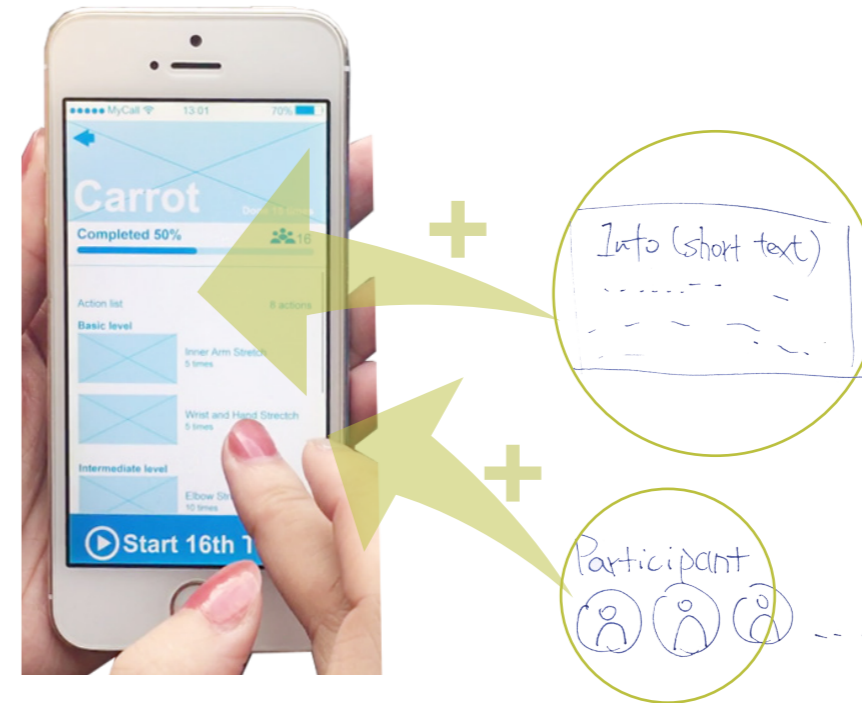
Fig 6.5(c) Suggestion on 'game' page.
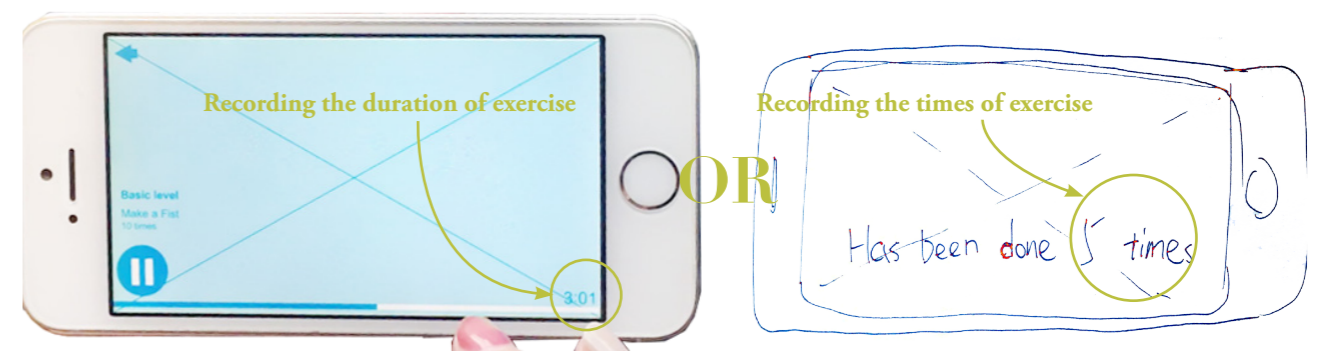
Fig 6.5(c) Suggestion on 'video' page.

Wireframe Navigation Map 02

The followings are some user interface picking from the second version of wireframe navigation map. It is the new and/or upgraded parts according to the above suggestions.

Coin is a new element. The rank depends on the number of cions. Tap it and move to check the cions.

Tap and move to profile page

Create Account Page

Homepage

Game Page

Assignment Page

Activity Page

Create Account

Name
Telephone
Email
Password

Sign Up

350

APPLE
Completed

Jacob
Smith

Milk
Processing

BALLOON
Processing

EGG
Completed

350

completed

Jacob
Smith

processing

processing

completed

Assignment   **Friend**

Milk

1.5 hours   Ordered by

Participant

Introduction
introduce how to complete the order and how many
golds the farmer can gain when he deliver the order.

Action list   3 actions

Make a Fist
10 times

Five Finger Spread
10 times

START

Assignment

Milk
1.5 hours   Processing

Apple
2.0 hours   Processing

Egg

TODAY   WEEK
Monday 20th   20th - 24th Feb.

◄ TODAY ►   WEEK
Mon.   20th - 24th
M   T   W   T   F

Milk Egg Apple Milk Balloon
Apple Milk Egg Egg Apple
Egg Yam Carrot   Yam
     Chicken Yam   Carrot
     Song   Chicken
Apple

Land

land

Land

land   0   +

coins   350

Purchase

Deleted the option of role. Sign up just for stroke patient.

The main area is the lands picture. The options in the bottom changed into two, assignment and friend. Patient would tap the assignment button or the circle mark on the lands to move to 'game' page.
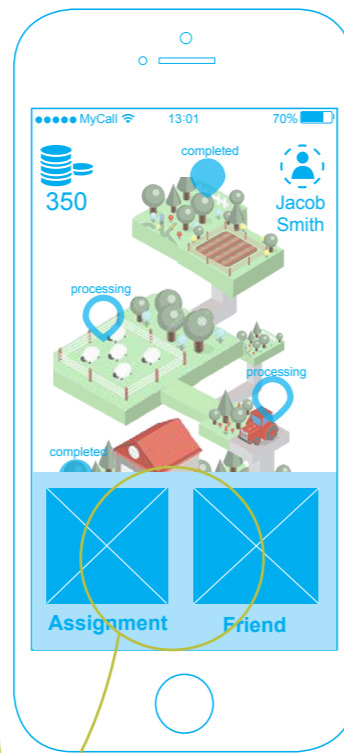
Added the information of participant and introduction into the 'game' page .
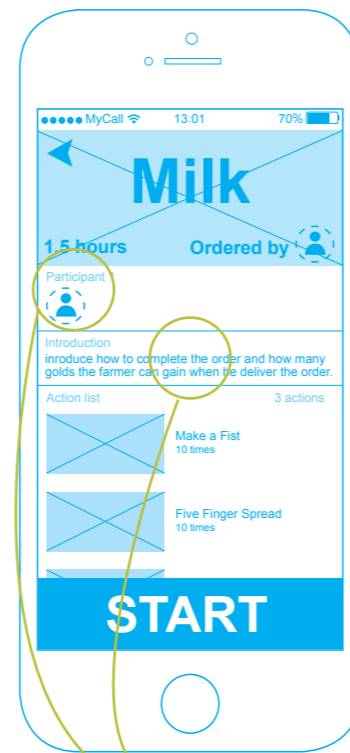
'Assignment' page divided into 'today' and 'week' mode. 'Today' mode shows one day's exercises. 'Week' mode shows exercise plan for one week.
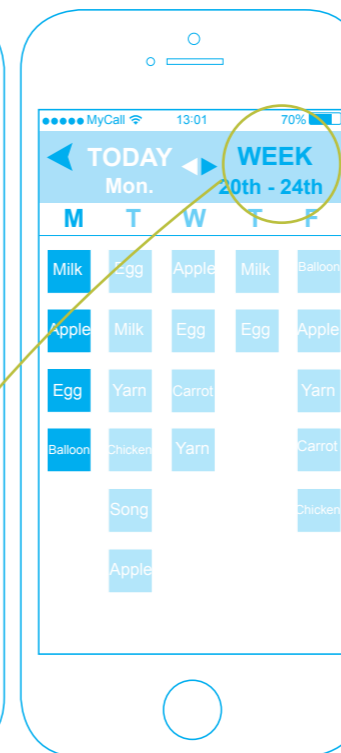
The 'activity'page is the new added page. The activities include 'purchase lands' and 'plant trees'.The aim of these activities is to increase the patient's motivation in the game.

* The whole navigation map 02 will be printed in 1:1 and presented at censor exhibition.

Testing 02

The **second** round testing is going to test :

1) The new and upgraded parts.

2) The calculation method, calculating the number of coins to evaluate the rank .
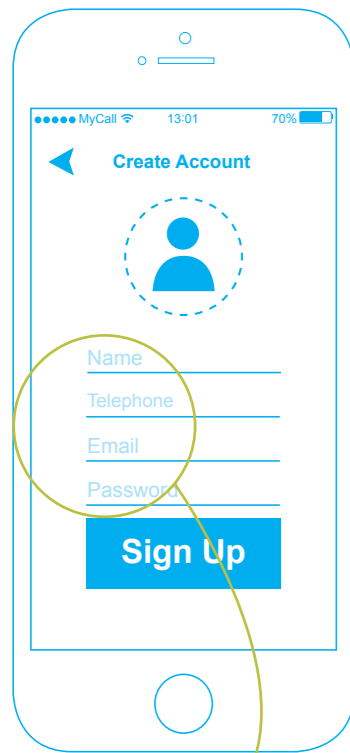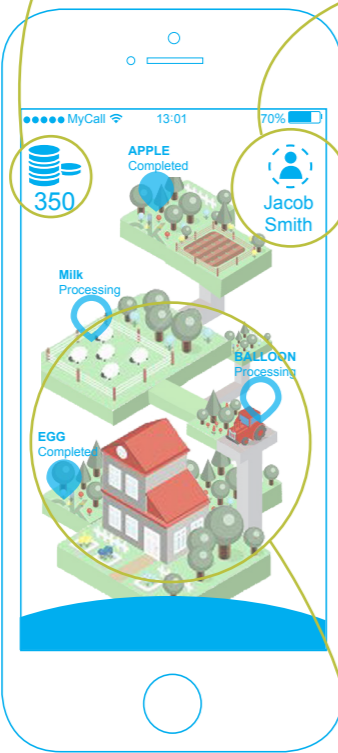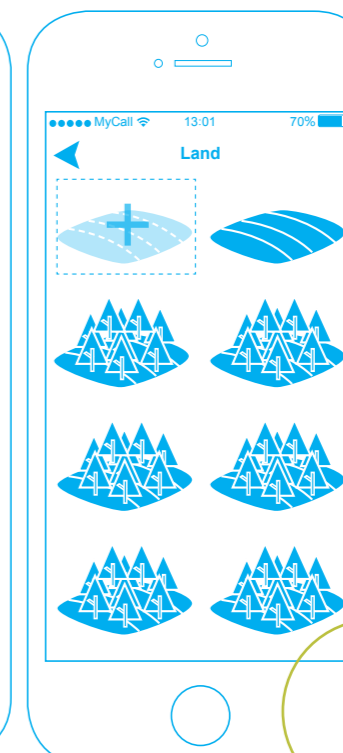
3) The motivation points.

4) The layout of user interface.

* The digital prototype of second version will be displayed by mobile phone at the censor exhibition.

The following is the **feedback & suggestions** :

1) There is a new idea to improve patient's motivation. Setting progressive levels for the farm game. It provides a positive way for patient to expanding their farm's scale by doing exercises (see fig 6.6(a)).

2) The operation of activity of purchasing lands and planting trees is too complicated. It embedded too many steps. ir need make it more easy (see fig 6.6(b)).

3) The evaluation method of the rank is good. The coin is a suitbale element.

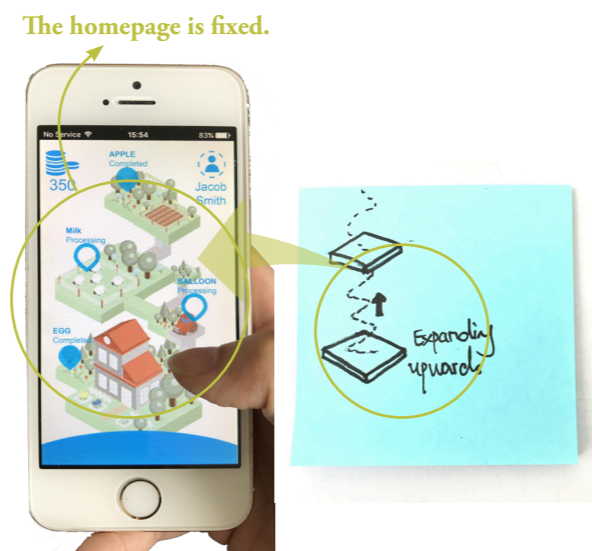4) The design and layout of the user interface can continue to develop till the best user experience.

Fig 6.6(a) New 'progressive level' setting.
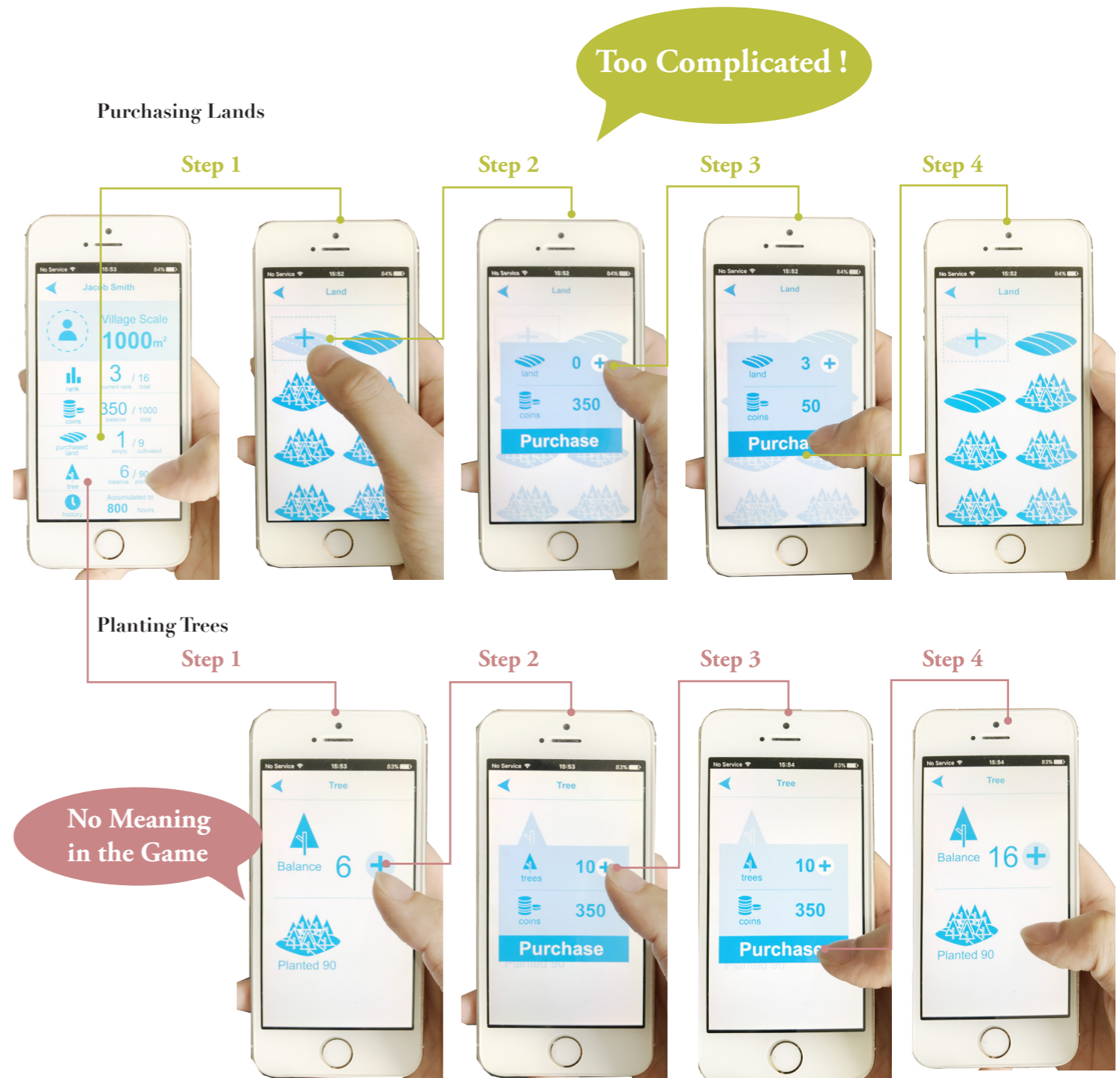
Purchasing Lands

Fig 6.6(b) The operation steps of 'purchasing lands' and 'planting trees'.

Wireframe Navigation Map 03

The followings are new and upgraded section from the third version of wireframe navigation map. I tried to make the game in third verison as simple as possible based on all of the above feedback and suggestions. This version save the coins as the only active element in the game. Players earn coins by completing games and their rank also rely on the number of coins. The rank is the key motivation point to motivate patient do exercise as much as possible so that reaching and keeping the number one. All of players would like to show good grade.

The most innovative point is the new progressive rule. the whole game setting is separated into lots of levels. There is a progressive relation between levels. Only if the player must complete all the current games and approved by therapist, the next level will unlock.Then the scale of farm would be expanded. The aim of setting is to provide strong game motivation to patient in a long-term but also to supervise the quality of recovery by therapist.

* The whole navigation map 03 will be printed in 1:1 and presented at censor exhibition.

Motivation point. The rank depends on the number of coins. The number of coins relies on how much exercise do.

Only if the player must complete all the current games and approved by therapist, the next level will unlock.

Patient   Therapist

Motivation point. Progressive rule motivates patient continues playing the game as long as possible till the end of the rehabilitation plan
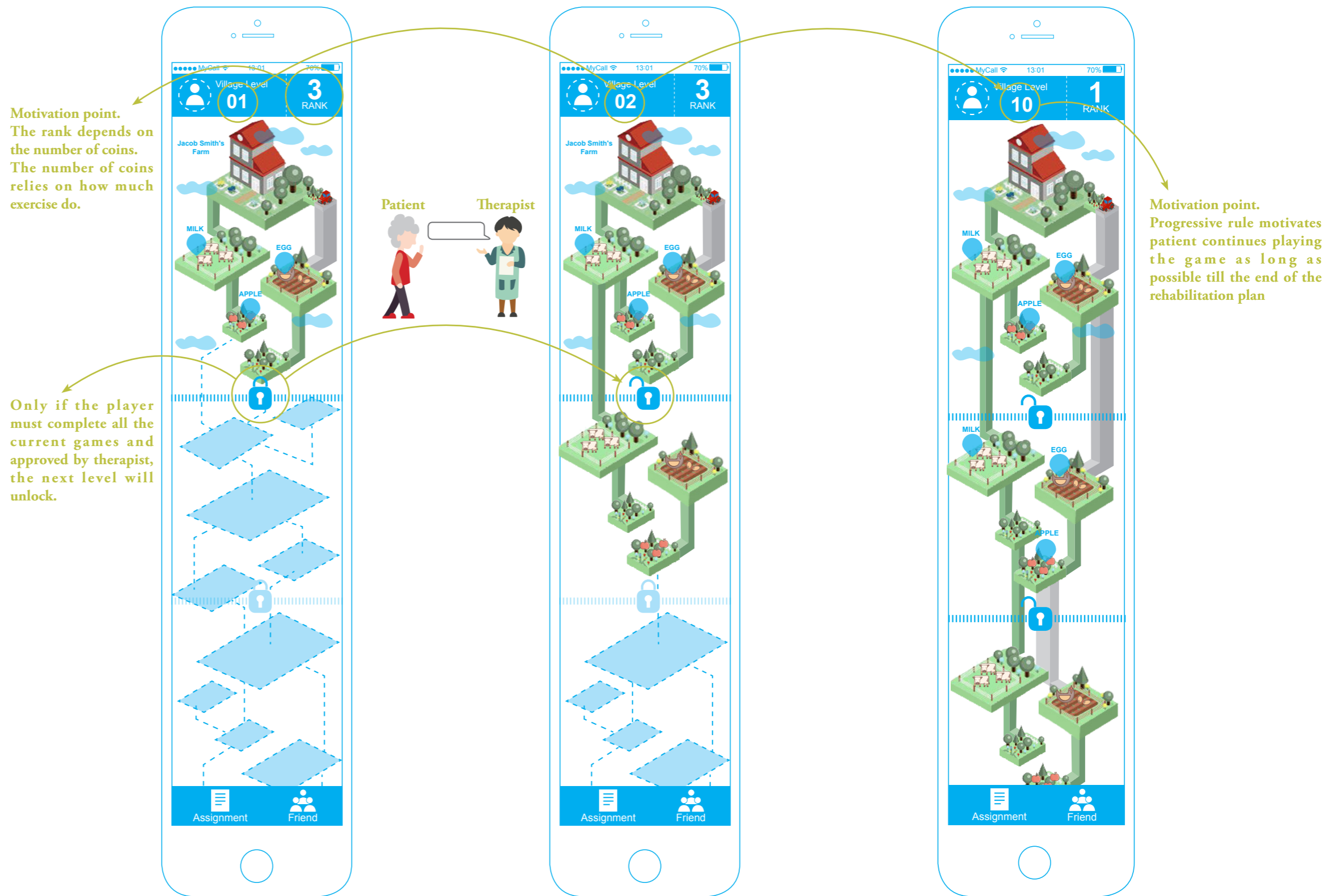
Testing 03

The **third** round testing is going to test :

1) The new progressive rule.

2) The fluency of the whole process and the completeness of the whole game.

3) The motivation points.

4) The layout of user interface and the detailed icon in the game.

* The digital prototype of third version will be displayed by mobile phone at the censor exhibition.

The following is the **feedback & suggestions** :

1) The progressive rule is a good motivation point for patient to engage the game for a long time.

2) The process of the game is almost fluent. The only point need to be mentioned is the lock unlock part. In what way to check and judge of the result of recovery (see fig 6.7(a)).

3) New idea for motivation. Creating an alterable part into the rehabilitation plan. The alterable parts include multi type of games, activities or events. It is up to the patient's favor. Patient even is able to share favorite picture. The aim of the idea is to integrate the game, farm story, into patient's real life (see fig 6.7(b)).

4) The design of user interface still need developing.

Fig 6.7(a) The communication between patient and therapist.

Fig 6.7(b) The idea of alterable parts.

Final Prototype with User Interface Design

Landing page

The game application is about a farm story. The farm is built in the sky with a fantastic structure. In order to bring more fresh to users, I choose the low-poly style as the user interface design style of the final prototype.

The followings are the main user interface. The digital prototype will be displayed by mobile phone at the sensor exhibition. Besides, I made a short animation to introduce the game app. It will be presented at the censor exhibition also.

LET'S FARM
Post-Stroke Rehabilitation

Homepage

Rank Page

Rank

3
340 Coins

Top Three

Amanda   985 Coins

Anna   410 Coins

Olga   340 Coins

Level 01 Rank 3

Olga's Farm

Picking Apples

Collecting Eggs

Milking

Games   Friends

Game Page

Games

Picking Apples Game

Collecting eggs Game

Milking Game

Game Page (individual mode)

Collecting eggs Game

Game Info
Mr. Ola orders eggs from your farm. You
can gain 1 coin when you deliver one egg.
Also you can group a team to earn double
or triple coins.

Group A Team
(invite your friends to pick apples together)

Performance

Action gif.

- Tip 1
   need infomation from professional
- Tip 2
   need infomation from professional
- Tip 3
   need infomation from professional

START

Friends

Milking Group

Amanda

Anna

Daniel

Denis

Edel

Jane

Solveig

Sigrid

Turid

Willian

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z #

Confirm

Game Page (team mode)

Collecting eggs Game

Game Info
Mr. Ola orders eggs from your farm. You
can gain 1 coin when you deliver one egg.
Also you can group a team to earn double
or triple coins.

Group A Team
(invite your friends to pick apples together)

Performance

Action gif.

- Tip 1
   need infomation from professional
- Tip 2
   need infomation from professional
- Tip 3
   need infomation from professional

START

Game Page (individual mode)

◀ **Picking Apples Game**

Game Info
Mr. Larsen orders apples from your farm. You can gain 1 coin when you deliver one apple. Also you can group a team to earn double or triple coins.

Group A Team
(invite your friends to pick apples together)

Performance

Action gif.

- Tip 1
  need infomation from professional
- Tip 2
  need infomation from professional
- Tip 3
  need infomation from professional

START

Video Page (individual mode)

◀ **Picking Apples Game**

🍎🍎 Has done **3** apples

⏸

Picking Apples Game

Picked **3** apples

Deliver **Continue**

🍎🍎 Has done **3** apples

Picking Apples Game

Congratulations !

Got **3** coins

🍎🍎 Has done **3** apples

Individual mode: 1 apple = 1 coin

Game Page (teammode)

◀ **Collecting eggs Game**

Game Info
Mr. Ola orders eggs from your farm. You can gain 1 coin when you deliver one egg. Also you can group a team to earn double or triple coins.

Group A Team
(invite your friends to pick apples together)

Performance

Action gif.

- Tip 1
  need infomation from professional
- Tip 2
  need infomation from professional
- Tip 3
  need infomation from professional

START

Video Page (team mode)

◀ **Collecting eggs Game**

🥚🥚 Has done **6** eggs

⏸

Collecting eggs Game

Picked **6** eggs

Deliver **Continue**

🥚🥚 Has done **6** eggs

⏸

Collecting eggs Game

Congratulations !

Got **18** coins

🥚🥚 Has done **6** eggs

⏸

Team mode with two person : 1 egg = 2 coins
Team mode with three person: 1 egg = 3 coins

Level **01** | Rank **3**

Olga's Farm

Picking Apples

Collecting Eggs

Milking

Games | Friends

Frineds Page

Friends

Milking Group Chat
Hi guys, Have you completed ...   19:20

Anna
Hi, how are you? Let's group a ...   10.30

Daniel
I've upgraded my farm just now ...   Yesterday

Amanda
See you tomorrow :)   Yesterday

Edel
Good night.   Yesterday

Willian
Hi, how are you? Let's group a ...   Yesterday

Jane
I collected many eggs and gain ...   5 April

Danis
Hi, how are you? Let's group a ...   23 March

Sigrid
Hi, how are you? Let's group a ...   18 March

Chats | Contacts

Friends

Milking Group

Amanda

Anna

Daniel

Denis

Edel

Jane

Solveig

Sigrid

Turid

Willian

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z #

Chats | **Contacts**

PROSPECT

In the chapter, it explored the potential development in the future, especially the application in the virtual reality device.

Future Development
of
the Conceptual Solution

————

Due to the limitation of time and individual ability, it leaves much potential for the future development of the gamified post-stroke rehabilitation service. Mobile application is the media to convey the farm narrative in the master project. For me, a master student, it is a practical and effective tool to do testing, even though the size of screen is a big limitation. In fact, a device with big screen can be the better media platform, such as television or projector. The interaction between the user and media would be more rich. The motivation would be stronger. The desire of recovery would be much enhanced. Finally, the quality and effectiveness of post-stroke rehabilitation would be much improved.

Besides of the possibility of media development,the testing section possesses deeper space to dig. The testers is a critical limitation in the master project. This testing should be improved a lot as long as the stroke patient is able to test in the future.

Finally, with the study on transmedia storytelling deeper and deeper, there is a huge opportunity to develop the conceptual solution in the future.

The Potential
of
Virtual Reality Device.

————

The term, virtual reality (VR), is pretty popular in recent years and would be applied widely in the future. Many companies has already developed VR device and program. Its main consumption market is electronic game so far. Based on this master project, gamified rehabilitation service, it is easy to be transferred into VR concept to be applied in the field of healthcare. According to the knowledge from UNIK course, it can become an innovation in product(service) space and position space. Product(service) space and position space are the two elements in the innovation space model (see fig 7.1).

In brief, it would probably create an innovative rehab model in the field of healthcare.
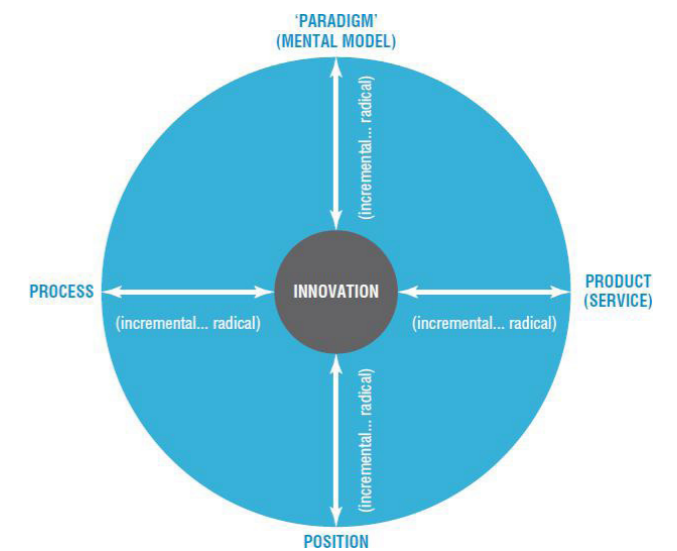

Fig 7.1 The 4Ps of innovation space.
Source: Joe Tidd & John Bessant, (2012), Managing Innovation.

REFERENCE

Zheng X, Chen G, Song X, Liu J, Yan L, Du W, et al. Twenty-year trends in the prevalence of disability in China.World Health Organ. 2011 Nov 1;89(11):788–97. doi: http://dx.doi.org/10.2471/BLT.11.089730 PMID: 22084524

Kirkwood TB. A systematic look at an old problem. Nature. 2008 Feb 7;451(7179):644–7. doi: http://dx.doi.org/10.1038/451644a PMID: 18256658

Young Y, Frick KD, Phelan EA. Can successful aging and chronic illness coexist in the same individual? A multidimensional concept of successful aging. J Am Med Dir Assoc. 2009 Feb;10(2):87–92. doi: http://dx.doi.org/10.1016/j.jamda.2008.11.003 PMID: 19187875

Marengoni A, Angleman S, Melis R, Mangialasche F, Karp A, Garmen A, et al. Aging with multimorbidity: a systematic review of the literature. Ageing Res Rev. 2011 Sep;10(4):430–9.http://www.goldcopd.it/gruppi_lavoro/2013/ageingmultimorbidityreviw2011. pdf Available from: accessed August 17 2015). PMID: 21402176

Baera B, Bhushan A, Abou Taleb H, Vasquez J, Thomas R, Fergusen L. The right to health of older people. Gerontologist. 2016 (In press).

Ageing in the twenty-first century: a celebration and a challenge. New York, London: United Nations Population Fund; HelpAge International; 2012 (http://www.unfpa.org/sites/default/files/pub-pdf/Ageing%20report.pdf, accessed 20 July 2015).

Political declaration and Madrid international plan of action on ageing. New York: United Nations; 2002 (http://www.un.org/en/events/pastevents/pdfs/Madrid_plan.pdf, accessed 4 June 2015).

Aboderin IA, Beard JR. Older people's health in sub-Saharan Africa. Lancet. 2015 Feb 14;385(9968):e9–11.doi: http://dx.doi.org/10.1016/S0140-6736(14)61602-0 PMID: 25468150

Mattelmäki, T. (2006). Design probes. in Vaajakoski, Finland.

Heffernan, C. document analysis. Retrieved from http://www.drcath.net/toolkit/document.html

Jenkings, K. N., & Rapley, T. (2010). document analysis International Encyclopedia of Education (pp. 380-385).

Lazar, J., Feng, J. H., & Hochheiser, H. (2010). Research methods in human-computer interaction. Chichester: John Wiley.

Miller, W.L. and Crabtree, B.F. (1999) Clinical research: A Multimethod typology and qualitative roadmap. In B.F. Cratree and W.L. Miller (eds), Doing Qualitative Research. Thousand Oaks, CA: Sage Publication.

Quesenbery, W., & Brooks, K. (2010). Storytelling for User Experience: Crafting Stories for Better Design: Louis Rosenfeld.

Sevaldson, B. (2011). Giga-mapping visualization for complexity and system thinking in design. Paper presented at the 4th Nordic Design Research Conference, Helsinki. https://designcalls.wordpress.com/2010/07/28/nordes2011-4th-nordic-design-research-conference-mayjune-2011-helsinki/

Lewis, J. (2006) Smaple sizes for usability tests: Mostly math, not magic. *interactions*,13(6):29-33.

Schusteritsch, R., Wei, C., and LaRosa, M.(2007) Towards the perfect infrastructure for usability testing on mobile device. *Proceedings of the ACM Conference on Human Factors in Computing Systems,* 1839-1944.