

Master's Programme in Urban Studies and Planning
MSc in Architecture

Master's Thesis

Ideas of future exterior environments for memory-friendly neighborhoods

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Abstract

Memory decline (MD) among the elderly is a growing global challenge. With the progression of MD, many seniors face relocation to memory-care-oriented facilities or isolation in their homes. Decreases in the level of physical activity and social connections are negative.

This thesis aims at designing a forward-looking neighborhood where people with MD could enjoy outdoor activities more independently instead of staying indoors. Such a neighborhood supports independent activities with a memory-friendly physical environment, enhanced with technology. The concept promotes social participation and prevents social isolation among seniors with cognitive impairment.

The concept of the memory-friendly neighborhood includes 3 elements:

- Developing a memory-friendly outdoor environment.
- Making the public services, recreational places, green zones accessible within 15 minutes.
- Applying the technology to support their outdoor activities.

The designed strategy prospected future memory-friendly neighborhoods. This thesis showed the memory-friendly neighborhood scenarios in the pilot area in the selected neighborhood in Helsinki and discussed possible assistive technologies that can be implemented in the current urban infrastructures to make them more memory-friendly.

Keywords

Memory-friendly neighborhood, Exterior environment,
The 15-minute city for MD,
Technology-advanced, Social participation

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Introduction

Memory decline is a global challenge, especially among the elderly. By 2050, it is expected to impact 152 million people worldwide (Alzheimer's Association, 2021). Living in a memory-oriented care facility is no longer people's expectation of fighting this chronic disease. Due to their physical, psychological, and social health factors, the limited capacity of residential care facilities, and the shortage of caregivers, a change in care mode is necessary. WHO released "Towards a dementia inclusive society: A WHO toolkit for dementia-friendly initiatives (DFIs)" in 2021 as a response to the need to develop a memory-friendly society to support the elderly in their own home. People in Finland pay more attention to the gradual decline of memory.

A society with high levels of aesthetic and performance quality (such as safety, comfort, and convenience) is what people with MD come to expect. The neighborhood is the context setting. One possible approach is to apply smart technology to support their independent outdoor journey in daily life and encourage them to live at home. When people experience slow perception, disorientation, or wander in their daily independent journeys, technology can play a critical role in compensating for people with MD (MD). The technology ensures their safety while they move independently in the outdoors. Accessible urban context and social service contribute to a technology-oriented exterior environment.

This paper summarized the innovative technologies that support people with MD in their independent outdoor activities and provided a framework for an accessible neighborhood. The aim is to let people with MD enjoy the outdoors independently and foster an inclusive neighborhood where they can live respectively and age gracefully.

Methodology

The idea of a memory-friendly neighborhood was mainly inspired by the Memory Inclusive Society (WHO, 2021).

To establish the memory-friendly neighborhood, the thesis first reviewed the relevant literature and then summarized:

- The model of memory care from the past to now.
- The benefits and challenges of exterior environments for people with MD.
- The current technology to support their daily lives and the advantages and limitations of the technology.

In the thesis, technology-oriented strategies were developed at a neighborhood scale to support independent social activities and participation. Based on the strategies, the thesis selected Kustaankartano and its surrounding area as the pilot site to implement the memory-friendly neighborhood design. Finally, the thesis concluded the shortcomings and looked forward to the future.

1

Memory decline and aging

In this chapter, the thesis introduces the relationship between memory decline, dementia, and aging. And briefly describes the memory decline situation worldwide and in Finland.

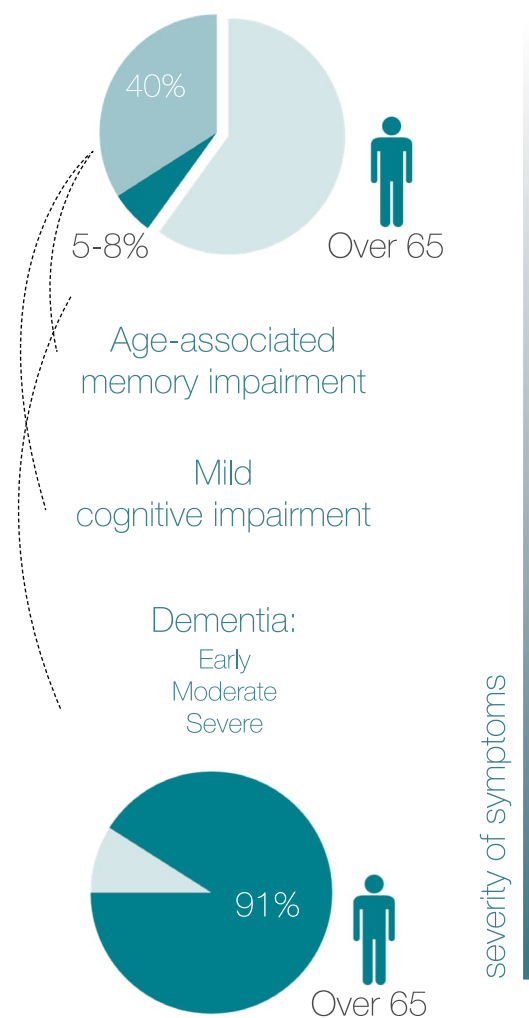


Figure 1.1 Different Stages of MD

1.1 Memory decline worldwide

Memory decline (MD) is a global challenge. Dementia, as a more severe stage of MD, has affected more than 55 million people globally, with nearly 10 million new cases each year (WHO, 2021b). WHO included it as a public health priority because, among all diseases, it is the seventh leading cause of death. It is also one of the major causes of disability and dependency among the elderly.

The actual number of people who suffer from MD may be higher. According to a European survey (Brooker et al., 2014), most countries had a huge amount of missing reports of dementia diagnoses. Generally, it is from 40% to 60%, but in some countries, missing reports are over 60%, while the least reported missing is 30%. Usually, people have already been in a moderate or severe stage when diagnosed. However, a diagnosis of dementia is used as a necessity for receiving statutory health care and services.

1.2 Aging, memory decline and dementia

Aging is a natural process and contributes to MD. However, MD is not an inevitable consequence of biological aging.

MD is progressive. Even though people experience MD, it does not mean dementia. Before dementia, some seniors had some age-associated memory impairment, which means they may have difficulties remembering things on occasion or could not remember things as quickly as they used to. Mild Cognitive Impairment (MCI) is the condition between age-associated memory impairment and dementia (Alzheimer Society of Canada, 2021). The symptoms include difficulty speaking, disorientation, etc. These symptoms are not severe enough to interfere with their daily functions and routines at this stage.

People in the mild stage do not necessarily progress into a severe condition. Still, they are at a higher risk of developing dementia. According to the WHO report (2021b), after 65, almost 40% of people would have some form of MD, while only 5 to 8% will develop dementia at some point.

Dementia is a syndrome. It includes MD and severe deterioration of cognitive function. The first symptom is short-term memory loss, followed by long-term memory loss, language difficulty, problem-solving difficulties, and other problems with cognitive functions (WHO, 2021b). There are three stages of dementia based on severity: early, moderate, and severe. More than 90% of diagnosed cases happen to seniors over 65 (WHO, 2021b). Although there are no universally accepted and effective treatments available (NHS, 2021), up to 40% of dementia cases may be prevented or delayed (Orgeta et al., 2018).

1.3 Memory decline in Finland

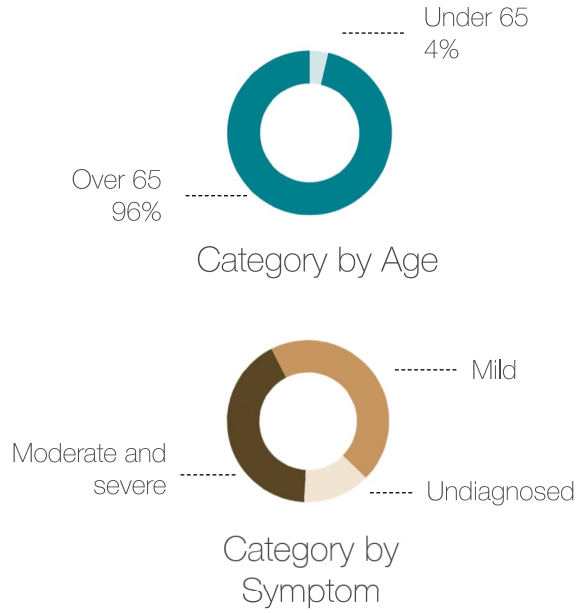


Figure 1.2 The Categories of MD

Gardner (2013) estimated 193,000 people with dementia, and 100,000 in the mild stage in Finland. The elderly are still the main group. Only 7,000 Finnish with dementia were under 65.

Around 14,500 people are diagnosed with dementia or a related disease yearly. Inevitably, there is still a proportion of MD remaining undiagnosed.

At the end of 2020, around 1.26 million people were 65 years and older in Finland. One out of every three people over 65 reported suffering from MD (Koivisto et al., 1995). Based on this ratio, around 420,000 people are suffering from MD.

Summary

Memory care is necessary but cannot be generalized. As mentioned above, people suffer from different levels of memory loss, and their needs vary. Therefore we need to consider and meet their needs separately.

Memory care is urgent. Considering the missing reports and age-associated MD, the number of people suffering from MD is far more than the number shown to us. With the rising aging trend in our society, more age-related MDs are likely to occur. We need to consider and prevent this situation, including the future shortage of facilities and care resources.

Memory care should be acted on earlier. Therefore, it would be able to delay and prevent memory deterioration rather than looking for remedies after diagnosis.

2

Exterior environment for people with memory decline

This chapter reviews and summarizes the benefits and challenges of exterior environments for people with MD. There are three current living modes for people with MD, each with its own advantages and disadvantages. This chapter also concludes the main outdoor activities for people with MD.

2.1 Exterior environment and its benefits

Exterior environment for people with memory decline

It is not new to create a friendly environment through design for people with MD. Since the 1980s, environmental design principles for dementia have been developed and expanded (Fleming et al., 2020). The indoor environment has attracted researchers and designers for a long time. The outdoor area has gradually expanded over the past few years. In this study, outdoor areas included the front yard, the neighborhood, and other public places.

The quality and atmosphere of care are essential for the health outcomes of people with MD. Accessing meaningful exterior activities and interacting with society enhances physical and cognitive functioning (McDermott et al., 2019). According to Orgeta (2018) and the Lancet Commission (Livingston et al., 2020), lack of physical activity, infrequent social interaction, and depression are three risk factors in the MD deterioration and prevention model regarding the exterior environment.

In the course of MD, deterioration in memory and cognitive abilities affects everyday activities (WHO, 2021b). Meanwhile, the uncertainty and insecurity caused by complex dynamics outside make it more difficult for them to participate in the exterior environment. Even worse, the effects of MD are more than expected. Natural England (2016) indicated that only 20% of patients with MD have difficulty using exterior areas, while caregivers claim 83% have trouble using them. Most people crave exposure to the outdoors rather than being trapped indoors. Mild cognitive impairment allows them to manage exterior activities through their physical abilities. However, they would gradually lose the ability to move independently if they stayed indoors for a long time. Therefore, how to deal with the challenges posed by the outdoor environment is the prerequisite to taking advantage of its benefits to people with MD.

Benefits of outdoors

• Physical benefits

Physical benefits include skin health, sleep patterns, reduced restlessness, and eating patterns. Friedman (1991) found that taking a structured walk three times a week for people with MD improved their communication abilities significantly. Being exposed to natural light can improve cognition, memory, and concentration (Riemersma-van Der Lek, 2008). Moreover, people with MD engaged in outside activities have better sleep quality than those who only participate in indoor activities (Hughes et al., 2013).

• Psychological benefits

Getting outdoors can improve the emotional state, uplift the spirits, and reduce stress levels. It could also strengthen the sense of self-control and reduce aggression and agitation (NIA, 2017). Just 10 to 15 minutes outside each day can improve the mood, agitation, apathy, and sadness of people with MD (Abbots Care, 2020). Alzheimer's Association (2021) stated that taking a walk outside might help to alleviate their loneliness and isolation.

• Social benefits

Social participation is an essential part of society's integration. Engaging in the outdoors and social activities has been proven to reduce dementia risk and prevent MD deterioration (Andrews, 2017; Gove, 2017). For people with MD, continuing their original social life maintains their dignity, self-management, and self-esteem (Kristanti, 2017). It can also increase their living experience, decrease the feeling of social isolation, and lift the sense of social belonging (Huber et al., 2011; Vernooij-Dassen & Jeon, 2016).

2.2 Exterior environment in different living mode

MD was regarded as a mental illness in the past. People with MD were typically placed in mental hospitals until the mid-twentieth century as a method to get them "out of sight."

MD is a chronic illness. Its related cognitive impairment is one of the leading causes of dependency, incapacity, and admission to residential and nursing care facilities. As of now, memory care is being provided in long-term care facilities and at homes with daycare supports. A high proportion of people with severe MD live in long-term care facilities. And others living at home are usually in mild condition, or they can obtain private care at home base.

Long-term care facilities

• Traditional care facilities

The traditional memory care facilities include residential care facilities, assisted living facilities, and nursing homes. In high-income countries, between 33% and 50% of people with MD were estimated to reside in these care facilities (Prince et al., 2013).

The differences between these facilities are (NIA, 2017):

- At the residential care facilities, personal care and meals are provided. Assistance is available 24 hours a day, seven days each week. But on-site nursing and medical treatment are not available.
- Assisted living facilities are for seniors who require daily assistance but not as much as nursing homes.
- Nursing homes offer a wide range of medical and personal care services centered on medical treatment.

People can obtain more professional and timely care in long-term care facilities than in their own homes. For their caregivers, it is much easier to offer timely help and meet their demands if they live together.

The greatest problem for long-term facilities is that staying in a fixed environment for a long time harms their physical and mental health, aggravating their illness and the sense of isolation from society (Andrews, 2017). But after measuring safety and the help that caregivers can offer, this issue has been selectively ignored. Although the outer space has gradually been valued in residential care facilities, the main outdoor activities for people with MD are restricted to the attached areas, such as front-door gardens (Schwarz, 2008).

• The village for memory decline

The memory-oriented village concept aims to introduce a non-institutional, patient-friendly approach to simulate an actual residential area by duplicating the neighborhood living mode. There is a paradigm shift in memory care through interventions in the building environment and service provision.

De Hogeweyk is a typical case in the Netherlands. People with MD can get together with family and friends in restaurants, go shopping at the supermarket, visit the theater, or participate in the many offered clubs. And they can freely walk or cycle around within the village. This concept accommodates each resident's unique needs, lifestyles, and individual preferences, allowing them to live a normal life and forget the misery of memory loss. The continuous practice of reminiscence therapy enables people with memory here to be more active and require less medication (Dementia Village Hogeweyk, 2022). The village showed the potential for people with MD who engage in the neighborhood frequently.



Figure 2.1 The living scenes in De Hogeweyk

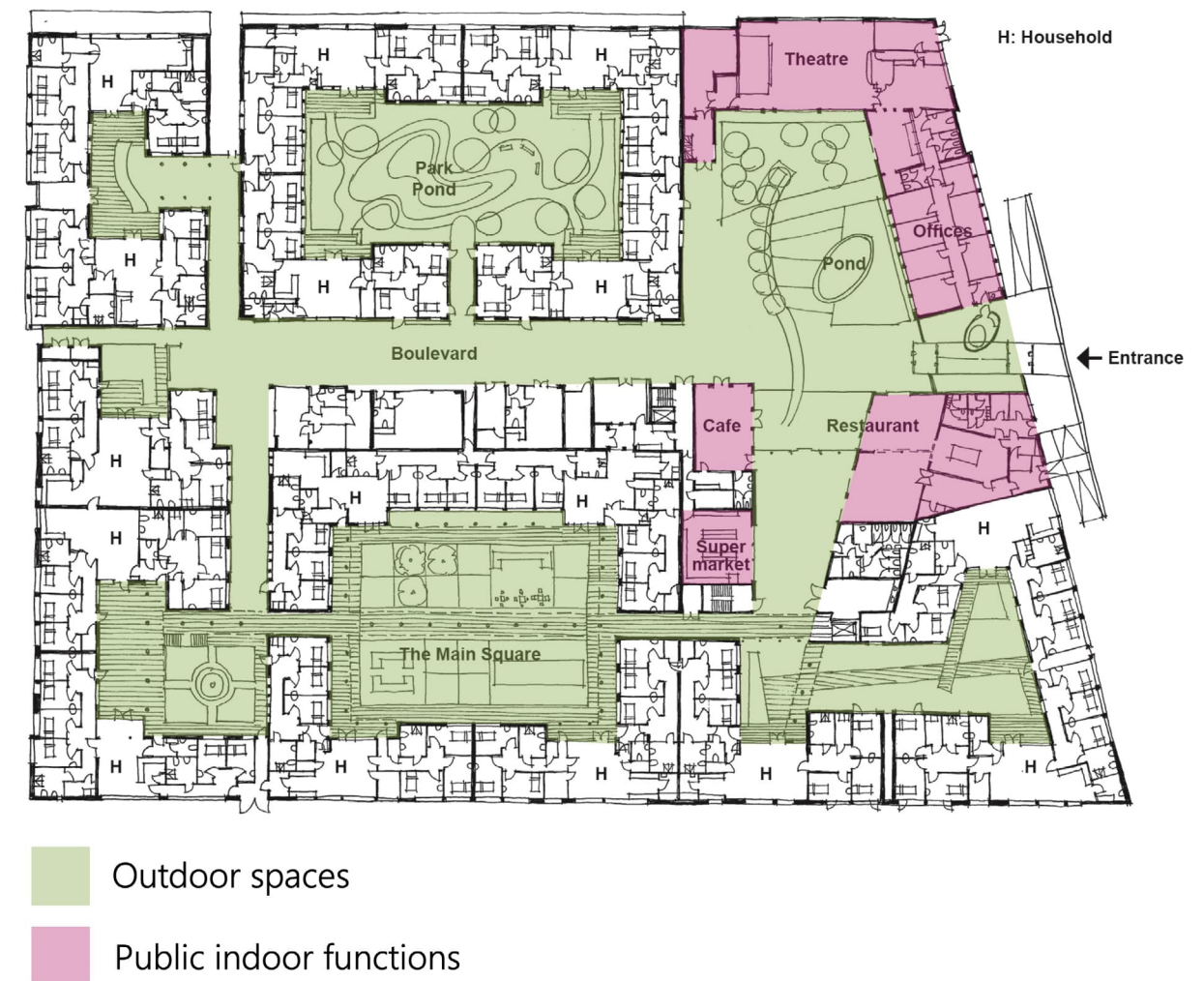


Figure 2.2 The 1st Floor Plan of De Hogeweyk
(Source: <https://hogeweyk.dementiavillage.com>)

The concept of the village increases the variety of the exterior environment for the people with MD who live here but are restricted by the village's boundary. There are some critical viewpoints for this gated village model:

It is still a 'Fake' village.

Chrysikou (2018) and Shannon (2020) both agreed that the sensation of "fake" architecture is the result of the village's proximity and the lack of amenities in the area. Residents live in the village for the rest of their lives but still look like guests, not hosts.

To maintain the village needs many human resources.

There are 250 employees totally, including carers, doctors, nurses, and 120 volunteers to provide the 152 residents' care (Dementia Village Association, 2018).

Segregation and loneliness

Those villages are mostly located in remote areas. People who live there communicated less with the younger generation or the people out of the villages. It leads to social and age segregation and might promote loneliness (Chrysikou, 2018). Meanwhile, if people are not the family members of residents, visiting seems like a forbidden invasion (Shannon, 2020).

Despite its limitations, the village concept for people with MD still inspired other parts of the world, such as Strømmehaven and Carpe Diem Dementia Village in Norway, Le Village Landais Alzheimer in France. These all villages created by the same agency BeAdvice (<https://www.bethecareconcept.com/>).



Figure 2.3 Carpe Diem Dementia Village, Norway
(source:www.bethecareconcept.com/en/case/carpe-diem-dementia-village/)



Figure 2.4 Strømmehaven, Village in Norway
(source:www.bethecareconcept.com/)

• Living at home

Aging in place refers to staying in people's own homes as they grow older instead of moving to a care facility (Wiles et al., 2012). It relieves the burden of the limited capacity of the long-term care facilities and follows the living wishes of people with MD (Sury et al., 2013)

Rather than being locked at home, living at home is about keeping a close relationship with the outdoors and society rather than being in unfamiliar surroundings. Although people suffer from MD, they still have the initiative to decide whether, when, and where to go independently. They can also decide what kinds of activities they want to participate in. Familiarity makes them feel comfortable and gives them a sense of safety.

Whether people with MD can access enough care and support at home or nearby is the dilemma of living at home. Increasing demand for caregiving would lead to a serious shortage of caregivers and add to the burden on their family members. Living alone with MD usually suffers from loneliness and social isolation (Poey, 2017).

Summary

The image summarized the enlarged scope of the exterior environment for people with MD in their daily activities. Following the development of care modes mentioned above, individuals can live in a single building, a memory village, or live at home to continue living in the community. It shows that people have caught the idea of an exterior environment and social participation and tried to put these into practice.

Different care modes meet the different situations and conditions individually. If people have suffered from severe MD, it may be better to live in a care facility where they can obtain timely and comprehensive care. But for those in the mild stage, living at home is ideal for preventing deterioration at the beginning of MD.

For those living at home, the neighborhood is the ideal and essential setting to go out and participate in society. It provides individuals with a connection to their home and community.

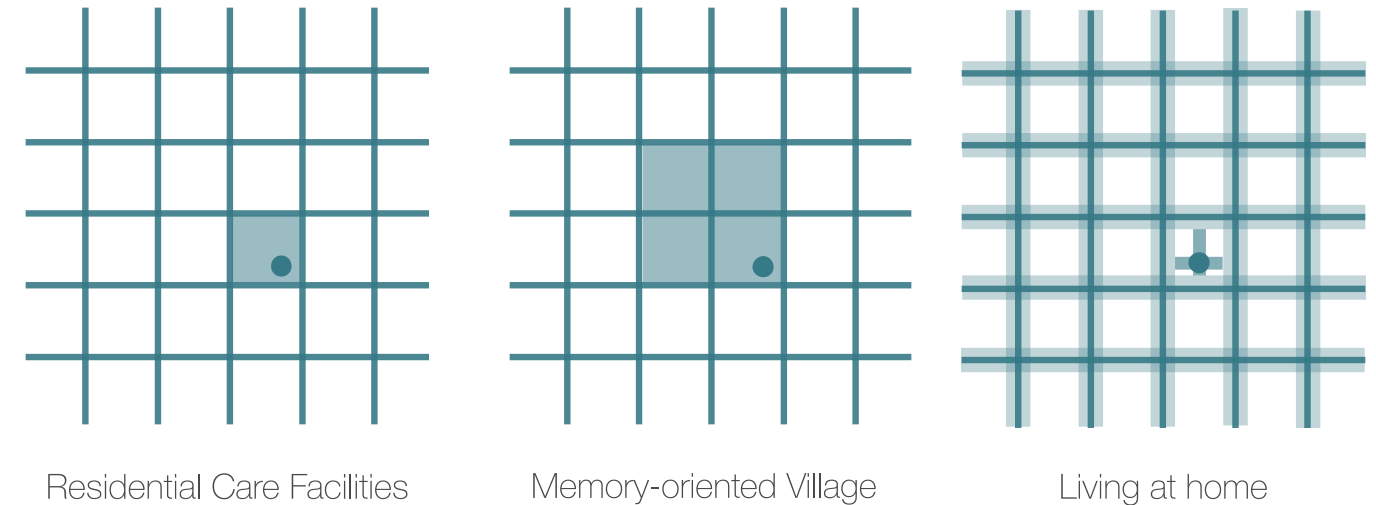


Figure 2.5 Exterior Environment in Different Living Mode

2.3 Outdoor activities

In the past, the common outdoor activities for MD took place in the front garden of their home or care facilities.

In recent years, some studies have turned their attention to the social participation of people with MD. Some activities were organized. For example, there were several museum and gallery activities. They aimed to make the arts more memory-friendly and better equipped for people with MD to enjoy. Australia's Museum of Contemporary Art created an art therapy program called Artful, lasting more than three years. The Museum of Modern Art in New York runs the long-term interactive activity-Meet Me at MoMA every month. Other memory-oriented activities were also launched, such as hiking and gardening.

There is no doubt that social connections and the sense of belonging are enhanced by these activities. The participation of these activities boosts their passion for life and social involvement while alleviating the loneliness and anxiety produced by social isolation. As a result of the broader activities settings, there could be a significant shift in how society views and responds to MD.



Figure 2.6 'Artful' Therapy Program in Australia's Museum of Contemporary Art (source: <https://www.mca.com.au/learn/art-dementia/>)

If there are no limitations on outdoor activities, according to the function of the places, Margot-Cattin (2019) classified outdoor spaces in four clusters where elderly with cognitive impairment, or mild MD would engage in their lives (Chart 1):

A "consumer, administrative, and self-care places"	<ul style="list-style-type: none">• Small grocery shop• Mall, supermarket, big shop• Small shop• Pharmacy• Hairdresser, salon, barbershop• Bank or Post office
B "places for medical care"	<ul style="list-style-type: none">• Doctor's surgery• Hospital or health centre• Dentist's surgery• Therapy• Day care
C "social, cultural, and spiritual places"	<ul style="list-style-type: none">• Friend or family member's place• Restaurant, café or bar• Senior centre or social club's premises• Building for worship• Cemetery or memorial place• Entertainment or cultural places
D "places for recreational and physical activities"	<ul style="list-style-type: none">• A garden in your backyard• Park, green areas, or community garden/ allotment• Forest, mountain, lake, or sea• Cottage, summer house, or chalet• Neighbourhood• Sports facility• Transportation centre

Chart 2.1 Four Clusters Where People with MD Would Engage in (modified from Margot-Cattin, 2019)

City parks

City parks or public gardens are very popular among people with MD. According to England Nature (2016), nearly 30% of people with MD mentioned visiting city parks and gardens when talking about going out. About two-thirds of them (63 %) live less than one mile from a park or public garden, and 46 % indicated they visited them at least once a month. Several people with MD optimize the park's role in providing them a place to join in activities with other people. Areas with water, such as rivers and beaches, are also popular in the same survey (England Nature, 2016). Nevertheless, people with MD need more attention because there is a risk of harm in these places.

Informal Walking

Informal walking was the most often mentioned activity by people with MD and caregivers as it calms the patient's emotions (Nature England, 2016). Dementia Australia (2019) noted that walking is a necessary daily activity even for people with MD. It aids with sensory stimulation, promoting social interaction and relieving the pressures of being indoors.

Taking informal walks every day is beneficial for people with MD. The health benefits of walking as a mode of transportation have long been recognized. Individuals would have a lower BMI (Frank et al., 2008), experience less stress (Pretty et al., 2009), and have a stronger sense of connection with the neighborhood (Kaczynski & Glover, 2012). Therefore, people with MD need a memory-friendly outdoor environment to step out.



2.4 Challenges of outdoors

Despite many benefits, memory care still did not include too much outdoor activity due to challenges that have been hard to solve so far. They are summarized in 7 points:

· Safety and missing incident

Missing and falling incidents are frequent for people with MD. Most of them would experience at least one missing occurrence because of MD (Alzheimer’s Association, 2020). These events typically occur in the places they usually visit (Tu, 2006).

· Decreased mobility

Progressive cognitive deterioration decreases mobility (Yordanova et al., 2017). This leads to less access to public spaces and social activities for people with MD (Brorsson et al., 2019). As a result, restricted activities further impair cognitive abilities. Finally, the interaction between cognitive deterioration and decreased mobility creates a vicious circle.

· Insufficient environmental support

Within the restricted scope, the current outdoor environment does not support their ability to overcome obstacles such as limited mobility, disorientation, and fatigue.

· Motivation decrease

The active motivation would decrease due to negative experiences such as: getting lost, being unable to distinguish directions, and forgetting destinations. And then, they gradually lose the confidence to step outside (Yordanova et al., 2017).

· Shrinking world

People with MD usually experience a shrinking world because of decreased mobility, fewer outdoor function demands, and difficulty being familiar with the new environment (Duggan et al., 2008). They appreciate social and aesthetic features more than functions. They rarely choose to go further because being in an unfamiliar environment is more stressful.

· Nordic climate obstacles

The weather pattern of Finland is one of the impediments to outdoor activities. The outside temperature contributes to making it more difficult for people with MD to go outside, according to Rappe (2007).

· Public awareness and stigma

Stigma from others contributes to negative stress for people with MD and their families in psychological and social aspects. Their human rights may be violated in this situation. Providing supportive surroundings and increasing public awareness of MD could eliminate stigma and prejudice for a better outdoor experience.

Summary

Those with MD can gain physical and psychological benefits at home, but to gain social benefits, they must participate in social activities outside of the home.

Reduced mobility and a 'shrinking world' impact the distances they can travel. However, the anxiety of safety and insufficient support in the outdoor environment prevent them from getting out.

As many challenges interact instead of being addressed individually, solutions should be based on a comprehensive view. For example, decreased mobility may be caused by the limitations of MD condition and the public stigma.

3

Technology for memory decline

In the future, technology may bring solutions to memory care. Technology is deeply woven into contemporary public life. It is also potentially mature enough to support independent and safe mobility, self-management, and social involvement. In addition, it allows people with MD to continue to live their previous lives by engaging in social activities. It could also alleviate caregivers' burden and shortage.

This section provides an overview of the available technologies and services, including those supporting independent movement out of the home. There is a summary of technology in characters, challenges as well as technology predictions that may help people with MD in the future.

3.1 Assistive technology

3.1.1 What is assistive technology?

Assistive technology for people with MD can be described as “Any item, piece of equipment, product or system driven by electronics, whether acquired commercially, off-the-shelf, modified or customized, that is used to help persons with MD or other cognitive difficulties in dealing with the consequences caused by it in their daily life” (Marshall, 1997). Assistive technology has been developing since the late 1990s to evolve the needs of people with MD and their caregivers (Amiribesheli & Bouchachia, 2017). It encompasses a range of technologies, from those used in clinics to evaluate memory impairment to the robotic arm that may assist severe patients in nursing homes.

Engaging in the exterior environment supports people in making the beneficial choices possible for their lives and boosting their physical and mental health. It aims to maintain independence, ensure safety, and improve wellbeing when people suffer from MD. Bjørneby (2003) proposed some principles of user requirements in technology. As he noted, technology should support skills that are being maintained and not emphasize skills that are being lost. It should not be about the user as a person with disabilities, but about supporting his or her self-image as a person with abilities. An emergency solution should be agreed upon by people with MD. Products are available, and information is always visible.

Memory and cognitive compensations, external information offers, and enjoyable social activities are essential demand areas (Van der Roest et al., 2009; Miranda-Castillo et al., 2013). Many technologies for MD are electronic devices themselves or based on some common devices such as phones, tablets, and VR glasses. Under the internet coverage, such electronic devices provide a new method to engage in society. This thesis divided the available technologies into five types according to essential functions.

Benefits

There is no doubt that assistive technology can bring benefits to help people with MD. Assistive technology can:

- Abilities to remind MD people of their calendar in case of sudden oblivion (Alzheimer's Society UK, 2015).
- Improve the confidence and life quality of the people with MD (Alzheimer's Society UK, 2015).

The symptoms of MD appear suddenly, which is the biggest challenge for people with MD when going out. Assistive devices can always remind people with MD of their schedules and what they are going to do at the moment so that they can continue their activities when oblivion occurs.

Assistive technology can help them, to some extent, with some of the common emergencies that occur when they are out and about. As a result, technologies allow them to go further out without concern. Meanwhile, assistive technologies are like an insurance policy for unexpected encounters, which makes people feel more confident when they are participating in outdoor activities.

- Weaken potential risks in their independent life and promote self-management (Prince et al.,2013).
- Delay entry into care and nursing homes and potentially save cost by the delay (Prince et al.,2013).
- Provide their caregivers and family with reassurance (Beer et al., 2017).

For the group with mild symptoms, assistive devices allow them to cope with daily life alone. In other words, they can still manage their lives on their own without the need for manual care.

The mild group can live independently with assistive devices, eliminating the need for human resources. When the condition deteriorates and requires care, people may visit the necessary care facilities. In this way, regional health care resources are maximized.

Assistive technologies allow family members and caregivers to confirm their safety and communicate with them when necessary.

3.1.2 Available assistive technology

This section provided an overview of available assistive technology for everyday living that may help independent living and social participation instead of covering every type of assistive technology for MD. Outdoor technology for MD is more complex and comprehensive than home-based technology. It is hard to generalize into a specific category. Such fall detection technology belongs to the assessment, monitoring, and assistive devices simultaneously. So the classification is according to the essential functions of the technology. Although certain types of technology may not be required immediately, knowing what is available and what may assist in the future might be helpful.

- Smart assistants
- Sensors based technology
- Locators, tracking and guides
- Social participation and leisure
- Data collecting

Smart assistants

- Reminder
With permission, family members or caregivers can access the digital calendar to help people with MD set reminders and get the appointments, visitors, and events.
- Robotic assistants
RAMCIP is a robotic assistant for mild cognitive impairment patients at home (Kostavelis et al., 2019). It might be used to turn on lights, monitor individuals, detect falls, deliver medications and water, pick up objects, and connect to their family by video conferencing.

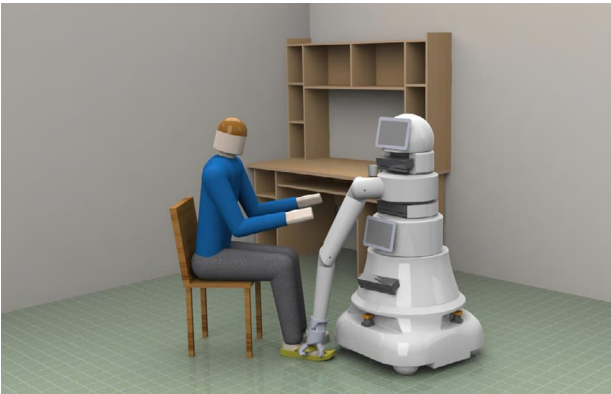


Figure 3.1 Robotic Assistant-RAMCIP (source: <https://ramcip-project.eu>)

- Mobile assistant
Under the modular system, Care-O-Bot can be multi-functional by inserting new modules besides the basic skills of a personal care assistant, such as fetching and reminders. The robot can then be set for various uses, including as a mobile information center in museums, DIY stores, and airports, collection and delivery services in homes and businesses. (Fraunhofer Institute for Manufacturing Engineering and Automation, 2015)



Figure 3.2 Robotic Assistant-Care-O-Bot (source: <https://www.care-o-bot.de>)

Sensors based technology

Sensors-based technology is the earliest and most extensive one for people with MD. Sensors-based technology is usually linked to cognitive assessments. A huge increase of smart home technology is developed based on sensors and cognitive assessments (Robbins, 1994). It benefits caregiving (Astell et al., 2010), improves cognition, and increases the life quality of people with MD (Astell et al., 2018). Some sensors are devoted to bringing a sense of safety. These technologies usually monitor the people’s movement and the surrounding environment in the current stage.

• Motion sensors

The motion sensors can link with the reminders. Once it detects nearby motions, it would play a voice prompt or an alert. For example, it could remind people to lock the door, bring their belongings, and ensure electronic devices off, such as stoves and ovens, when the sensor detects the front door opened.

Caregivers and family members can oversee activities of people with MD remotely in a needed period. Sensors can calculate the time of activities in certain places, such as lying prone time, daytime and nighttime of sleep, and how long they spent outside the home. It can help the caregivers, and their family better understand their activities preferences and whether they are trapped if someone with MD hasn't moved in a long time. For example, a sensor can be placed on a chair or a bed. If a person does not get up or return within a pre-scheduled time or needs assistance getting to the bathroom in the middle of the night, their caregivers will get a notification.

• Fall detection sensors

Falls are one of the leading causes of injury in seniors, and people with MD are even more likely to fall (Alzheimer's Association, 2021). Fall detection sensors are usually installed in a portable device such as a pendant on a lanyard or anything attached to clothing. The sensor monitors changes in movement and height in real-time to detect a fall. If they get concerned, or an event occurs, such as a fall, they can press the device's button to ask for assistance.



Figure 3.3 Mat with Sensor (source: <https://smartcaregiver.com/floor-sensor-mats>)

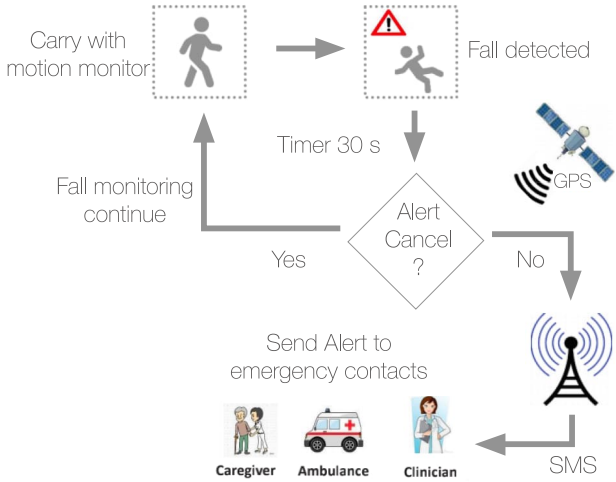


Figure 3.4 Fall Detection Alert System (modified from Shahzad, 2018)

Locators, tracking and guides

• Surrounding monitoring sensor

The surrounding environment can be assessed and monitored by sensors or devices which are carried by people with MD, or by public facilities that can deliver the results immediately. Compared to the monitoring of personal movement, there are fewer ethical issues in environmental monitoring.

There would be an alert if the surrounding temperature is too low, too high, or change suddenly. At home, sensors are used in the kitchen for a boiled-dry pot or installed in the living room to ensure the environment with a comfortable temperature and humidity. In the exterior environment, the first aim is to ensure that the surrounding environment is safe and comfortable enough for people with MD. For example, if the sensor carried by them is exposed to sunshine or in a low-temperature environment for a long time, in that case, it can remind people to avoid the risk of heat stroke or hypothermia.

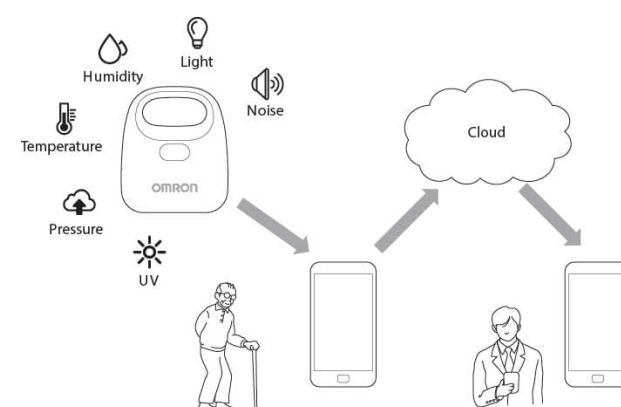


Figure 3.5 Environmental Sensors from Omron
(Source: <https://www.allaboutcircuits.com/news/environmental-sensors-omron-bosch-sensortec-sensirion/>)

The ICT tools ensure safety status by combining medical alert devices, allowing for independent outdoor journeys and active monitoring functions. Location trackers and wandering alerts are the most common technology in assessment and monitoring, aiming to provide safer walking for people with MD. According to the statistics, more than half of people with MD would wander, forget where they are going or coming from, and become lost or disoriented in the exterior environment (Alzheimer's Association, 2021). Because sometimes, the symptom of MD makes it hard for them to ask for help.

• Locator the item

People with MD would be irritated if they usually kept misplacing stuff. Attaching a little digital tag to each item is one option. People can track them using an app on the phone or tablet and see where the objects they put the last time are.

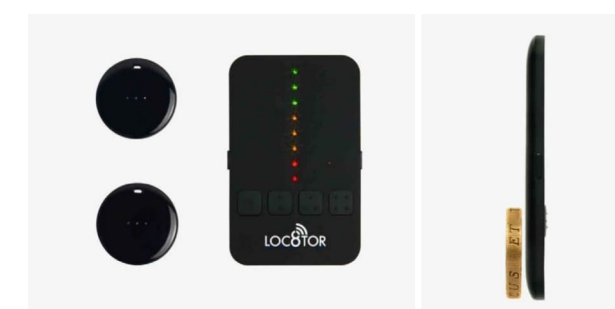
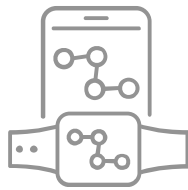


Figure 3.6 Digital Tag Example: Loc8tor
(source: <https://loc8tor.co.uk/everyday/>)



- Find where the person is

GPS (global positioning system)

GPS offers information on geography by tracking location. Although GPS tracking is not a novel technological objective, the usage of those systems in dementia care remains very low. A Smart Dementia Project, launched in the Netherlands, used GPS tracks whereabouts of people with MD by a wristwatch and app. It aimed to allow people with MD to walk around more freely in the nursing home setting.

The limitation of the GPS is that the wearable or portable device is a necessity. At the same time, people with MD may forget or have less willing to carry them. Particularly, people with MD may also unable to respond appropriately when an alert is triggered.

Face recognition

Face recognition is the coming tracking technology. It is based on deep learning of artificial intelligence. It would recognize a person and then track them in a defined space by building a camera system. For instance, Muistipiha is an independent mobility project that monitors the exterior activities of elderly patients and makes alarms when needed. Automated monitoring frees up working time for more critical caregivers' tasks and increases exterior safety for people with MD. There are two main challenges in the project. On the technology level, how to monitor several accompanying video images with sufficient accuracy but still effectively is still unsolved. On the environment level, trees and other obstacles in the surrounding environment created more challenges for the placement of the cameras.

Social participation and leisure

Technology is utilized to encourage social activities and enjoyable leisure time. It assists persons with MD in maintaining relationships, skills, and well-being. Many new options have become available with tablets, smartphones, and applications. Communication technology can support socializing to increase positive emotions (Hori et al., 2009) and reduce agitation (Ploeg et al., 2016). The critical issue for people with MD is how they use this technology actively and independently. The devices' outlook and system could be redesigned with fewer buttons with a more straightforward operating method.

Technology can also offer leisure activities. Music and art have been proved effective in improving the depression and anxiety of patients with MD (Jacobsen, 2015). Researchers believe that music therapy may partially replace therapeutic drugs with greater side effects. The long-term effects of this therapy need to be further studied.

Other games and digital entertainment are also developed. The traditional one is through laptops or tablets, and now the AR and VR technologies bring the possibility to have an immersive experience such as an exhibition or a concert. While, there is consistent evidence of improvement in cognitive function aspects trained by games and other digital activities such as Eldergames (Gamberini et al., 2008), Living in the Moment (Astell et al., 2014). There is still no convincing evidence that leisure activities can prevent or postpone MD so far.

Data collecting

Many technologies are data-based. Some focus on how to collect more accurate data, and some concentrate on how to take full advantage of the data by calculating and analyzing to get valuable results finally. The researchers can do more studies regarding MD based on the data from different people. Monitoring and collecting, storing, and analyzing data is a cyclic process.

Miles for Memories Help Home is a data storage project launched in Michigan State, US. A bar code would store people's basic identification with MD in a bracelet after diagnosing the MD. Emergency responders can get their basic information if they get lost by scanning the bracelet.

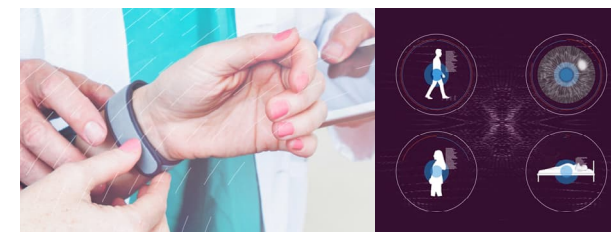


Figure 3.7 the Concept of EDoN Project
(source: <https://edon-initiative.org>)

EDoN is a project spearheaded by Alzheimer's Research UK. They use wearable devices to monitor the status of people and try to make some contribution to the detection of MD. A watch carried in the daytime and a headband at night collect digital data on a range of measures, including sleep, neural activity, cognition, speech and language, gait, heart rate, fine motor skills, and physical activity.

Artificial intelligence (AI) advancements, including the Internet of Things (IoT), can also assist people with MD in remaining independent. The information about the surrounding environment of individuals, health, and well-being can be collected by wearable devices and delivered to the carers and health professionals in real-time via the IoT. Then a customized model could be formed after calculating the collected data and learning the physical habits and symptoms of the individual. Effective prediction models need a specialized approach to monitor that can be costly (Moyle, 2019).

Summary

• Indoor settings

In the current stage, most technologies are set and taken functions in indoor settings. Installation of sensors at home is the most common method of assistive technology. Most assistive technologies of function maintenance are in a compensatory approach to provide individuals with prompts and assistance in continue their daily activities (Mihailidis et al., 2008). Although these devices are set indoors currently, they may be used indoors and exteriors through upgrades to their portability.

• Multi-function

Multi-function technology is the trend. Some of the devices may be used for several purposes, and how they are utilized will be determined in part by the individual who uses them. Multi-function can be achieved by superimposing different types together. It can be multi-functional by inserting new modules.

• Friendly devices

Seven features of devices relevant for MD were proposed by dementia care central (2019). They were default activation, non-emergency response, sequential contacts, cellular network coverage, comfort, water resistance, ease of use, and battery life. One of the reasons for the low willingness of people with MD to use may stem from their unfamiliarity with new devices and lack of motivation to learn how to use new ones. Inserting the new technology or sensors into the original outlook of the devices could be one solution. Portable devices with multiple functions avoid the need to use and carry too many devices when they are out of the home.

• Remote participation

Remote participation provides a contact form virtually, which is not limited by physical ability. It benefits the people who suffer from the severe stage of MD, but advantages derived from the natural environment cannot be enjoyed.

• 'No effort to use' is important

'No effort to use' is an essential character of technology for people with MD. For example, the operation interface can be simplified in memory-oriented devices or systems. In addition, Some functions could be activated automatically by detecting their approach. These may be the solutions for the low initiative to use the devices of people with MD.

• Sharing operating platform

Different functions can be activated by the same method such as voice, gesture, or movement. Among those, voice is the most mature way. There is no need to figure out the operating process of new devices or tools instead of only speaking out the requirements. Under the same operating platform, more usage scenarios both indoors and exteriors can be considered. It is a more economical and efficient method for multiple user groups to use the same public facilities.

• Emotion reaction

Consistent care is the advantage of technology support. There is no emotional disturbance, no matter how busy. The emotional reaction is always the main difference. Recent research has focused on incorporating identification and emotion models into prompting systems (Robillard & Hoey, 2018).

• Customized service

Customized service is great to meet individual demand. It is based on data collection of individual preferences and behaviors through machine learning, analyzing and calculating the data, and finally, providing personal help. For example, by learning the personal walking speed, the navigation system can automatically plan the travel schedule that best suits the individual pace speed and scheduled time.

3.1.3 Challenges and ethical consideration

Privacy is always the issue when tracking and monitoring technology are mentioned for people with MD. And there is also a risk of misuse of data that was collected by tracking and monitoring. People with MD should be able to choose how their data is used and be assured that their information is secure. The problem is mainly focused on the authority, purpose, and time of access to the data and the classification of data to distinguish its privacy.

Further, it is challenging to balance the concerns of privacy and safety considerations. Under most situations, safety cannot be ensured if weighing too heavily on privacy. In Leikas's (2018) research, older participants stressed that safety must take precedence over privacy, especially in the case of MD people living alone. This is a threat to the person's privacy but a safer choice. This example of ethical thought contradicts itself, as obeying only one principle is impossible. Others in Leikas' project suggested it could be easier for them to receive help from technology rather than being afraid to accept help from a human caregiver in some instances. Every person has a right to privacy, but the obstacle is that when people suffer from MD, they may not perceive what is best for them. For example, the caregivers hide the equipment in the belongings of people with MD, such as putting it in their clothes without telling them the real purpose as the data collections are based on reliability from the people for the technology.

We need to know that data itself is secure enough. The root of the privacy problem is whether the people who access the data will leak it out. For privacy reasons, such data should only be accessed by the necessary people. Access to the data should also be restricted depending on the individual's identity.

In all, careful consideration of monitoring and privacy from societal views should be taken to obtain the full benefit to support the care and independent living of people with MD (Moyle, 2019).

Other challenges

Although several potential assistive and technology items are being produced, they rarely reach the market they were designed for (Bedaf, 2017). This problem may be related: development research institutes may not always explore commercialization options for their goods. It takes a long time to develop advanced robots results in high production costs (Cleetus, 1993; Rafinejad, 2007). Even if they enter the market successfully, whether they are affordable technology for everyone.

3.2 Future technology

Smart City

The smart city aims for a more sustainable living environment for residents through improving public services and infrastructures. It is user-centered with a framework comprised of information and communication technologies (ICT) (Thales Group, 2021).

Because of its user-centered feature, this framework also shows the great potential to assist people with disabilities, including people with MD. It can connect their individual devices, forming an invisible digital network, and finally leading to a well-established memory-friendly neighborhood. Institutional infrastructure, physical infrastructure, social infrastructure, and economic infrastructure are considered as the four pillars or themes of a smart city (Mohanty et al., 2016). Most facilities and services, talked about in the thesis, belong to the physical infrastructure part. A more sustainable city is achieved by improving public services and infrastructures.

Briefly, it is a framework for deploying and promoting sustainable development practices comprised of information and communication technologies (ICT) (Thales Group, 2021). ICT connects objects and machines and transmits data through wireless technologies and the cloud. Real-time data collection, analysis, and management assist stakeholders in making better decisions and improving their quality of life. Citizens interact with smart city ecosystems in various ways, such as connecting their automobiles or homes with smartphones and mobile devices.

Smart Poles

The smart poles are suitable for playing the role of sensors for a smart city. They can collect the data from the people, transfer it to the cloud, do the calculation, and provide the services for them as the final reaction (inteliLIGHT, 2021). Many smart poles appear in the form of lighting poles including security cameras, environmental sensors, traffic counters, or electric vehicle chargers, by combining sensors and engaging in navigation systems (inteliLIGHT, 2021). Many cases had similar ideas. For example, in the LuxTurrim5G project launched by Nokia, the 5G powered smart street lighting pole network collects a huge amount of data from integrated sensors (Nokia, 2020).

It could provide the streets with smart lighting solutions. In the future, it may help guide people with MD homes if they are wandering in the darkness exteriors. The multi-function smart pole can be the window to receive support and ask for help for people with MD.

For example, their device can be charged by approaching the smart pole in an emergency. For the face recognition technology mentioned before, the smart poles are where to install the camera system. The smart pole also set up the basic platform for future mobility, such as autonomous driving and shared mobility.

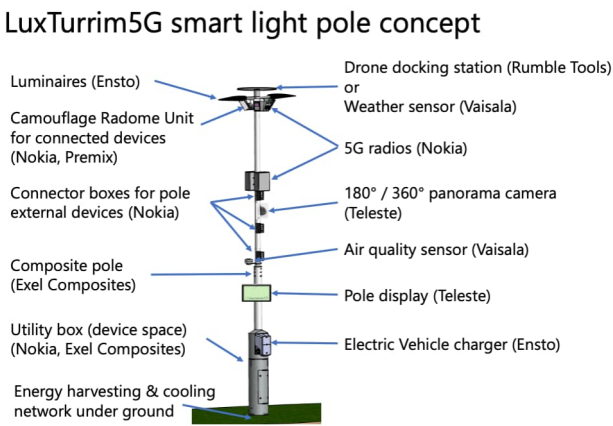


Figure 3.8 Nokia LuxTurrim5G (source: Nokia)

Future mobility

Today's driven shift in transportation, like shared mobility and autonomous driving, is getting close to us. It brings opportunities and worries for a livable future city for every citizen, including people with MD. Some would potentially support the independent mobility of people with MD.

· Autonomous driving

Autonomous driving allows vehicles to navigate without a human behind the wheel (Marc Weber, 2014). Under autonomous driving, people can have more free time and mobility with no effort. It benefits more for those who cannot drive. If it is available, people with MD would not be limited by the obstacles of location and transportation.

· The real-time transportation network

The real-time networked transportation could help people with MD to decide how to get from A to B, according to their personal preference. They can help them finish the payment, compare the route options, and ensure their safety. One challenge is how to link different modes of travel together on the same digital platform across many different mobility providers.

· Shared mobility

Shared mobility brings more convenience, benefits for a sustainable environment and decreases energy consumption. For people with MD, it also increased their social participation.

4

The strategy of a memory-friendly neighborhood

The memory-friendly or dementia-friendly method was first developed in Japan and was later championed in England, Wales, and Northern Ireland by the Alzheimer's Society. Several terms have been used to refer to the same endeavors, including dementia-friendly communities, living well with dementia in the community, dementia-friendly surroundings, dementia-sensitive living environments, and a society mindful about and accepting of neurocognitive disorder (WHO, 2021a).

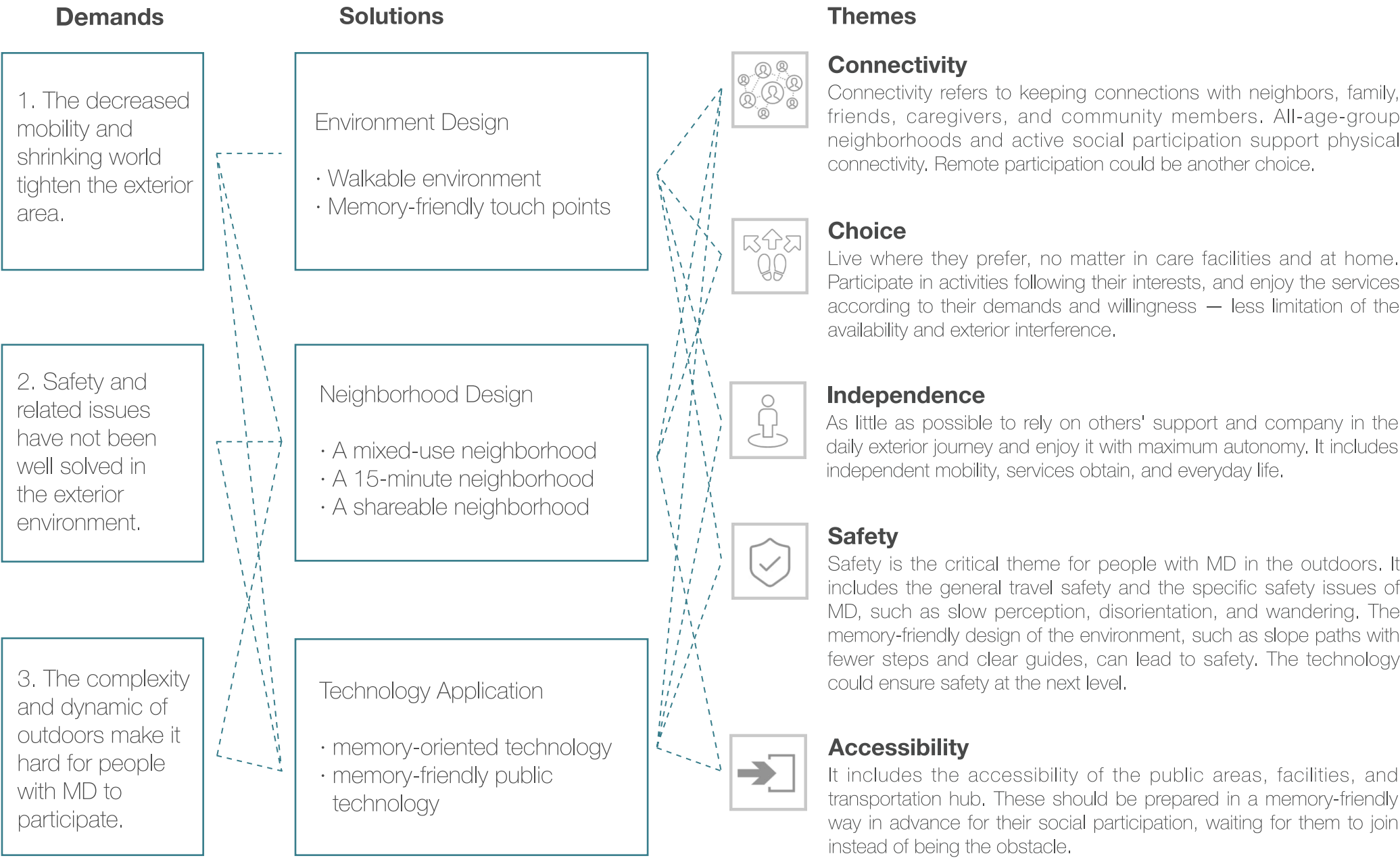
The toolkit, released by WHO (2021a), supports the idea not to limit the activities of people with MD at home or in residential facilities but to establish memory-friendly societies where they can meaningfully participate. It affirms and strengthens the current trend that a memory-friendly exterior environment is necessary and urgent. Many actions have already been taken in different fields.

In this chapter, the strategy of a memory-friendly neighborhood consists of 3 parts:

- describe the essential aspects of a memory-friendly exterior environment
- organize an accessible neighborhood under the 15-minute city concept
- insert the technology to contribute to their outdoor journey in the neighborhood

4.1 Demands, solutions and themes

Three main demands were summarized according to the challenges in the previous review. The strategy was purposed in three levels and guided by five themes. The strategy tried to increase people's social participation and be active and independent in their neighborhoods, even if they suffered from MD.



4.2 The memory-friendly neighborhood

The memory-friendly area out of the home should focus on the neighborhood setting. The memory-friendly neighborhood with developed walkable environment is the idea of this thesis. It includes a network of meaningful services and social places and assistive technology infrastructure.

The rise concentration of exterior environments is because its benefits are approved, and people with MD are going out of their homes. The scope of their exterior activities expands from the front-door area to the surrounding area and would be more extensive in the future.

The neighborhood is a significant context setting of their living. Because of the decreased mobility and the shrinking world they experienced, the neighborhood offers the most immediate opportunities for them to participate in social activities and fulfill their potential and obligations.

A mixed-use neighborhood

The varieties of surrounding facilities and services determine what they can enjoy in their daily lives. So a mixed-use neighborhood can fulfill and fertilize the exterior activities for people with MD.

The figures show the out-of-door areas for people with MD in different living places.
(a) live in the nursing home or care facilities
(b) live in residential groups
(c) live in the mixed-use neighborhood

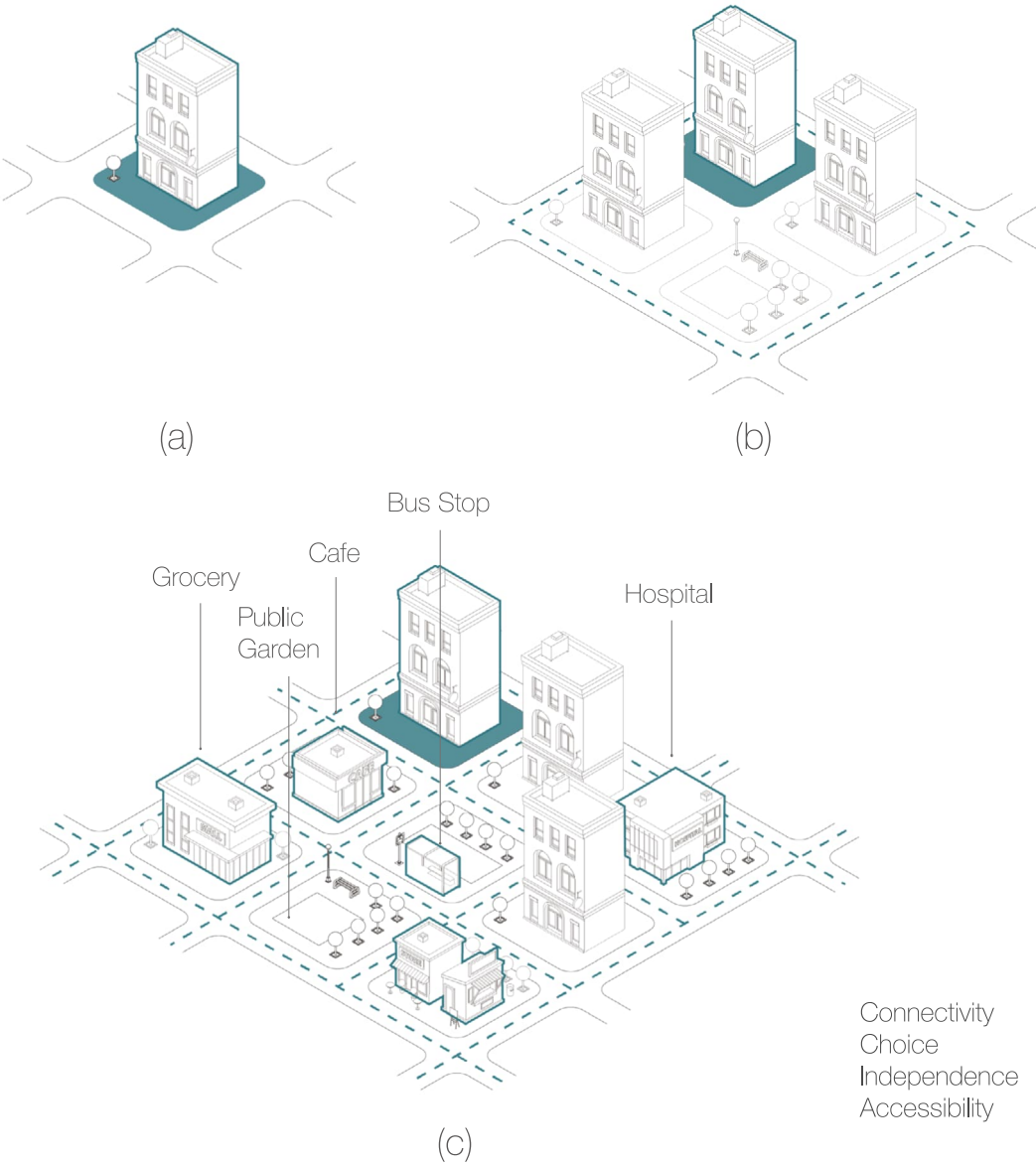


Figure 4.1 Out-of-door Areas for People with MD in Different Living Places

An accessible neighborhood

A 15-minute neighborhood for people with MD

What is the 15 mins city

The 15-minute city is an urban planning concept that tries to improve living quality by increasing local accessibility and walkability. Carlos Moreno described it as a "return to a local way of life, " reflecting the rhythm of human pace instead of cars (Willsher, 2020). In other words, there is no reason for individuals to go elsewhere in order to experience a full existence - which includes work, food, leisure, green space, housing, medical offices, and small companies, among other things. So the cancellation of a driver's license due to cognitive impairment would no longer challenge people with MD to have independent travel. It has also been put forward to serve groups of people better. For those historically excluded from planning, such as children, the disabled, and the elderly (Pozoukidou & Chatziyiannaki, 2021).

The five-minute walking

Some people believed that a 15-min city is built from a couple of 5-minute neighborhoods (Weng et al., 2019), which are known as walkable neighborhoods or the pedestrian catchment area (The 5-Minute Walk, 2019). It was determined by the distance most people will typically be willing to walk from the start point to the destination as well as measuring how walkable a neighborhood is (Patrick, 2010). It is generally defined as a 400m walking distance based on the average walking speed (1.34m/s). Considering their decline in physical function, 400m would take 6 minutes (1.12m/s).

Most researchers agreed that 5-min walking(400m) is a reasonable distance for determining access to public transportation (El-Geneidy et al., 2013). The five-minute walk circle would change to a linear area extending 400m around transportation stations. Undoubtedly, combining five-minute walking and public transportation can help people conveniently reach more activities.

Radius and door to door

Radius is usually be used to define whether the services or destination is reachable. But the straight-line distance ignores the actual route and general accessibility of those services. The real routes are far more complex than just physical measurements.

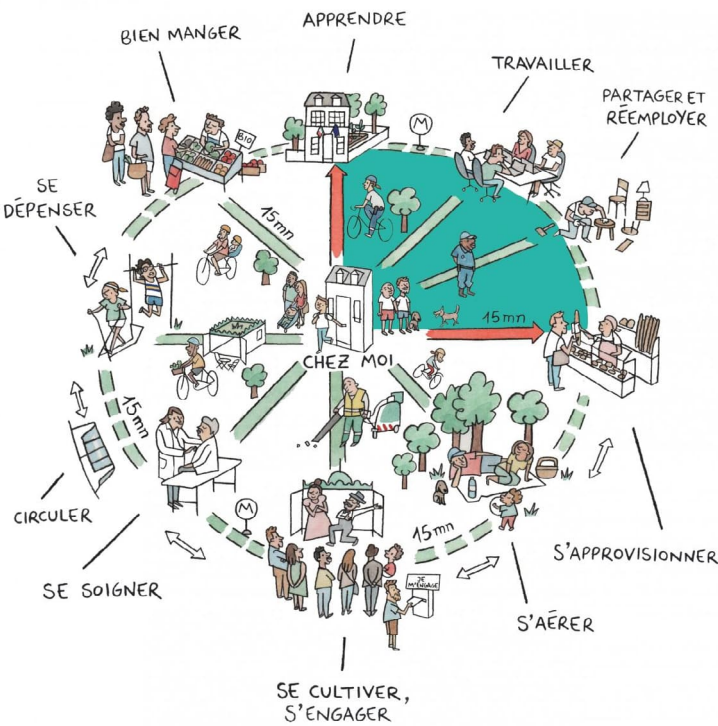


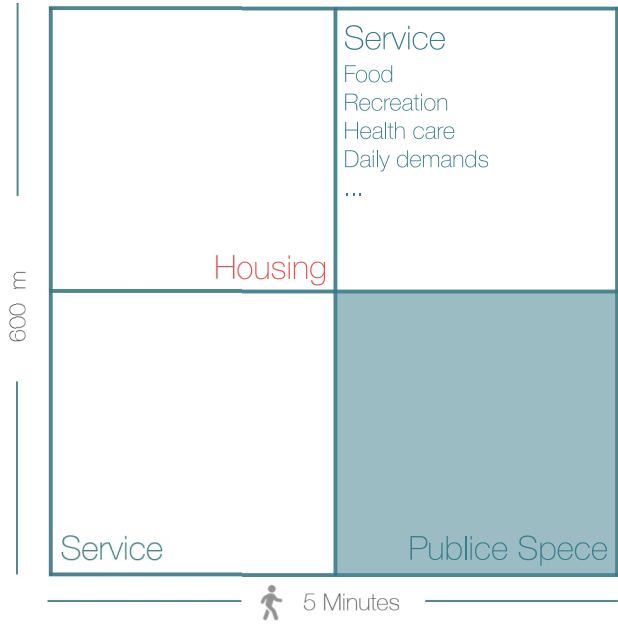
Figure 4.2 The 15-minute City Concept of Paris (source: <https://ecf.com/news-and-events/news/cycling-towards-15-minute-cities>)

The 15-minute neighborhood for people with MD took the framework of the 15-minute city and transferred it into a memory-friendly neighborhood. It strived for the outdoor scheme of accessibility and choices to foster interaction with the world out of their home.

In the 15-minute neighborhood for people with MD:

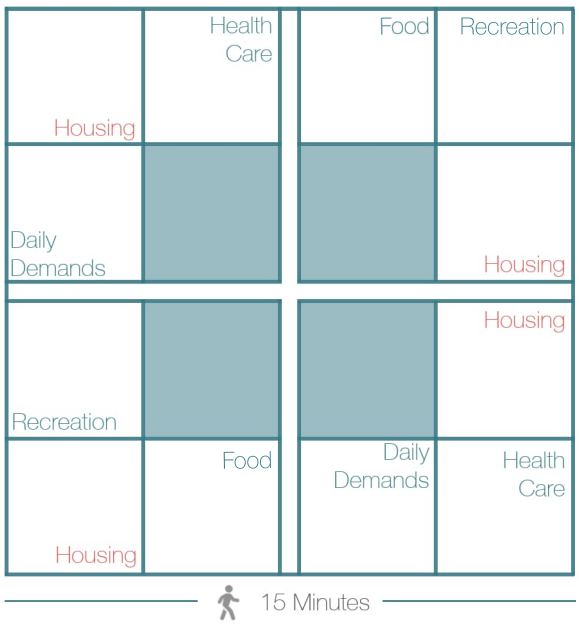
- Public transportation would instead of cycling
- Walkable neighborhood
- Consider the routes from door to door

Connectivity
Choice
Independence
Accessibility

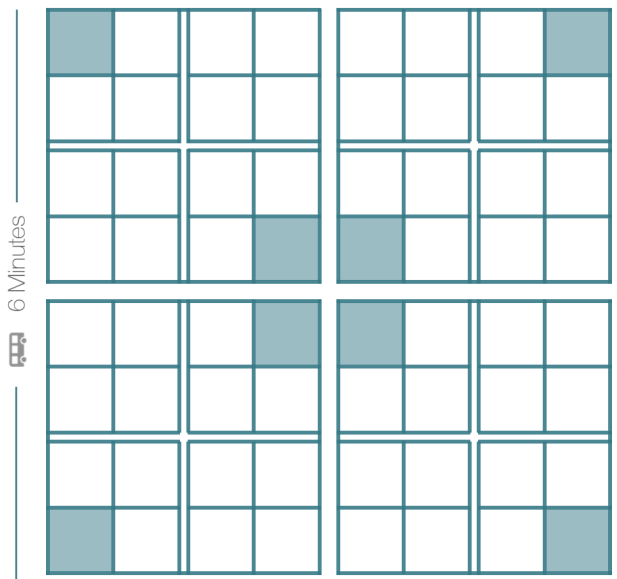


Every lot unit can have 3 different modes of use: housing, services, and public spaces. The combination of 4 units defines the 'Block.'

The only rule of the block is to follow the relationship between one residential area, two service areas, and one area destined for public space.



The blocks are based on the different people's demands, which aim to guarantee direct and immediate access to every type of need.



The connection of the blocks takes place in the neighborhood. The distribution of a single module is fundamental for the definition of the space in order of the neighborhood's specific needs.

The maximum distance between one area to another has to be accessible within 15 minutes, on foot or public transportation for people with MD.

Figure 4.3 The 15-minute City Concept for People with MD

A shareable neighborhood



Figure 4.4 A Shareable Neighborhood

The ideal neighborhood is safe and comfortable for all age groups where builds social harmonies, connection, and participation.

So the ideal neighborhood for people with MD is a shareable one. The memory-friendly idea should be inserted into the existed neighborhood rather than build up a new one, which means:

- The people who live here are in different age groups.
- The infrastructures are shareable with other residents, especially seniors.

According to the research from Alzheimer Disease International (Prince, M. et al., 2013), long-term cares for seniors were the primary resource for caring for persons with MD. From the Alzheimer's Society (2016) report, 70% of care facilities residents lived with some form of cognitive impairment or MD. So it is reasonable for people with MD to share the care facilities with seniors. The public facilities with technology should be considered shareable from the beginning. For example, with the booming development of shared mobility, the people with MD should be included in the user's consideration from the start.

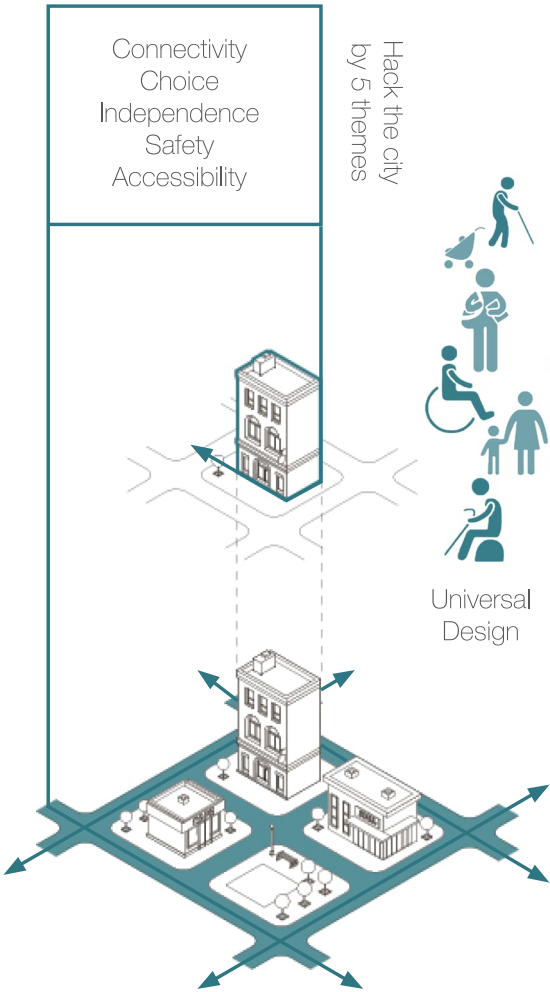


Figure 4.5 The Design Concept of a Shareable Neighborhood

Universal design refers to less demand for adaptation. Under the lens to people with MD, the 7 principles (Ronald Mace, 1997) mean::

- Equitable use: share with other people
- Flexible in use: accommodate their preferences and abilities
- Simple and intuitive use: regardless of experience and knowledge
- Perceptible information: regardless of the colonization skills
- Tolerance for error: minimize hazards of accidental
- Size and space for approach and use: considering their decreased mobility

Hack the existing urban means to celebrate the existing one, from individual buildings to their integration into the neighborhood. Our cities are densely packed with existing, underused infrastructure. So the focus of shareable neighborhoods is how to "hack" and reuse the existing infrastructure rather than construct the next new thing.

These plans may occur at the urban level and their influence should be felt long beyond.

The walkability of neighborhood

Walking friendly elements

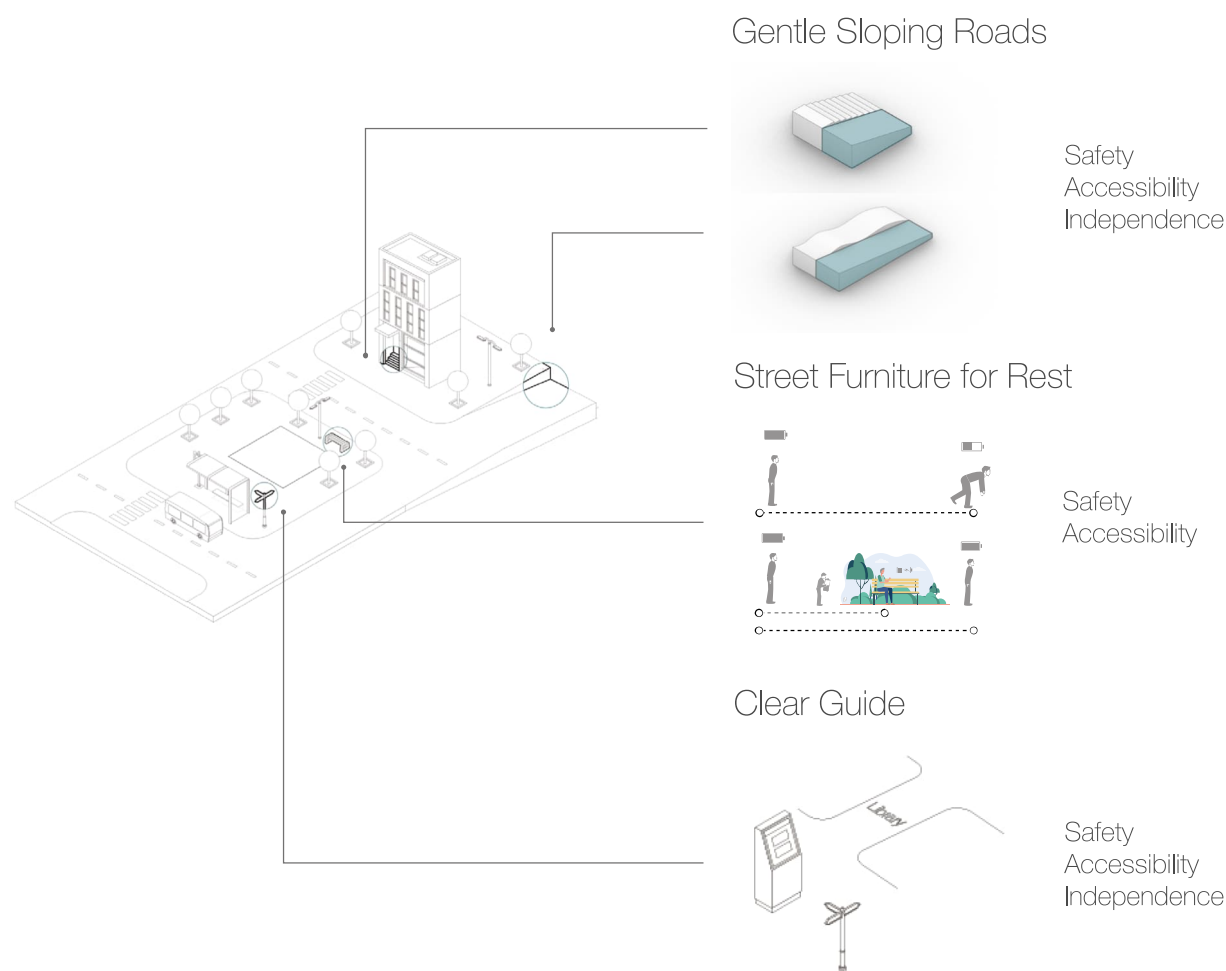


Figure 4.6 Walking Friendly Elements

Separation of pedestrian and vehicle

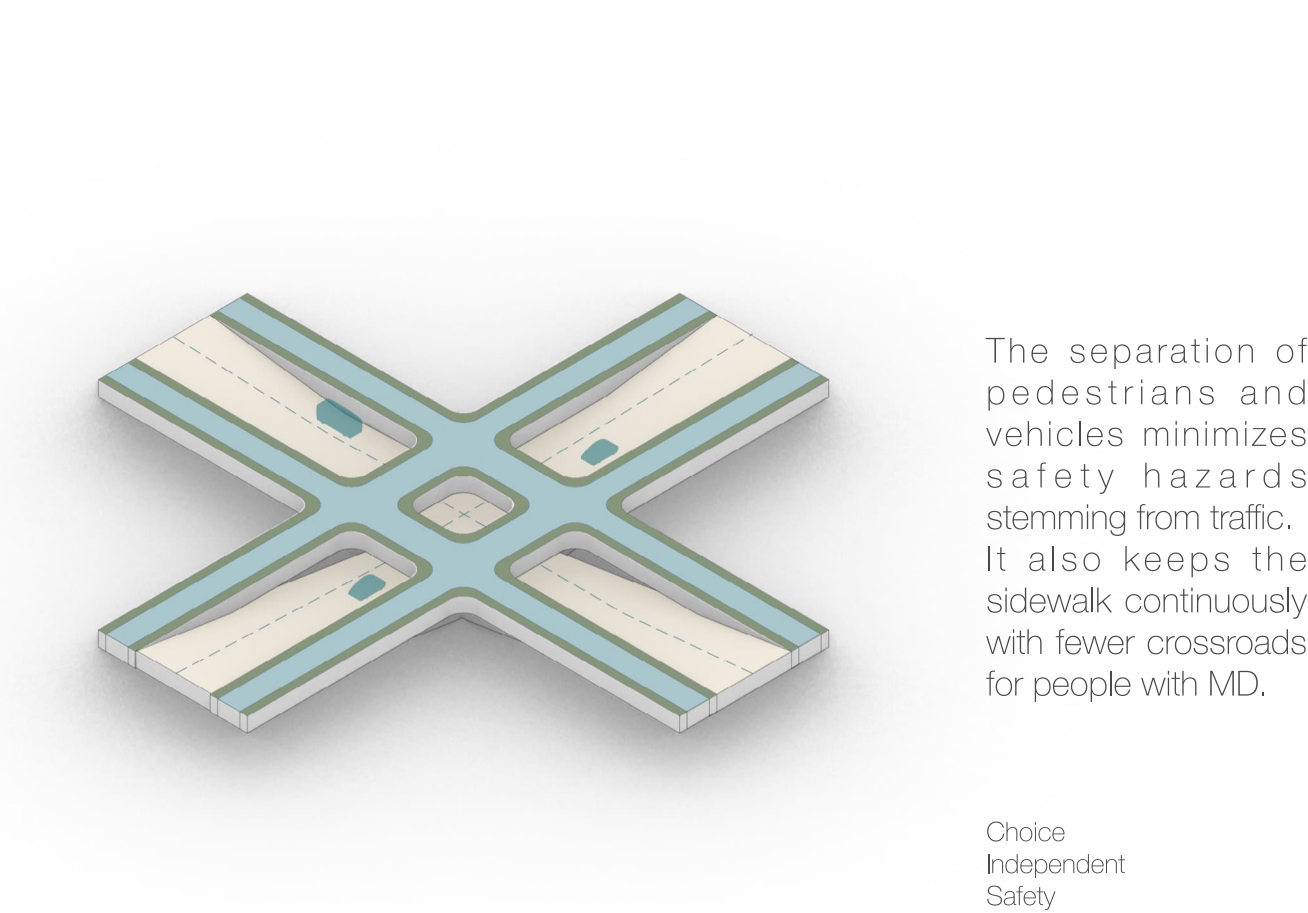


Figure 4.7 Diagram of Pedestrian and Vehicle Separation

The touch points of neighborhood

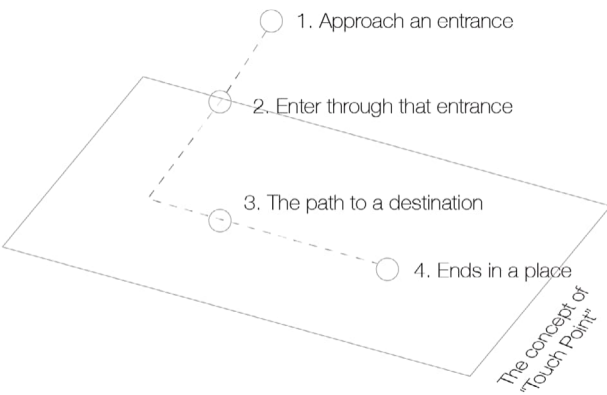


Figure 4.8 Concept of Touch Points

For people with MD, the outside travel experience weight than the travel function (Boex, 2012). The value of 'touch points' during their outside travels should be emphasized. Because, usually, it is difficult for them to capture the information than other people.

Touch points are the moments and locations at which an individual interacts with the physical and social environment of the space. They serve as a framework for exploring the sensations and challenges that a person with MD encounters while navigating a journey and determining how to use the space. This concept serves as a method for making recommendations regarding the design of the areas traversed and for concluding. This design thinking, which originated in health care, can provide new ideas on neighborhood design.

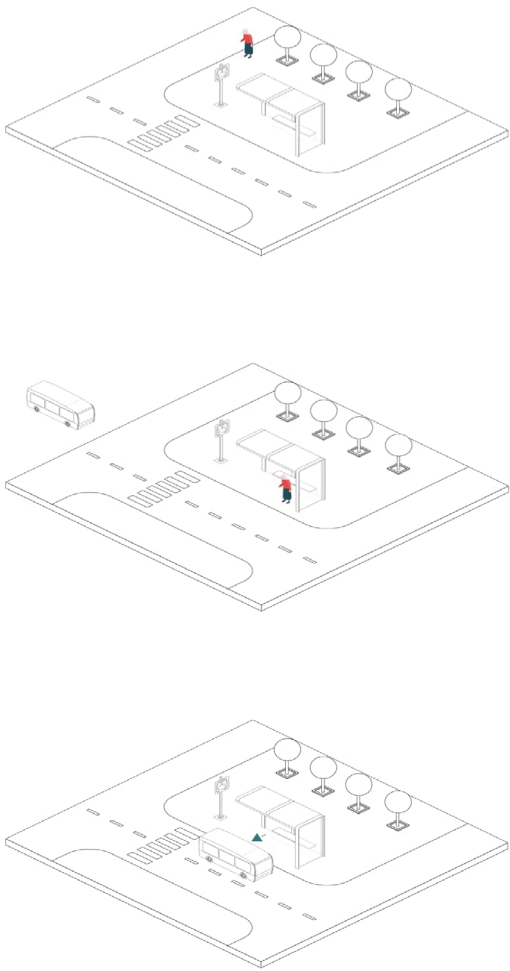


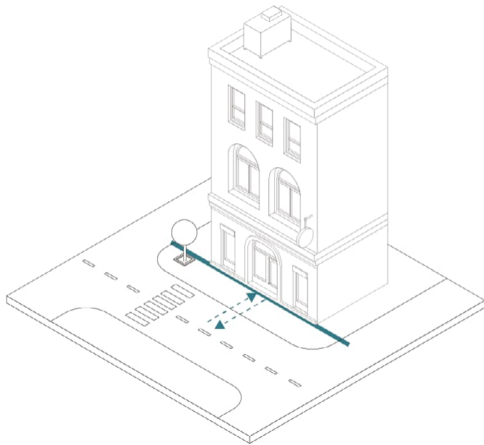
Figure 4.9 Touch Points of Bus Stops

For example, if a person prepares to take a bus. Touch points begin when he sees the bus stop and approaches it. He arrives and waits for the bus to arrive at the bus stop, and finally, takes a bus smoothly. If someone wants to visit the library, he would approach an entrance, enter via the door, and follow the path to a destination, such as a corridor. The path eventually finishes where the person performs a task or activity.

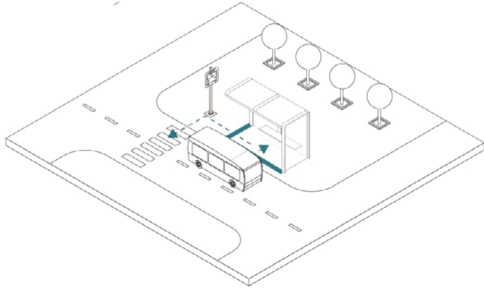
Generally, there are 3 main scenes of touch points in a memory-friendly neighborhood:

- (a) Touch Points of Space
- (b) Touch Points of Transportation
- (c) Touch Points of Function:

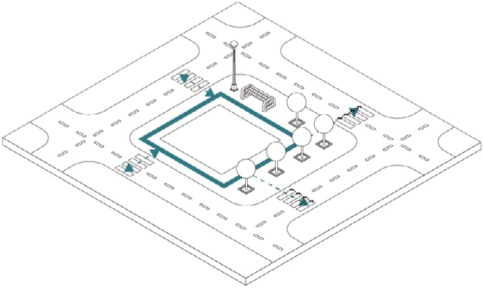
Connectivity
Safety
Accessibility



(a) Touch Points of Space:
such as from indoor
to outdoor



(b) Touch Points of Transportation:
such as from walking
to take the public transportation



(c) Touch Points of Function:
such as from the sidewalks
to the park

Figure 4.10 3 Scenes of Touch Points

The home belt for neighborhood

The Home Belt

For people with MD, the home belt connects the facilities and places for social activities within a 15-minute walk or public transportation.

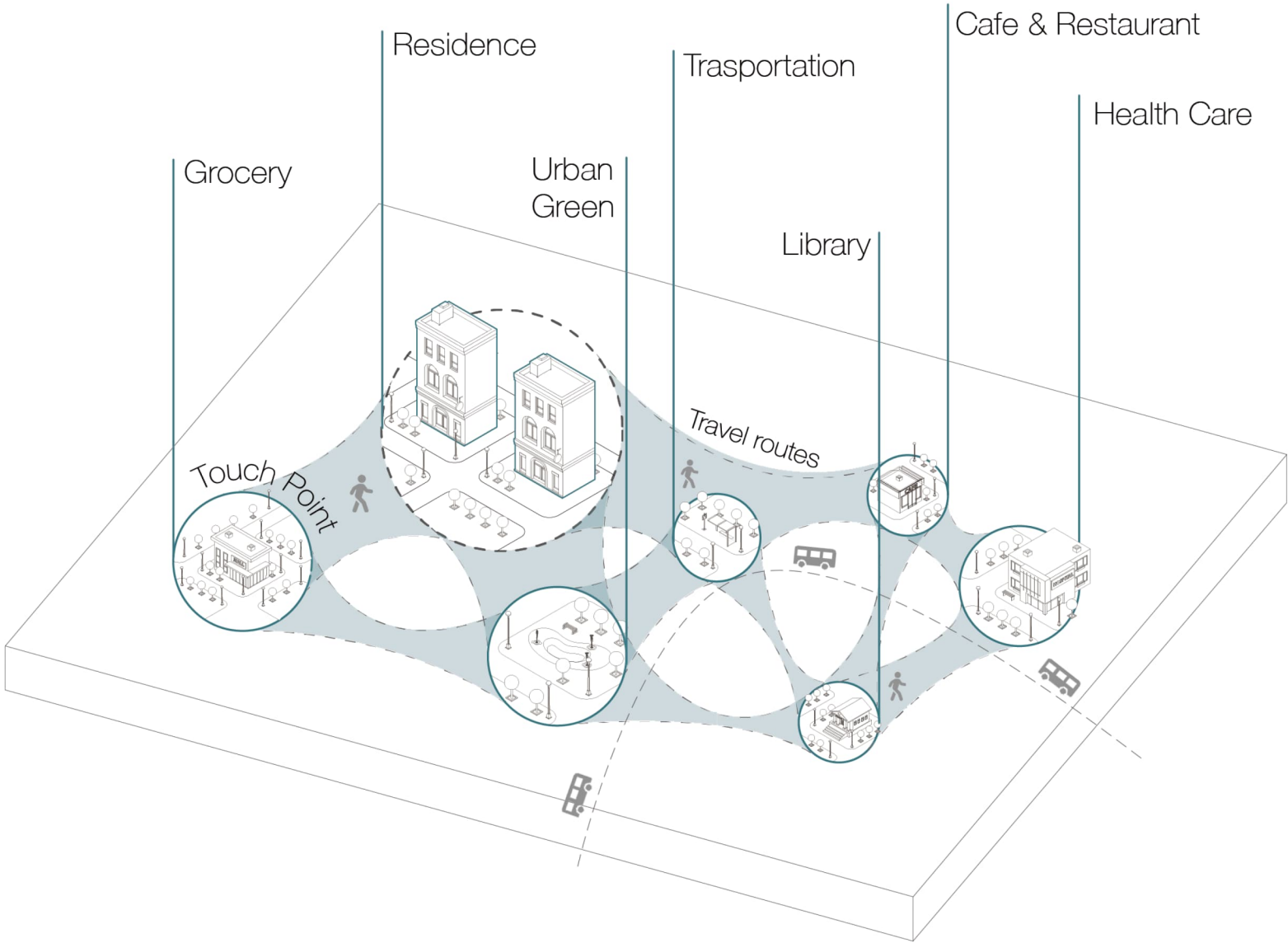


Figure 4.11 The Concept of Home Belt

4.3 The technology-advanced exteriors

It is context-dependent how memory-friendly neighborhoods are adapted and interpreted. The application of technology is an integral part of the solution. It helps accessibility and remote participation. Public sharing technologies, such as public infrastructures and social service systems, and personal memory-oriented technologies, such as portable or wearable technology, both support people with MD outside of the home.

According to the activities' category, there are four journey maps considering their exterior journey in a 15-minute neighborhood.

Activities: Group A

“Consumer, administrative, and self-care places.”

- Small grocery shop
- Mall, supermarket, big shop
- Small shop
- Pharmacy
- Hairdresser, salon, barbershop
- Bank or Post office

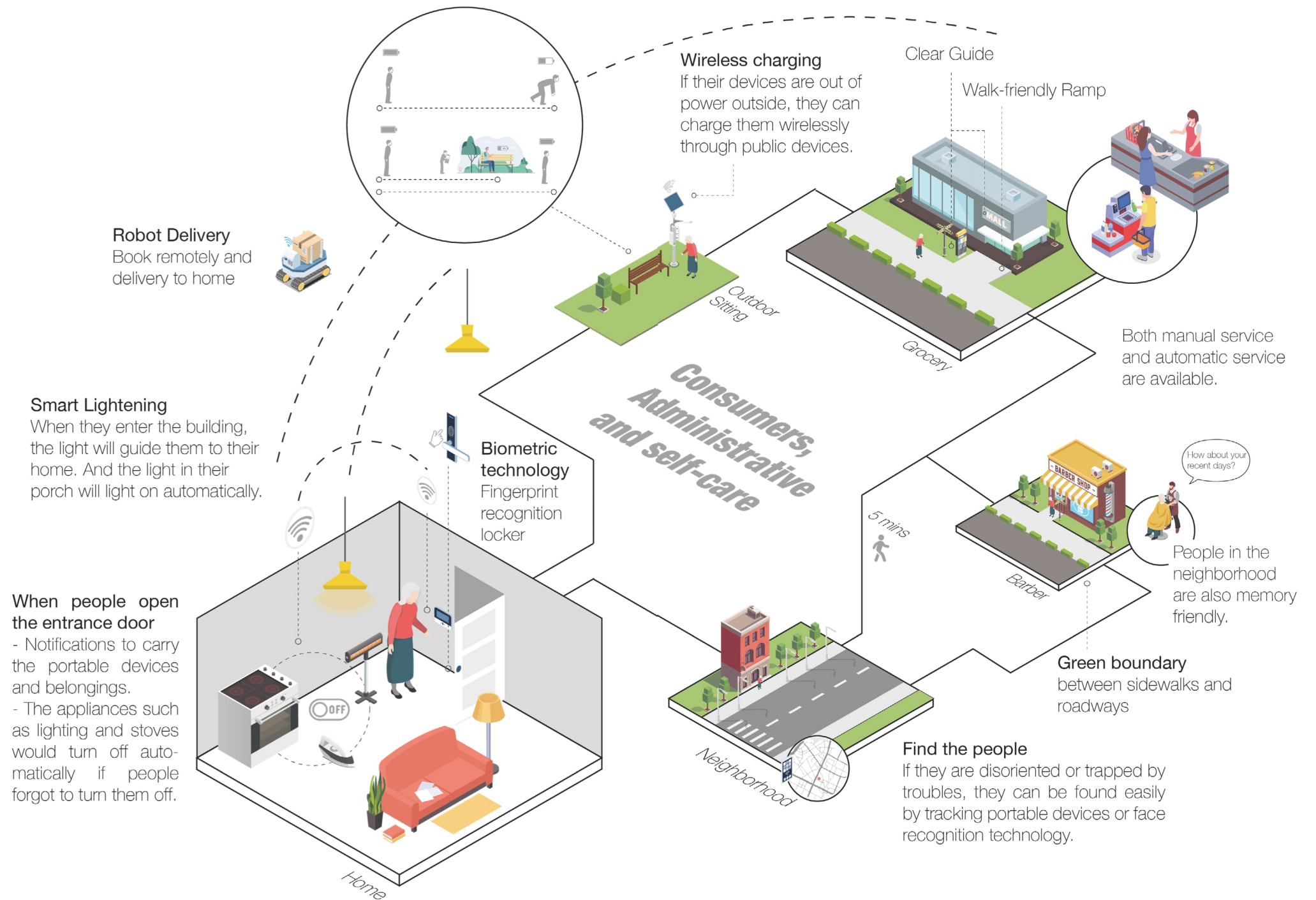


Figure 4.12 Technology-advanced Journey of Group A Activities

Comprehensive medical care can be obtained in the neighborhood. Local health centers and hospitals are supported by the city hospital. So there is no need to visit the city hospital. And retail healthcare is a new method to provide healthcare. It considers prospective locations in underutilized retail areas, ranging from malls to supermarkets, where people usually visit on their exterior journey.

Activities: Group B
“places for medical care”

- Doctor’s surgery
- Hospital or health centre
- Dentist’s surgery
- Therapy
- Day care

City Hosipital
There is one city hospital. But there is no need be a big area scale, but coordinates and networks specialists and research.

District Hospitals
District hospitals cooperate with specialist clinics and rehab.

Community Health Centres
Community health centers on neighborhood levels act as the first contact for healthcare and health education.

Retail Healthcare
Health services may pay attention to healthy lifestyles in the future, which feels more like retail. Some retail settings, from malls to supermarkets, would be potential locations to support the home living mode of people with memory decline.

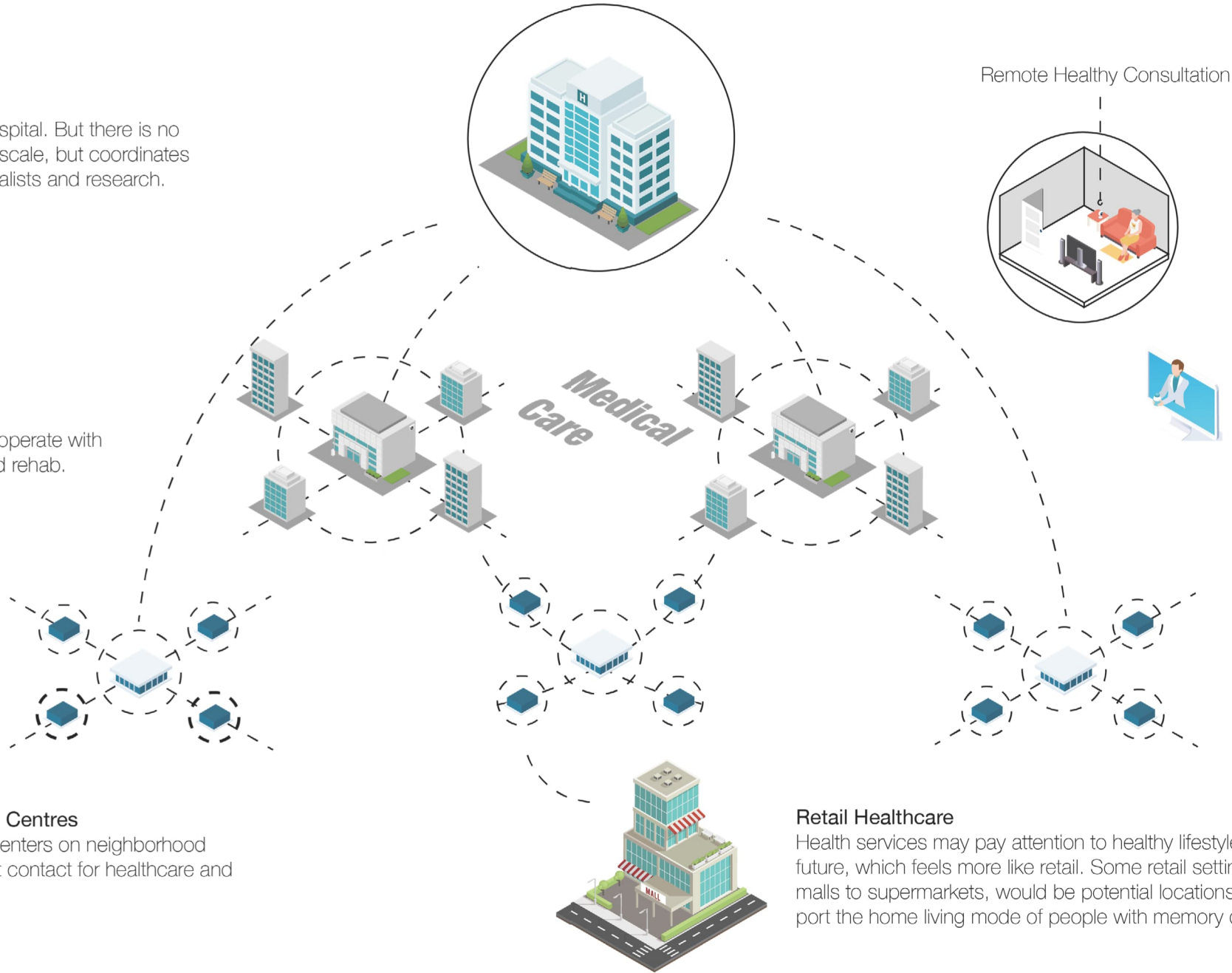


Figure 4.13 Technology-advanced Journey of Group B Activities

It is meaningful for people with MD to participate in social and cultural activities. It can help them avoid social isolation and enrich their spiritual lives.

Activities: Group C
“social, cultural, and spiritual places”

- Friend or family member's place
- Restaurant, café or bar
- Senior centre or social club's premises
- Building for worship
- Cemetery or memorial place
- Entertainment or cultural places

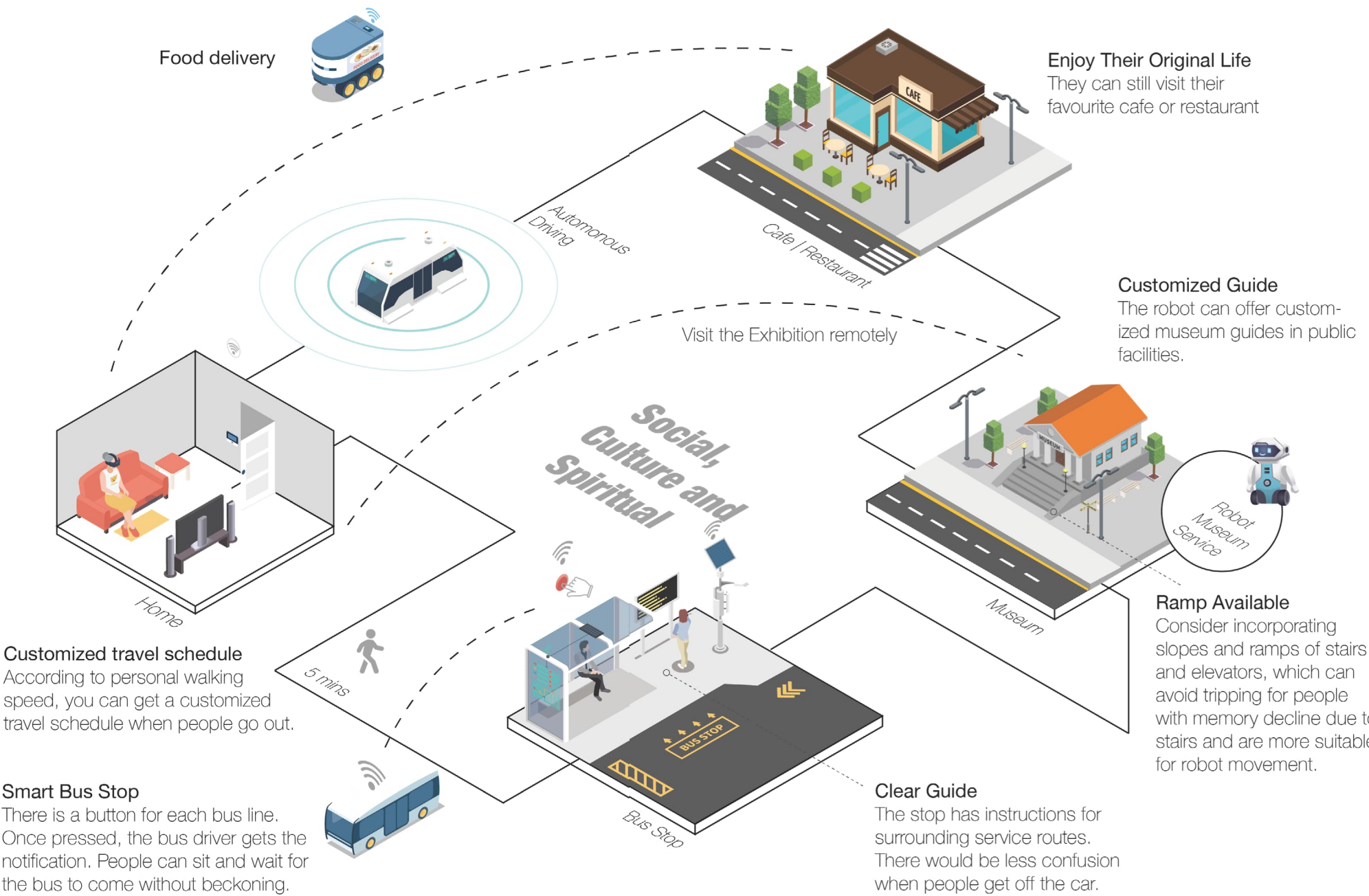


Figure 4.14 Technology-advanced Journey of Group C Activities

Recreational activities also enrich the lives of people with MD and bring them more choices to communicate with the people in the neighborhood.

- Activities: Group D**

“Places for recreational and physical activities”

 - A garden in your backyard
 - Park, green areas, or community garden/ allotment
 - Forest, mountain, lake, or sea
 - Cottage, summer house, or chalet
 - Neighbourhood
 - Sports facility
 - Transportation centre

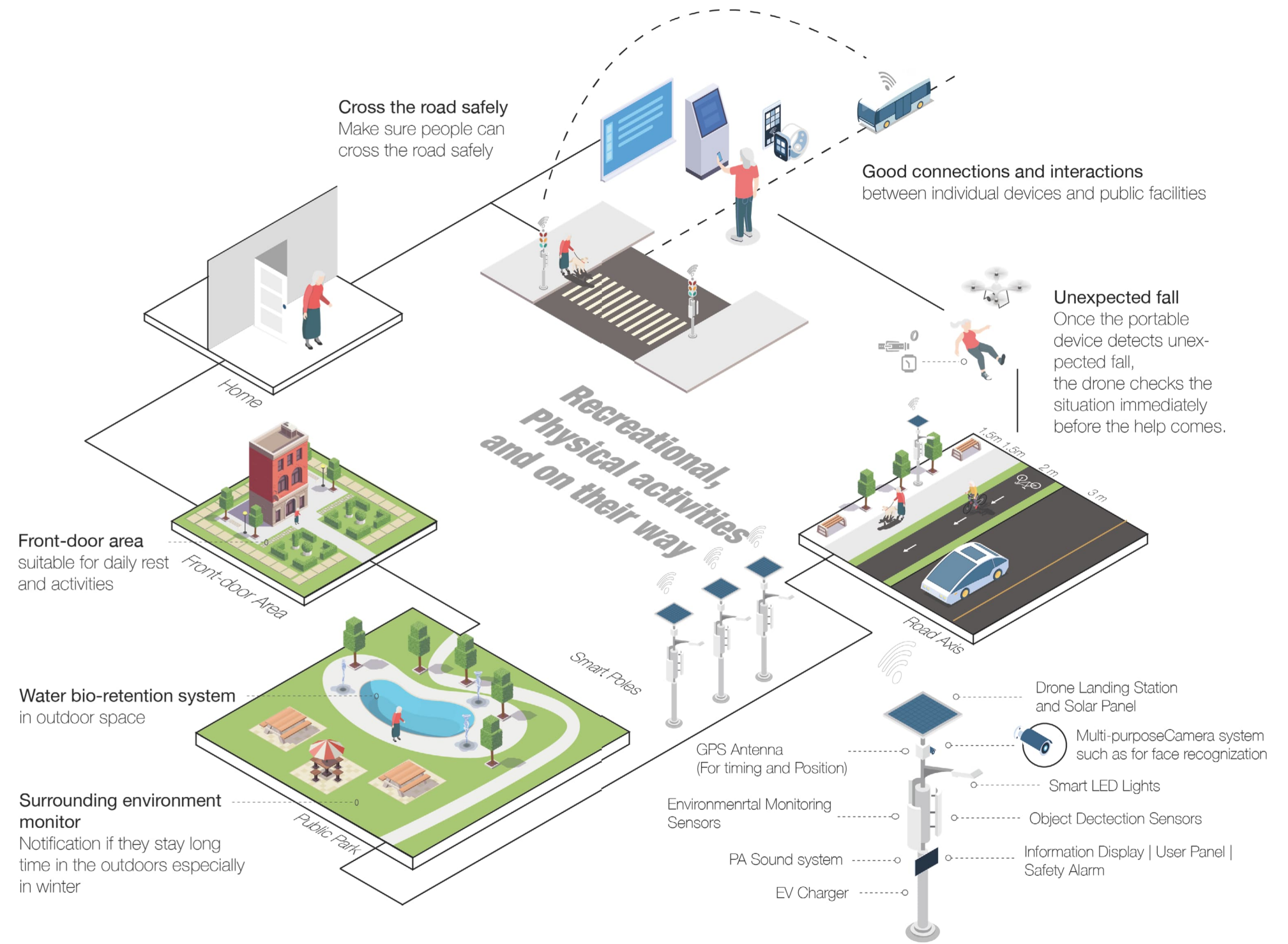


Figure 4.15 Technology-advanced Journey of Group D Activities

5

Experimental Case in Helsinki

Site introduction

Kustaankartano Comprehensive Service Centre and its nearby neighborhoods was the experimental case location.

This area is located in Oulunkylä which is a less crowded urban area in the North of Helsinki. It is a residential area with supporting services and infrastructures.

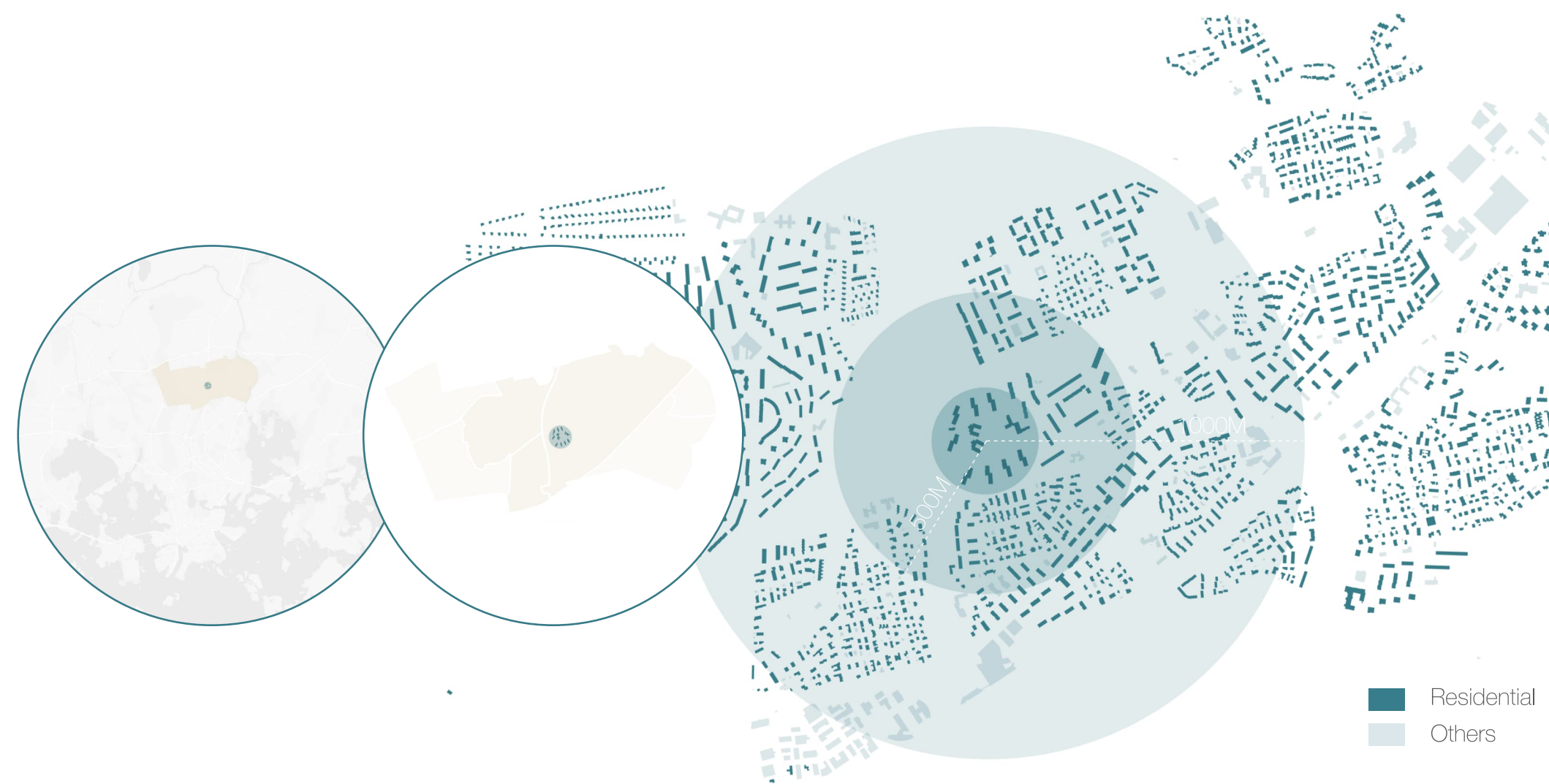


Figure 5.1 Site Introduction & Neighborhood Context

Population

Nearly 20% of the population in Oulunkylä is over 65. According to the WHO, about 40% of 65-year-olds will suffer from some form of MD. The predicted number exceeds the capacity of the nursing home.

Most of them are not so severe to ask for personal care but still need some memory care and support in daily life. Especially when they go out independently, they may still face challenges due to MD such as wandering or getting lost.

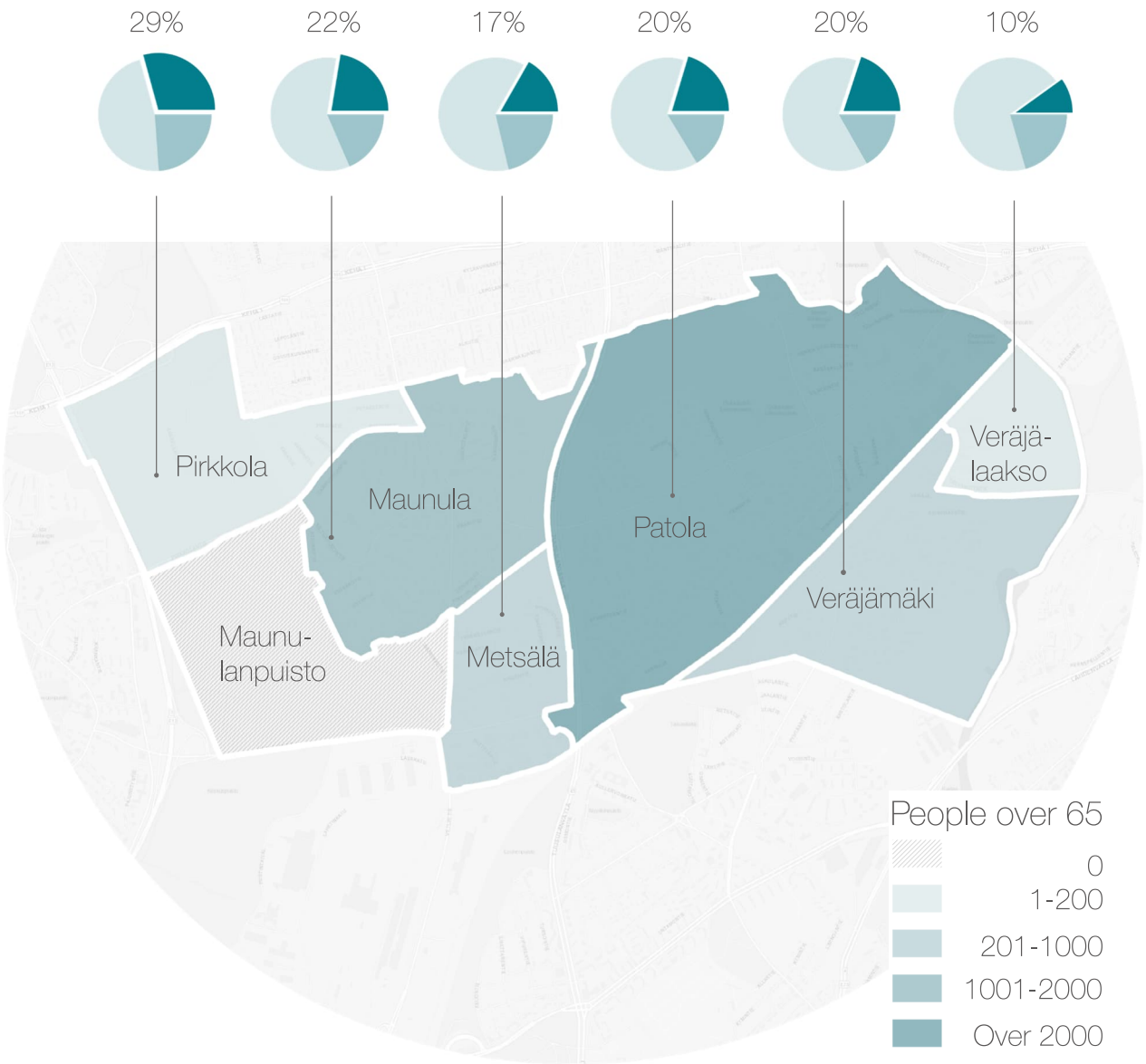
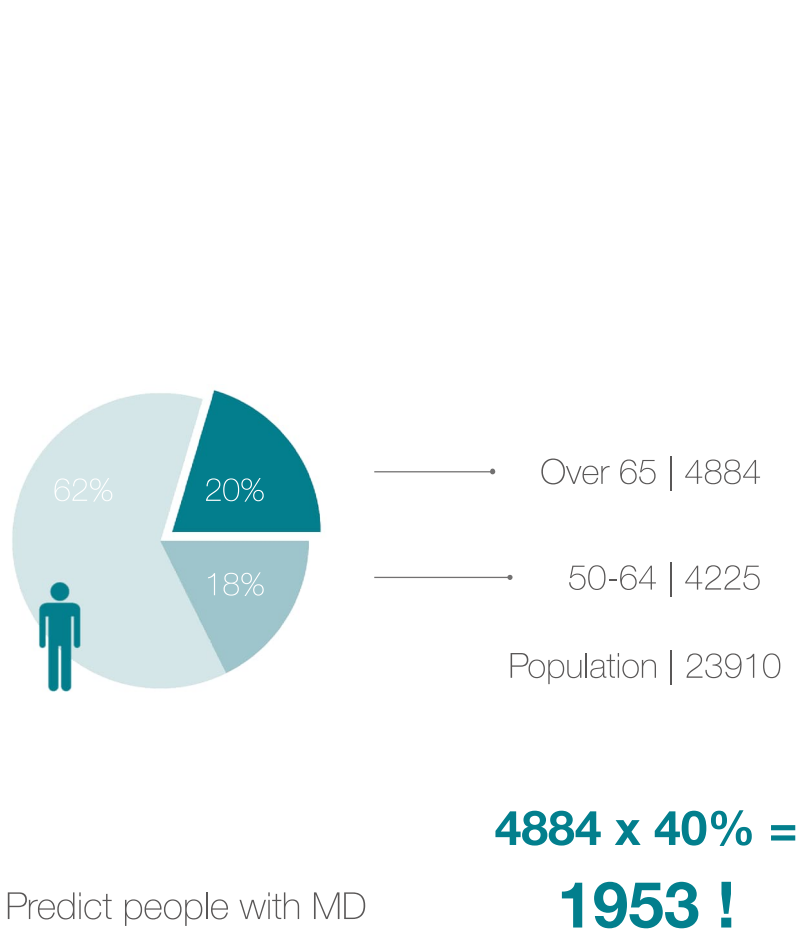


Figure 5.2 Population Proportion by Neighborhood

Seniors and Residential
Distribution

The distribution maps of residential areas with high senior proportion are showed in the previous two maps. As the senior and memory care center in this district, people usually viste the Kustaankartano on foot, by public transportation and private transfer.

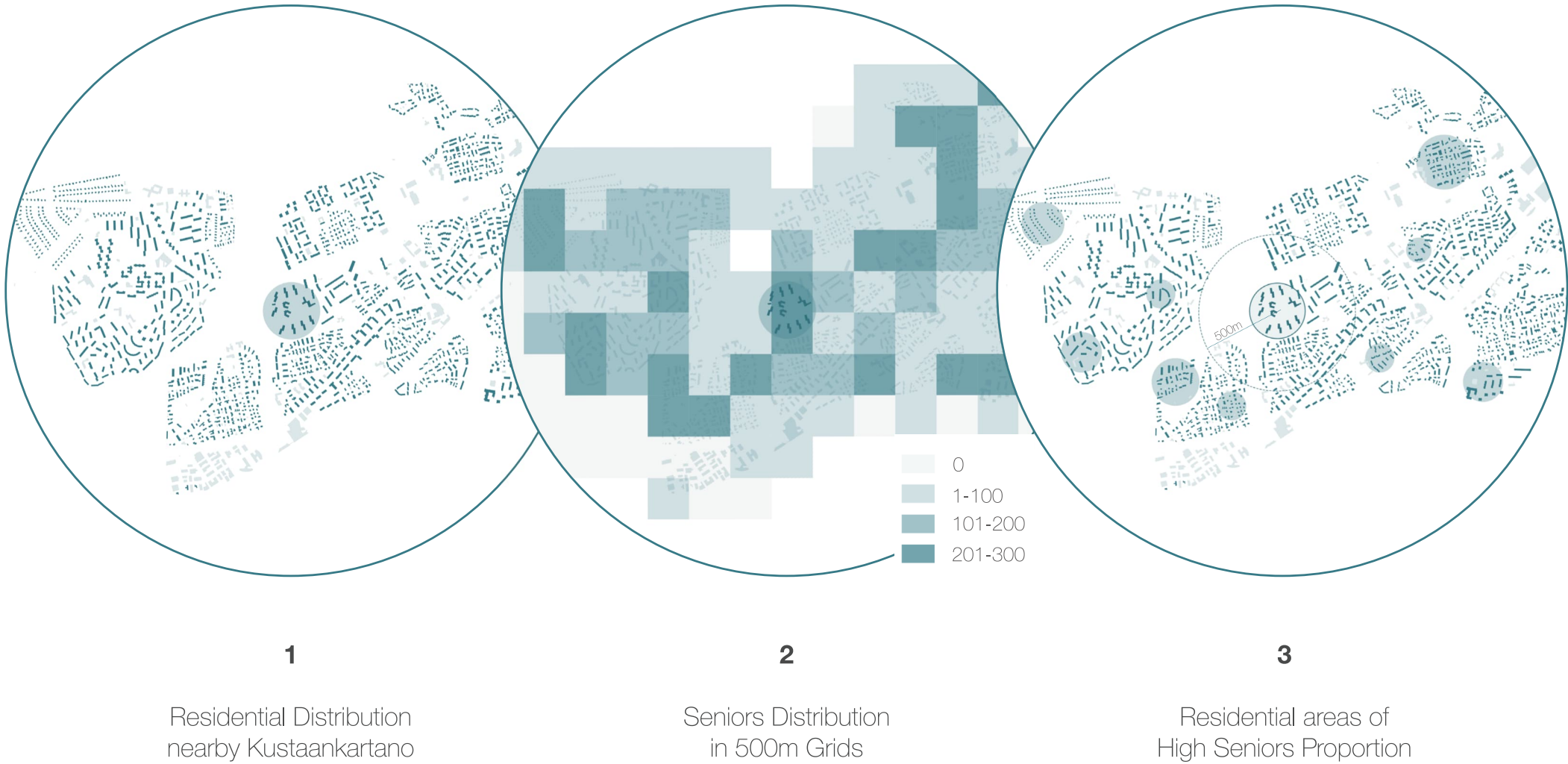


Figure 5.3 Seniors and Residential Distribution

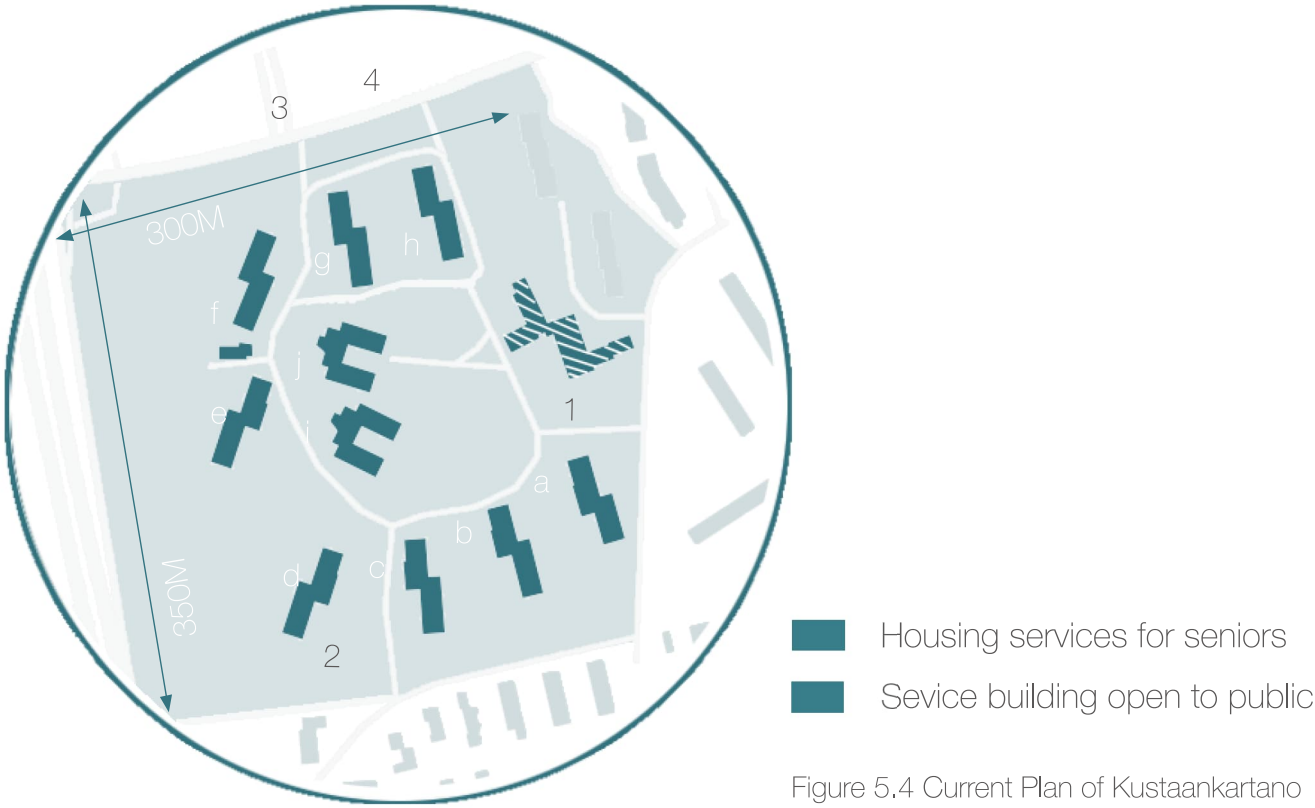
Kustaankartano service center

The service center is composed of eleven buildings. It comprises group homes, short-term units, and daycare activities for people with MD as well as seniors. There is a circular belt around a large outdoor green space.

- Services and facilities
- Restaurant
 - Cafe
 - Library
 - Gym
 - Counselling services for seniors
 - Daily healthcare

This form shows the distance of each building to the service building and to the nearest entrance.

Buildings	To Service Building	To Nearest Entrance
a	120 m	No.1 100 m
b	150 m	No.1 150 m
c	200 m	No.2 100 m
d	270 m	No.2 100 m
e	210 m	No.3 210 m
f	160 m	No.3 100 m
g	100 m	No.3 150 m
h	50 m	No.4 140 m
i	70 m	No.1 160 m
j	100 m	No.1 170 m



Current Situation

People with MD are not encouraged to leave the service center once they move here for long-term living. But the social places, facilities, and outdoor environment offered here are limited.

While some services are open to the public, most people who visit these facilities live here, with their caregivers, and family members. Social isolation happens here because the people who live here have less chance to connect with other age groups and the world outside.

In Kustaankartano, people and vehicles share the same road. It is easy for people to be led to the side doors. Benches, for example, usually have fewer connections to other facilities.



Figure 5.5 The Main Road in Kustaankartano
(Photo: author)



Figure 5.6 The Side Entrance of One Building
(Photo: author)



Figure 5.7 The Bench in Kustaankartano
(Photo: author)

Accessibility of walking

The maps illustrate the door-to-door accessibility of walking in distance and time from the entrances of the service center to the services and facilities nearby. Add the distance between the buildings and entrance for the people who live in the Kustaankartano. It would take some effort for them to go to the social places outside the service center by walking. In the meantime, it is the same for many seniors who want to visit the Kustaankartano.

Accessibility of public transportation

The map also shows the journey to the nearby bus stops and train stations. It shows that the buses are the most supportive public transportation to enhance the accessibility of Kustaankartano in the current situation.

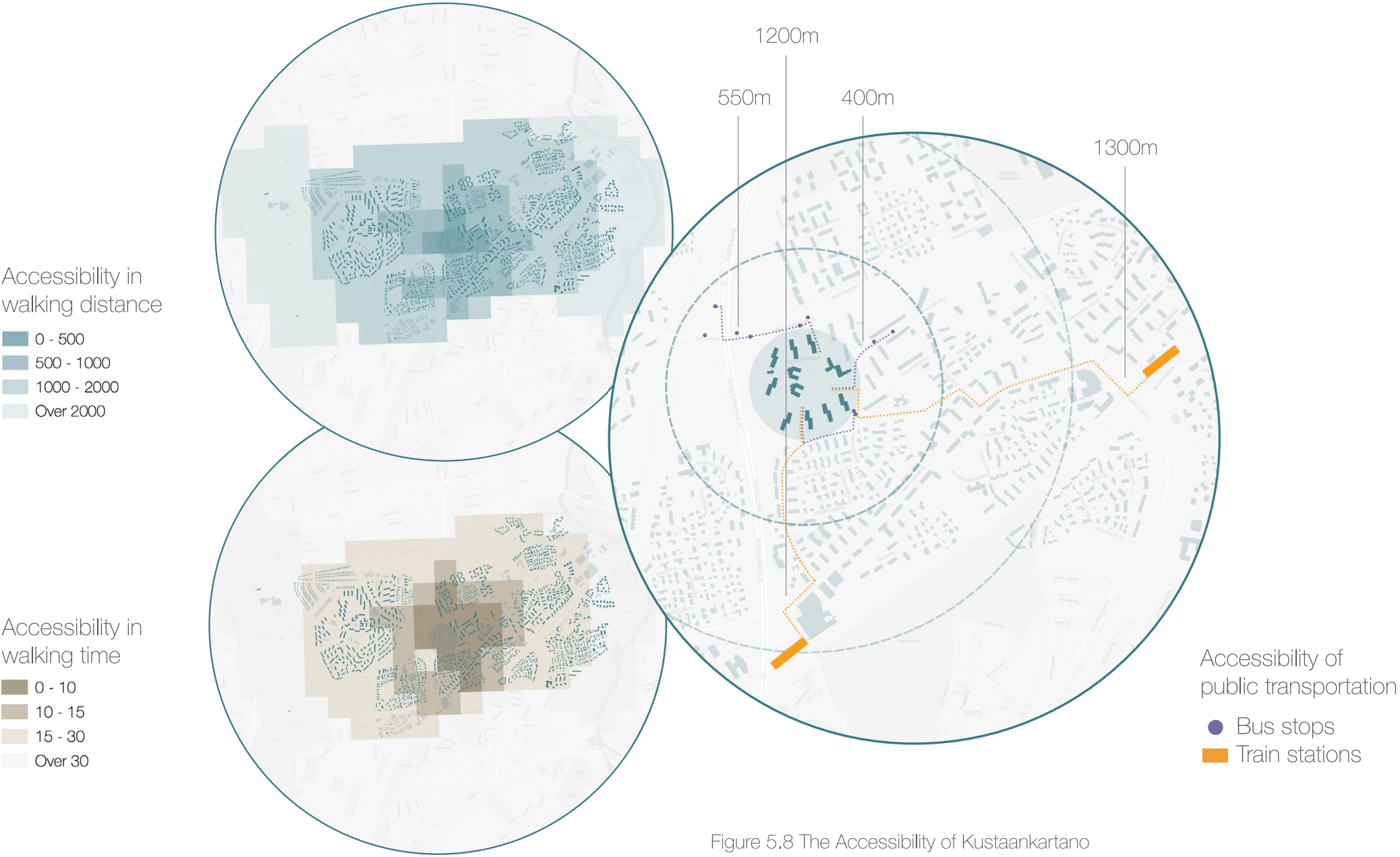


Figure 5.8 The Accessibility of Kustaankartano

Services and facility

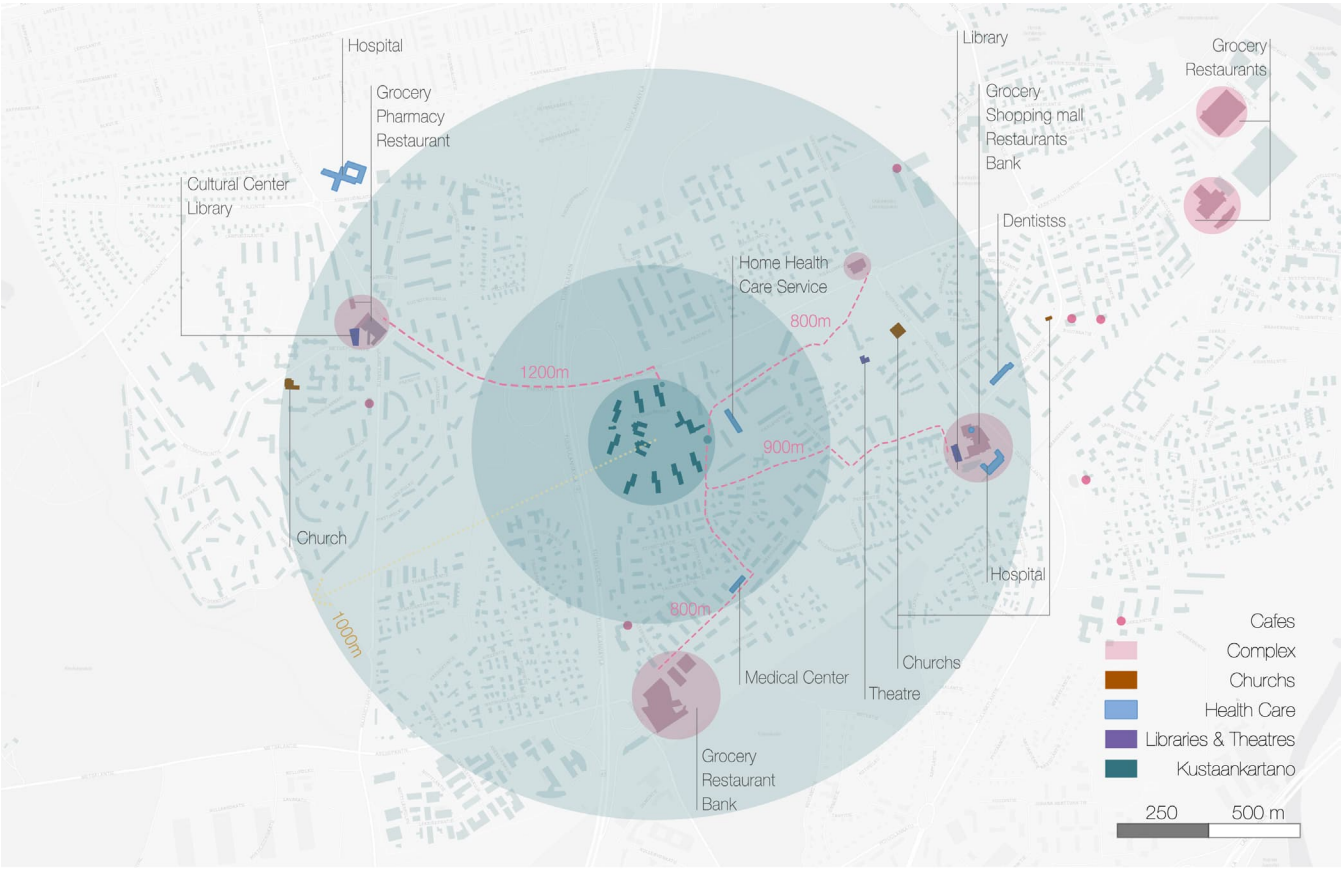


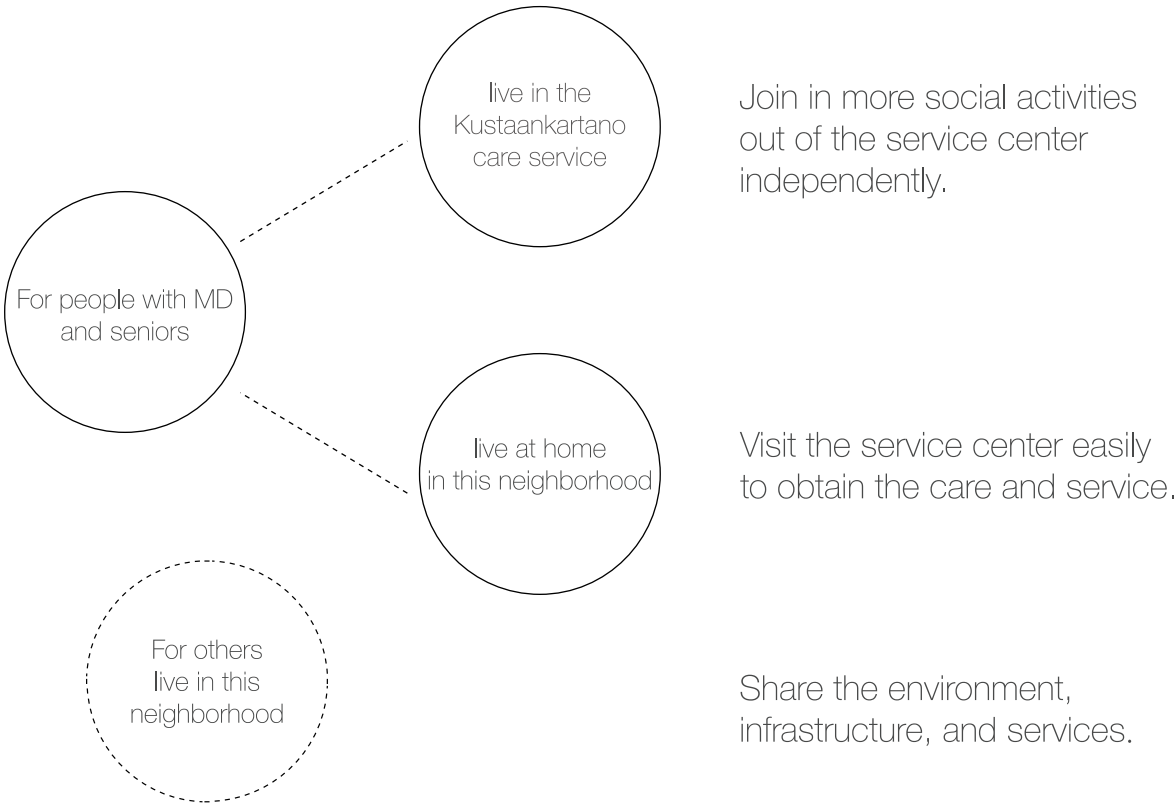
Figure 5.9 The Service and Facilities in Neighborhood

Method

So the memory-friendly solutions for Kustaankartano and nearby neighborhoods are:

- Build up a memory-friendly outdoor environment
- Design a home belt to enhance the accessibility
- Apply the technology to increase the sense of safety and experience

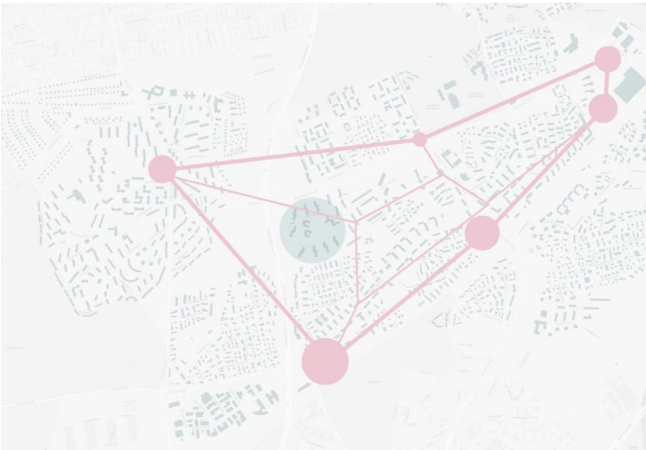
Aim



The home belt

Access to the services

Services and facilities



Cross the green

Public Green



Connect the residences

Residences with high seniors proportion

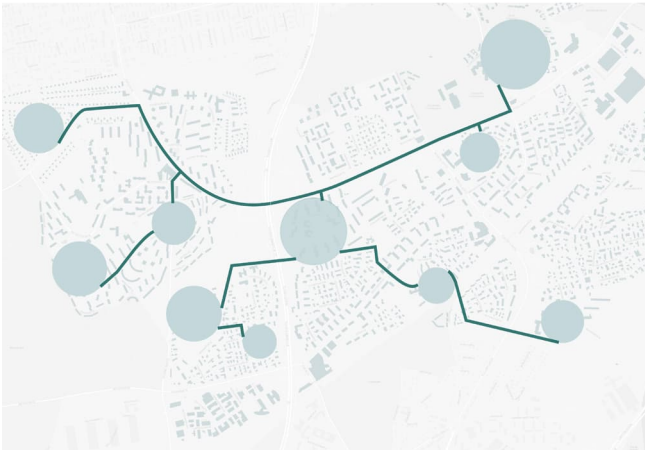
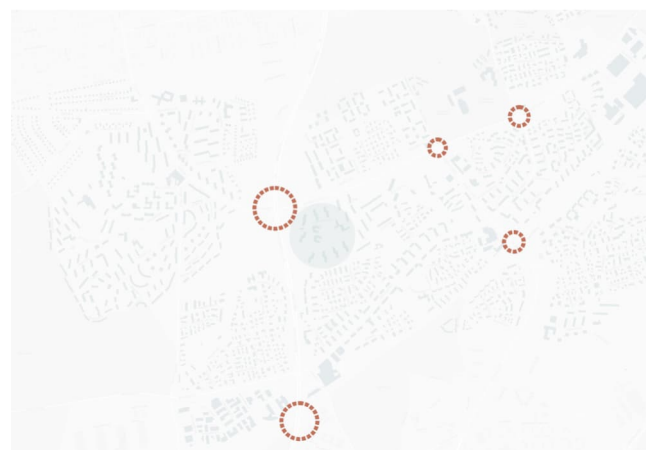


Figure 5.10 The Concept of Home Belt

Avoid the heavy traffic nodes

● Heavy traffic nodes



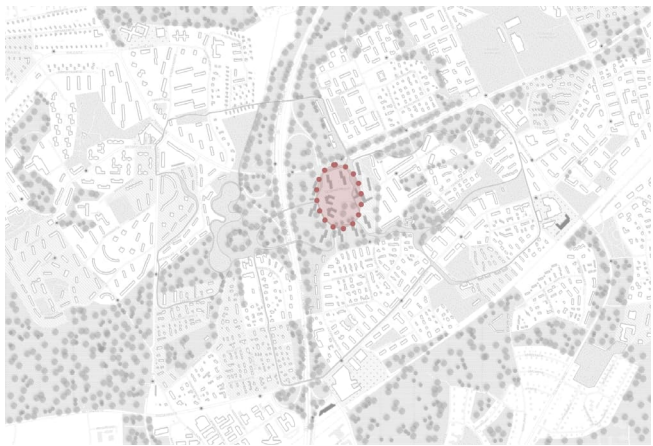
Close to the traffic hub

● Public Green



Figure 5.10 The Concept of Home Belt

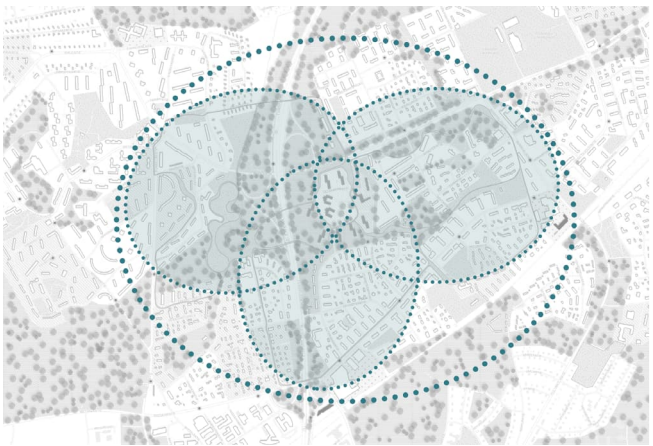
Home belts for different groups



 For People with MD in servere stage

They would prefer to:

- have a short walk around
- visit the service oriented to them
- stay in the outdoors for relax



 For People with MD in mild stage

They would prefer to:

- enjoy the public green area
- join in the outdoor entertainments
- access to public services
- have a rest during the outdoor journey



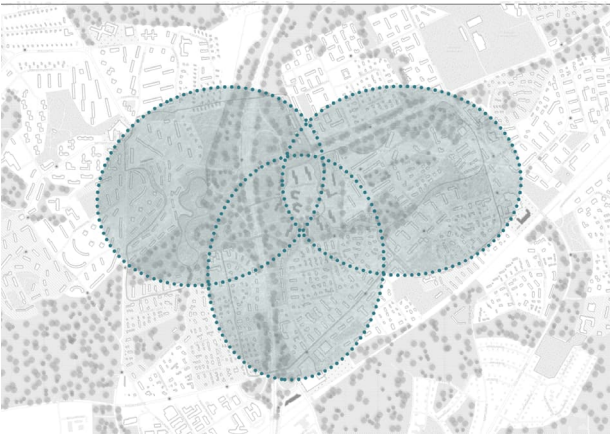
 For Seniors living in the neighborhood

They would prefer to:

- join in the friendly environment
- visit the services center
- be more active in the neighborhood

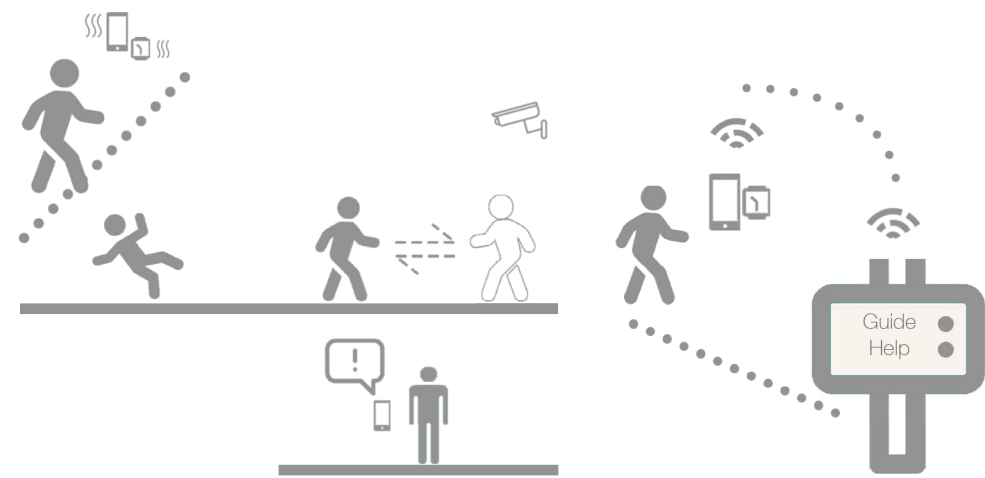
Figure 5.11 The Home Belt for Different People Groups

The home belt of Kustaankartano consists of 3 circles to connect the services and facilities in the neighborhood.



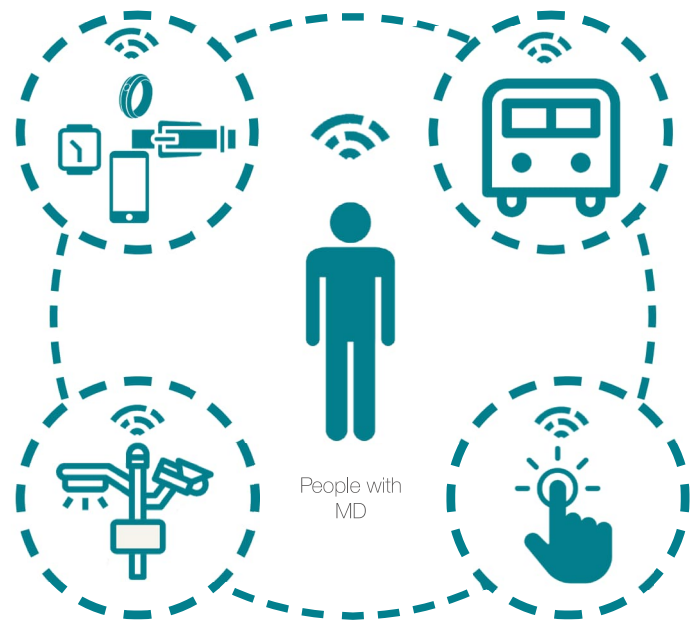
Portable devices

- Remind them if they are stepping out of the preset boundary or when an unexpected situation occurs.
- Remind them if they are wandering for many times and staying in one place for a long time.
- Notify their caregivers if there is no response for the reminder for them.



Smart pole with face recognition camera system

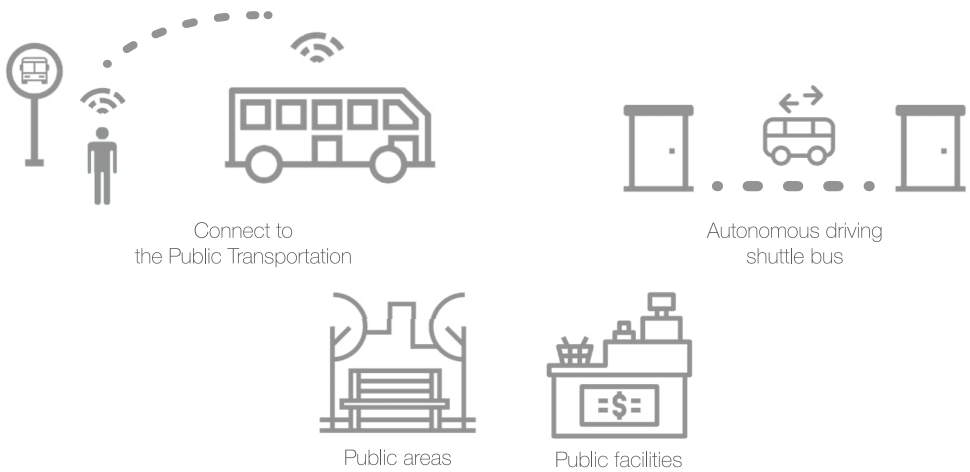
- Double protection for the function of the portable device in case they forget to bring the devices, or the devices do not work properly.
- The screen attached to it connects with portable devices. Once unexpected situations are detected nearby, guiding the people get close to the pole. The screen can offer the solutions, guide, and contact with caregivers through the screen.



Caregivers & Family members

Public transportation

- The individual journey plans connect with the public transportation system, so they can get the best solution for travel.
- Public transport can know their travel needs in advance, from where to the destination, so that they are not ignored.
- In the future, self-driving shuttle buses could provide them with an independent door-to-door approach. It's like they're driving around on their own.



Ask for help

- Besides asking for help by individual devices.
- The system of asking for help is needed in the public area and attached to the public facilities, such as on outdoor benches for rest and self-counters of groceries, banks, or libraries.

Circle 1

The total length of Circle 1 is 2.8km.
There is no need for people to walk in one direction to finish a journey. People who live in Kustaankartano can arrive at the destination by the nearest sidewalk. And people who live in this neighborhood could join in this sidewalk when their destinations are on the belt.

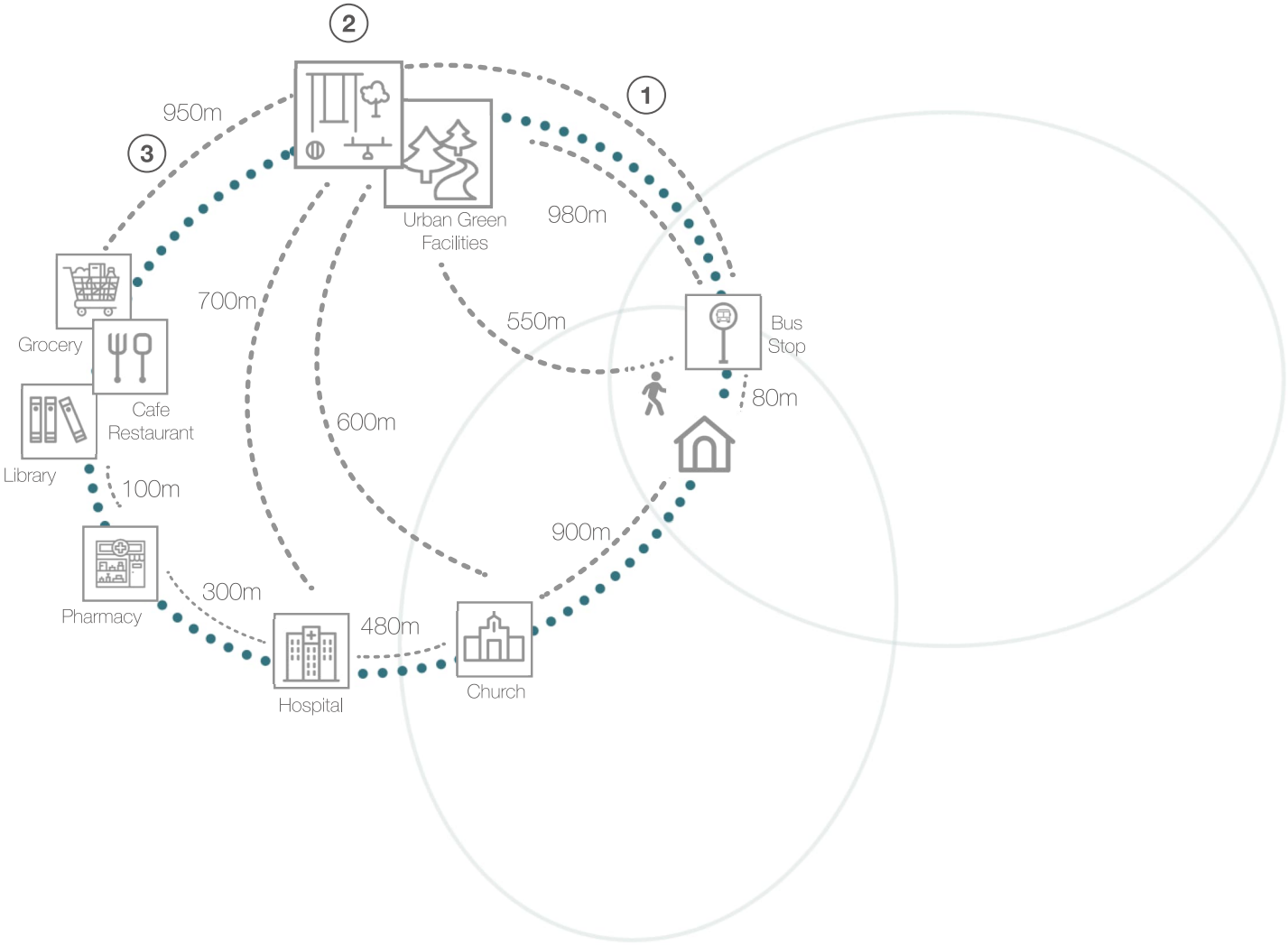
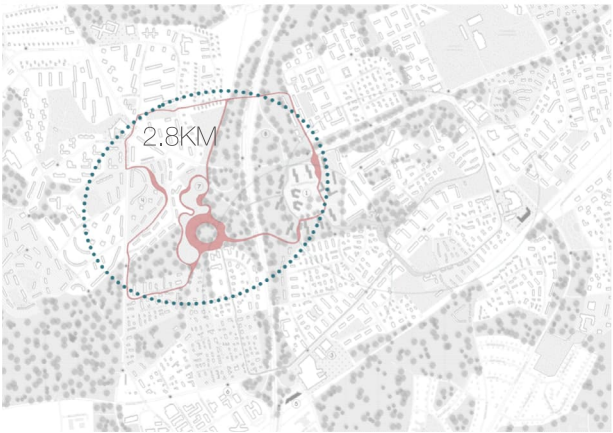
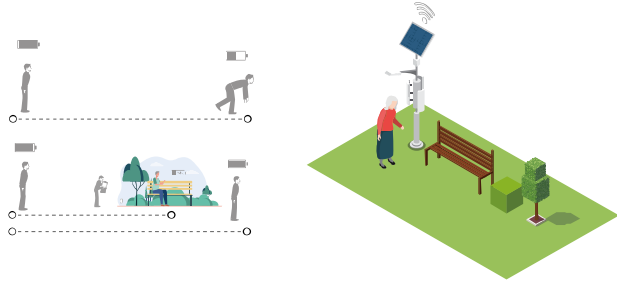


Figure 5.13 Accessible Services of Circle 1

① Provide more rest space



② Be active in urban Green

People with MD are easy and safe to access to the urban green. Surrounding environment monitors can notify people if they stay a long time outdoors, especially in winter.



③ Smart Pole is on the street



Smart pole is the multi-function. It could be:

- wireless charge
- parts of environmental monitoring system
- interaction devices platform between individual and public

Good connections and interactions between individual devices and public facilities.



Circle 2

The total length of Circle 2 is 1.7km. Circle 2 connects the public green, the complex mall and the nearest train station. It is the main circle support the people take the advantage of public transportation.

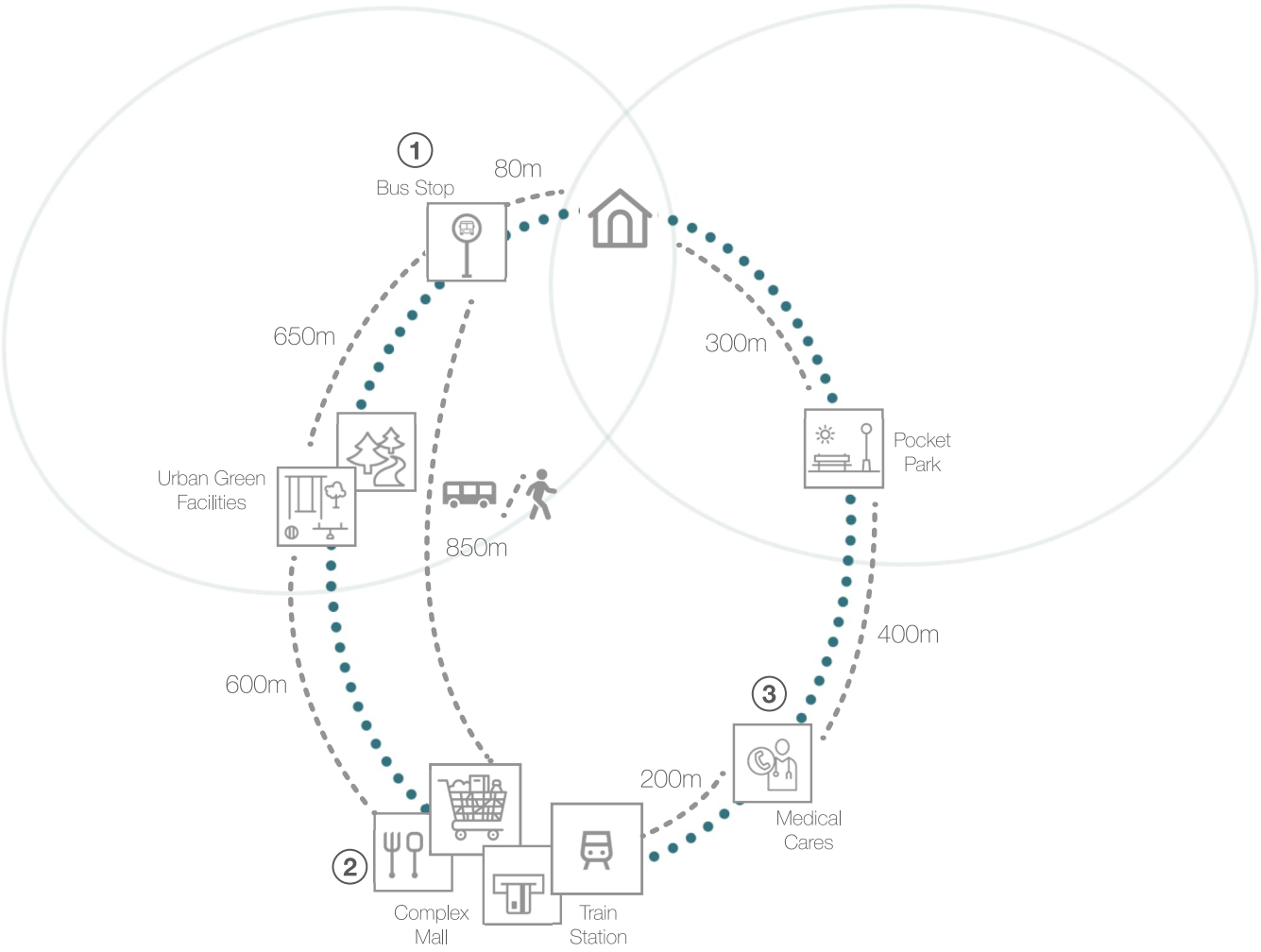
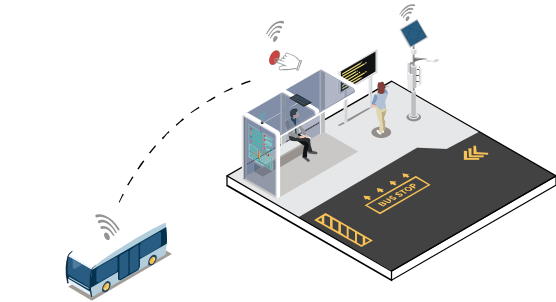


Figure 5.14 Accessible Services of Circle 2

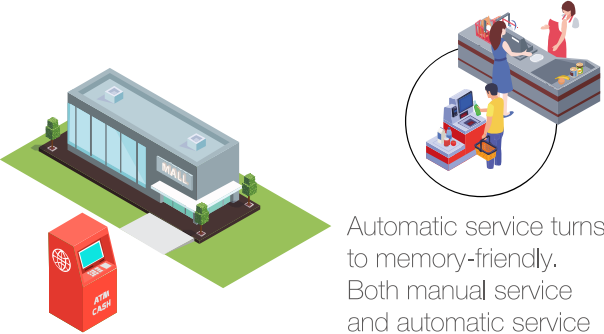
① Easy to use the public transportation



Smart Button:
There is a button for each bus line. Once pressed, the bus driver get the notification. People can sit and wait for the bus to come, without beckoning.

Clear Guide:
The stop has detailed instructions for surrounding service routes.

② Memory-friendly public service



Automatic service turns to memory-friendly. Both manual service and automatic service are available.

③ Remote service and delivery



Remote services such as healthcare services and delivery services are available for people with MD.

Circle 3

The total length of Circle 3 is 2.3 km.
The most social and entertaining activities for everyday life are found in Circle 3. It consists of 2 loops to meet the different individual entertainment demands.

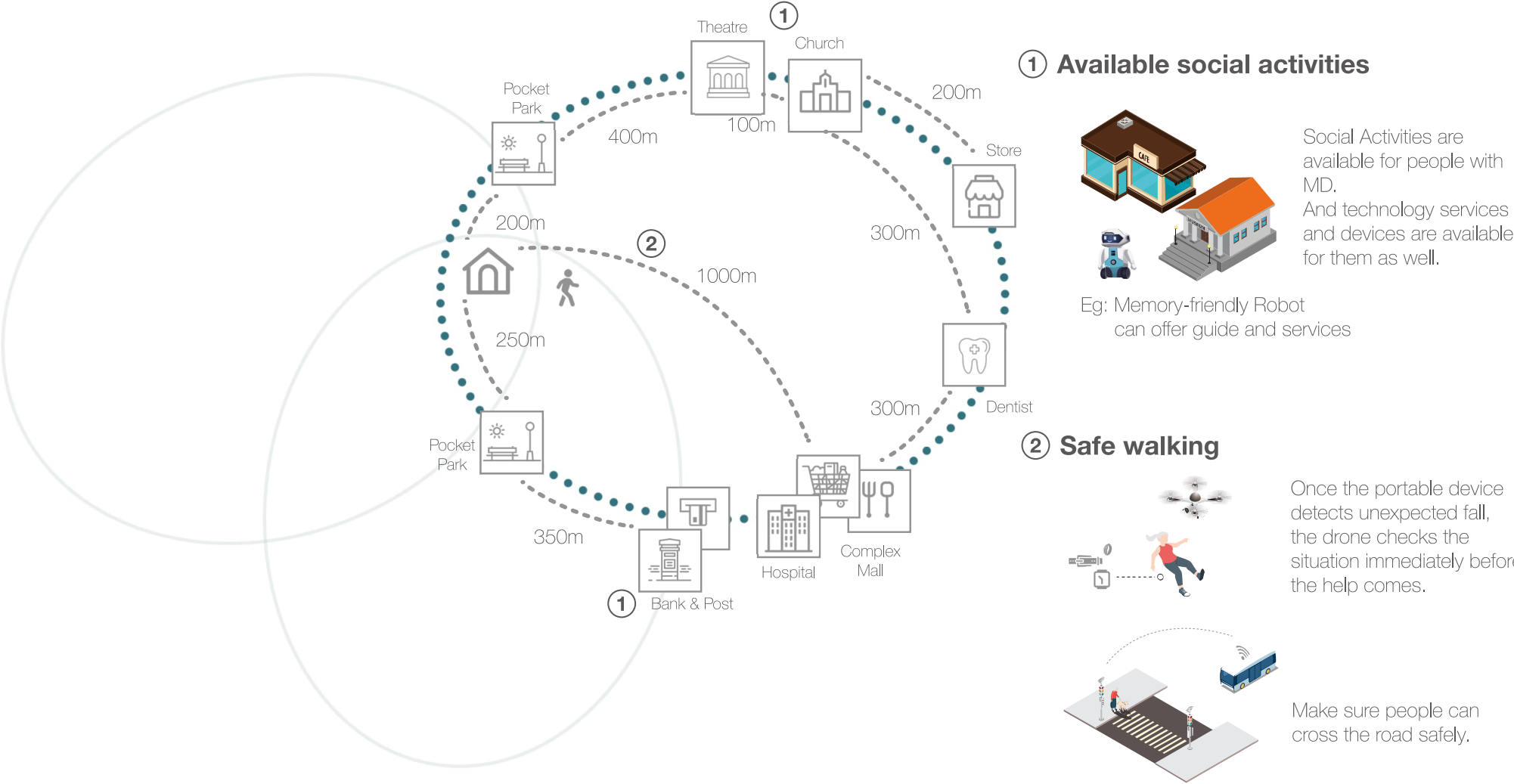
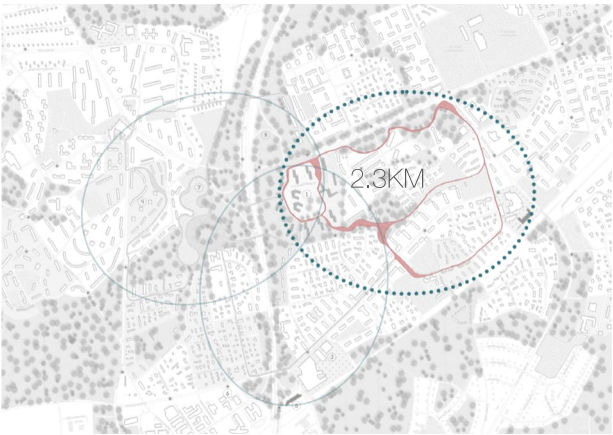


Figure 5.15 Accessible Services of Circle 3

Connectivity
Choice
Independence
Safety
Accessibility

Access to the services
Close to the traffic hub
Avoid the heavy traffic nodes
Cross the green

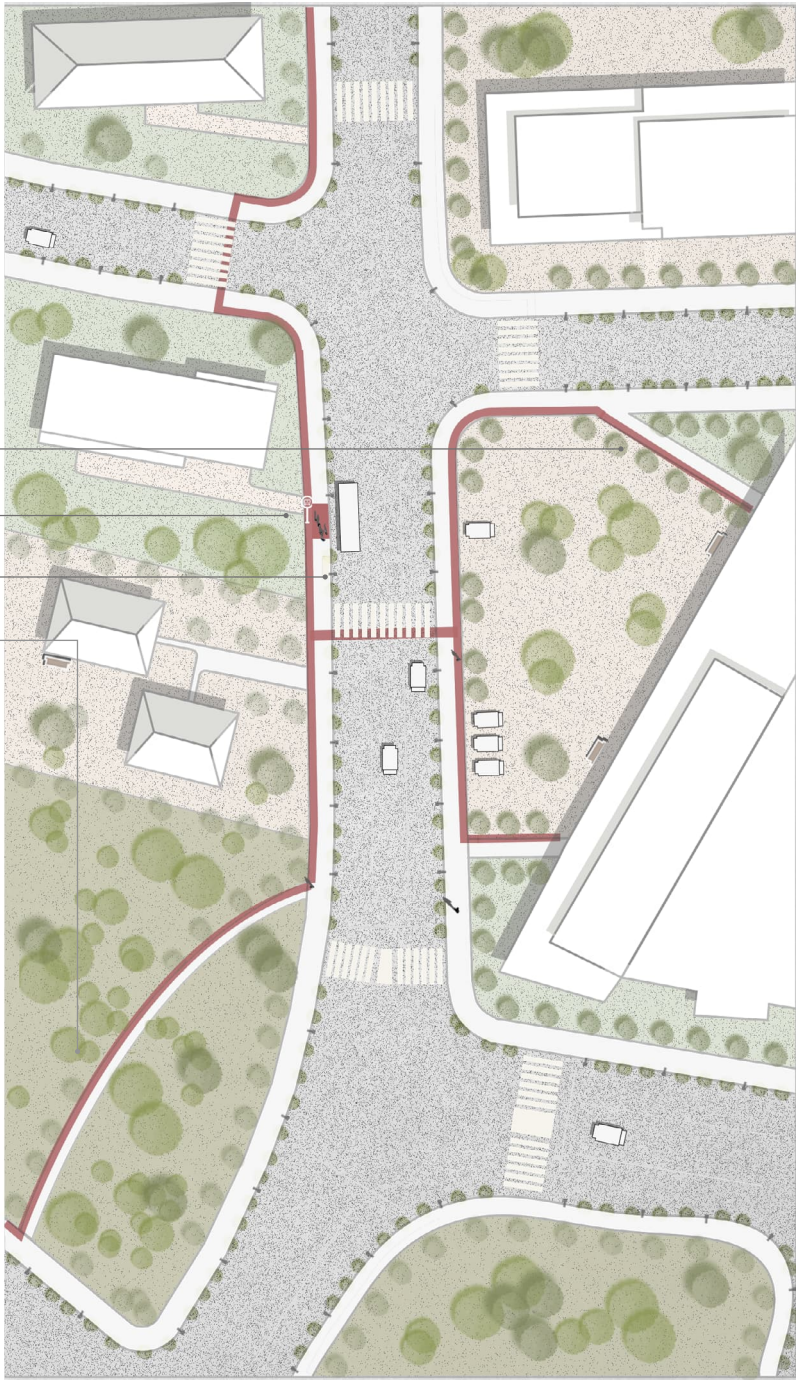
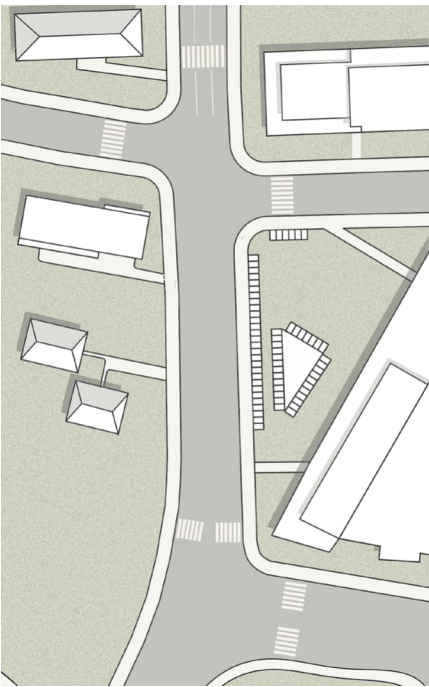


Figure 5.16 Traffic Knots and Accessible Services of Homebelt

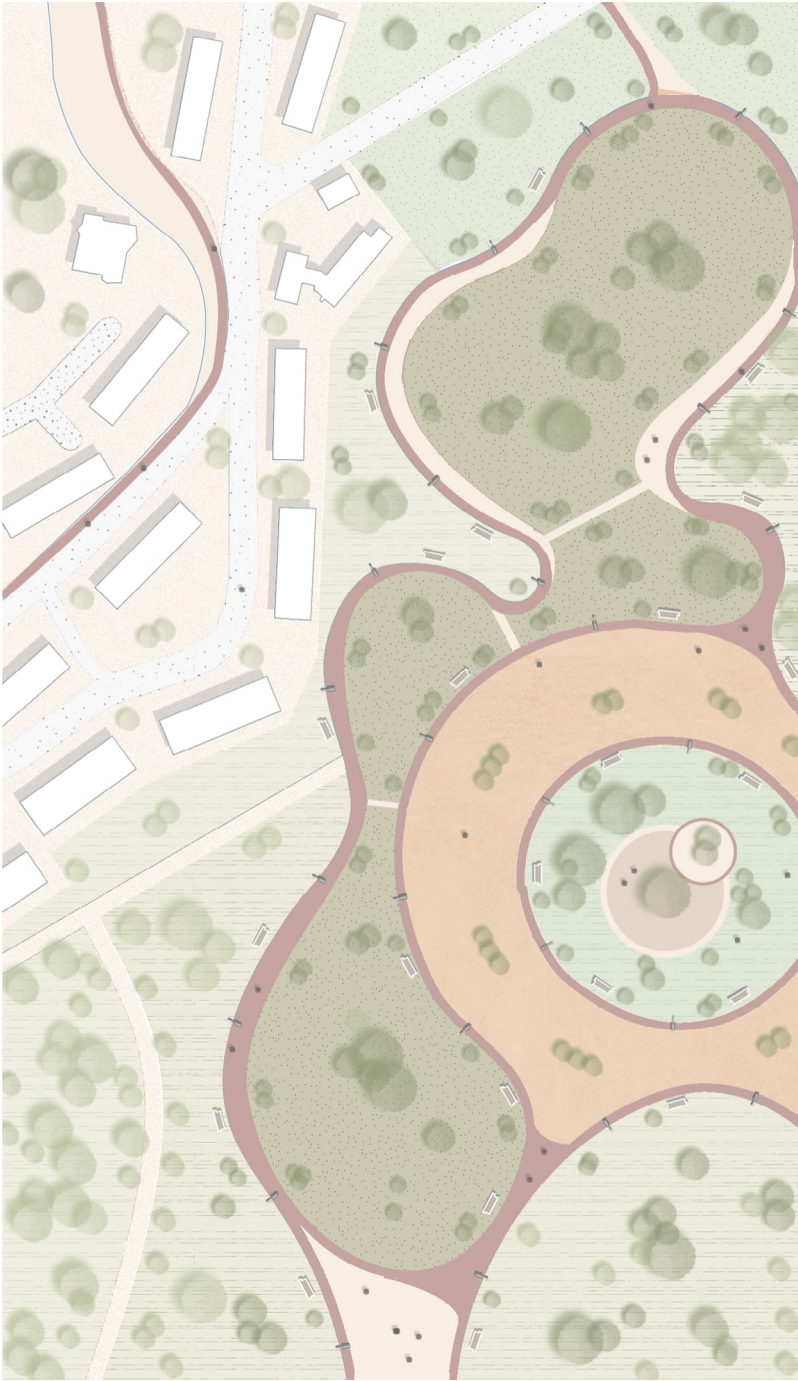


Figure 5.17 Public Green of Home Belt





Conclusion

The care of MD would no longer be limited to the indoors and the front-door areas. Especially for those with mild MD, stepping outside, enjoying the outdoors, and continuing their original lives is expected.

The thesis designed a memory-friendly neighborhood where exterior challenges were solved through environmental design and technology applications. To achieve this, the outdoor environment for people with MD and its role in memory care were summarized and analyzed. Additionally, the thesis reviewed available and possible technology to support people with MD in their daily lives. Moreover, technologies were combined with the outdoors to create a safe and enjoyable outdoor experience. Finally, a home belt connected the neighborhood, making public areas and services accessible for people with MD.

Technology is changing everyone's life. Technologies are mature enough to support their independent exterior journey, but ethical and privacy concerns remain. The thesis discussed and weighed the benefits and issues, but there was still no concrete answer to completely protecting the privacy of people with MD.

A memory-friendly neighborhood also needs to combat the aging trend. The trend in memory care is to allow people with MD to live at home and walk around the neighborhood freely.

Future and outlook

It is a long-term process to develop a memory-friendly neighborhood. Creating an environment based on the memory-friendly concept is the first step to welcoming people with MD outside their homes. However, a sustainable environment needs to consider people's feedback and continuously improve the design.

On the technology side, unexpected situations with tracking technology, such as a weak signal or a dead battery, ought to be avoided. The accuracy of monitoring people's state and position needs to be improved, such as by face recognition. Autonomous driving would be the solution, with great potential, to support independent movement from door to door for people with MD. Moreover, privacy and ethics still require comprehensive consideration and solutions.

From the perspective of society, stigma is still the barrier to social participation for people with MD. People with MD can experience public care from the designed environment and raise awareness through environment design.

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