THE ROLE OF TECHNOLOGICAL DEVICES IN SUPPORTING ELDERLY INDEPENDENCE AT HOME

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ABSRACT

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Master Program in Design Studies

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Smart interior environments can also be named smart homes supported with technological devices and smart systems to enable automation. Smart homes can monitor the elderly in their homes, improve their safety, and observe their health situation without caregivers' need. This research aims to understand the elderly thoughts about smart interiors prepared to accommodate and monitor them daily to continue independently. This research examines the concept of "smart interiors" and its possible contributions to enhancing the elderly's daily lives and supporting independence as independence concept for the elderly means self-confidence. Therefore, this research uses a theoretical framework as a base of this study, including elderly needs, inclusive design principles, design for elderly requirements, and recently innovative technology for elderly assistance. The method involves interviews with 20 participants following up with cognitive mapping to strengthening the interview technique to analyze and evaluating hypotheses to understanding the elderly needs, difficulties, and acceptance of innovative technologies. Finally, the results

indicated that a tiny percentage of the elderly had background information about the smart home concept in general. Still, the vast majority of the participants did not have any idea about it. Most of the elderly were welcome to learn more about technological devices and smart homes and how they work. Although knowledge of the smart home concept and its impact on supporting the independence of the elderly is welcomed, not all participants prefer to convert their home into smart home if the opportunity permits.

Keywords: Inclusive design, Elderly, Independent living, Technological devices, Smart homes.

ÖZET

TEKNOLOJIK ALETLERIN YAŞLILARIN EVLERINDEKI BAĞIMSIZLIĞINDALİ ROLÜ

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Yaşlıların evde bağımsız yaşamasının yanında öz işlerlik sağlayan teknolojik cihazlar ve akıllı sistemler, bu kişilerin günlük yaşamlarının iyileştirilmesinde önemli bir role sahiptir. Teknolojik cihazlar yaşlıları evlerinde gözleyebilir, güvenliklerini artırabilir ve bakıcı ihtiyacı olmadan sağlık durumlarını takip edebilir. Bu araştırma, yaşlıların bağımsız günlük yaşamlarını düzenlemek ve izlemek için tasarlanan teknolojik cihazları kullanma konusundaki düşüncelerini kavramayı amaçlamaktadır. Ayrıca, "akıllı iç mekanlar" kavramını ve onun yaşlıların günlük yaşamlarını iyileştirme ve yaşlılar için özgüven anlamına gelen bağımsızlığı destekleme adına olası katkılarını incelemektedir. Bu nedenle çalışmada yaşlı ihtiyaçları, kapsayıcı tasarım ilkeleri, yaşlı gereksinimleri için tasarım ve yaşlı destekleyici yenilikçi teknolojileri içeren temel niteliğinde teorik bir çerçeve kullanılmıştır. Araştırma yöntemi yaşlı ihtiyaçları, zorlukları ve yenilikçi teknolojilerin kabul edilmesini anlamak, hipotezleri analiz etmek, değerlendirmek ve görüşme tekniğini güçlendirmek için gerçekleştirilen bilişsel haritalamayı takiben 20 katılımcıyla yapılan görüşmeleri içerir. Nitekim,

sonuçlar yaşlıların sadece küçük bir kısmının akıllı ev konsepti hakkında genel bir arka plan bilgisine sahip olduğunu ortaya çıkarmıştır. Buna rağmen katılımcıların büyük çoğunluğunun bu konuda herhangi bir fikrinin olmadığı gözlemlenmiştir. Yaşlıların çoğu teknolojik cihazlar, akıllı evler ve bunların nasıl çalıştığı hakkında daha fazla bilgi edinmekten memnun olmuştur. Akıllı ev konseptine dair bilgiler ve yaşlı bağımsızlığını destekleme üzerindeki etkisi memnuniyetle karşılansa da katılımcılar evlerini akıllı evlere dönüştürmeyi ellerinde imkan olmasına rağmen tercih etmeyebiliyor.

Anahtar Kelimeler: Kapsayıcı tasarım, Yaşlı, Bağımsız yaşam, Teknolojik cihazlar, Akıllı evler.

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CHAPTER 1: INTRODUCTION

1.1. Introduction

Due to the increasing population of citizens over 65 years old worldwide, it is essential to create smart interiors to allow all people to use regardless of their age, size, disability, or ability. According to data from World Population Prospects: the 2019 Revision, by 2050, one person in six people will be over age 65, representing 16% of the world population, up from one person in 11 people in 2019 average 9%. Depending on this forecast, the number of individuals aged 65+ is predicted to reach 1.2 billion in 2025, 1.3 billion in 2040, and 2 billion in 2050 globally. Research states that the interior architectural environment has an essential role in improving the elderly daily lives and support them to communicate, interact, and remain living independently in their homes. Smart interior environment for the elderly is technological assistance sustained by innovation and smart systems such as sensor technology systems, smart wearable devices (Demiris and Hensel, 2008), and wireless connections that afford healthcare controlling management devices to facilitate independent existence for the elderly in their homes (Cavallo et al., 2015).

In this study, the word "home" was chosen as a keyword rather than "house" because of the home's moral meaning, which represents elderly emotions, memories, and a sense of safety. A house is presented as an architectural structure of a residence, but a home refers to the emotional relationship between users and structure. The best way to define home meaning is to realize the relationship between it and its residence; simply, it is a person's soul (Karjalainen, 1993). Houses sound like the meaning of the interior architecture space as a functional space. The home reflects the user's emotions, feelings, and experiences. Home always is the moral and psychological meaning of feeling safe and private (Karjalainen, 1993). While trying to find out the differences between home and house, it was noticed that the full meaning of home and house that both a place to live in, but the house more refers to the building and the home refers to the whole meaning of feeling the home, it is more about emotions.

The emerging dependency between design and technology to achieve the elderly's needs in interior space is the focus of this research. The technology could have an impact on supporting the elderly to continue active, independent, and healthy. Nevertheless, various technology usage varies among the elderly (Peek et al., 2016).

The elderly face many problems using the latest technology because it does not fit their mindsets. There is a need to work on elderly needs in design and the elderly's issues and challenges that focus on this research. The design of smartphone interfaces or technological devices for the elderly is becoming more critical as the population ages and their use of technology increases. The health care system took a step forward with technologies to better the elderly in their daily activities and become independent. It is imperative to provide innovative technology for the elderly, making their daily routine easier (Aslam, and Latif, 2020).

1.2. Research problem definition

As the population of citizens over 65 years old increases worldwide, as mentioned before, it has become imperative to think about design for this age group. The role of smart interior environments that suitable for the elderly is the central core of this research, and before thinking of just a design for the elderly, this thesis focuses on the effect of technological devices and smart homes on improving elderly independence in their home, which attentions to the elderly needs and issues. One of the critical factors, if not the most important, that affects implementing smart homes and integrating technology into the daily life of the elderly or not is the extent to which the elderly themselves accept this principle. One of the goals of this research is to determine how older people accept integrating more technology into their lives and how they perceive technology's role in supporting their independence. This research posed the main research question and sub-question to be answered in the next chapters as follows:

- ***Research question***

How can technological devices improve the elderly daily lives and support them to continue living independently in their homes?

- ***Sub-questions***

How can smart interiors environments influence the elderly in continuing their daily routines independently?

How can the elderly accept the concept of smart homes and adding more technological devices/ systems in their life to support them in remaining independent?

1.3. *Research aims and purposes*

- ***Research aim/ objective***

This research aims to understand the elderly perspectives on innovative technologies and the smart home concept that supports them in continuing their daily lives independently. There are several technological devices that assist the elderly so that their life runs more smoothly. This study aims to clarify the elderly opinion and acceptance to integrate more technology into their lives to maintain independence.

- ***Research significance***

The research's significance lies in understanding the elderly views and opinions about the concept of smart homes and their knowledge of the potential impact of technology on their daily lives. As technology-induced homes can significantly impact elderly independence, developing a strategy and proposal for an integrated technological solution would decrease difficulties that the elderly face daily in their homes.

- ***Theoretical framework***

This research has a critical lens that aims to emancipate the elderly habits and support them in dealing with technological devices and application in their daily activities. Moreover, the elderly relationship with technological devices and exploring how the elderly would participate and interact with their smart homes are studied.

This research focuses on design for the rapidly aging population in Turkey and worldwide and how home design can support the elderly to live independently. Moreover, this research examines the elderly's behavior through literature research in designing for the elderly. It attempts to gather knowledge about the relation between design for the elderly and innovative technological devices to assist the elderly's life. Therefore, this research will use a theoretical framework, including elderly needs, inclusive design principles in improving elderly's lives, design for elderly requirements, and contemporary innovative technology for elderly assistance. Following up with analysis with the interview, logbook for the elderly to record their daily activities, and cognitive map methods to explore an aspect of the theoretical framework that might be used to design a smart interior environment for the elderly.

1.4.Thesis structure

This research is divided into several chapters to achieve research goals and access the proposed solution to the research problem; after the introduction chapter, that gives a general idea of this research's central core and defines the research problem, research aim, and objectives.

Chapter two starts with Previous research about design for the elderly topics to clarify the difference between this research and the previous ones, followed by " the elderly" definition, needs, and daily activities as they are the research's target group. Specifically, this research focuses on the elderly in the Turkish community; the aging population is expected to reach 10.2% by 2023, 20.8% by 2050. These percentages refer to the proposed increase from 2000 to 2050, from 3.8 million to 8.6 million in 2023 and 19.5 million by 2050, an apparent increase from 3.8 million in 2000 to 8.6 million in 2023 and around 19.5 million by 2050. As this research under the inclusive design approach, chapter two will end with the inclusive design definition and features to consider these features while designing for the elderly. Also, this chapter explains the concept of independence for the elderly, defining this concept, and how good home design improves elderly independence. Design for the elderly has an essential feature, and consideration will clarify in this chapter. Chapter two will end with the main issues in designing for the elderly; this research categorized the main issues into two sections "health" and "psychological" issues.

Chapter Three focuses on the smart home definition and features. This chapter display different innovative technologies for use in smart homes. In addition to technological devices and smartphone applications, especially for the elderly, these innovative technologies support them living independently in their homes. Also this chapter describes the main challenges for designing smart homes for the elderly, which are three main challenges:

The financial challenge as the cost of innovative technologies in smart homes is one of the main issues for installing smart homes for the elderly.

The Technical challenge, smart home technologies are not familiar with the elderly.

The Psychological challenge as depending on previous studies, most elderly have technology anxiety, and fear are pervasive in computer-related systems and

information network systems

Chapter four presents the methods used to collect data analysis techniques used in this research. It discusses every approach and technique and the reason for choosing these methods for this study. The findings and discussions part will discuss the findings and analyze the collected data from the participants and the previous chapters to give the proposed solution and open discussion for future research.

Chapter five is the concluding chapter, which summarized the main aspects of the thesis and suggested future studies.

CHAPTER 2: THE AGING POPULATION, INCLUSIVE POPULATION, AND ELDERLY INDEPENDENCE

Due to the change in demographic status globally and the increase in the aging population, the United Nations developed and published the critical principles needed for the elderly to remain living in their homes (resolution 46/91). The UN focuses on the necessary living conditions for the elderly and categorized them into five main sections: independence, care, participation, self-fulfillment, and dignity. These principles are aiming to support independence for the elderly. Much research proves that the vast majority of the aging population prefer to continue living in their homes as they have close links and memories in their places. Unfortunately, the standard home designs serve the young ages sectors rather than those with limited mobility and sensory and cognitive limitations. Thus, it has become commonplace recently in the various design fields the concept of inclusive design, which aims primarily to think of all human groups in the design process (Feddersen, and Lüdtke, 2017). Inclusive design theory describes the beliefs, practices, and values of the property experts such as developers, architects, and designers in responding to all age groups' needs, including elderly and disabled people in building design. (Imrie, and Hall, 2001). Home design development and modifications by integrating new services and technologies for the elderly have a role in extending the time they can remain independently without assistance.

Elderly is defined as: "As people age and experience a greater number of years filled with chronic health problems and disability, the question of how they are going to live out those remaining years in a dignified and positive way increases in perplexity" (Regnier, 2002, P. 1).

2.1. Related work and previous studies

Increasing aging societies and citizens globally extend the need for a smart interior environment and smart homes to serve the elderly citizens and limit social challenges. There are several types of research recently on smart homes to serve the elderly and support their independence; most of them deal with the issue from one side, either independence or the integration of technology in smart homes, also; this research has been researched and developed in other countries.

Galof and Gricar published a study in 2017 in Slovenia with the title "Independent

Living of the Elderly in the Home Environment." This research paper investigates if there is a marked difference in the degrees of the independent practice of the elderly in their homes and how they perform their daily tasks, daily living activities, and instrumental daily living activities. This research also focuses on analyses and reviews the interior space factors that may affect the level of independence and interrupt the elderly while practicing their main tasks. This research showed that there are differences between males and females in practicing their daily activities and independence. Also, it showed that some environmental factors barriers affect their attitude while doing several tasks.

This research's knowledge gap focuses only on how the elderly perform in their interior environments and the differences in maintaining independence between males and females in their daily activities through a quantitative method through a questionnaire for 450 participants aged 65 and older only in Slovenia. This research proves that most of the elderly wish to remain in their homes, and supporting them to remain in their homes costs less than remain in a care house. As a specific result for this research shows that there are a gender-based difference in the daily needs, daily activities, and independence condition between men and women

Allam published his Ph.D. thesis in 2015 at the University of YORK/ UK with the title "The meaning of independence for older people: a constructivist grounded theory study." This thesis intends to understand the significance of elderly independence in the United Kingdom by examining the setting of policy in the UK and the national and international indexes in addition to interviews with the elderly. The findings showed that the concept of independence for the elderly is personally formed and included various dimensions. These dimensions are categorized into two separates but interlaced core categories " the sense of independence and the practice of the independence." These categories were formed by the elderly's daily lives, knowledge, personal backgrounds, and the broader social and cultural discussions, and these classifications could change depending on individual state, favorites, and beliefs. This thesis is also focused on the meaning of independence for the elderly, "especially in the UK," through reviews of the UK's English policy context. This research clarifies the independence concept in two central cores, as mentioned before, the sense of independence and the practice of independence; it defines independence as a mental section that differs from the physical part. This catches the attention to the mental

health effect for the elderly in dealing with their daily lives; if they were convinced that they could remain independently, this would reflect their independence practice. This research will deal with the mental and physical health issues for the elderly and their effects on elderly independence. This thesis's results show that all the participants want to remain independent as much as they can. The elderly also know that independence is related to health conditions, which may change over time. It is noticed that some of the elderly try to adapt to their physical changes and encourage themselves to feel a sense of independence.

Lê, Nguyen, and Barnett published research with the title "Smart Homes for Older People: Positive Aging in a Digital World" in 2012. This paper analyzes the smart home theory, especially in overall improvements in technology globally and its role in improving the elderly's independence. The findings in this paper are focus on the issues in the use of smart homes by the elderly, which is Economic Accessibility, Technical Accessibility, Psychological Accessibility, and Ethics issues. This research is directed and depends on the older adults in Australia, including some government rules related to applying smart homes in their country, so this research only fits the Australia model.

Cocco published an article with the title "Smart Home Technology for the Elderly and the Need for Regulation" in 2011 at Journal of environmental and public health; this study addresses particular problems faced by aging Americans, including their desire to live at home as they age, the technological response to this desire, and resultant privacy implications. This research also examines the elderly population in the United States and the impact of aging on individuals. This paper also described the theory of "aging in place" and the elderly people who wish to remain living independently in their homes. Moreover, the research addresses some technological devices for assistance that has been developed in 2011 to support the aging in place concept. The conclusion and recommendations of this article focused on the privacy of using technology for the elderly as the author Cocco mentioned about a simple fix to the problem with the definition of "protected health information" is to say that all information received from and transmitted by smart home "relates to" the individual's "physical or mental health or condition" are protected, regardless of the appointed recipient of the information. Cocco mentioned a proposed solution about protected health data to prove that all the information and data transmitted and received by the smart home and innovative technologies related to the users are protected.

Jabbar, Kian, Ramli, Zubir, Zamrizaman, Shepelev, and Alharbi published a study in 2019 about smart homes and automated homes with the title "Design and Fabrication of Smart Home with the Internet of Things Enabled Automation System." This study mentioned different definitions of smart homes and automation systems. This research focuses on one of the main challenges and issue for applying smart homes not just for the elderly but for all users, which is the financial issue- that will be discussed in details in chapter five-. This study presents a low-cost smart home proposal model that works with the IoT system that allowing home control from a smartphone. As this study aims to find a solution for the expensive smart network in smart homes, the findings presented the effectiveness of the proposed model designed and executed by the researchers; this model by the developed system could be applied in the real-life as it provides a safe, comfortable and efficient smart home model.

Aslam and Latif published a research in 2020 with the title "Impacts of Mobile UX Design on Older Adults"; this research focuses on the user- the elderly- experiences using smartphone applications with different interfaces. This research used various methods to collect information from the elderly to understand their acceptance of learning new skills and clarify their issues while dealing with new technological interfaces. The results show that most elderly face most application interfaces; they could not deal with the sudden changes that occur through the screen. However, many of them also accept learning these new skills because it helps them achieve their tasks independently, and this a significant purpose for the elderly.

Therefore, adding to the existing research categories are; design for elderly, smart homes, elderly independence, and smart homes for the elderly. This study investigating and focusing on developing the shortcomings mentioned above data by bringing up a design suggestion for smart homes depends on the users' needs in Turkey after doing interviews and observation with the Turkish elderly; as the identity and culture significantly affect the results of the needs. The previous studies touched upon vital points used as a starting point for this research. Previous research deals with the issues from one side, and the research methods and techniques are applied to different countries other than Turkey. This research is based on the concept of implementing independent living for the elderly by concerning them in the design progression to achieve their needs in a usable and acceptable smart interior.

2.2. The elderly

It is complicated to define "elderly," especially when identified the changes that occur by the person while aging. Describing who is categorizes as an older adult is problematic (Benyon, 2010). It is most likely to define the elderly as individuals aged 65 and over, and this if it is vital to give an age range for describing the elderly. Although it is essential to understand that these categorizations are not accurate and correct, as there are changes from one person to another, some people did not reach the age of 65 but suffer from aging factor issues, and others over the age of 75 and still active. So, there are no accurate boundaries between who is considered "young" and who is considered "old adult"; it is not easy to define these age categories. Physical, cognitive, psychological, and social changing factors are the four dimensions of aging (Czaja et al., 2019). A simple conclusion makes it clear that those who define as the elderly are not a similar group. There are individual differences between them, so the World Health Organization defines the elderly into three categories, three different age groups. The first category representing the age range from about 65 to 74 years old is called " younger-old"; this stage refers to the changeover from work life to retirement. The second category, called "old-old," refers to the elderly aged 75 to 84 years old; this period noted the start of functional losses and physical weakness. The third category refers to those aged 85 and over; most likely in this stage, the elderly need support and care (Czaja et al., 2019). Usually, the elderly people have been defined as the age group who starts from 65 years old and older, the elderly age groups divided into different classifies those aged from 65 to 75 years old are well-defined as " early elderly" and those 75+ old are defined as " late elderly" (Orimo et al., 2006). Aging and old age is a normal process and stage for humans, caused by irreversible degeneration of human cells and systems through age (Özel et al., 2014). Aging is not an unhealthy process; old age consists of physical, emotional, and social shifts and changes (Özdemir, 2019). Therefore, the definition of old age "elderly" is quite broad and complex, and to reflect on the meaning of aging through the keyword of "the elderly" apparently is a way of understanding and knowing the actual definition of "old age," which would help and improve the design process when designing for elderly. Defining the meaning of the old age " the elderly" is quite tricky because it depends on understanding the physical and mental individual changes resulting from aging reflected in old age. this knowledge will create strategies that allow improvements for

the elderly to sustain their daily activities independently (Freitas et al., 2010)

2.2.1. Elderly needs and daily activities

The Activities of daily living (ADLs) are routine activities the elderly's do every day without assistance. The main daily activities are separated into basics activities: eating, showing and bathing, getting dressed, and mobility. These ADLs' performance is essential in determining the type of long-term care and health coverage, such as short-term care or long-term care support the elderly will demand soon. The capability to do daily activities must be used to define healing situations for health coverage and long-term care choices. Activities of daily life are a guide to measure a person's practical situation. The capability and incapability of the elderly to complete their daily activities reflect on other individuals' dependence status as the failure to fulfill necessary daily routines may lead to risky situations. Determining if an individual's daily activities achievement is vital as these are analysts of the need for alternative living arrangements for the home design (Guidet et al., 2020; Costenoble et al., 2019). The United States National Health in 2011 did a survey which results was that 3.4% of adults aged from 65 to 74, 7% of elderly that aged 75 to 84, and 20.7% of the elderly that aged 85 or older needed help to perform their ADLs (Wolff et al. 2016; Adams et al. 2012). According to Lawton, 1985 after doing a survey with 50 elderly participants to understand more about their independence level and how they practice their ADLs and IADLs almost half of them have planned their own safe zone which Lawton refers to it as a “control center” which displayed the practice of proactivity, and these control centers aimed to maximize their control over their surrounding environment. The control center refers to maximizing the amount of enrichment, information, and opportunity to increase independence level in the home environment, given the significant impairments the elderly suffering from due to aging. The control center is mostly in the living room with a comfortable, suitable, and maneuverable chair or sofa as its focus. The couch or the chair is located in a place that allowing a view of the front door, window, front yard, and street. Equally significant are the television unit and telephone. In this study, Lawton described the elderly who have created these control centers seemed to have maintained substantial self-respect and independence. And the human factor approach to improving behaviors that provide a sense of competency and independence in the control center would be an appreciated addition to the knowledge necessary for supportive facilities in-home services for the elderly

(Lawton, 1990).

2.2.1.1.Types of daily living activities "ADLs"

The standards of the daily activities (ADLs) are divided into two major types "ADLs" and "IADLs." The daily activities refer to the physical status and needs of the elderly, the daily instrumental activities (IADLs), which are extra complicated activities that show the capacity to live independently in the surrounding environment. The ADLs reflect the elderly's ability to care for themselves, which affects independent live availability.

Table 1. Activities of Daily Living " Main categories and Descriptions." (Source: Edemekong PF et al.,2020).

ADLs categories	Description
Personal hygiene	Bathing, shower, grooming.
Toileting	This refers to the capability of the user to get in and out of the bathroom and use it properly
Continence management	This defines the mental health and physical function of the individual that allows using the bathroom properly
Getting dressed	The capability to select clothes and wear them independently
Self-Feeding	Refers to the person's ability to feed themselves independently or with assistance
Ambulating and mobility	Defines the person's ability to move smoothly and independently

2.2.1.2.Instrumental daily living activities types "IADLs"

IADLs "Instrumental activities of daily living" are the next level of the elderly's daily activities and are more complex and reflect on the elderly's ability to live independently. IADLs thus include securing assistance for:

- Mental health and cognitive function
- Mobility, transportation, and grocery
- Cooking and self-feeding
- Commanding a person's household
- Handling medications
- Social interaction and communication
- Financial management

The differences between the daily activities and the daily instrumental activities as the person's ability to perform the ADLs refer to independence when these basic tasks become hard to do, so the person needs assistance, differs from the IADLs which sometimes the elderly can do it (see Figure 1). Other times they need help to perform it (Cahn-Weiner DA et al., 2002).

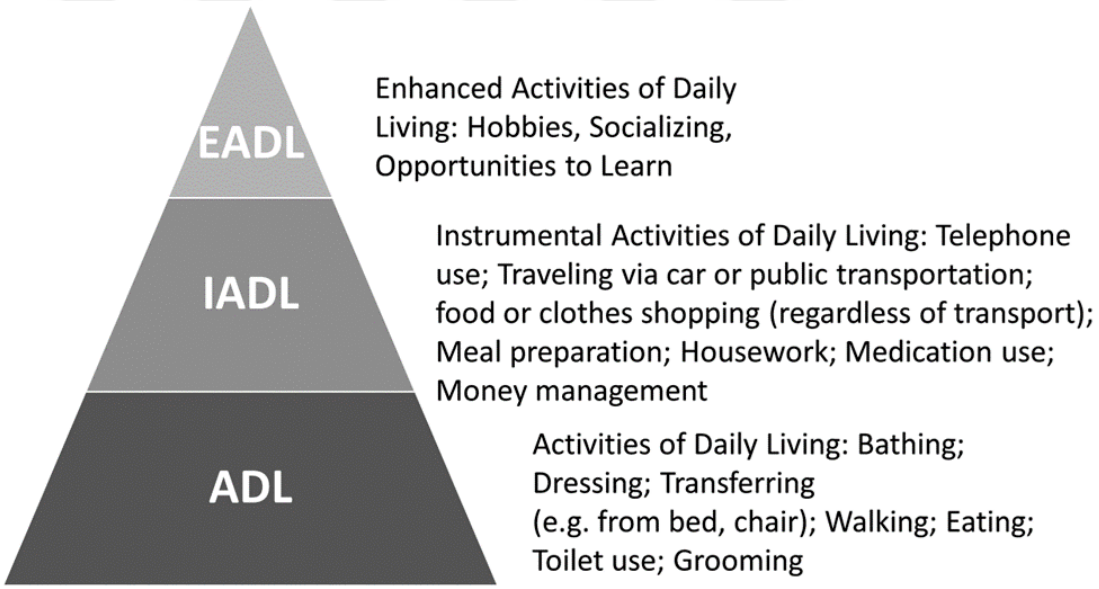

Figure 1. ADLs, IADLs and EADLs pyramid (Source: Czaja et al., 2019).

The elderly desires and needs pyramid were designed by Czaja et al., 2019. at the bottom of the pyramid shape are the ADLs, which are the necessary needs and reflect the ability to perform the daily activities, followed by the IADLs that reflect the full ability to be independent. The enhanced activities of daily living (EADLs) come on the top of the pyramid and are related to life satisfaction from socializing or doing hobbies.

2.3. Aging population in the Turkish context

Due to the rapid aging population, which currently occurred worldwide, design for the elderly is vital. Globally, the elderly population aged 65 and over is rising quicker than all other age groups. One of the reasons for the rising aging population globally is the remarkable decrease and stability in births in the previous years. Increasing the aging population is a global condition; every country is expected to grow in elderly citizens. There were around 703 million elderly citizens in the world aged 65 or over in 2019, and it is predicted to double to 1.5 billion elderly citizens in 2050 (UN, 2019)

The figure below (Figure 2) will describe and compare the different age groups percentage starting from 2000 and what expected to be in 2050. It shows the expected increase in the aging population in the world till 2050.

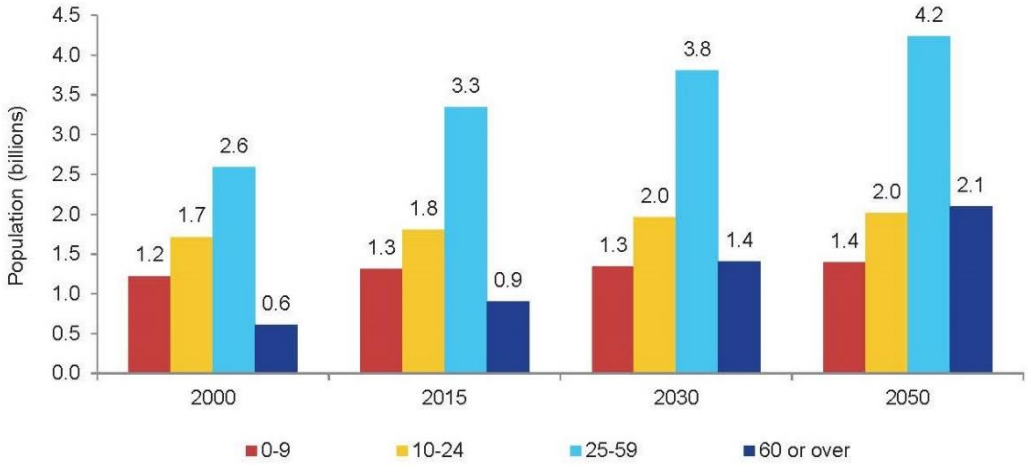

Figure 2. world population aging graph 2000-20150. (Source: United Nations, 2015)

In the case of Turkey and depend on the Turkish Statistical Institute (Türkiye İstatistik Kurumu, 2016) with the report published in 2016, the percentage of residents aged 65+ in 2016 was 7.7% and is predictable to rise to 10.2% by 2023, 20.8% by 2050, and 27.7% by 2075. These proportions show a noticeable jump from 3.8 million in 2000 to 8.6 million in 2023 and nearly 19.5 million by 2050. The Turkish Statistical Institute (TSI) announced that Turkey's aging population older than 65 has increased and reached 17.1%, an average of 6.5 million in 2016 compared to 43.9% in 2012. The largest percentage of the elderly population In Turkey is women, representing 56.1%, and the men represent 43.9%. Dependence on the expected rate of population increase rate in Turkey, specifically concerning the elderly population, it is predictable to rise to range 10.2% of the total population in 2023, growing up to 20.8% in 2050 and

estimated to reach 27.7% in 2075 (Ünal, and Özdemir, 2019).

Regarding the allocation of the elderly population in Turkey, depending on the three elderly age groups, there are differences in the rate over the years. In 2016 the younger-old population (range from 65-74) represented 61.5%, which was more than the rate in 2012 that was 60.3%; in the old-old age group (range from 75-84), the percentage lowered from 32.5% in 2012 to 30.2% in 2016 and the oldest-old population (85 years old and older) characterized 8.2% of the whole population in 2012 (TUIK, 2017). The elderly population was about 8.7% of the world population in 2016. The ranking of the world countries concerning the elderly population; Monaco ranks the first country in the world with the most rate population of the elderly citizens they represent 31.3%, coming in the next rank Japan with 27.3% and the third country is Germany the elderly population represents 21.8%. In Turkey's case, the aging population in 2017 represented 8.3%, which ranked 66th globally. The median age value is one of the most critical signs of old age. In 2016, Turkey's median age was 31.4 years, and for the whole world population, it was 29.4 years. A quick assessment of the world median age rate, Monaco ranks the first again on the average 50.5 years, the second is Japan with 45.8 years, and the third is Germany with 45.7 years. The rank of Turkey is 104^{th,} according to the TUIK 2014 report (TUIK, 2014). The length of Turkey's expected life from birth reported in 2015 as 75.3 years for men and intermediate 80.7 years for women, 78 years for everyone in Turkey (Ünal, and Özdemir, 2019). The aging population in Turkey is over 10%, and The United Nations refers to the countries in which the aging population range more than 10% as a high elderly population country (Yılmaz, and Çolak, 2018). Depend on these expectations; Turkey will be among the high aging population countries in 2023.

The aging population increases quickly rather than the other age groups. Although Turkey is in a demographic transformation process and appears to have a young population, the elderly's absolute number of the elderly is too great (TUIK, 2013). As a result of these calculations, this research focuses on design for aging with a prospective model of applying independent living for the elderly, which aims to create safe, attractive, and usable smart interior homes in which the elderly are involved in the design process. We face smart products in our daily lives like smartphones, computers, and smart TV, but we should admit that the elderly often struggle when interacting with technologies. The elderly mindsets are not familiar with the new

technologies' components, whether software or hardware. Recently there has been a real development in the field of design for the elderly, and most of these studies suggested that most of the suggested models are lacking in the theory of technology acceptance and the elderly opinion on technology. It was also noticed that cognitive and physical health, social interaction, educational background, and cultural factors affect technology acceptance (Peek et al., 2016). This research aims to understand the elderly mindsets about smart homes concept and innovative technologies that support them to continue their daily lives independently.

The figure below shows the transition of Turkey's demographic status from 2010 till 2030 and the marked increase in the aging population.

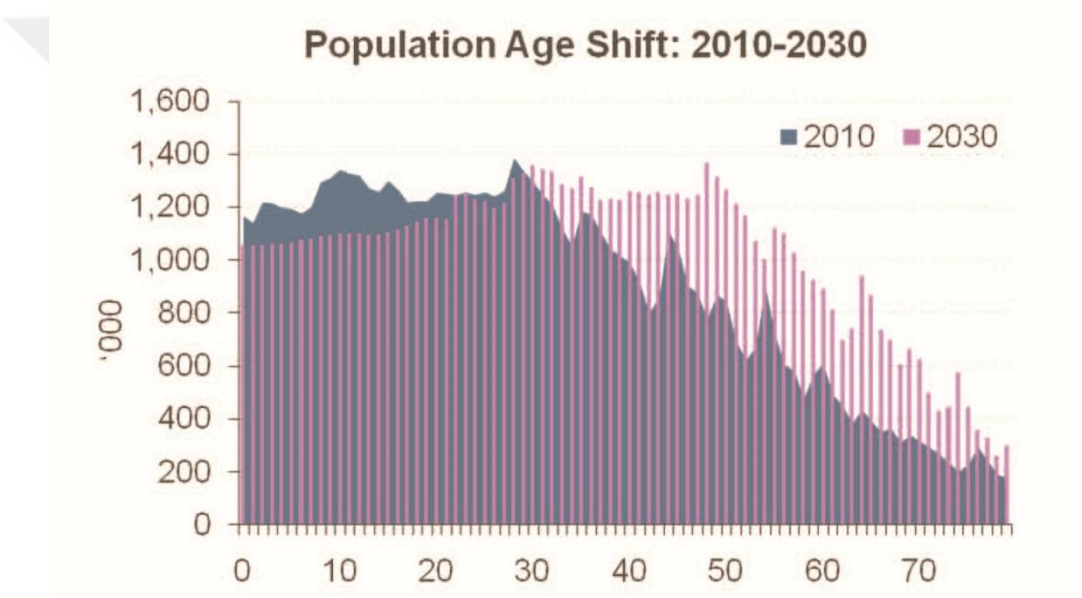

Figure 3. The future demographic of Turkey: Turkey in 2030. (Source: Euromonitor International, 2011).

2.4. Universal Design and Inclusive Design definition and Principles

The concept of inclusive design," which extracted from the Universal design concept," starts in the UK, one of the first countries where the concept of the necessity of designing for the elderly and incapables and placing them within the design process. The inclusive design concept officially started to accelerate in 1995 when the center for "Accessible Environments" started to think about Disability Discrimination and "The Building Regulations" create a significant influence to modify the design's general concept by incorporate and keep in mind the elderly and disabled people while

designing. Various terms start to appeared to supports the idea of designing inclusive environments. The same concept is available for a long time but with different titles, and updating occurs with every new title: inclusive design, universal design, design for all, and accessible design. They all have the same concept with different principles and features that focus on creating spaces that fit all different users' needs. At the same time, the USA and European countries produced universal design principles. However, some UK organizations were troubled with these principles to imply a single design solution that fits everyone's needs. However, there is no doubt that there are many differences between the various human needs, which will make it challenging to meet all the different needs at times (Manley, 2016).

This research is considered an inclusive design approach, an extension, and development of the universal design concept that aims to involve the excluded participants by swiftly transforming technology, especially the elderly population. The inclusive design intention is to allow all the users and participants to interact and participate in an environment fairly, comfortably, and independently. The inclusive design targets to eliminate the limitations that generate separation and unnecessary effort for the participants. Inclusive design generates new methods to produce creative problem-solving choices. The inclusive design keeps and understands the diversity of people. It is essential to understand the barriers faced by people suffering from visual weakness, hearing feebleness, physical issues, and mental or cognitive health and understand the desires of wheelchair users and mobility-impaired people. Inclusive environments do not strive to fit everyone's needs. The inclusive design breaks down barriers and exclusion by respecting people's differences to achieve creative solutions that benefit everyone (CABE, 2006). People with disabilities are not standardized, but reflecting their requisites through designing the space will protect everyone's gains. Meeting the inclusive design principles and features require understanding how space will be utilized and who the user is for the designed space. Environments need to be created so that the users and participants can accommodate for modifying uses and requirements. Respecting and considering everyone when designing interior environments means respecting lighting design, selecting materials, signage locations, and optical contrast (Boxill, 2006). The design community has developed several design approaches to consider the differences in human abilities and limitations throughout the design planning. Inclusive design is one of these approaches, used as

an extended-term for the universal design and design for all approaches (Heylighen et al., 2016). The inclusive design meets with "universal design" and "design for all," in addition to include the concept of "reasonable." In 2005 the Standard British organization described the Inclusive design as the design of dominant products, space, service, or environments easy to use and accessible as sensibly available for numerous participants, without the necessity for unique adjustment, modification, or specific design. Inclusive design has benefits for all audiences, but most importantly, it helps incapable people and the elderly; inclusive design is everyone's responsibility.

2.4.1. Inclusive design aim and concept

The inclusive design aims mainly to allow all users to interact with space equally and independently. Inclusive design space gives various possibilities for the user while using the space to interact with the environment in many different ways (Heylighen et al., 2016) (see table 2). Many discussions are explaining and defining the features and principles of inclusive design. The CABE " Commission for Architecture and the Built Environment organization" in the UK in 2006 shaped the sum-up of the main features straightforwardly, which open the domain for further discussions. However, it is essential to recognize that inclusive design should integrate into other righteous design essentials as It cannot disregard other main design concerns. It was noticed that the designers sometimes ignored to design a good-looking space in order to apply inclusive design features. Disregarding the design's main purpose of creating a good-looking and creative space because of attention on expanding space accessibility may reach a bad design. It is necessary to create the required balance between the designer's creativity and meet the user needs; it cannot be ignored that reaching a good design is also one of the user's needs (Manley, 2016).

2.4.2. Inclusive design features

The Commission for Architecture and Built Environment organization refers to the inclusive design's main feature that includes involving all the user in the design process regardless of their age and abilities, create a flexible design that could be used with different users for different purposes, and put in consideration the wide variety of the

users, as shown in Table 2.

Table 2. Inclusive Design Principles and Information. (Source: Manley, 2016).

Principle	Information
Involve people in the design process	Include the user in the brainstorming process while designing a space; consider the user first
Accept difference and diversity	A successful design should put into consideration the vast varieties of users need; each category has its own needs, including elderly with physical disabilities, disable people with handicapped, mental function issues, parents and children; all these types have different needs in design
It offers users the choice to acknowledge that a single solution that fits all users is not possible.	It should fits and accommodating all users regardless of abilities, age, and gender.
Flexibility in use	The flexible design suggests a variety of adoption and modifications to meet user need in the various categories
Convenient and enjoyable places for everyone.	Good design does not need someone to explain; it should be direct and easy to use by everyone. So every user knows what they should do and where they should go in the space.

- ***Inclusive design principles***

Table 3 refers to the main keywords considers in inclusive design the description of each principle; there are eight main principles shown in Table 3.

Table 3. Inclusive Design Main Keywords and their Description (Source: CABE, 2006).

Inclusive Design Keywords	Descriptions
Inclusive	A space that safe and efficient to use respectively by everyone.
Responsive	The environment that reflects users requirements and needs
Flexible	Flexible design that allows different users to use the space in a different way that fits their needs and abilities
Convenient	Easy to use by everyone without effort or separation in practicing in the space
Accommodating	Space able to be used by all users of different ages and abilities
Welcoming	The environment that is welcoming all user, no barriers
Realistic	The design should suggest various solutions to equality between different users' needs, giving more than one option to expand the target users.
Understandable	Understandable design, whether it is a place or a product, can be easy to use without assistance.

2.4.3. Principles of universal design

The institution of CABE defines inclusive design as creating a place that can be used by everyone. It allows everyone to deal with the area equally, efficiently, and independently. The inclusive design keeps in mind every person despite the person's ability or disability. Simply this means including everyone in the design process. In the mid-nineties, the seven principles of universal design were devised and still hold today. These principles are a great starting point and framework for designing and creating any building, environment, product, or service. Some of the designers and

professors in 1997 at the USA from five research establishments discussed the principles of the universal design as:

Table 4. Principles of Universal Design and Descriptions (Source: DSAI, 2015).

Principles of Universal Design	Principles description
Equitable Usage	It could be used by anyone and do not neglect any person. Include everyone in the design stage put into consideration different user abilities.
Flexibility in Use	Provide different facilities for the user. Variable design that could be modified easily to offers many facilities to the participants and users.
Simple, Intuitive Use	Easy to use and understand design to accommodate a different user with different age groups, educational backgrounds, and languages.
Perceptible Information	Design, which communicates with user efficiency and provides the necessary information for the user.
Tolerance for Error	Straightforward and understandable design to eliminate the mistake chance in the design space.
Low Physical Effort	The design that supports comfort and efficient use by the users and minimized physical efforts
Space and Size	Design that respects different body types and sizes; space fits all users with different body sizes. Everyone can move through space comfortably.

In 2012 these principles were updated and devised by Steinfeld and Maisel as the universal design's eight goals; the eight goals are more action-based than the seven

principles and considered cultural inclusion. The universal design developed eight goals, which update the main principles and extension of more factors; refer to user performance, health, social support, and cultural concerns.

Steinfeld and Maisel in 2012 mention the eight goals of the inclusive design and describe each goal aim; mentioned in the table below (Table 5) these eight goals and their aims

Table 5. The eight goals of universal design developed by Steinfeld and Maisel in 2012 (Source: Steinfeld, and Maisel,2012).

The Eight Goals	Goals Aim and Descriptions
Body Fit	Design that supports various variety of abilities and body sizes.
Comfort	Design that allowing all the needs with considering limits of human body function.
Awareness	Design easy to understand by the user, all the critical information is understandable
Understanding	Design that is forming easy, clear, and direct methods of use.
Wellness	Design that is supporting health conditions prevent injuries and avoid diseases.
Social Integration	Respect all age groups and treat them equally.
Personalization	Including possibilities for selection and allow individual preferences expression.
Cultural Appropriateness	Strengthening and respecting the cultural and social values in any design project, in addition to the economic and environmental context

This research is under the inclusive design principles' approach, which involves the elderly in the design process by merging innovative technologies to create a usable interior space that meets the elderly's needs.

2.5. Elderly independence

Designing homes and spaces under the approach of inclusive design mean designing the society, including the elderly. The elderly consider as disabled as they decline vision, hearing, and physical ability over time. Home design could be an issue or a supporter of the elderly aging in place. Some previous research proves a measured relationship and connection between home design and elderly well-being. The home becomes a safe and comfortable place for the elderly to maintain social relationships with people and the community. Interior home design must satisfy the elderly's needs for their daily activities and reflect security and independence (Demirkan, 2007). Sometimes it is surprising to know that only five percent of the elderly live in care homes, and all the rest living at their own homes, as most of the elderly choose to live at their own homes (Galof, and Gricar, 2017). Aging in place is a concept and an international movement aiming to encourage the elderly to continue living in their homes or remain living in the places they lived in for years. This concept comes in different ways to help and assist the elderly in remaining independent by social support, home maintenance services, and health care support "by private or governmental institutions" (Bornstein, and Languirand, 2013). Home design can play an essential role in the aging in place concept, and smart homes could help the elderly remain independent.

The elderly desires to stay living in their homes, which is the same as an "aging in place" concept that supports the elderly to remain to reside independently in their homes and promotes the socializing between the elderly and their friends and neighbors to eliminate the social isolation in the community; aging in place does not require professional caregivers for elderlies unless needed (Diana, 2008). Technology and smart homes have an essential role in supporting the elderly to remain independent in their homes. For technology to affect independent living, it is crucial to develop central principles of what creates balance and differences in the elderly's use of technologies over time. (Greenhalgh et al., 2016; Peek et al., 2016). Lee, and Kim,2019, introduced the four main characteristics of supporting elderly independence in their smart home: Automation, Affordance, Physical support, and Psychological support. Smart home systems offer computerization abilities to support the elderly's independence, which allows them to manage their interior space and monitor it. Several types of interior living environments and smart home concepts are available

recently for the elderly—the elderly desire to live independently in their well-known space or home as long as they can. Many innovative technologies developed and emerged into smart interior environments recently, but it is essential to understand the elderly emotional and cognitive needs and aging changes to make smart homes more familiar and comfortable for them. The elderly aim to keep their independence as long as possible, and they prefer to sustain a higher level of individual independence or help from their relatives (Lee, and Kim, 2020).

Independence refers to maintain daily activities as usual without the need to assist. Independently living for the elderly is a significant concept and main required to support them in their homes. Most elderly want to remain living in their own homes rather than go to assisted care houses; it is more related to the psychological issue as it is so difficult to change their place, habits, and way of thinking (Sixsmith et al. 2014; Luciano et al. .2020). In 2007, Demirkan published a study that stated that the elderly with limited physical abilities could successfully and independently practice their daily activities if they are familiar with their surroundings and space. The same activities could be arduous for the elderly in an unfamiliar space, even by less disabled elderly. Demirkan combined these studies with the concept of "aging in place" and confirms that most of the elderly aim to continue living in their homes. As this is their familiar space and surroundings, staying in a familiar space supports independence as there is no need for extra effort to recognize a new space (Demirkan, 2007). In its most general sense, independence while aging denotes self-reliance or autonomy. A change occurs in the performance of a person's vital functions in old age, and pathological symptoms resulting from aging like pain, sleep disorders, blood pressure, delirium, and falls closely linked to mortality (Liang et al., 2018). Fragility is the common aging symptom characterized by adverse health outcomes such as reducing the body mass index, physical deformation, weakness, frailty, lower level of physical movement, and stress intolerance that may result in death (Forman, andAlexander, 2016). Sick and fragile elderly individuals become more sensitive towards geriatric syndromes (Fried et al., 2001; Polidoro et al., 2011). 20% to 30% is the fragility rate for elderlies aged 75 and over; regarding those aged 85 and over, the rate is 30% - 45% (Schoufour et al., 2014). it is vital to prevent the diseases from spreading with primary protection and effective treatment ways for the elderly to achieve successful and healthy aging in place. Successful aging often refers to the importance of the independence concept for

mental, cognitive, and physical health (Beswick et al., 2010). There are already many technological devices that help the elderly assist their life more quickly, so developing strategies and proposals for integrated, more technological solutions would decrease difficulties older adults face daily in their homes. It is essential to know of the different age classifications for the elderly, as the elderly population are split into three life-stage subcategories as mentioned before: the young-old (approximately 65–75), the middle-old (ages 75–85), and the old-old (85+) (Lee et al. 2018). Smart interior environments are necessary for the elderly to independently manage and control their daily lives independently when they suffer from aging issues like physical frailness of cognitive weakness. Smart homes' design should consider the elderly physical and cognitive health to provide usably comfortable and affordable options. The elderly attitude in adopting innovative technologies in smart homes is an essential factor for their independence, so it is vital to understand the elderly characteristics and apply them to design. The elderly acceptance of smart home technologies depends on understanding the key factors that affect their opinion. The smart home concept's primary goal is to support the elderly in remaining independently in their homes as long as possible, promoting their psychological and physical health wellness; also, an essential aim of smart homes is to develop and improve security and energy saving (Lee, and Kim, 2020).

2.6. Designing interior environment for the elderly

"We often are asked the question – why is designing for older adults important? Clearly, an obvious answer is that they represent an increasingly large segment of our population" (Czaja et al., 2019, p.10).

The elderly represent an active user group and engage in all aspects of life. Aging, an unavoidable stage, is generally held by chronological age and, as usual known, an individual aged 65+ is often regarded as 'elderly' (Orimo. H et al. 2006). The elderly's different characteristics should be considered in the design process that formed due to demographic, psychographic, perceptual, cognitive, and psychomotor factors. Demographic characteristics reflect the chronological age, gender, ethnicity, and education. However, psychographics refers to personality, beliefs, opinions, attitudes, interests, and emotions.

When designing an interior environment for the elderly, it is vital to consider the

personal ability to sense, perceive, and understand data and physically interact with it. The successful interaction between the elderly and the environment have a role in improving the quality of practicing the activities of daily living. The two conceptual models that represents the interaction between the interior environment and the individual are the competence approach, which assumes that the behavior results from how the individual's level of competence and independence meets the needs of the environment. In contrast, the congruence model developed by Kahana,1982 contends that behavior is the result of how the environment satisfies the individual's demands (Gupta, 2017)

The congruence model of person environment interaction referred to that the behavior is a function of the relationship between the individual and the environment. The congruence theory of person-environment fit clarifies that individuals adjust their surrounding environment or modify their attitude of needs to achieve a fit between their needs and the environment. Individual behavior is a function of the personal characteristics and environmental characteristics together including a ‘subjective appraisal’ by which the individual recognizes the life condition not only through the existing state but through future expectations as well as through past experience. The congruence model of environmental characteristics and individual needs is proposed as a means of understanding the impact of environmental settings on the well-being, independence, and adjustment of the elderly (Kahana, 1982). The congruence model of person environment interaction proposed and developed by Kahana refers to that the behavior is a function of the relationship between the person and the environment. Kahana mentioned the significant of the environmental variables and factors in influencing attitudes, daily activities, independence and well-being for the elderly in their homes. The personal needs and preferences, and the environment has certain and different characteristics. When the characteristics of the environment meet the preferences of the individual and satisfy the individual's needs, there is a high environmental fit or congruence. So, the congruence model refers to the proposed impact of the environment on the elderly daily lives provided that considering the elderly personal differences and needs while designing the interior environment. A common mistake when considering the aging population that they are all the same, and mostly the opinions about the elderly are negative: elderly are weak, sick, incapable to learn, disinterested to deal with new activities, and most of them stay in the elderly

care houses. Some primary challenges and issues should be kept in mind while designing for the elderly, despite it is difficult to generalize all characteristics. Aging describes a continuous method that starts with the person at birth and includes growth, balance, and stability, then decline. Many factors, such as environmental setting, social factors and family, different experiences, attitudes, and behavioral factors, affect the person while getting older. These factors define why there are differences between the elderly because every person represents a culmination of these different factors; everyone represents personal experiences and attitudes (Czaja et al., 2019). The elderly start to have special requirements for the interior environment space as they need special needs for the furniture dimensions due to physical changes that occurs by aging (Mast et al., 2012). Designing homes for the elderly means that their home should be accessible and easy to deal with it and allow the interaction between the elderly and the surrounding environment. Accessible home features include access space for wheelchairs, wide doors, handles on stairs (or where needed), grab bars in the bathroom, and suitable space for the handicapped under the sink. These features should be clear for the elderly in their homes (Demirkan, 2007). Designing for the elderly requires a certain level of expertise; smart interiors should correctly reflect the balance between comfort and accessibility so that the elderly can live independently in their adapted smart homes. Aging brings about many challenges because of the common physical issues; these challenges will impact the design process and/or re-design smart interiors for the elderly. Designing smart homes for the elderly has guidelines depending on the special conditions of the elderly's needs and social and physical issues. Smart home features should consider all these factors while designing an interior environment for the elderly.

Moreover, it is essential to customize a bathroom for the elderly because bathrooms are disposed to causing accidents. Due to their slippery surfaces, there are many nonfatal injuries recorded every year all over the world. As a result, regulating toilet height or installing a seat extender, grab bars near the toilet, and bath/shower is needed in addition to a shower seat, slip-resistant floor treatment (Kalita, 2017).

When designing and/or re-designing a kitchen for the elderly, the cabinets should install a suitable height that allows the elderly to reach easily. Adjusting the sink's height, low sink, and front-mounted controls on the cooktop all these guidelines is essential in elderly kitchen to improve independence.

2.7. Main issues for designing for the elderly

Sensory weakness is one of the main symptoms of aging; it appears in hearing, vision some times in nerves, smelling, and shrinking muscle mass, which affects the person's stability and is also noticed in the vast majority of the elderly. Also, the mental health affected by aging as dementia and Alzheimer's are more common cognitive health issues for the persons aged 65+ (Cocco, 2011). Few issues need special consideration when conducting a design for the elderly, moreover to the design factors: health (physical issue) and psychological (social issue); these issues have special significance for the elderly given age-related variations in abilities, needs, and preferences. The main concern in designing for aging is to make the interior space accessible for the elderly and the other age groups by improving their ability to deal efficiently with space—the elderly facing problems in the interior space at the circulation, flooring, lighting, and acoustics.

The main issues of designing for the elderly are design factors, physical issues, and psychological issues as shown in figure 4 (Brawely, and Taylor 2003). The aging process can be presented in four main factors; this process occurs and affects the physical, cognitive, mental, psychological, and social factors (Czaja et al., 2019). The elderly are less familiar with innovative technologies such as detection devices and smart sensors, and they may also have some doubts or anxiety about their ability to perform or complete their daily activities successfully. Thus, it is crucial to make the environment as stress-free and to relax as possible, depending on the age-related changes. Physiographic changes related to aging express functional and physical losses of the elderly; physiographic aging presented the reductions in learning, sensing, perception, and ability to solve problems; sociological aging shows the decrease of values given from society to the individuals (Özdemir, 2019). It should be understood as a phase and process in the life cycle while aging; there are changes in the physical, psychological and social levels that affect the elderly's interaction with their social setting (Freitas et al., 2010). So, the main factors that should be considered while designing a smart home for the elderly are design factors, physical and psychological health.

The figure below (figure 4) shows a summary chart for the three main issues in designing interior environment for the elderly which are: design factors, physical

issues, and psychological issues. These issues should be considered while designing interior spaces for the elderly.

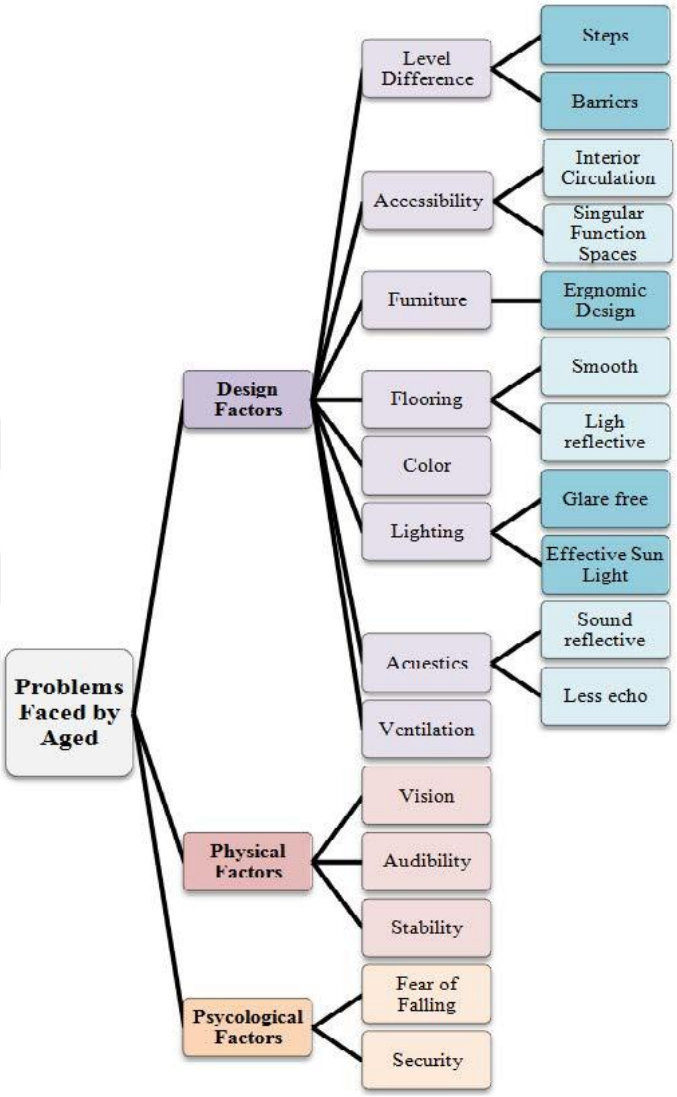

Figure 4. Problems Faced by The Elderly in Interior Space (Source: George, 2017).

2.7.1. Design factors

Design factors are related to the problems the elderly facing during interaction in their home with the furniture or with the circulation. The design factors represent the main design barriers in the interior environment that could affect practicing of the daily activities for the elderly.

Home design for the elderly should be easy to use and fit their expectations; the home must accommodate the elderly needs. Also, the home design for the elderly must be

comfortable, accessible, easy for mobility and use. Good design should be easy to understand with the elderly and especially when designing a smart home. A smart home should be easy to control and manage by the elderly and show how it could help the elderly perform their daily activities independently (Sebesi. et al., 2016). The interior environment barriers such as level differences, accessibility, materials, light and color could affect smooth mobility, which could also cause falls and fatal accidents for the elderly (see figure 4). Age-friendly interior space should concern the accessibility, lighting, floor levels, used materials, and home ventilation (Brawely, and Taylor 2003).

2.7.1.1.Level differences

It is essential to avoid floor level changes, as the changing of levels in the home design for the elderly are not preferred and should avoid it in the design to respect the physical issue for the elderly, which affects their mobility. It is difficult for the elderly to access the high objects on the shelves because of the physical changes caused by aging. So, it is crucial to make everything easy to access to avoid the pain for the elderly (Brawely, and Taylor, 2003).

2.7.1.2.Furniture

The furniture also has a vital role in improving the quality of the interior environment for the elderly. A quick summary as it is unfair to address the required furniture design for the elderly in a few sentences, so the elderly home should have both movable and fixed furniture to allow the modifications needed in various situations. Most of the time, the elderly face problems while sitting down and getting up from a sofa or a bed, especially if the furniture is low height. Designing ergonomic furniture for the elderly will positively affect decreasing physical issues (George, 2017).

2.7.1.3.Flooring

The floor material that selected for the elderly home should be the slip-resistant floor type, and prevent unnecessary interior space barriers while designing a home for the elderly or modifying the existing one.

2.7.1.4.Accessibility

The accessibility refers to the problems the elderly face with home circulation. Furniture dimensions needed modifications to fits the elderly abilities and make it easy

to use.

2.7.1.5.light and color

Color can play an essential role in helping the elderly achieve their target in their home as most commonly, the elderly's have vision weakness. As the studies show, the person who is 65+ needs light three times more to see clearly than the person who is 20 years old.

2.7.2. Physical health

Maintenance of physical function, consider biological change, and improve independence in daily living activities, mobility, falls, sight, etc. The health issue focuses on physical aging, reflecting the changes that occur for the person physically due to the aging factor. The vision seems weaker and more unclear; the muscle loss mass, walking and mobility seem a little bit difficult than before; of course, this is not included all the elderly because there is a personal difference. Physical and health issues are centered into:

2.7.2.1.Cognitive function

Brain health and cognitive health referred to remembering, discovering, creating, thinking, and learning. The elderly face some cognitive issues while aging; dementia and cognitive abilities loss are the most common. The national institute of aging define cognitive health as

Cognitive health is one factor of the brain's overall health, representing the ability to remember, learn, and think; cognitive health is a vital element of performing daily activities. Aging affects cognitive health as the whole rest body, like up and down mood, which causes depression, anxiety, Alzheimer's disease, and traumatic brain injury. Brain health refers to how well the person performs daily functions; the characteristics of brain health contain:

- Cognitive health: the way the elderly think and remember
- Motor function: the way the elderly control their movement and balance
- Emotional function: the way the elderly deal with the response of emotions
- Tactile function: the way the elderly feel and respond to sensations, pain, pressure, and temperature

2.7.2.2.Physical injury

A lot of the elderly globally are going to the emergency room daily because of falls. The aging stage affects the physical ability of the elderly and causes bone contracts and muscle losses of flexibility and strength. The elderly have a high probability of losing balance, breaking bones, and fall. the two common diseases related to weakness are osteoporosis and osteoarthritis (Tieland et al., 2018).

Muscular strength begins to decline around age 60. Muscle mass decreases, including hand-grip intensity and probability. These changes and the onset of illness processes such as pain may reduce the elderly's power in general. However, strength changes are often the result of muscle mass loss. As with speed changes, muscle mass loss changes have some effects on the functional limitations of the elderly (Buckely et al., 2018).

2.7.2.3.Sensory impairments

Vision and hearing weakness or issues are effortlessly treatable by medical devices or aids like hearing aids or glasses. Innovative wearable technologies improve the status of hearing and vision weakness through wearable aids and devices (Saunders, and Echt, 2007; Correia et al., 2016). Weakness in vision is the most common sign of aging is a fragility of vision of the near objects (see figure 5). The lens's weakness causes this situation due to the aging factor, and it is almost normal at a certain age, and eyeglasses could solve most cases. This weakness is usually noticed in the mind's 40s, as at the age of 20, the person's near-point focus is 10cm, and at the age of 70, it is 100 cm (Farage et al., 2012).

There are basic and straightforward guidelines to design for the elderly with vision impairments, and these guidelines will improve the elderly daily lives. Minimizing the glare in the interior space is an important aspect; it can occur by using matt materials rather than glossy ones. Higher light should also occur and minimize the glare to make the vision clearer for the elderly direct light sources to achieve this and benefit from the natural light (Czaja et al., 2019). The figure below shows the percentage of male and female vision and hearing impairments in the different age groups.

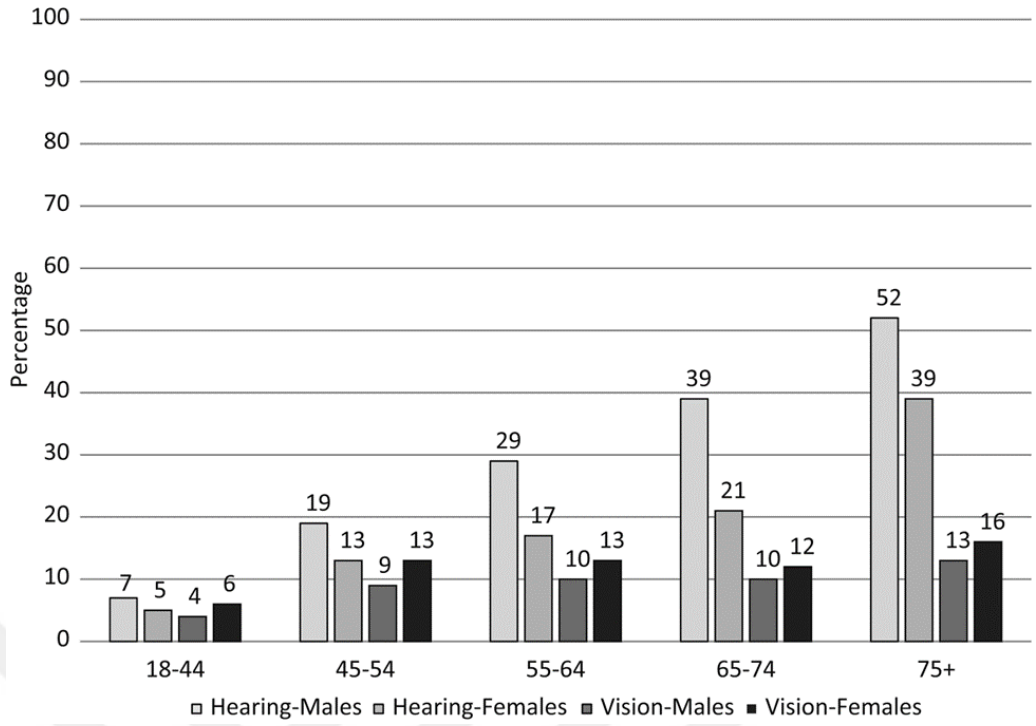

Figure 5. Percentage of males and females across age groups with hearing or vision impairments (Source: Czaja et al., 2019).

Hearing is the second sensory impairments that affect the elderly. The people aged 55+ start to have some hearing weakness, while those aged 80+ 20% require a medical hearing aid device, the elderly who are 70+ are most commonly to have vision and hearing weakness, and some cases could be a total loss. Previous studies presented that the elderly aged from 70-74 13% of them suffering from both hearing and vision weakness, while 27% for those aged from 80-84 and the elderly aged 85+ it was recorded that 40% of them suffering from both issues (Brennan, Horowitz, and Su, 2005). Hearing impairments or hearing weakness could affect the elderly's ability to deal, functionally practice, and interact successfully with the interior environments. Various studies indicate that, on average, 10% of middle-aged adults suffer from hearing impairments and hearing losses, which affects their social interactions. The elderly age 65 and over recorded that almost 50% of the men and 30% of the women have had hearing impairments. Maybe some differences between men's and women's ability to hear in the 65+ depend on the women's social interaction more than the men as the previous studies refer to (Czaja et al., 2019).

2.7.3. Psychological health

Anxiety, depression, safety, accessibility, participation, and social activities may be multiple risk factors for psychological problems at any point in life. The elderly may feel stressed because of common factors related to aging in their later life, like their continuing loss of mobility capacities and functional ability (Parkar,2015). The elderly may also experience the losses of their friends and shortness in the socioeconomic situation with retirement. All these factors can occur depression, loneliness, social isolation, and psychological issues for the elderly. They may need long-term care; one of the smart home aims is to reduce these issues' effects on the elderly (WHO,2017). The psychological problems categorize into:

2.7.3.1.Mental health

Mental health represents the emotional health of elderlies. The WHO, 2017 declares that more than 15 percent of the elderly 65+ have a mental disease. A common mental disease among the elderly is anxiety and depression; depression occurs in 7 percent of the elderly globally. Most of the elderly's have neurological disorders like depression, which may lead to disability. Depression is a common and well-known condition with aging; the previous studies propose that depression is under-recognized and under-treated for the elderly (Barrett et al., 2011).

2.7.3.2.Financial security

The high cost of living for the elderly, especially after retirement, while living with a fixed income or a pension increase the financial issue and restrictions. The limited income less the ability for comforts and relaxation for the elderly and increase anxiety and depression.

2.7.3.3.Loneliness

It is common for the elderly to feel alone, maybe because of losing their friends due to their limited physical ability, which affects their move, Alzheimer's disease, or even death. The elderly must spend their time with their relatives, family, neighbors, and friends. Socializing is vital to the elderly cognitive and physical health; having a social life supports their independence, feeling, and wellness. Loneliness and social isolation are referred to when the elderly lose contact with people and other social resources because they lost the desire to communicate. Loneliness also could affect the

physiological and wellness of the elderly. Living lonely for the elderly affects their daily lives and increases the lack of confidence, depression, loneliness, fear, and also anxiety. The process of making sense for the new life after retirement for the elderly depends on their relatives and families. Most of the elderly express their longing for family gatherings and spending more time together (Püllüm, and Çevik Akyıl, 2017).

This chapter has dealt with previous research explaining these researches' results and their differences, besides the previous research differences. As a detailed beginning of this research, this chapter deals with the elderly definition, ADLs, IADLs, and elderly needs. As this research relies on participants from the Turkish community, so also this chapter presented the elderly population percentage in Turkey in past years compared to the current and future years to clarify the importance of design for the aging population, as the aging population is continuously increasing not only in Turkey but in the world. The concept, definition, and principles of universal design and inclusive design are also discussed in this chapter.

Also, this chapter introduced the concept of independence for the elderly, the design of systems for the elderly, and critical design issues for the elderly. As mentioned earlier, most elderly people wish to live in their homes rather than in care homes, so this chapter introduces the importance of independence for the elderly, and the "design for the elderly" section supports the idea of independence by presenting due process controls in design to the elderly to support their independence. Besides designing for the elderly issues, this chapter clarifies the most important aspects for designing for the elderly " physical health" and "mental health," how to consider them while designing, and the extent of their impact on the lives of the elderly.

CHAPTER 3: SMART HOMES AND INNOVATIVE TECHNOLOGIES FOR ELDERLY INDEPENDENT LIVING

Traditional homes are generally not designed for exceptional cases and needs – the elderly - like monitor the home environment or the occupants' physiological conditions and activities (Noury. et al. 2003). In contrast, a smart home is embedded with innovative technologies and a smart communication network that can enable remote and automatic monitoring of the residents' home security and overall health status. A smart home is defined as incorporating various smart systems related to home needs through innovative technologies like fiber optic cable installed in the home. This fiber optic cable allows sharing information and communicating within the home. The smart home's main purpose is to accommodate an efficient, safe, comfortable, and interactive environment (Li. M et al., 2018).

Smart homes can de be defined as five levels of innovations and complexity of installation. The first and most straightforward version of smart homes is a home that contains smart objects that practice intelligently. The second version and the more advanced one is a home that has interaction, communication, and intelligent objects. The third type of smart home is a more complex version is the connected homes that contain external and internal smart networks. The fourth version is a progressive type of smart home called learning homes that could record and collect data to expect user needs and manage the technology according to these needs. The most complex, advanced, and the fifth version is the ‘attentive home, which contains all the previous types of features and locations of objects, users, and activity inside and outside the home are recorded regularly so the technology can respond immediately in real-time (Bitterman, and Shach-Pinsly, 2015)

3.1.Smart home definition

In the 1990s, the smart home concept developed and defined by Stapthy as a home that is smart enough to support the elderly to live independently and efficiently with the help of technological devices is described as a "smart home." In the smart home, all the technological devices are connected to produce a smart system that's with each other and interact with the elderly user to create a smart interior environment. (Lobaccaro et al., 2016). The smart home aims to enable the elderly to live independently at homes as long as possible to promote their safety, health,

psychological, and physical well-being (Lee, and Kim, 2020). The smart home idea was initially formed to focus on developing safety and energy-saving (Chen et al., 2010). The central concept of smart home technologies has gradually expanded in the previous decade to include supporting residents with disabilities, the elderly people, and those with less physical abilities to enrich the interior environment and improve comfort and satisfaction (Ding et al., 2011). The smart homes concept focuses on improving comfort, safety, and convenience in the home and reducing energy use through enhanced home energy management (Hargreaves et al., 2018). The four major goals to develop a smart interior environment are safety, health, sustainability, and convenience (Chen et al., 2010).

In 2013 Balta-Ozkan et al. defined the smart home as an interior environment provided with a high-tech system, smart sensors and technological devices, and innovations that can be controlled remotely, managed, and implement tasks respond to the demands of its occupants. Smart homes automatically control the home facilities, services, and devices from a distance or outside the home. Innovative technologies such as AI and IoT systems can examine residents' living patterns and allow interaction and data gathering between smart devices, things, and individuals (Arunvivek et al., 2015). Many innovative technologies that use multiple smart sensing networks, such as movement detectors and detection cameras, are being improved to the amount that they can automatically support the user's data without the necessity to manipulate straight devices (De Silva et al., 2012). Smart homes' goal is to improve independence for the elderly in their homes through technological devices and systems to allow them to remain in a safe, healthy, comfortable environment independently (Gračanin et al., 2011).

Smart homes or connected homes apply the IoT system concept, which allows a platform and system to monitor and follow up home security and safety and control automatically home appliances or environment over the internet from anywhere. The IoT system is an intelligent network accomplished by sharing and organizing information, resources and data, decision making, and replying to response (Madakam. et al., 2015). IoT systems allow interaction between things to things, human to things, human to human by providing an exclusive character to each object (Aggarwal. et al., 2012). Intelligent networks improve energy control systems and support access to devices and far monitoring of installed devices (Li et al., 2016). An IoT framework

offers an automatic continuation of residents' living patterns through several sensors attached to the human body and interior environment space to avoid sudden accidents and offer personalized health care facilities accordingly (Mann et al., 2001). Smart home sensors could be applied in three ways: wearable sensors, environmental sensors, and infrastructure sensors. The wearable sensors could be attached to clothes, placed on the skin, or portable accessories. The environmental sensors are distributed through the home could be on walls, floors, or furniture and objects and can monitor the user. Finally, the infrastructure sensors could be installed in the home infrastructure system (Bitterman, and Shach-Pinsly, 2015). The technological system of smart homes categorized into two methods: 1) distributed direct sensing (DDS) and 2) infrastructure-mediated sensing (IMS) (Chung et al., 2016). The first type of the distributed direct sensing system is a smart and intelligent network installed within the home infrastructure; its role is to detect the motion and sense the presence and behavioral signs. This system transfers the data collected from the installed sensors to the main monitoring system attached to the home.

On the other hand, the second type of smart home system, IMS based on smart sensors attached to the home equipment such as air condition systems to monitor the user's activity. This smart home type focuses more on external technological devices and smart applications working with wireless systems such as smoke detectors, door security, lighting sensor, temperature, and video monitoring (Bruce, 2011; Kang et al., 2010). Integrating innovative technologies gradually in the elderly daily lives will limit assistance needing and support independence (Iwasaki, 2013). Various technology types are available to assist the elderly in their homes, such as smart emergency systems, monitoring sensors, and fall detectors. These types of technology are introduced as smart home intelligent technologies.

Furthermore, many e-health innovative technologies and devices support the elderly in self-managing their daily health conditions. However, these devices and technologies have not been reached on a broad scale for different reasons (Peek et al., 2016). In other words, technology is the implementation of experience to achieve a task, the output of that application, a method to accomplish a task, and a framework to understand and address an issue. Although many forms of technology are involved and depend on microprocessors to quickly process large quantities of information, this definition reminds us that this does not necessarily have to be the case.

3.2.The four-layer architecture for smart home

Smart homes consist of activity and physiological sensors, environmental sensors connected through a wireless communication network system. Innovative technologies are now more familiar and usable in the market, there are advancements in lower-power and inexpensive technological platforms such as microcontrollers and microprocessors that paved the way for the low-cost smart home system (Agoulmine et al. 2011).

Table 6. A four-layer architecture for smart homes (Source: Majumder et.al., 2017).

Smart Home Network	Description of the Services of Smart Home
Services and System	▪ The remotely wireless healthcare system ▪ Security and emergency system ▪ Long-term automatically monitoring support system.
Computing and Decision-Making System	▪ Data analysis ▪ Context-based knowledge ▪ Forecast by smart rationalizing ▪ Automatic Decision making and a quick warning.
Communication Network	▪ Secured data transmission networks ▪ Physical and computing platforms connection ▪ Discovering sensors and devices
Sensors and actuators	▪ Environmental sensing devices ▪ Wearable sensors for controlling health care condition ▪ Actuators for devices control

3.2.1. Smart home features

Automation service: refers to the capability to provide automatically controlled devices.

Multi-functionality space: refers to the capability to perform various tasks in the same area and use the same environment to fill up different functions depending on the needs.

Flexibility: refers to the ability to adjust the current space to meet the needs of users.

Interactivity: refers to the capability to allow the user to interact quickly and efficiently with the surrounding environment.

Efficiency: refers to allowing the user to complete the needed tasks in a minimalist time, minimum cost, and comfortable method (Lê.Q. et al., 2012).

3.3.Smart technologies that reflect smart home features

Smart technologies that support the elderly independence concept are divided into two categories, which are smart technological devices and smart technological applications. Pervasive smart software can be helpful for fall detection depends on the person's motion differs. Smart devices in the home, from smartphones to furniture, kitchen appliances, cabinets, and bathrooms, motivate the users to control their daily lives, like taking medications on time or maintaining exercise (Hudson, and Cohen, 2003). Furthermore, healthcare technologies have become more familiar, especially for the elderly. These technologies could connect the user with clinicians (and emergency if needed) to monitor their physiological signals such as blood pressure and heart rate through wearable sensors or devices installed in their smart homes. (National Research Council et al., 2004). The future of smart and intelligent homes depends on designing an efficient, healthy, and interactive interior environment" (Do, and Jones, 2012).

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3.3.1. *Smart technological devices to assist the elderly in their home*

Technological devices and technology positively impact the elderly and supporting them to live more independently in their home. The elderly can follow up on their health status through some applications or devices installed in their home. The internet and technology make life more quickly, mostly, and for instance, a fast response for a sudden health issue could result from using technological devices in the home. Also, the technology could improve the social life for the elderly as they can connect to their families and relatives through the technology, they can communicate with the world, which could lessen the loneliness and social isolation feeling. The elderly may face some problems while dealing with technology for the first time as mostly it is not familiar to their mindsets, but if they have a familiar technological interface, this will encourage them to deal with it (Mostaghel, 2016).

Smart technological devices for the elderly that support their home independence could be divided into two central systems: wearable devices and installed devices, as shown in figure 6. Smart wearable devices have several types, such as wearable accessories or smart wearable clothes; the other type is the more advanced, small, and transparent sensors attached directly to the body. The installed devices refer to the external devices installed at home, such as detection cameras or smart monitoring systems; it could be installed on an existing home to transform it into a smart home and the other type installed within the home's infrastructure. The diagram below (see Figure 6) shows technological device types, whether available at the market or still in the research and development process.

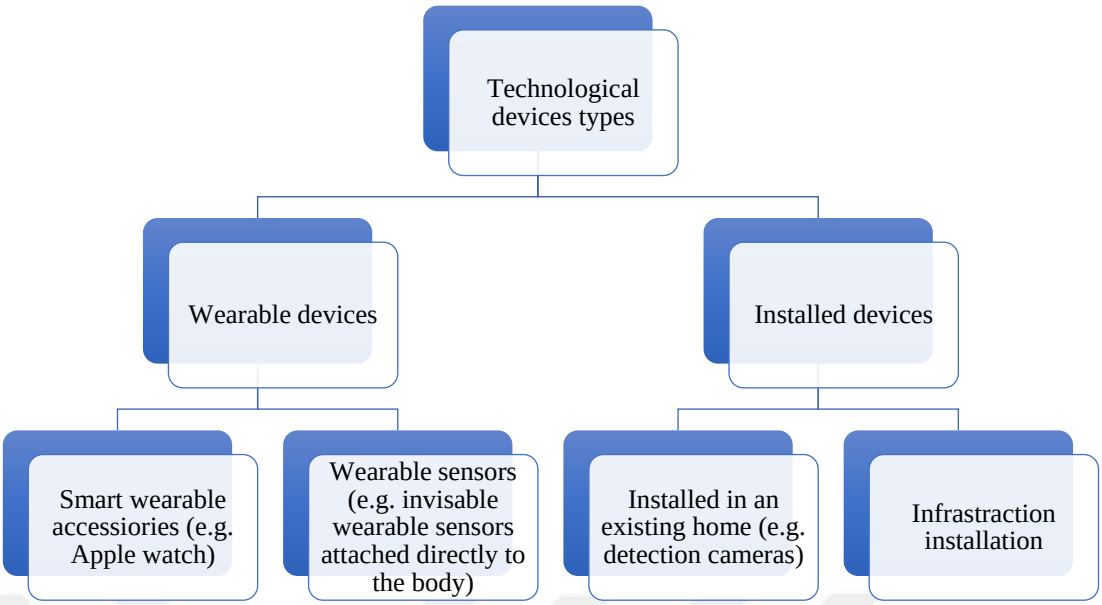

Figure 6. Technological Devices Types Map

3.3.1.1.Installed technological devices

The installed technological devices implement in elderly homes by creating a smart network for receiving and transiting the collected data. Several systems are available recently; all the systems focus on improving the elderly safety in their home and immediate response for emergency conditions.

- ***The sensor-based monitoring system***

This smart system monitors the elderly in their daily lives and evaluates their health condition, and affords predictions of emergencies to send a direct notification to the nearest health institution with direct interaction with the elderly (Tsukiyama, 2015). It is a sensor with the same function as the detection cameras, which could be in bed, carpet, kitchen, or any place in elderly homes. These sensors could detect the movements and sounds without infringing on the elderly's privacy.

- ***Smart security system***

An important matter for the elderly living alone is their home's safety, in both directions, the safety from intruders and safety of accidents such as "fire." With the rapid technological development in smart homes, especially for the elderly, this issue has many solutions available in the market, such as installing a smart security system to monitor the whole home like doors and windows. The smart security system detects the motion and can send notifications and alarms to the caregiver or/and authorities if there is a problem. This smart system could also manage the whole home essential

tasks, such as smoke alarms and temperature sensors. The caregiver could monitor the smart security system to check the home safety via the smartphone application, of course, if the elderly gives access.

- ***Smart sensors***

This device is a smart sensor that can improve home safety by monitoring it and detect if there are intruders. Also, if this device is connected to a smart hub, the user can use it in performing several tasks such as turn the light on and off automatically when the elderly are walking through their home, and this could help in energy management and also this will less the falling risk for the elderly in the dark. These sensors can be installed anywhere in the smart home as they are low-powered and also so small. The sensors can monitor and observe the daily activities and detect the motion the same as the cameras without adding cameras. The smart sensors can significantly impact the elderly aging in place as it could observe every room's behavior patterns and send notifications to the emergency contact in case of unusual situations. When adding the sensor to the bed, it can send a notification to the caregiver when the elderly is getting up from the bed; this could help the caregiver if the elderly are in an unusual situation like staying at the bed for a long time. The sensors can also observe how many times the elderly accessed the medicine cabinet and let the caregiver know. These sensors support smart home automation, allowing the elderly to live more independently as the smart home can automatically manage home energy and safety and make the different modifications needed day or night. The smart sensors developer says, " This tiny device is useful for safety and other smart home purposes as it can detect and sense the motion, light, temperature and more (Abode systems, 2020).

- ***Walabot home***

The Walabot home device continuously scans the bathroom movement; it is intended to build upon the bathroom wall. The Walabot home device dimensions are a 7 x 7-inch square with an AC power adapter for electricity. A screen displays the monitoring; the device carries out all the users' functions through this screen. It immediately sends a notification to the elderly trusted contact or the emergency when a fall occurs. Falling is one of the significant reasons for hospitalization for the elderly, and the situation could be worse if the help is delayed. The Walabot home device deals with this issue by noticing if the elderly person has fallen and automatically sends a notification for requiring help. The Walabot device uses sensors to detect and monitor the falls, then begins a two-way communication channel on the device, so by using this device, the

elderly do not require to press on a key if they fall even wear a small fall detection device. This device is established by Vayyar Imaging, a leading-edge tech company. When the device detects a fall, a led light will work. The device will then notify that a fall has been detected in a clear sound and will call and send a notification text message to the trusted contact or the emergency. If the elderly do not ignore the alert at this time, the device will automatically call the emergency contact, establishing a conversation with the Walabot home device, and the elderly will speak with the emergency contact and hear him/her through the device's speakers. The whole process takes on average two minutes, starting from the time the elderly fallen until the contact is reached and called. (Walabot home, 2019)

- ***Sense***

The Sense is an energy monitoring device installed in the smart home's electrical panel and learns about the other various devices in the home. Speaking of monitoring devices remotely, the sense is a monitoring system for the whole home attached to the smart home electrical board. This device is Invented to track home energy usage; it can also show the on and off devices at home and allow the elderly to turn the devices off from the Sense application "when connected to a smart plug." An assistant who has access to the application can monitor the elderly condition in the smart home remotely, getting warnings when devices turn on or off or if the devices have been on or off for a long time or (unusual situation), permitting them to display the regular daily activity and notice when it has not happened. The sense product was produced in 2015 (Sense Labs, 2020).

Installing technological devices in the elderly home could be a first step toward the smart home. The home that contains smart and innovative devices is the simplest version of a smart home (Park et al., 2003). Technological devices and smart sensors could be installed and integrated with the exciting home design. Various technological devices and sensors such as environmental sensing system could be distributed around a home on walls, floors, ceilings, windows, specific apparatuses, home appliances, furniture, and carpets can provide continuous monitoring of the ambiance and its residents. Environment sensing smart systems may include an unlimited number of simple binary sensors installed throughout the home, video cameras, radio frequency identification technology that could control the elderly home without the need for direct interaction between the elderly and the devices (Miura et al., 2008). in addition to the environmental sensors for controlling home temperature, humidity, light, and

smoke sensors, and more (Cook, and Das, 2007). environmental sensors can monitor physiological and behavioral parameters without the elderly feeling under observation or even aware of the scrutiny. The monitoring system includes stability, use of home appliances, or any other devices inside the home—also, observing the motion detection. The system also provides location tracking, activity level, mobility, disturbance, sleep, wake duration, time spent in different home zones, immobility, and inactivity. In addition to pressure measures or satisfaction level, even facial expression and emotional analysis (Chan et al., 2012).

3.3.1.2.Wearable devices

Wearable sensors and devices include smartwatches, headbands, and sensors attached to clothing; wearable sensors are the most common in the literature studies as it is the most affordable option for using by the elderly (Stavropoulos et al., 2020). The most common wearable devices are different motion detectors wearable sensors, and some are already existing in the market. Moreover, the current researches refer to smart textiles and jewelry. Advanced wearable sensors can continuously observe the elderly physiological and behavioral parameters such as body temperature, heart rate, blood pressure, emotional and mental condition. Besides monitoring, smart wearable sensors systems can also provide real-time processing and information transmission via wireless body communication networks, informing the necessary people as soon as a critical situation occurs and storing the information (Chan et al., 2012; Demiris, and Hensel, 2008).

- ***Wearable technology for the elderly***

Kaunas University of Technology (KTU), in collaboration with the Department of Geriatrics at the Lithuanian University of Health Sciences (LSMU), is working on developing a smart wearable system for the elderly. A wearable device (a portable device on a neck strap) to monitor the elderly health all the time and the system consists of a wearable device, a small sensor attached to the neck, and an external server to receive and send data on time. This technology aims to monitor the elderly health condition and send an alarm in emergency cases automatically to the emergency room or the caregiver. The wearable device is about 3-5 cm high, and stationary sensors are mounted in the home; it monitors the health conditions and the body positions of the elderly. When the sensors detect any unusual movement like a fall, it sends a

notification directly to the emergency contacts listed on the server. The system controller integrated with Bluetooth low energy model to recognize the elderly's location almost accurately as one meter. Firstly, the system was developed and installed in the medical facilities, but now it could be installed and implemented at home. The system server is flexible enough to have various applications; it could be a small external small server about the size of two matchboxes or software installed on the computer, or it can also be installed on a smartphone and in connection with the controller. The main concern while designing this system is developing accuracy of the fall detection, and in case of the wrong signal, the elderly could cancel the alarm immediately with one touch of the bottom. (James Ives, and M.Psych, 2019). This is one type of the technologies available in the wearable device's system; several systems are available whether in the market or the research and development process. These technologies' main aim is to support the elderly in maintaining independence and having help on emergency cases.

- ***Lively wearable2 mobile medical alert plus fitness tracker***

Lively Wearable2 Mobile Medical Alert is a small wearable device that could be wearing as a necklace. This device is connected with an application pre-installed on the smartphone. It is an urgent response to getting help anytime and anywhere. The Lively Wearable2 works 24 hours of fall detection; it senses the sudden movement and automatically sends an urgent call through the smartphone. It is a small, light, and water resistance device. The device helps keep the caregiver and family members updated with the elderly health condition through the same application and by permitting them to show all the needed data “health condition, location….”. (GreatCall, 2017).

3.3.2. Smartphones applications ‘especially for the elderly’

Nowadays, smartphones are essential devices in our daily lives, even for the elderly, due to their role in communicating with their families. The elderly usage of smartphone applications and social media was increased in recent years as it helped them interact with their relatives quickly and easily. Refers to figure 6 mentioned below, social media usage increased from 2% in 2013 to 12% in 2019 by the elderly. Technology for the elderly has come far recently. Smartphones for the elderly's can afford that instant linking they would need in an emergency in their daily lives. Also, the

availability of the elderly necessary medical information could improve their daily lives; merely the touch of a key on their smartphones could be lifesaving. The figure below shows the social media users' age group in Turkey from 2013 to 2019. It is expected to the elderly acceptance for the technology to be increased due to the elderly risen usage for social media in turkey from 2013 until 2019; the statistics show that in 2013 the elderly aged over 65 represents 2% of the total internet users in Turkey (see figure 7), in 2014 it was 3%, in 2016 it increased to reach 5%, in 2017 represents 8%. It jumped in 2019 to represents 12%. Based on the rise in social media usage by the elderly aged over 65, a conclusion can be expected that the elderly acceptance of technology is in progress, or at least they accept to integrate more technology in their lives.

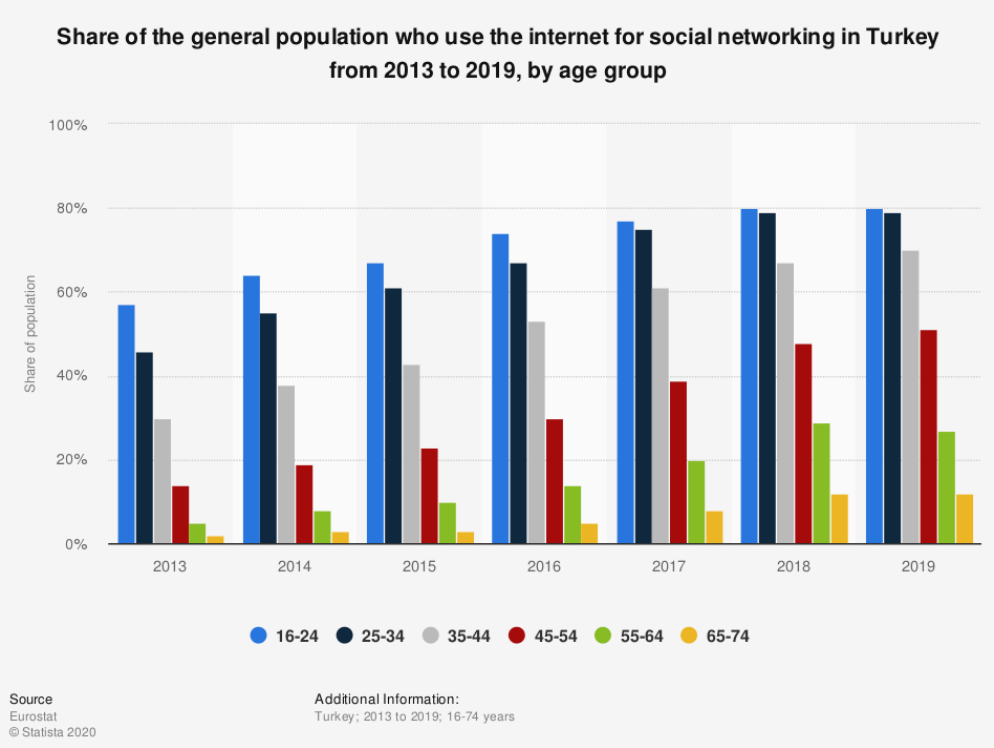

Figure 7. The general population who used the internet for social networking in Turkey from 2013 to 2019, by age group. (Source: Johnson, 2020).

3.3.2.1. Motion and detection applications

Motion and detection applications is an alternative for the detection detector devices. There are many types of these applications installed on the smartphone, and it detects the motion, and some types of it detect the fall and send notifications to relatives. These are easy to use alternatives and an affordable choice also for the elderly.

- ***Fade: fall detector (Android)***

Fade fall detector application uses sensors in elderly smartphones to detect falls immediately. The elderly can set up the alert application to send a notification to a trusted contact when a fall is sensed. This notification, which can be sent through text and email, states the fall's time and location using the smartphone's built-in geolocation tools. This application is designed for android users. FADE application is developed and manufactured by Instituto Tecnológico y de Energías Renovables, S.A. ITER / Spain (The Frontier Group, 2019).

- ***Fall safety (IOS)***

The 'Fall Safety App for Pros' is a fall detection application for iOS that works similar to Android software. The application can identify fall warnings to those trusted contacts that are entered into the device. This application is specially produced for iPhone users. A timer is possible and can be placed; the elderly can ignore the timer before the limited time is up if they do not want to send an alarm. The application allows the user to add a maximum of five contacts who need to be alerted in case of an emergency or when a fall occurs (FallSafety Home, 2020).

- ***AARP Caregiving***

This application is one of the best-rated notable names in elderly care. AARP Caregiving is an application that authorizes relevant data on how to care for the elderly effectively. The application permits the users to monitor indications, coordinate care with another family member, and save track of appointments and medications. It also helps the caregivers to find responses to crucial or commonly asked inquiries (Cheng, 2015).

3.3.2.2. Health care applications

Health care applications are also an affordable type of technology; the elderly can follow up on the blood pressure and heart rate easily and quickly.

- ***IBP Blood pressure***

IBP Blood Pressure application released in March 2009 and developed by Leading Edge Apps LLC, USA (Based in the United States), can help the elderly manage and analyze their blood pressure. It is a tool that creates interactive diagrams to display the

changes and trends in elderly blood pressure over time (IBP Blood Pressure, 2014).

- ***Pillboxie***

This software is intended to remind the elderly of the exact medications they should take at specific times, like their medicine. It is also doubling as a handy list of their medications and amounts for doctor visits (Pillboxie, 2011).

- ***Medical ID***

Medical ID smartphone application comes pre-downloaded into every iPhone via the Health application. This application allows the elderly to add their medical information and history, trusted contact data, and blood type, which can be immediately reached in a sudden accident even if they have locked down their smartphone screen (Apple, 2020).

- ***Vizwiz***

VIZWIZ application allows blind users to receive fast responses to inquiries about their surroundings if they are elderly or young. The user takes a photo and records an inquiry on their smartphone. This information goes out to object identification software, a selected email contact, and secret operators, who can transfer answers back (VizWiz, 2011).

- ***Eye reader***

The application directly applies the smartphone into a magnifying glassful. It begins to be hard to read paperwork while aging with version weakness. Eye Reader application will expand and light up the text for the elderly (EYEREADER, 2019).

After presenting the options available now and others within the research and development process from technological devices and advanced technologies to assist the elderly live independently in their homes, it is necessary to show the effect of these devices on the home design and the challenges facing these technologies' implementation. Technological devices and intelligent software offer an opportunity for the elderly to cooperating with innovative technologies easily and quickly. Despite the recent continuous research to find the best technologies models to support the elderly in their daily lives, there are still clear challenges that may become an obstacle to implementing this concept. The elderly will use technological devices and integrate

more technology in their lives if the technology is affordable " not expensive and they able to buy it," usable " easy to use, as they fear from technology because it is not familiar to them" and accessible " easy to reach the information and service."

3.4.The effect of technological devices on home design:

The state-of-the-art smart home design is similar to the design of any traditional existing home. It only differs in the addition of invisible and visible technological devices and smart sensors systems. Moreover, because the elderly prefer to remain living in their familiar homes to feel comfortable despite innovative technologies, the smart home design could be similar to their familiar environment (Bitterman, and Shach-Pinsly, 2015). The smart home design focus on creating an adaptable home that possibly planned to last a lifetime especially for the elderly and has the ability to be modified continuously if needed. Therefore, a multi-functional layout with various operation modes should be planned, enabling the elderly to use the home depends on their changeable needs and abilities (Jeong, and Proctor, 2011; Jeong et al., 2012). Spatial arrangement within the home should be re-design. The current and traditional home was planned and designed according to its present appliances, furniture, devices, and residents' activities. For example, the standard kitchen was designed and planned according to activities performed in it with the existing equipment, calculating distances between devices and furniture to improve efficiency and optimize workflow (Georgoulas et al., 2012). On the other hand, when designing a smart kitchen equipped with innovative technological devices, not everything has to be within arm's reach. Everything could be automatically movable and controlled to provide satisfaction for the elderly. The physical location for the furniture and the home devices will have less significance in the smart home design, and home equipment and appliances could be flexibly located. Accordingly, criteria such as reducing mobility in the home become less weighty criteria for home design (Bitterman, and Shach-Pinsly, 2015).

Material selection in the smart home should be picked carefully to enable the smart sensors and devices' full functionality. This signifies avoiding metals that may create electrical troubles, using materials that should not distort sound, and affect home acoustics to allow useful voice analysis for preventing dead zones in the home where no sound detection can be executed. Smart materials based on nanotechnology, such as shape-remembering materials, are preferable to selected in the elderly home design.

the shape-remembering materials could be adjusted automatically for diverse users under various conditions that will be part of the smart home design in the future (Huang et al., 2010).

3.5.The main challenges in applying smart interior environments for elderly

Mostaghel in 2016 mentioned that the previous studies show that age and educational background could affect the elderly technology usage and acceptance (Mostaghel, 2016). Technological devices and intelligent software offer an opportunity for the elderly to cooperating with innovative technologies easily and quickly. Despite the recent continuous research to find the best technologies models to support the elderly in their daily lives, there are still clear challenges that may become an obstacle to implementing this concept. The elderly will use technological devices and integrate more technology in their lives if the technology is affordable (not expensive and they able to buy it), usable, easy to use as they fear from technology because it is not familiar to them and accessible (easy to reach the information and service). The previous studies show that age and educational background could affect the elderly technology usage and acceptance (Mostaghel, 2016). The privacy and safety of the transmitted data through the smart home and intelligent system represent an essential matter. Smart systems, despite their advantages, but there are still some ambiguities, especially for the user, principally for the collected data. It may contain private and sensitive information about the user that may affect their privacy. Accordingly, user data integrity must be verified, and the measures taken to maintain privacy must be clearly explained to users. A smart home is also a complex system for use, especially for the elderly, with many devices and networks at home. The elderly's mentality must be taken into account in smart systems design, as it is difficult for them to understand complex systems, which forces them to avoid interaction with innovative technologies. Therefore, to ensure intelligent homes' success for the elderly, the smart grid must be designed smoothly and directly in dealing with and avoiding adding a lot of information or commands required from the elderly. Moreover, smart homes' sensing systems and monitoring systems aim for long-term control, so it is vital to design them as energy-saving systems that can work with a low-power system (Majumder et al., 2017).

A Smart interior environment should be presented to the elderly with particular thoughts of smart home advantages and possible dangers. A small risk in the elderly smart home may come up as a significant issue. The elderly do not prefer to spend much money on smart homes, as the vast majority are of retirement age and have limited income, and their concerns about whether they need these intelligent systems or do not need this change in their lives (Gunge, and Yalagi, 2016). It is essential to understand the elderly's needs correctly to provide a smart home suitable for them, reflecting their requirements (Haines et al., 2007). The elderly face further challenges because, as people getting old, their cognitive, physical, and sensory capabilities transform, causing the elderly to display changed attitudes toward technology. Researchers easily observe that the elderly have various characteristics (Courtney et al., 2008). The elderly are currently being open to new technologies and improving their skills with younger people's assistance.

As a result of the previous studies of smart home challenges, this research categorized the issues into three main issues in creating smart homes for the elderly: financial, technical, and psychological.

3.5.1. Financial issue

Smart home technology is often expensive to obtaining and sometimes causes extra costs throughout use. The high cost of smart homes acts as a financial issue for the elderly as they are less likely to accept technology supposed as expensive (Mitzner et al., 2010; Lee et al., 2013). Moreover, smart home technology's advantages are not always instant and fast, and additional cost savings expected by innovative technologies may not be simply predicted. This imbalance between tangible costs and potential benefits can prevent elderly adoption and acceptance of the smart home concept. Smart home includes new technologies, systems, and structures which can be very overpriced and challenging inaccessibility for some of the elderly (Lê.Q. et al., 2012).

The cost of innovative technologies in smart home is one of the main issues for installing smart homes for the elderly. Any new technology's success depends on the affording cost (Yusif, and Hafeez-Baig, 2016; Islam, and Hossain, 2015). The high cost associated with smart network and healthcare facilities supplied by smart homes can negatively affect the elderly mindset. The elderly users consider the price to be an appropriate monetary sacrifice for their services from using smart homes (Lian, and

Yen, 2013). As a result, the supposed price affects the behavioral goal of the elderly to use and unpleasantly interact with innovative technologies.

3.5.2. Technical issue

The insufficient knowledge of many elderlies with smart home new technologies is another widespread concern (Lê.Q. et al., 2012). The elderly who do not use the technology or the Internet do not think the technology will add value to their lives (Gitlow, 2014). The elderly concentrate on orienting the task very well while learning new technical skills; they need to precisely understand the benefits and effects of learning these skills before they are motivated to do it (Callahan, Kiker, and Cross, 2003). The elderly population strongly adapts to new technologies when motivated by the perception of profits (Melenhorst et al., 2006). One of the main challenges for the elderly to adapt to innovative technologies and smart homes is that they cannot easily realize and understand the role of smart home technologies and their potential contribution to their daily lives (Walsh, and Callan, 2011). The elderly's acceptance of technology depends on the successful transmission of its purpose and benefits on their lives as they use technology to reach a specific outcome (SCAN Foundation, 2010). In technological devices, usability is essential because it involves user interaction; usability is significant, especially for the elderly to use technology.

An estimation of many current technological systems found that the elderly, who often suffer from physical and cognitive difficulties, could not use it efficiently (Murata, and Iwase, 2005). The age-related shifts and differences can affect usability and impact decisions around adopting and utilizing innovative technologies (SCAN Foundation, 2010). Even the smart and good design with useful features could fail; if it fails to deliver its presence and availability, the lack of information can be a barrier to acceptance. The elderly people are less likely to adopt and accept new technologies that do not fit their mindsets. the elderly decided that the technology should fit with their daily schedule and physical space to affect their conceptual compatibility in adoption (Lee et al., 2013)

3.5.3. Psychological issue

The elderly usually fear all the mixture of suspicion and uncertainty, the worry of being controlled, and fear of losing secrecy (Lê.Q. et al., 2012). When introducing technology to the elderly, it is vital to learn about the possible advantages (Aula, 2005). Many elderly’s feel frightened and anxious when faced with innovative technology

(Piper et al., 2010). Studies have stated that the elderly are less self-assured and more worried when dealing with technology than younger people (Czaja et al., 2006). The elderly anxiety of technology can lower satisfaction, benefits besides the limitation of the possibility of the frequent usage of new technologies (Meuter et al., 2003). Technology Anxiety or fear of technology is described as the worry, trepidation, and people's feeling, especially the elderly when using certain and new technology that they have not used before (Meuter et al., 2003). Previous studies and research indicate that technology anxiety and fear are pervasive in computer-related systems and information network systems, especially for the elderly. (Kummer et al., 2016; Powell 2013). The elderly prefer to use technological devices that are familiar to their mindset and which they are habituated to and using for a long time rather than swapping over to innovative and new technologies and platforms (Liu et al., 2013). The higher level of technology anxiety negatively affected the target and purpose of merging new technologies for the elderly in their home, as the technology anxiety negatively affects the behavioral goal of the elderly to practice technological devices and services in smart homes to support independent living. Smart homes can provide healthcare facilities by collecting, monitoring, managing, and analyzing the individual health information related to the elderly. These facilities and aspects increase the feeling of fear and trust issues that can unfavorably affect the implementation of these smart homes by the elderly. (Wilson et al., 2017; Alaa et al., 2017; Pussewalage, and Oleshchuk, 2016).

The elderly have a negative view regarding the security aspects (Mitzner et al., 2010; Arning, and Ziefle, 2009), so the trust in technology has an essential role in the acceptance of new technologies for the elderly; moreover, it has a strong positive impact on the supposed usefulness (McCloskey, 2006). A rise in the estimated security will increase the Behavioral Purpose of the elderly to use innovative technological devices as the state of mind of the elderly where they believe that their information will be secure and fully defended (Pal et al., 2018). The elderly decisions are affected by the psychosocial need to stay independent. The elderly feel hostile towards systems that visually show them as frail, old, and need assistance (Walsh, and Callan, 2011). Many elderly are opposed to using technology to independently maintain their daily lives as they fear being dependent and weak (Esse'n, and stlund, 2011; Kang et al., 2010). Improving user training programs to understand the elderly's previous

experiences with existing systems could limit technology anxiety so that the elderly will build confidence while learning and adopting innovative technologies (Czaja et al., 2006).

This chapter presents the main concept of smart homes for the elderly and the innovative technologies that may support the elderly independence. Moreover, it was presented the variety of the technological devices designed for the elderly to improve their daily lives. Different technological devices and software are available for the elderly for different using proposes. Also, this chapter presented the main challenges that may arise in the minds of the elderly while thinking about accepting or rejecting innovative technological devices. These aspects, as mentioned in the chapter, financial issue, which is the biggest obstacle to implementing smart homes, the psychological aspect, and also the financial issue effects one way or another on the psychological factor, like the elderly and after the age of retirement have limited income, which affects the extent of their acceptance to integrate new technologies in their homes. Of course, the technical aspect is also an essential factor as it is difficult for the elderly to deal with complex technology

CHAPTER 4: DESIGN OF THE STUDY

This research study attempts to broaden the theoretical and methodological scope of the discussion that has focused on supporting the elderly's independence by merging innovative technological devices in their homes to convert them into smart homes. This study focuses on the question of how smart interior environments support the elderly to remain living independently?

Table 7. Research Methodology Table

Design research	Data and Sampling	Methods of Analysis
Qualitative Research	Target Group and participants	Interview logbook Cognitive Mapping

4.1.Methodology

This research is qualitative as this study focuses on people's experience in their daily lives, especially the seniors. This study method focuses on understanding the elderly behaviors, beliefs and mindsets in merging technology in their own homes and this is the aim of this research. Qualitative research gives priority to the users and participants in the study. As a continue to the qualitative research, in this study, both techniques will be used in collecting data, desk work to collect and analyze the previous and existed studies related to this research and, fieldwork which will shape in interviews, logbook, and cognitive mapping to understand in-depth elderly's behaviors and needs.

4.2.Data and sampling

This study is dealing with the research problem by conducting an interview with the elderly as a target group (aged 65+) and putting into consideration the elderly needs and challenges of using technological devices by the elderly to arrive at the findings and conclusion at the end of this research and provide a design proposal. This research is focusing on the elderly opinions and thoughts about innovative technologies. This study method of analysis deals with the elderly and aims to gather additional information directly from them and integrate them with the literature review to propose a solution.

- ***Participants***

Due to the COVID-19 pandemic and its risks, communication with the participants was through their friends and relatives. 20 elderly volunteers participated in this research as it was difficult to communicate directly with the participants, especially that they are all elderly. Furthermore, this was to preserve their health, follow the laws issued against them to limit their movement. The best solution was to communicate with some elderly's in nearby knowledge circles, which facilitates Communicating with them directly or through one of their relatives.

Participants of 20 elderly volunteers participate in this study by filling out the research instrument booklet (see appendix 1) that consists of 23 Interview questions, a logbook template, and cognitive mapping. The elderly aged into four age groups: 65+, 70+, 75+, and 80+. The elderly who participate in this research was 12 males “60%” and eight females “40%,” as shown in figure 8.

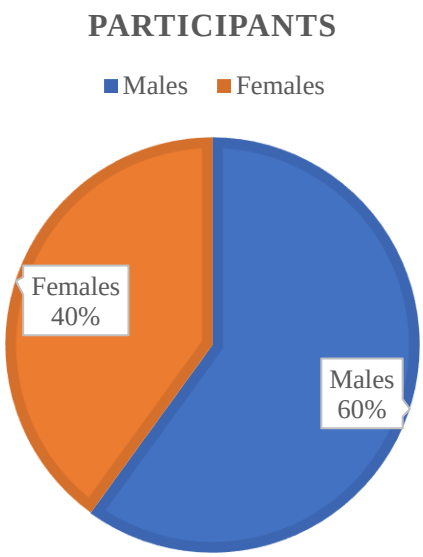

Figure 8. Participants males and females percentage distribution

The 65+ age group represents 45% of the total participants, which is the most percentage which is nine elderly, 70+ age group represents 25% which is five elderly, 75+ represents 20%, which is four elderly, and the 85+ represents 10%, which is two elderlies as shown in figure 9.

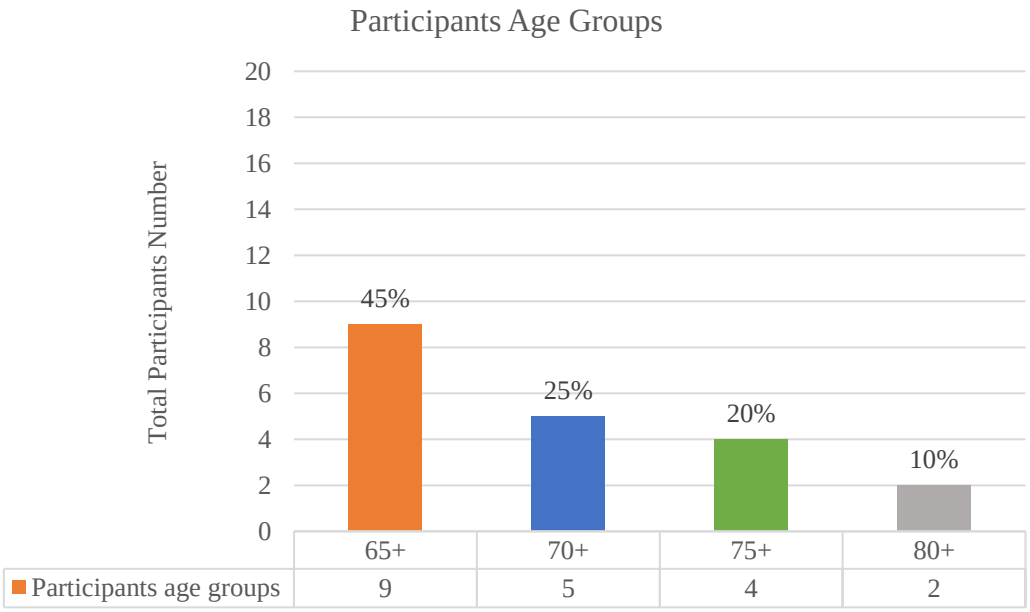

Figure 9. participants four age groups

4.3.Instruments

In this study, as the target group is the elderly in Turkey, this study uses several techniques to collect data directly from the participants and target groups (elderly) and analyze and evaluate hypotheses to improve the design principles and apply their needs.

4.3.1. Interviews and logbook

Interviews used to contact in person and collect the data directly from the participants. In this study, interviews are a technique and tool to understand the elderly's daily activities better. Still, they may be performed remotely by phone or using social media. The interview will help to understand better and explore the elderly opinions, behavior, experiences, knowledge, and background by asking them some questions (open-ended questions) to gain more information about their needs. In addition to the interview questions, there is a logbook that the elderly will fill in; this logbook is used to clarify the elderly health condition, ADLs and IADLs, and technology usages. In this research, the logbook will be used in parallel with the interviews to explore the difficulties that the elderly face daily.

4.3.2. Cognitive mapping

Cognitive mapping helps the researcher to analyze how participants/users use a specifically designed environment by recording participant performances and following participant movement in their homes. The cognitive mapping technique will help improve the design principles for the elderly and improve residential areas' overall design. It will show the circulation of the elderly in their homes and where they face problems.

4.4.Findings and discussions

The research aims to understand the elderly perspectives on innovative technologies and the "smart home" concept that supports them in continuing their daily lives independently. The findings focus on understanding the elderly's mindsets about innovative technological devices and smart homes that may positively impact their daily lives and independence status. Moreover, in this study, after gathering information in the literature review, this will contribute to analyze and evaluate the elderly needs, design for elderly principles, challenges facing designers during design for the elderly through the research technique instrument (see appendix 1).

After conducting the interview, logbook, and cognitive mapping, the research problem solution appears to be clearer. This research intends to develop suggested solutions to the research problem based on the use of research techniques to know the four aspects mentioned in the research problem: the elderly's health status, daily activities, their use of technological devices, and their knowledge of the concept of smart homes and their opinion of adding innovative technologies in their homes.

4.4.1. Results of interviews and logbook

4.4.1.1.Participants health status

As mentioned before, aging health factors affect elderly independence in some cases as most of them have a vision, hearing impairments, and physical issues. This research identified that 65% of the participators have vision impairments from aging factors, and 35% do not have this problem. 15% of the participants recorded to have a hearing impairment, 5% were caused by accident, and 10% from aging factors, 5% were using medical ear headsets. As the physical issue is an essential factor for independence status, the participants were asked if they have any physical issues while mobility in

their homes or while dealing with furniture. One of the participants, "P.8," said: *" I have difficulty accessing the tall cabinets; I also have difficulty hanging clothes because I am having trouble using my left arm due to breast cancer surgery, and it is increasing due to the aging factors."*

It was observed that 70% of the elderly participators are in good health and did not suffer any physical problems, and 30% of them have physical problems that affected daily practicing activities; it was detected that the persons who have physical problems are frustrated as this affects their daily activities.

Participant, "P.2," said: *"I am suffering while standing and sitting down from a chair or a sofa. I think it should be a little bit high. Also, I could not use hard chairs. I should use soft ones because I have problems in my bones due to the high blood sugar; my bones are so weak."*

Also, it was noticed that 35% of the participants were suffering from another special health issues; it was different from one person to another, but the most common was blood pressure, as 20% of them were suffering from it.

4.4.1.2.Participants technology and internet usage

The total percentage of the elderly connected to social media is 77%, and 23% do not use social media applications. Most of the elderly use the (WhatsApp) application, which allows them to talk to their families and relatives; this is the most critical factor in using social media. The figure below shows the number of the elderly using social media application.

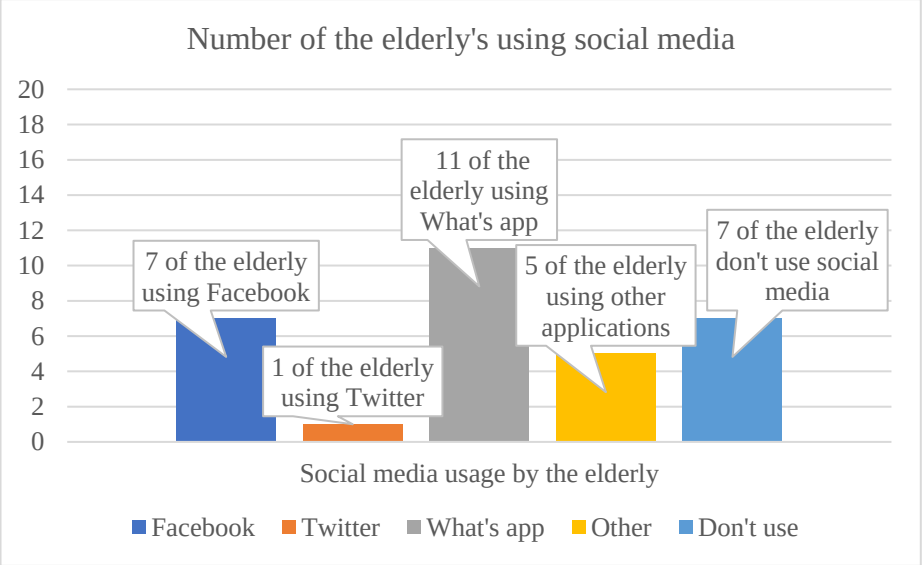

Figure 10. number of the elderly participants connected to social media and most application used by the elderly

After asking the elderly connected to social media, it was found that 15% of them spending from zero to one hour per day, and 39% of them spending one to two hours per day. 23% of the elderly connected to social media spend two to three hours daily, and 15% spend three to four hours, and only 8 % spend more than four hours daily, as shown in figure 11. Most of the elderly use smartphones to connect to social media 80% of them, and 20% do not use smartphones or other technological devices.

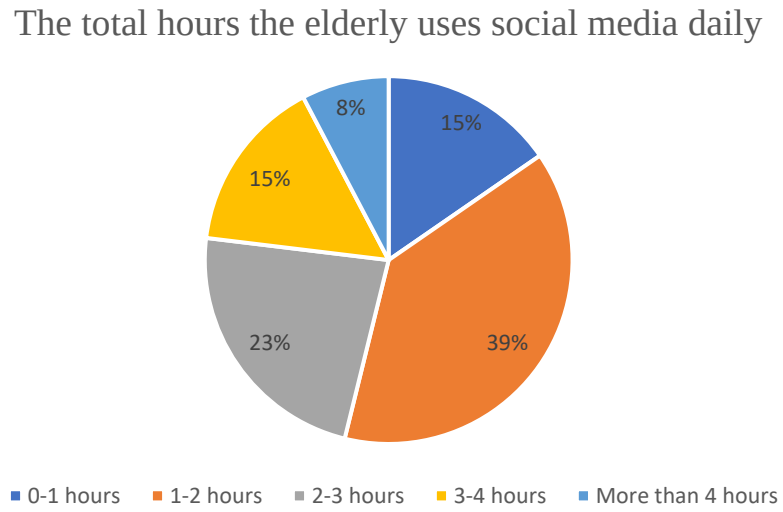

Figure 11. total hours the elderly connected to the social media every day

4.4.1.3.Participants acceptance of smart homes concept and technological devices usage:

The participants were asked if they have any background information about smart home concepts, and 20% of the elderly who have a background information about smart home concepts do not have accurate information's they know some basics knowledge about the connected homes. As for 80% of the participants, they do not know any information about smart homes. When the participants were asked if they accept to convert their home into a smart home if they have the opportunity to do that, 67% of them accept to convert their homes to a smart home, as shown in figure 12. The most factor they accepted using technological devices and the smart home concept is the health factors; they think the innovative technologies will support their sense of safety in monitoring their health on an ongoing basis. Most of the elderly fear a sudden illness while alone in their home, so they are welcomed to have such technology to send notifications to their relatives if a sudden accident occurred. The participant "P.13" said: *"I totally accept this concept because I have a bad experience as I lost one of my friends last year, he died in his home alone and his relatives knew after two days, so I hope to have the opportunity to install these types of technology."* The figure below shows the percentage of the elderly accepted to convert their traditional homes into smart homes if they have the opportunity to do, and the percentage of the elderly did not accept the convert their homes.

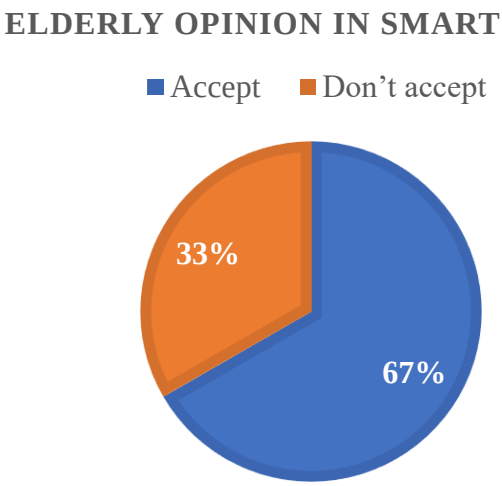

Figure 12. Percentage of the elderly accepted and refused the smart home concept

Moreover, three participants are using technological devices for different reasons; one

participant uses a smartwatch to control health conditions, and two of the participants use a safety monitoring camera. Seventeen of the participants do not use any technological devices; most of them prefer to do not to use them as they are not needed from their point of view.

4.4.1.4.Participants common issues that affect independence status observed from the logbook

It was concluded from the logbook that all the elderlies who participated in this research could do their personal hygiene independently, and only 5% want assistance in getting dressed and moving through the home, which is one participant. While the 95% can conduct their personal hygiene, moving in the home, getting dressed, and preparing food/ self-feeding independently. However, it was noticed that there are common issues most of the elderlies suffering from them. The table below shows the common issues concluded from the interviews and logbook and how many participants are suffering from these issues that may affect their independence; it is a summary table for the common problems in the elderly daily activities observed from the logbook.

Table 8. Common Issues faced by the elderly in their daily lives "participant 1-10"

Common Issues	P.1	P.2	P.3	P.4	P.5	P.6	P.7	P.8	P.9	P.10
Vision	✓	✓	✓	✓	✓	✓		✓		✓
Hearing	✓	✓		✓		✓				
Physical issue	✓	✓						✓		✓
Sitting down and getting up		✓								
Kitchen cabinet height								✓		
Stairs	✓	✓		✓				✓		
Housework								✓		✓

Table 9. Common Issues faced by the elderly in their daily lives “participants 11-20”

Common Issue	P.11	P.12	P.13	P.14	P.15	P.16	P.17	P.18	P.19	P.20
Vision		✓			✓	✓	✓	✓		
Hearing				✓						
Physical issue						✓				✓
Sitting down and getting up						✓				
Kitchen cabinet height						✓				✓
Stairs	✓		✓	✓		✓				
Housework						✓		✓		✓

4.4.2. Cognitive mapping results

4.4.2.1.Participants daily activities

For the cognitive mapping, the participants have three options to apply the map, they have the flexibility of choosing what they prefer the first option, and the main one is to draw their home from a top view and draw their usual path to identify the most exciting zones and the common issues. The second option was to draw their daily path and indicate to the furniture and the places they face problems in a standard model; the last chance was to write in details and attach photos to their homes to allow the researcher to recognize the space. The main target of using cognitive mapping techniques is to understand: the elderly daily activities, path, and routine in their home to clarify their needs and issues. After applying the interview and the cognitive mapping, almost all the elderly spend their time in the living room; they practicing their daily activities and spending most of the time there. In addition to the interview, it was also noticed through cognitive mapping that almost all participants have the same path in their home daily, as shown in the figures below. When they asked if they face any technical problems in their home or with their furniture, they all think about the living room and kitchens. The most common issue was dealing with kitchen cabinets due to aging, and as mentioned before, in chapter three, 65+ people could suffer from muscle contractions and loss of bone mass. Another common issue was

sitting down and getting off chairs and sofas; it is because of the same reason, physical weakness.

P.1 The participant drew the home plan; it is almost accurate, as the proportion of the room-scale is accurate enough to reflect the real plan of his home. P.1 usual daily path in his home is starting from the bedroom then to the bathroom, after that spending time between kitchen for preparing food and the living room as shown in figure 13. The living room is the main space he spends most of his time in; it consists of a sofas dining table with chairs and television. It was noticed that P.1 did not use the second bedroom; he said, *"Sometimes many days pass I do not enter this room. I think I do not need to go into it very often, as I spend my whole day in the living room, surfing the news and talking to my relatives on the phone there."*

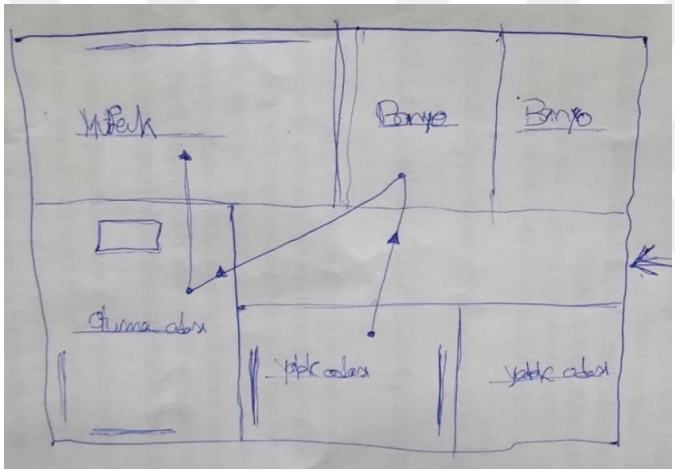

Figure 13. Participant one cognitive mapping method

P.2 describes his daily path as: *"I start my day of course from my bedroom then to the bathroom, after that to the living room to take my breakfast, then to my bedroom again as I spend most of my day there. In my bedroom, I have everything as I can sleep on the bed or read a book on a chair or surfing the internet on my office desk. I live with my wife and daughter, so I spend some time with them in the living room. As I mentioned before, I have problems with my bones, so I could not sit down on a hard chair. I should use just the soft furniture."*

P.2. focused on the bedroom in his drawing and his daily path and routine description as he spends most of his day there. He did not care about the rest of the home; he did not even enter the kitchen and the other zones (see Figure 14).

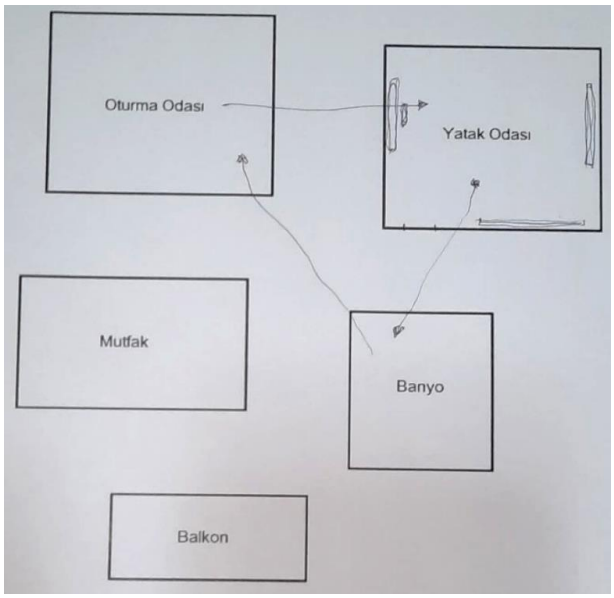

Figure 14. participant two cognitive mapping method

P.3 showed in his drawing the most critical zones in the home from his point of view. He focused on the living room and the office room as he spends all day between the two rooms (see Figure 15). P.3 have a private business, so he spends a lot of his time in his office room to consultant his work and the rest of the day in the living room, spending time with the family, eating, and watching television. P.3 lives in a villa with three floors, but he refers to significant zones in which he spends his time.

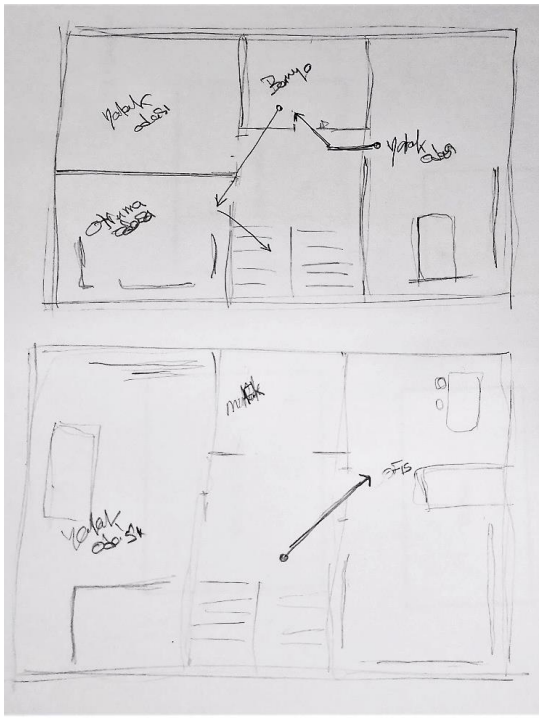

Figure 15. participant three cognitive mapping method

P.4 preferred to use the second and third options of cognitive mapping to apply the map (see Figure 16). The drawing shows that the participant's main focus is on the living room also as he did not mention the starting point from the bedroom as usual. Also, he indicated the furniture in the whole home, but he mentioned more details about the furniture in the living room.P.4 mentioned that he spends most of his time in the living room and the garden. P.4 faces some problems with the stairs; P. 4 mentioned, *"it is hard to move between the first and second floor; the stairs present a problem for me."*

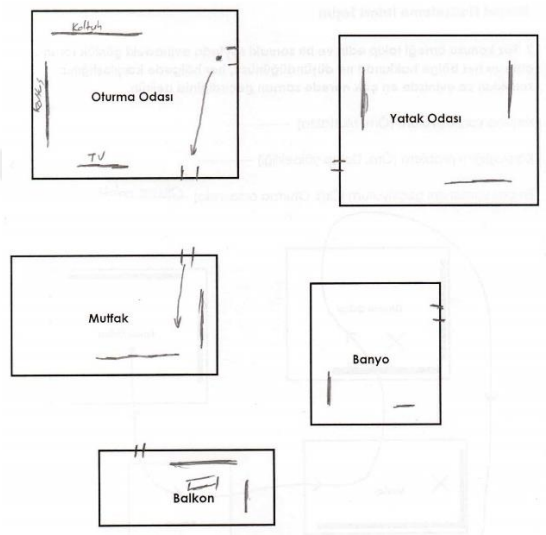

Figure 16. participant four cognitive mapping method

P.5 drew her daily path in the home, starting from the bedroom to the bathroom and spending most of the time in the living room (see Figure 17). After observing the map and the participant's comments on her daily routine, it was noticed that P.5 is active elderly and also reflected from her answers as she did not mention any problems or issues she may face daily. P.5 said, *"I wake up in the morning in the bedroom. I go to the bathroom. After washing my face in the bathroom, I take a walk down the hall. I go to the kitchen and have my breakfast. I tidy up the kitchen; I cook my meal. I spend time with my flowers on the balcony. I do the handicrafts I donated to LÖSEV in the living room. I eat dinner in the kitchen, watch TV in the living room and go to bed around 11-12 pm".*

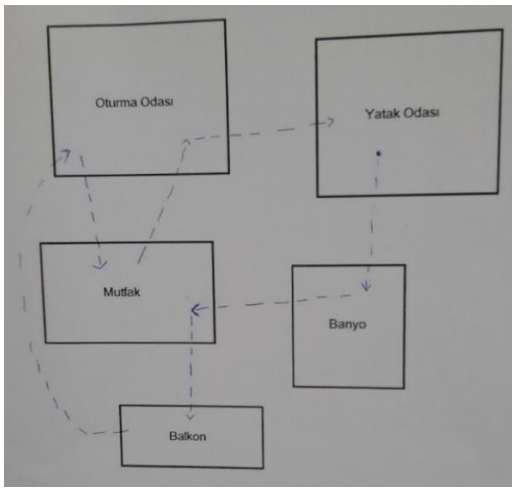

Figure 17. participant five cognitive mapping method

P.6 used option one to apply his map (see Figure 18). The map shows only the living room with the furniture indications; it seems the home's largest zone. P.6 mentioned some difficulties he faced while moving in the bathroom, but he did not indicate any problems on the map. P.6 daily path mainly from the living room to the bathroom, he did not enter the kitchen, and he entered the bedroom in sleeping time he did not spend any time there through the day.

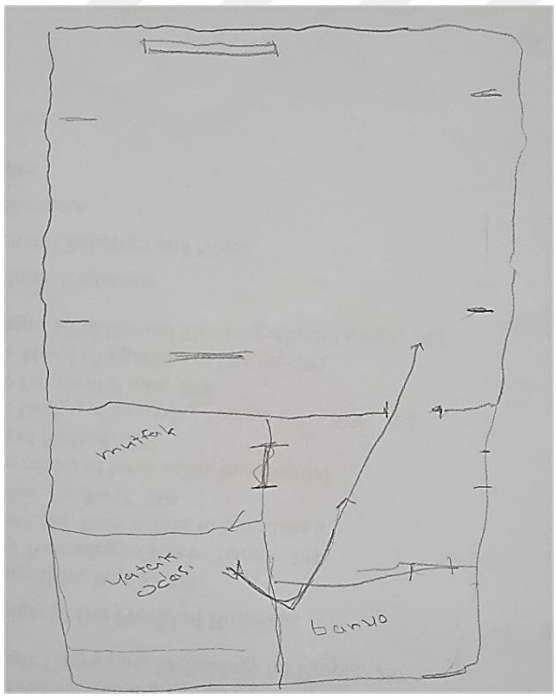

Figure 18. participant six cognitive mapping method

P.7 drew an accurate plan for the home with a detailed daily path. P.7 is connected to the internet and aware of some innovative technological devices. The map reflects the

participant's activeness; P. 7 did not enter the kitchen in his daily path as shown in the map; the map shows the main zones P.7 entered and deal with daily. The most critical zone is the living room and the office room; he spends most of his time there, as shown in figure 19.

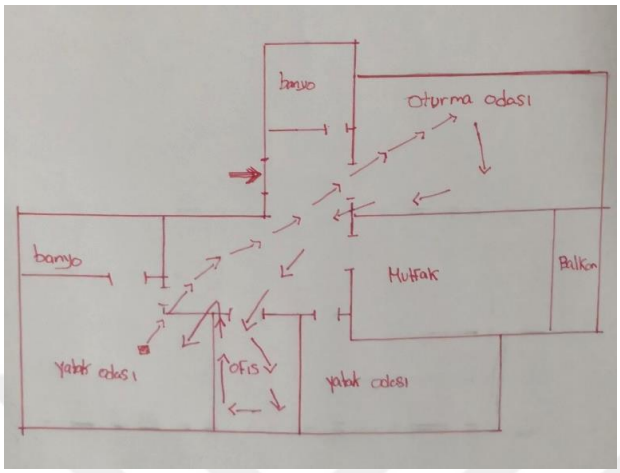

Figure 19. participant seven cognitive mapping method

P.8 spends most of her time in the living room and balcony (see Figure 20). She drew her daily path using option two and describes in details in option three of the cognitive mapping (check appendix 1 “Research techniques instruments”). P.8 mentions some difficulties she faced while accessing the high kitchen cabinet. Also, she faces problems while hanging clothes as she is suffering from physical issues in her arm and shoulder. P.8 said, *“I wake up from the bedroom in the morning and go to the bathroom. I go to the kitchen to prepare breakfast (I have difficulty accessing the tall cabinets.) I bring my breakfast to the living room and do it there; I watch TV, and then I go out to the balcony; I have difficulty hanging clothes. Then I take care of my daily chores in the kitchen. I spend all day in the living room, walking around the house during the day. I sleep in the bedroom at bedtime.”*

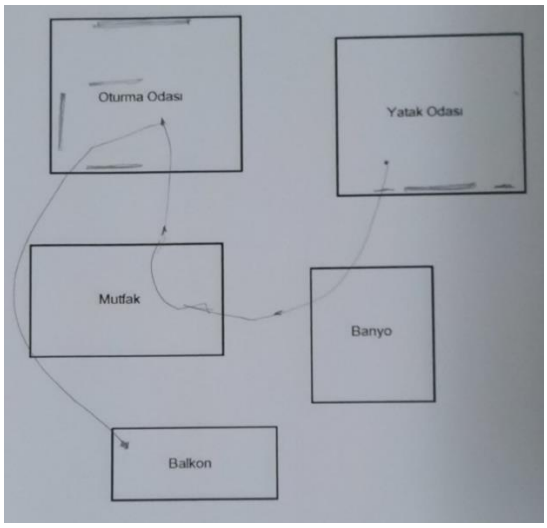

Figure 20. participant eight cognitive mapping method

P.9 refers to her map that she spends most of the time between the kitchen and the living room as shown in figure 21. P.9 drew her daily path from the bedroom to the bathroom to the kitchen to prepare the food; after that, she spends some time with her family or watching television in the living room. P.9 said, *"I spend most of my time in the kitchen and doing housework, I do not face a certain problem in my home I think everything is ok till now, I could do my daily activities from preparing food and doing housework independently. The only thing that I could not do all the tasks like before I do not have the same power."*

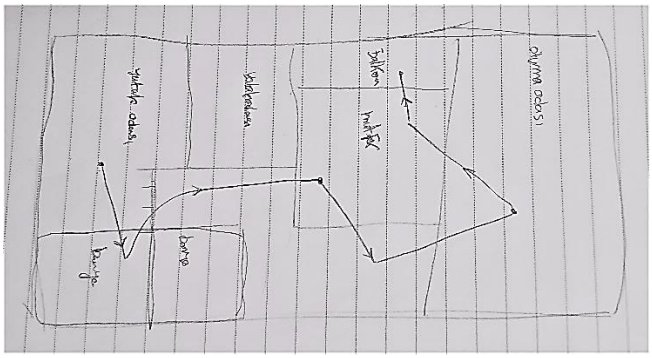

Figure 21. participant nine cognitive mapping method

P.10 map shows that she spends her time between the living room and the balcony (see Figure 22). P.10 daily path starts from the bedroom to the bathroom, then to the kitchen, and finally to the living room or the balcony. The home plan is almost accurate; it shows all the home zones with the right proportion scale between them. She mentioned and indicated about problems she faced in the bedroom and the living room; the problem is that these zones have many furniture pieces that affect her movement and make it difficult in some time, but she did not face any technical issues

when dealing with furniture.

Figure 22. participant ten cognitive mapping method

P.11 drew the map due to his daily path; he starts his day from the bedroom to the bathroom then spending time in the living room while reading and watching television. P.11 spends most of his time in the living room and the office room; most of the time, he is reading, so he is focusing on the light quality to read comfortably (see Figure 23). P.11 said, *"I start my day with having my breakfast in the living room or the balcony; then I go to my office room to read some books that's the most thing I usually do, at the sundown time I go up to the roof to spend some time in the sun then I go to the living room till the bedtime; it is a little bit hard to go up with stairs I could not do it more than one time per day."*

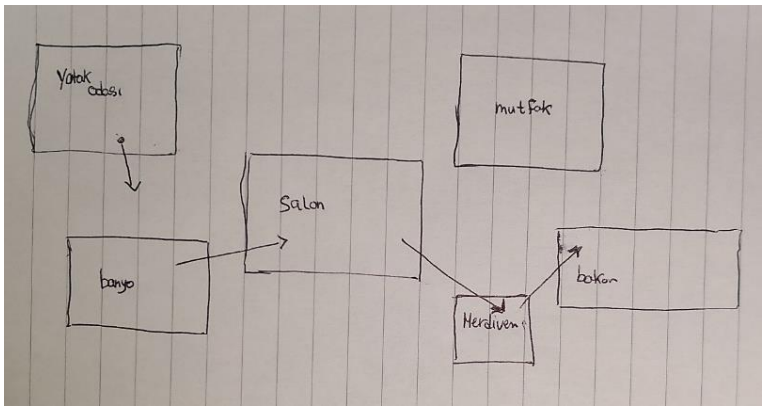

Figure 23. participant eleven cognitive mapping method

P.12 drew the map nearly accurate to the real plan of the home. It was noticed in this

map that the living room has no limits and walls; it seems like the participant feel it is an open place where he spends most of his time this room, he finds that there are no limits, so this is his spacious private space, or maybe he reflected that the living room is the core of the home and it is open to rest zones of the home (see Figure 24). P.12 mentioned that he spends most of his time in the living room and sometimes at the balcony, but he did not refer to the balcony on the map. Moreover, his daily path starts from his bedroom to the bathroom, then to the kitchen, and finally to the living room. P.12 did not mention any technical problem faced in the home or with the furniture. Also, P.12 did not indicate the furniture in his drawing. He mentioned before that he did not face any problem with the furniture, so he did not indicate the furniture in the conclusion. When the elderly are asked to draw their homes, the elderly (not just the elderly) draw what they have in their mind, how the elderly see their home from their point of view or as they feel it.

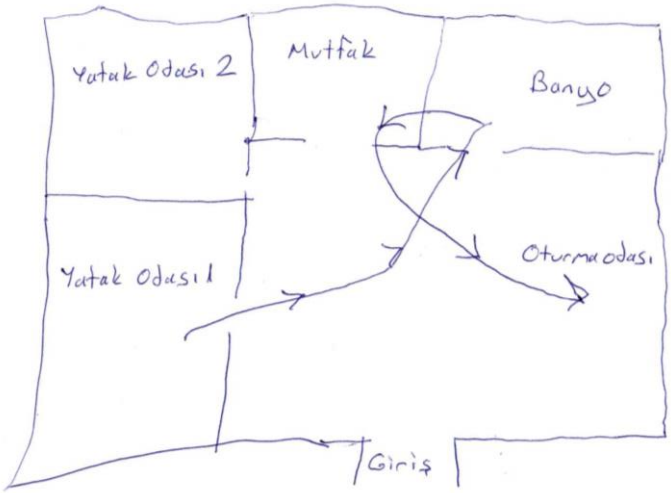

Figure 24. participant twelve cognitive mapping method

P.13 drew an accurate plan for his home with the right proportion between the zone. P.13 spends most of his time in the living room; there are two living rooms in this home, one is the main, and the second is a living room with an office, so he spends his time in the second living room. P.13 daily path starts as usual in the bedroom then to the kitchen to take his breakfast with his wife then he spends the rest of the day almost in the living and office room as shown in figure 25. P.13 said, *"I do not have a certain problem with my home, in my opinion, my home has much furniture, and most of them are old, so I need to redesign my home and get rid of the extra furniture pieces to make the movement easier; also I have problem with the stairs it is so hard for me."*

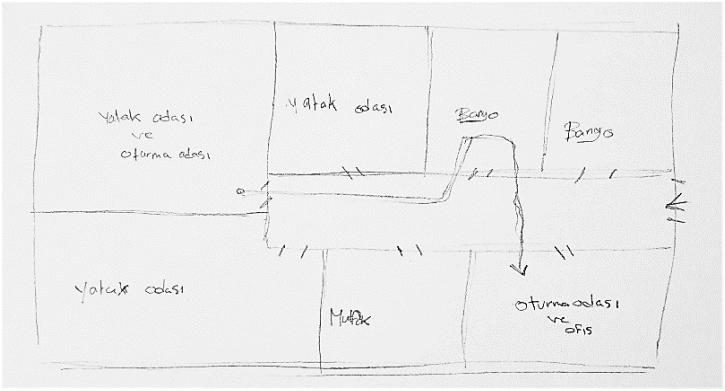

Figure 25. participant thirteen cognitive mapping method

P.14 refers to the living room as the main and largest room in the home as she spends most of her time in it. The corridor is also not too long, but it seems long for the first impression, so the drawing reflects how she sees her home. P.14 daily path is between the bedroom, kitchen, and the living room; she spends some time in her bedroom while reading books and praying and the rest of the day preparing food and watching television in the Livingroom. She did not mention particular problems in her home (see Figure 26). An additional note that P.13 and P.14 are two couples in the same home, and it was noticed that the two maps are different; it seems like they are two different homes.

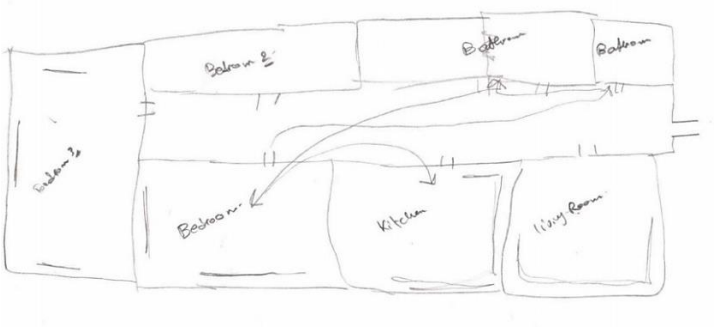

Figure 26. participant fourteen cognitive mapping method

P.15 starts his daily path from the bedroom and bathroom then to the living room as shown in figure 27. He spends all day in the living room watching television or spending time with his wife. P.15 did not mention any difficulties he faces in his home; he said he does not have any technical problems with the furniture. P.15 said, *"in my home, in my opinion, everything is ok; I just feel tired when going up the stairs."*

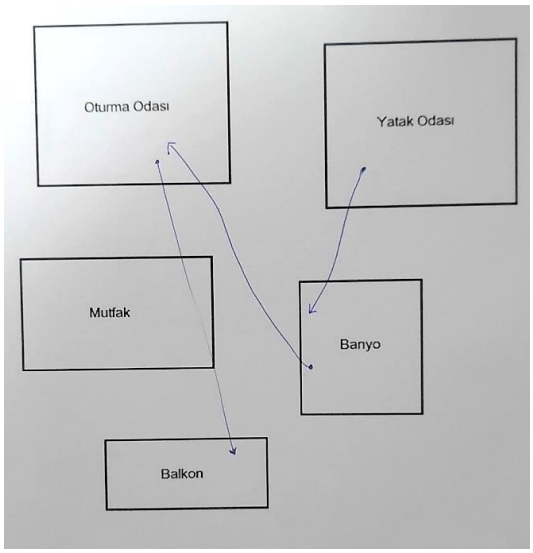

Figure 27. participant fifteen cognitive mapping method

P.16 starts her daily path from the bedroom then to the bathroom and after that to the kitchen then spends most of her day in the living room (see Figure 28). P.16 applies the cognitive mapping with the second and third option; she mentioned a physical issue that affects her movement with the home as she is suffering from a problem in her knees. She said, *"I have a problem with my knees, so walking is a little bit difficult and especially in the kitchen because it is very small."* In addition to this problem, she faces difficulty while dealing with heigh kitchen cabinets; she added, *"Every day when I get up, I go to the bathroom and then to the living room. I go to the kitchen to preparing the breakfast, but the narrow kitchen and the height of the cupboards make me suffer every time I enter the kitchen."*

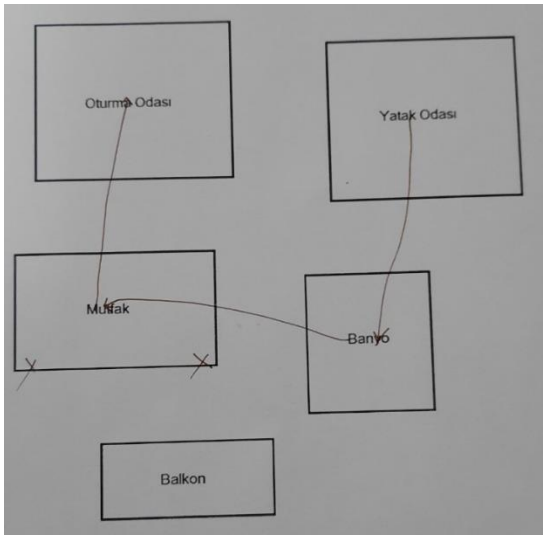

Figure 28. participant sixteen cognitive mapping method

P.17, living in a villa of three floors, drew the most floor he spends his time in. the

map shows the garden is almost the same in scale as the whole plan. P.17 focuses on the ground floor, which contains the living room and the garden, and he mentioned that this is the most preferred place for him in his home as shown in figure 29. P.17 said, *"I prefer to stay in the garden most of the time, especially in the sunny days, and in the winter, I spend most of the time in the living room which overlooking the garden, and for my daily path, I wake up and move from my bedroom in the first floor to go down to the ground floor and spend all the day there as mentioned before in the living room or the garden depends on the weather."*

P.17 drew the map and attached a description with his usual path without indicating with this path on the map; he said, *"I spend most of the day at this floor on the right after the entrance is the reception it is a closed room and on the left after the stairs, there is an open kitchen and the living room which I stay most of the time there."*

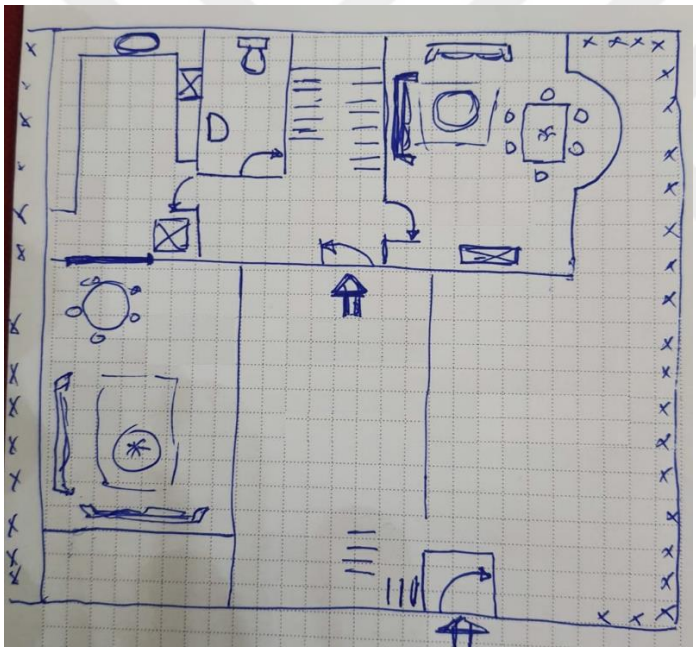

Figure 29. participant seventeen cognitive mapping method

P.18 as shown in the figure 30 the differences inaccuracy from the plan drawn by her (on the left) and the real plan (on the right), she focused in her drawing on the living room, kitchen, bedroom, and bathroom and skipped the other bedroom. As noticed from all the participants' maps, the map reflects the significant zones for the elderly and where are the most places they spend their time.

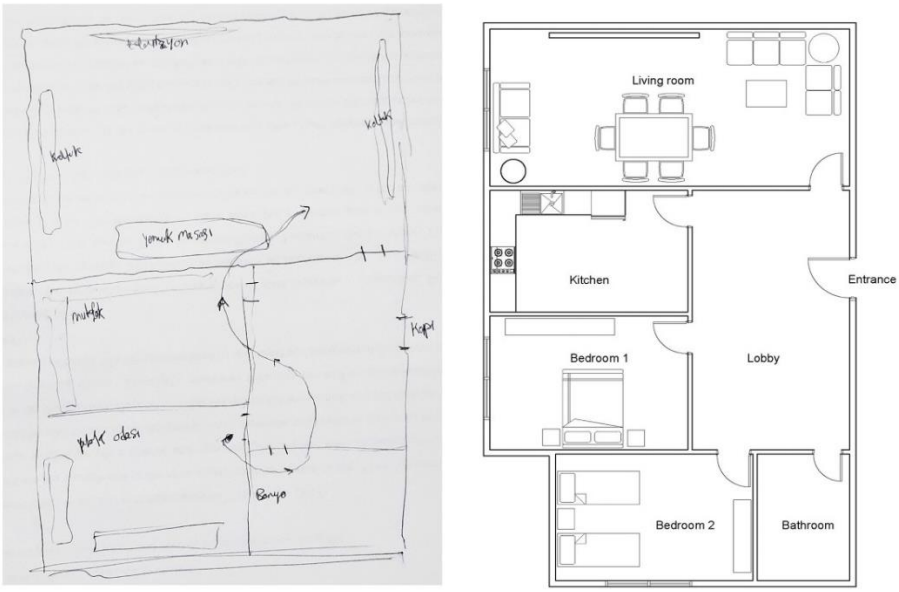

Figure 30. participant eighteen cognitive mapping method (Home cognitive mapping has been drawn by participant 18 compared by the real plan to show the accuracy differences)

P.19 the map shows the participant daily path; he drew the plan and focused on indicating to the bedroom and the living room; he did not draw all the furniture in the home; P.19 drew the significant pieces from his point of view, bed and cardboard in the bedroom, sofa, and TV unit in the living room (see Figure 31). P.19 also spends most of his time in the living room, his daily bath centered between bedroom, living room, and kitchen.

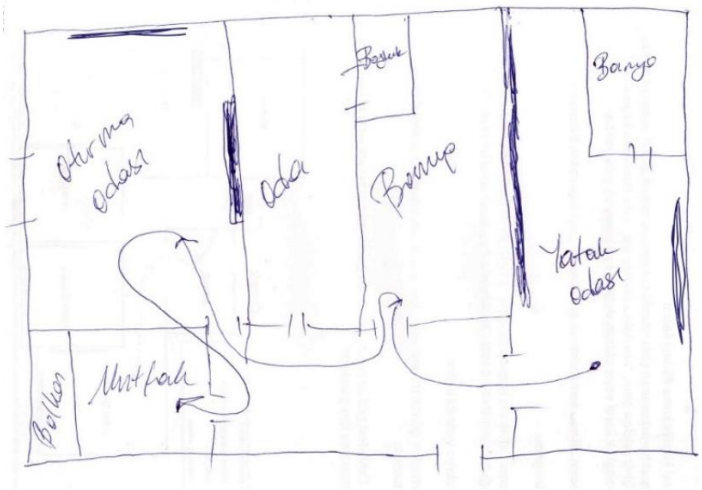

Figure 31. participant nineteen cognitive mapping method

P.20 drew the map that reflects the home zones, but it is not accurate and precisely real, reflecting how she sees her home and how she deals with her home. The figure

below shows the differences between the plan has been drawn by the participant and the real plan, which reflect that everyone could see the space differently (see figure 32). P.20 daily routine starts from the bedroom and the rest of the day between Livingroom and kitchen. P.20 mentioned that she faces some problems dealing with the high kitchen cabinets as she is having a problem with her shoulder, and she recently did surgery on her shoulder.

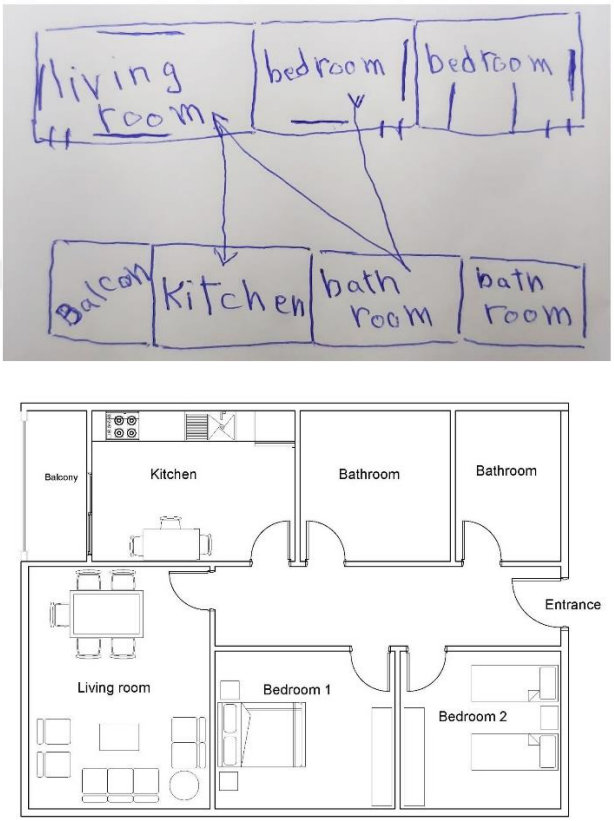

Figure 32. participant twenty cognitive mapping method (Differences between home mapping that has been drawn by participant 20 and the real home plan)

It was observed from the cognitive mapping that the participants focused on indicating for Living room most than the other zones at home. The living room is still the most critical zone for the elderly in their homes, as mentioned in the Lawton study (chapter two) that mentioned that the elderly created their "control centers" in their home. After almost 25 years from the Lawton study, human behaviors and needs still nearly the same; the individuals create a safe zone to fit their needs. The living room is the most suitable zone for creating "control centers" as it is the core of the home, and the elderly doing most of their daily activities there. In this zone, the elderly can control and manage their needs, such as watching TV, communicating with their family, reading,

and mostly enjoying the sunlight. The difference between this study and Lawton's study is not human behaviors and needs but the ability to create smart environments to fit these needs efficiently.

Moreover, some of the elderly ignored some zones in their home when they were asked to draw their home as they know it. After observing 20 maps and some of the participants being couples living in the same home, it was remarked that everyone has a different mental picture of the home and has different needs. The maps show their usual path and the most exciting zones for them in their homes; It follows from this that some zones must be focused on in designing for the elderly to make the time they spend in these rooms more comfortable and safer. The findings show that the elderly could accept adding more technological devices to their lives, especially in their homes, to support their independence. They can learn and interact with new technologies if they understand the benefits of technology and its positive effect on their daily lives. As some of the participants refused to accept the idea of changing their homes and their ordinary life, the vast majority accepted after they understand that this change will positively affect their lives. To conclude the results, there are many concerns about elderly acceptance and readiness to replace human assistance with technological assistance if needed.

Moreover, there are many discussions about privacy while using technology or technological devices, as this is a global concern nowadays, especially for service types that involve detection cameras or recording videos. The elderly acceptance and awareness of technology are expected to progress over time if a particular solution for the challenges is available. However, the rise of awareness about technology depends on involving the elderly perceptions and needs in designing, modifying, and improving smart services or systems.

CHAPTER 5: CONCLUSION

In this study, understanding the elderly views about technological devices and opinions about the concept of smart homes and their knowledge of the proposed positive impact of technology on their independence was investigated. One of the most important goals of this research was to determine whether the elderly, in particular in Turkish society, will accept, in one way or another, the incorporation of new technologies into their daily lives to help them remain independent, or if they prefer to live as usual in their traditional homes. And what is the effect of technological devices on the elderly independence? The independence concept is an essential feature for the elderly in their daily lives. Previous studies prove that remain living in the home is the most valuable thing for the elderly rather than anything else. Supporting the elderly independence and self-care ability is a common approach nowadays among many countries globally due to the rise in the aging population.

Consistent with the findings of the years 2020 and 2021, It was found that the elderly's have a high probability of accepting the concept of smart homes, despite their previously unaware of the existence of these innovative technologies that would support their independence. After conducting the literature review in the previous chapters and analyzing the results of this study, it was concluded that the technological devices could positively impact the elderly lives in their homes and encourage them to remain independent. Depending on the findings mentioned in chapter five most of the participating elderly in this research showed their interest in learning more about new technologies and technological devices after interviewing and knowing more about their positive effect on their daily lives. The elderly mainly care most about the role of technology in protecting them, whether on the health level from motion sensors or at the security level. So, technological devices and intelligent systems have a significant role in improving the elderly independence. It was not expected that 67% of the participants in this research would accept the idea of integrating more technological devices into their homes, as explained in Chapter Five.

This research purposes of understanding the elderly thoughts about technological devices and smart homes, and that have been done to open new discussion of more studies about the solution of the challenges. Technological devices and smart homes are a promising idea if implemented suitably while considering the feelings and

concerns of the elderly. There is no doubt that the elderly need a longer time and sufficient explanation about the various factors of technology, how to use it, benefit from the positive aspects, and deal with and understand the negative aspects. Acceptance of technology depends on the awareness of that technology; no one needs to use useless devices, significantly increasing the financial burden. The positive side of using technology in the homes of the elderly could be lost if there were no radical solutions to the main challenges in providing these technologies. The purpose of technological devices in assisting the elderly independence in their home was the main concern of this research. Based on the concluded results; Further studies are needed to discover new solutions to the challenges and how the limitation of issues and challenges will affect the elderly opinions incorporating innovative technologies in their homes. According to the findings, it was noticed that most of the elderly would accept to convert their homes into smart homes; and the main reason was to benefit from the role of technology in "protecting" them, whether from the home safety perspective or the health safety perspective. This was an interesting finding that further research could explore. The elderly were welcoming to adding innovative technologies to their lives to improve their psychological health and support their safe feeling, especially for those living alone. The elderly acceptance of the smart home concept was influenced by having a system that could automatically detect the emergency and take action.

Depends on these findings and conclusion, the elderly's needs to adopt innovative technologies is becoming more apparent to designers. The elderly accepted the concept as shown in the findings if it is affordable and easy to use. Design for the elderly means before thinking of the design; it must understand their mindsets, beliefs, thoughts, backgrounds, and needs. Designing technological devices that respect the elderly mental and physical health and affordability and flexibility in use will fit the elderly mindsets. Using technological devices by the elderly could positively impact aging societies; it will reduce the need for assistance. Technological devices offer various options for use by the elderly to limit the challenges, whether financial, technical, or psychological. However, there is no doubt that integrating technologies in elderly homes and the use of advanced technologies are still fearful and not preferred unless there is an urgent need to use them.

Finally, after arriving at the results of this research, which may inspire designers when

designing for the elderly, it recommends further research on proposed solutions for the challenges mentioned in this study. Also, to know the real impact of technological devices and smart systems on supporting the elderly independence in their homes, these technologies should be applied in reality to recognize how the elderly will deal with it. Moreover, if applied, these innovative technologies may open a discussion about new challenges or new advantages. Although there are positive aspects and other negative aspects and challenges of technology, which has been discussed in this research, the benefit from the positive factors of technology is mostly dependent on the ability and acceptance of the elderly to use it.

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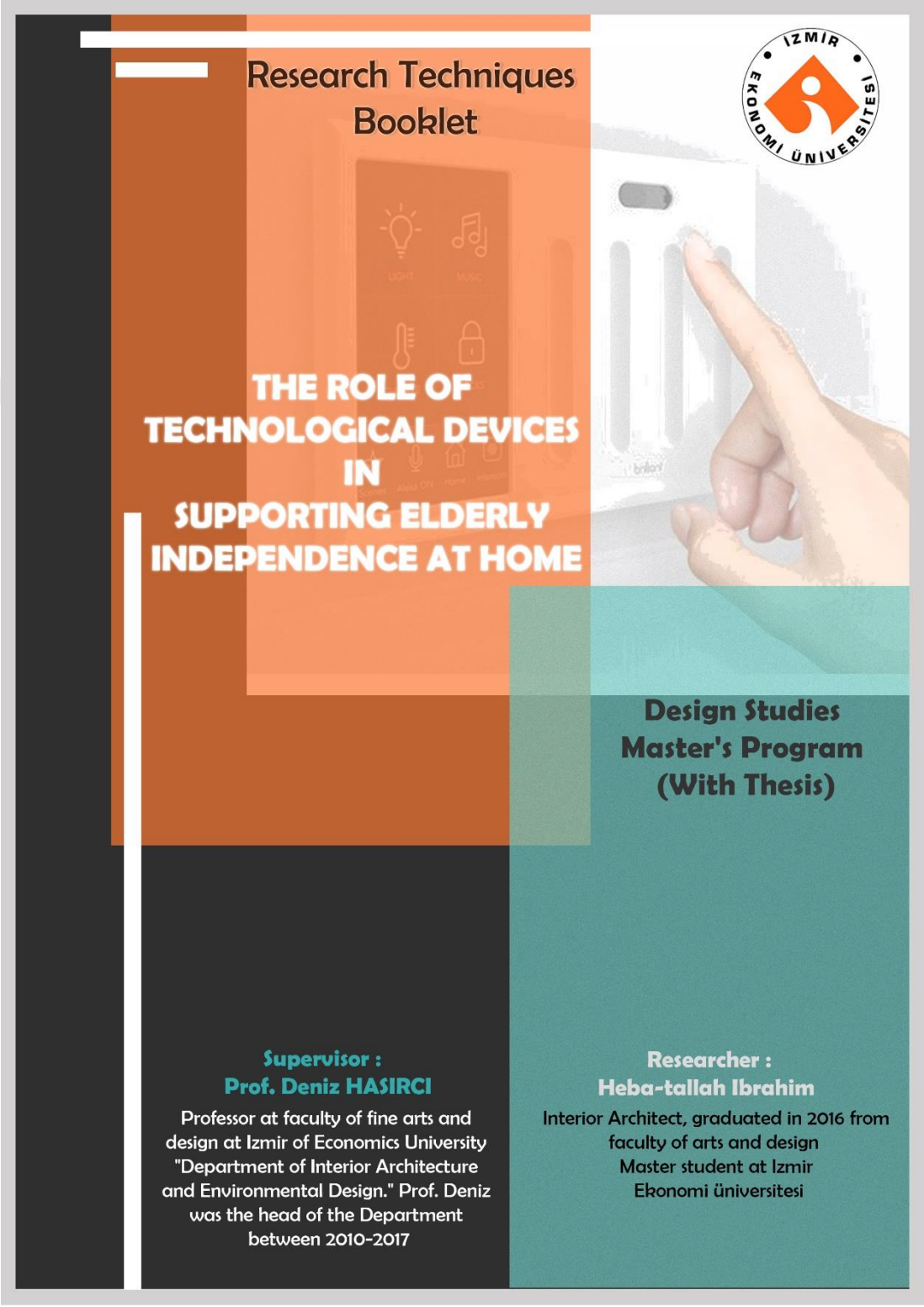
APPENDICES

Appendix A: Research technique booklet English version



CONSENT FORM

Informed consent form for the elderly participants who are 65+ in the Turkish community

[Name of Principal Investigator]: *Heba tallah Ibrahim*
[Name of University/ program]: *İzmir University of Economics/ Design Studies Master's Program (With Thesis)*
[Name of Project]: *Designing Interactive Homes to Reduce Physical Deficits Related to Aging*
(non-final title)

I am an interior architect; I am studying for my master's degree at İzmir University of Economics "Design Studies program". I am doing my research on designing smart homes for the elderly. This research focuses on reflecting how smart interiors can support the elderly to remain living independently This research is done under the supervision of Prof. Deniz HASIRCI, professor at "Faculty of Fine Arts and Design, at the Department of Interior Architecture and Environmental Design," İzmir University of Economics.

Purpose of the study

This research aims to suggest smart interiors that are geared to accommodate the elderly. This research examines the concept of "smart interiors" its possible contributions to enhancing the elderly's daily lives and supporting independence.

Whom to Contact

If the participants have any questions, feel free to contact the researcher:
Name: Heba tallah Ibrahim
E-mail address: hebaemad10@gmail.com
Phone number: +905446777281

Procedures

The participants can choose the preferable method for doing the interview:
1. The interview could be held online through a video call with the researcher.
2. The interview can occur with a voice call rather than a video call with the researcher
3. Still, if the participants do not prefer to hold it online. The interview can occur through one of the participant's family members after reviewing all the principal information and understanding how to conduct the interview with the participant and refer to the researcher in case of a participant's question.

CONSENT FORM

Informed consent form for the elderly participants who are 65+ in the Turkish community

Certificate of Consent

I have been invited to participate in this study, which is about designing smart homes for the elderly, and I have read the previous information or read to me.
I voluntarily consent to participate in this study, and I confirmed that I agree to use all the collected information and visual data.

Print Name of Participant_____
Participant Signature _____
Date _____
Day/month/year

Statement by the researcher

I have accurately read out the information sheet to the potential participant, and the best of my ability, making sure that the participant understands that the following will be done:

1. Answer the interview questions.
2. Fill out the logbook template.
3. Draw a cognitive map

I confirm that the participant was allowed to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this information consent form has been provided to the participant.

Print Name of Researcher _Heba tallah Ibrahim_____
Signature of Researcher ___hebatallah_____
Date _____
Day/month/year

Important note: We will not share any personal information about the participants, only the researcher will know these pieces of information, and we will refer to the participant's name in this research (if needed) with the first letter of your first and last name.

INTERVIEW QUESTIONS

Interview questions:

- **General Question "background, age group, etc.":**

1. Tell me about yourself (background, age)?

Educational background	Age group			
	65+	70+	75+	80+

2. Are you staying alone at your home or with a friend or relative? If with a friend or a relative, mention whom?

Yes living alone	Living with a relative / Mention whom

3. Are you still working, or are you retired? If still working, mention your job and how many hours you spend at your job?

Yes, still working/ Mention your job	No, I am retired

- **Participants' Health Condition:**

4. Do you have any issues with vision, hearing, or any other particular health condition?

Yes/ Mention It "tick below."					No don't have
Vision	Hearing	Physical issue	Special health condition	Others	

❖ Mention if this health issue is from aging factors or not. If not, please explain the reason.

Yes, from the aging factor	No, please explain

INTERVIEW QUESTIONS

5. If you have health issues, how many times do you visit your doctor? Weekly, monthly...?

Weekly	Monthly	If needed

6. Do you suffer from any physical issues in mobility within your home?

Yes, I have a physical issue/ mention it	No, I don't have this problem

- ❖ Like difficulty in movement and weakness in the muscles that affect the performance of daily needs

- **Participants' Daily Activities and Independence status:**

7. Tell me about your ADLs or your Daily routine?

Walking	Exercise	Housework	Preparing food	Others

- ❖ ADLs: Activity of Daily Living

8. Can you do all your daily activities alone and independently, or you need assistance?

Yes	I need assistance in all	I need assistance in some of the ADLs/ Mention it

9. Do you spend more time in a specific place at your home?

living room	Bedroom	Kitchen	Bathroom	Balcony	Others

INTERVIEW QUESTIONS

10. Do you have any difficulties or technical problems while dealing with your furniture? If yes, mention it?

Yes, Please explain	No, I don't have

11. Do you have any suggestions or recommendations on new improvements for your home? If yes, mention it?

Yes, Please explain	No, I don't have

- **Participants' Relation with Technology "applications, devices, smart home":**

➢ **Personal use:**

12. Are you connected to social media? If yes, which platform you use the most? And why?

Yes				No, I don't use social media
Facebook	Twitter	Instagram	Others	

❖ Mention how much do you use social media.

0-1 hours	1-2 hours	2-3 hours	3-4 hours	More/ mention how many hours

INTERVIEW QUESTIONS

13. What types of personal technological devices you usually use?

Smartphone	Ipad	Laptop	Other	I don't use

➢ **Applications/ Software:**

14. Are you using some smartphone applications/ software to help you to perform your ADL smoothly and independently? If yes, mention the application name or Function? If no mention why "you don't know these applications or you don't prefer to use it"?

Yes / mention application name or Function				No, I don't use/ mention the reason
Motion detection application	Health care application	Medication reminder	Others	

➢ **Technological Devices:**

15. Are you using technological devices in your home in addition to the home appliance? Sensors, for example? If yes, mention the device name? If no mention why "you don't know these applications or you don't prefer to use it"?

Yes / mention device name				No, I don't use/ mention the reason
Sensors	Cameras	Smart monitoring devices	Others	

INTERVIEW QUESTIONS

❖ If you are using technological devices, mention how much you are using

0-1 hour	1-2 hours	2-3 hours	3-4 hours	More/ mention how many hours

16. What do you think about adding/ installing new devices like cameras and sensors in your home to increase the safety factor? If your answer is "no," mention why?

Yes	No, I don't prefer/ mention the reason

17. Did you face any problems while using technological devices if you have?

If Yes, Can you rate the difficulty from 1-5					No	I don't have technological devices
1	2	3	4	5		

1 is the least, 5 is the most

➢ **Smart Homes Concept:**

18. Do you have any idea or background information about smart home concepts and how it could help you continue living independently?

Yes, Please explain	No, Please explain

19. If you don't have any idea about smart home concepts, would you prefer to understand more about it or you don't prefer to deal with new innovative technologies?

Yes I prefer	No, I don't prefer/ mention the reason

20. Have you ever improved your home design with new technological devices or even making a little transformation in the home circulation or furniture to support you to remain independent in your home?

Yes, I have; please explain	No, I don't

21. Would you prefer to transform your home into a smart home that supports you living independently without assistance?

Yes, I prefer; Please explain	No, I don't prefer/ mention the reason

22. Would you prefer to use technology in assistance (if you need it) rather than human assistance?

Yes I prefer	No, I don't prefer

INTERVIEW QUESTIONS

23. If you have the option for making modifications in your home by adding a new smart system for "safety, motion detection, health care…." Would you accept these modifications or don't prefer; If you don't prefer, can you mention "why" if it's due to financial, psychological, technical, or others?

Yes, I will accept	No, I don't prefer/ mention the reason

End of the interview questions move on the next step « logbook »

LOGBOOK TEMPLATE

HEALTH CONDITION

CAN YOU RATE YOUR HEALTH ISSUE FROM 1-5

- 1 is the least
- 5 is the most

Vision Impairment		1	2	3	4	5
Yes : ☐	Don't have: ☐	Comments:				

Hearing Impairment		1	2	3	4	5
Yes : ☐	Don't have: ☐	Comments:				

Physical Issues		1	2	3	4	5
Yes : ☐	Don't have: ☐	Comments:				

Taking Medications Properly		1	2	3	4	5
Yes : ☐	Don't have: ☐	Comments:				

Special Health Issues		1	2	3	4	5
Yes : ☐	Don't have: ☐	Comments:				

LOGBOOK TEMPLATE

INDEPENDENCE STATUS WHILE PERFORMING ADLs / IADLs

NEED ASSISTANCE WHILE DOING/ OR INDEPENDENT	IF YOU NEED ASSISTANCE CAN YOU EVALUATE FROM 1 TO 5 / COMMENTS
	❖ 1 is the least ❖ 5 is the most
Moving about (e.g. from bed to bathroom/ moving in the bathroom)	1 | 2 | 3 | 4 | 5
Yes : ☐ No: ☐ Don't do: ☐	Comments:
Getting dressed/ undressed	1 | 2 | 3 | 4 | 5
Yes : ☐ No: ☐ Don't do: ☐	Comments:
Preparing food/ Self feeding	1 | 2 | 3 | 4 | 5
Yes : ☐ No: ☐ Don't do: ☐	Comments:
Housework (ironing, wiping dust, etc...)	1 | 2 | 3 | 4 | 5
Yes : ☐ No: ☐ Don't do: ☐	Comments:
Doing exercise	1 | 2 | 3 | 4 | 5
Yes : ☐ No: ☐ Don't do: ☐	Comments:

LOGBOOK TEMPLATE

INDEPENDENCE STATUS .....

Going up stairs			1	2	3	4	5
Yes :	No:	Don't do:	Comments:				

Light work (desk work, activities on computer, etc....)			1	2	3	4	5
Yes :	No:	Don't do:	Comments:				

Hygiene

NEED ASSISTANCE WHILE DOING OR INDEPENDENT		IF YOU NEED ASSISTANCE CAN YOU EVALUATE FROM 1 TO 5 / COMMENTS				
Personal hygiene		1	2	3	4	5
Yes :	No:	Comments:				

Using the toilet		1	2	3	4	5
Yes :	No:	Comments:				

Showering / Bathing		1	2	3	4	5
Yes :	No:	Comments:				

LOGBOOK TEMPLATE

Technology usage

NEED ASSISTANCE WHILE USING/ OR INDEPENDENT	IF YOU NEED ASSISTANCE WHILE USING CAN YOU EVALUATE FROM 1 TO 5 /COMMENTS
Using smart phone/ IPad / Computer	1 | 2 | 3 | 4 | 5
Yes : ☐ No: ☐ Don't do: ☐	Comments:
Using smart phone applications/ software	1 | 2 | 3 | 4 | 5
Yes : ☐ No: ☐ Don't do: ☐	Comments:
Using technological devices in the home	1 | 2 | 3 | 4 | 5
Yes : ☐ No: ☐ Don't do: ☐	Comments:
Surf the internet	1 | 2 | 3 | 4 | 5
Yes : ☐ No: ☐ Don't do: ☐	Comments:

End of the logbook template move on the next step « cognitive mapping »

COGNITIVE MAPPING

Cognitive Mapping Choices and Instructions

On the next page, you will be asked for applying the cognitive mapping by choosing your preferred method from the following options:

1. Draw your cognitive mapping " Draw a simple draft map for your home " try to draw the way you know your home in your mind," you are totally free in drawing way " there are no rules and no right or wrong way to do it.
In each zone, mark in the place you face difficulties in " if there is. " Draw your daily path in your home " if this is not clear, you can check the attached examlpe".

2. Or you can follow the mentioned example and draw your daily path in your home and mention what you think about each zone, the difficulties you face in each zone, and where you spend the most time in your home?

3. If you don't prefer any of the previous options, you can describe in detail what is your daily path in your home and answer the questions attached to this option.

Important Note : Please can you take photos of your home to help the researcher understand and visualize your daily routine. If it is available also to record a walk-through video for your home, this will be full of thanks and appreciation.

COGNITIVE MAPPING

Cognitive Mapping Choice One

1. In the next page draw your cognitive mapping as a top view of the rooms " Draw a simple draft map for your home " try to draw the way you know your home in your mind, " you are totally free in drawing way " there are no rules and no right or wrong way to do it.
Under the map mention where is the most place you spend your time

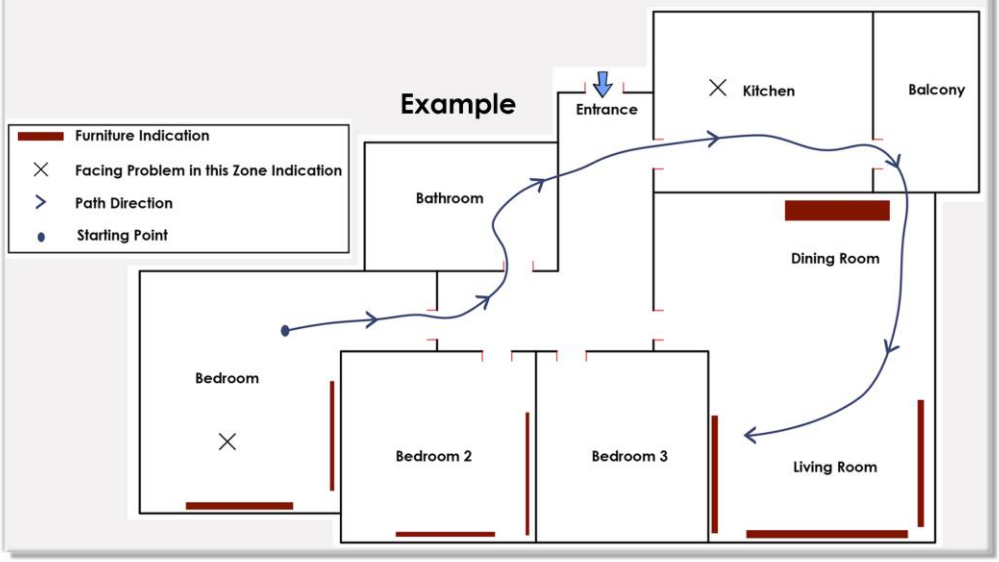
In each zone:

1. Mark in the place you face difficulties in " if there is " and mention under the map what is the problem in details « if it is with the furniture or what»

2. Indicate for the furniture places

3. Draw your daily path in your home " if this is not clear, you can check the example mentioned below "

Note: You are not required to draw the map like the example; this is to help you to understand the concept.



COGNITIVE MAPPING

COGNITIVE MAPPING

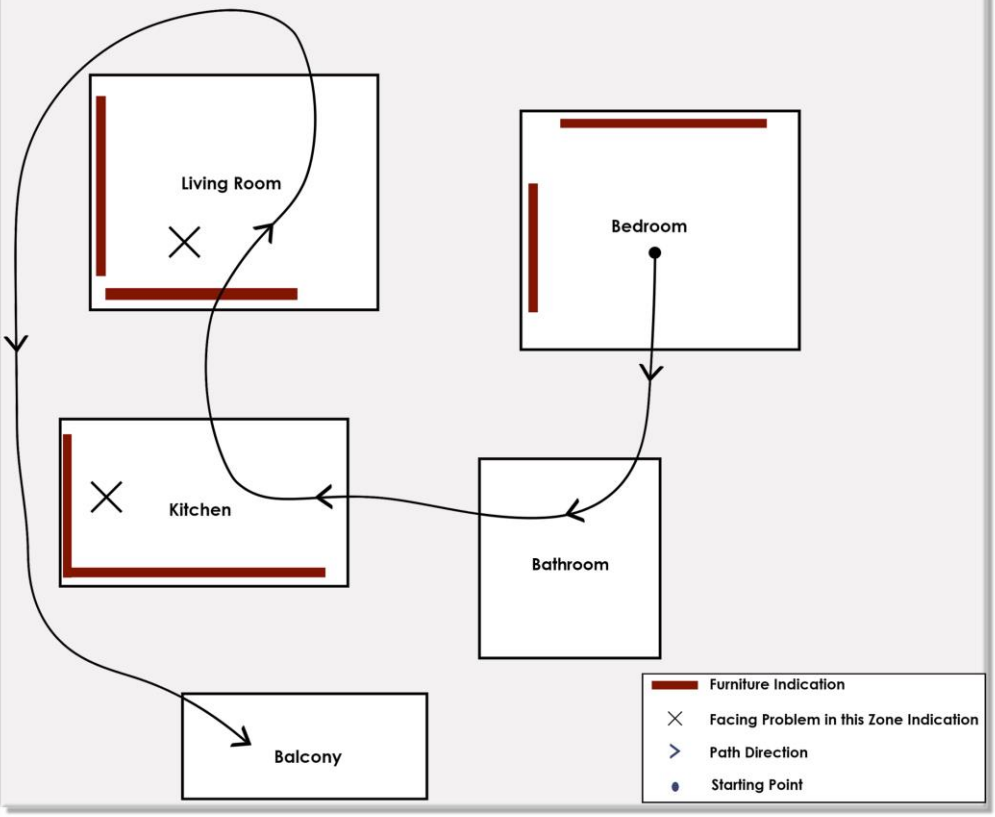
Cognitive Mapping Choice Two

2. Follow the mentioned example and draw your daily path in your home in the next page and mention what you think about each zone, the difficulties you face in each zone, and where you spend the most time in your home?

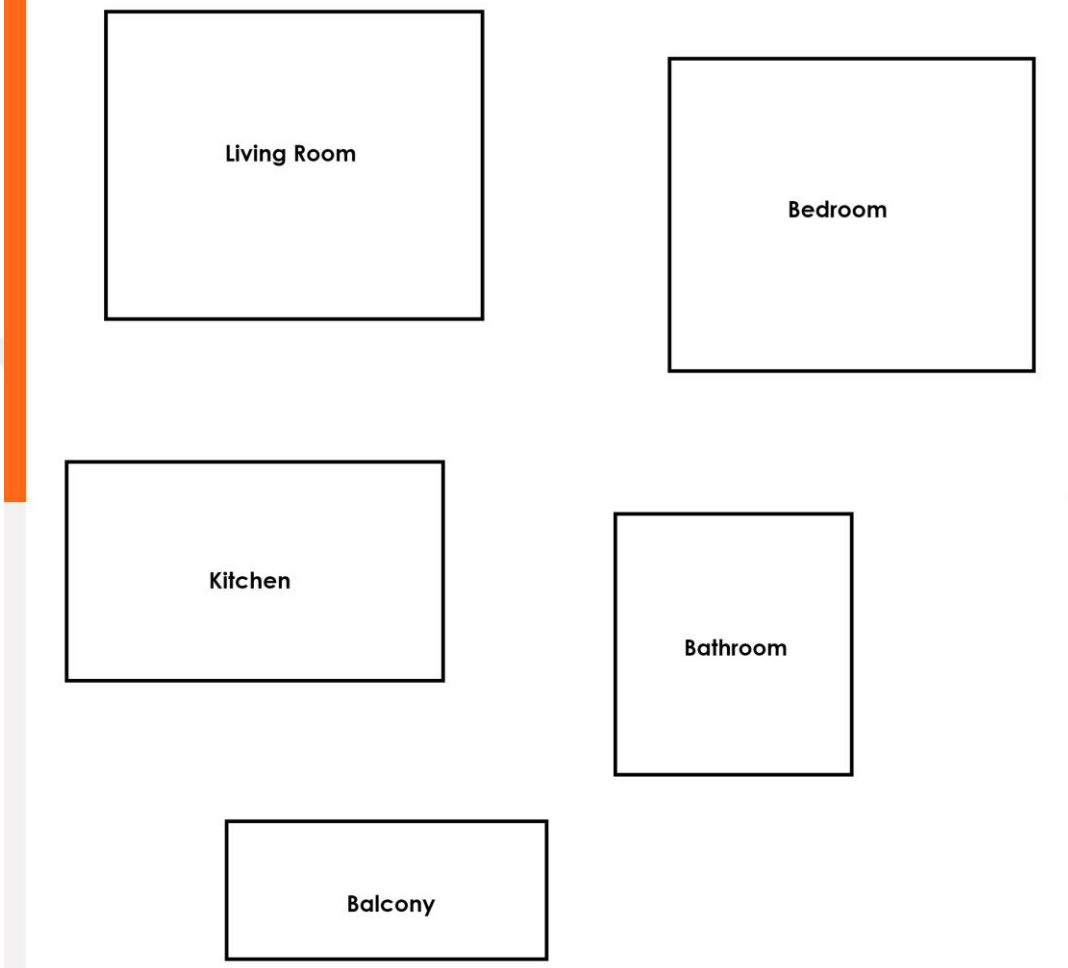
I face difficulties in (e.g. kitchen) ----------

The problem what i faced is (e.g. cabinet height) ----------

I spend most of the time in (e.g. Living room) ----------



COGNITIVE MAPPING



COGNITIVE MAPPING

Cognitive Mapping Choice Three

3. If you don't prefer any of the previous options, you can describe in detail what is your daily path in your home and answer the questions attached to this option.

1. Can you describe your daily path in your home?

e.g., My usual path starts from the bedroom (usually I have some difficulties getting up from bed), then to the bathroom and then to the kitchen, and there I have difficulty while dealing with cabinets height…….

2. Where do you spend the most time in your home?

Living Room	Bedroom	Kitchen	Balcony	Other

3. Do you face any difficulties while walking through your home? If yes mention where and what?

Yes, Mention where	What is the problem	No, I don't face problems

4. Do you have any comments, special notes, or suggestions?

Yes, Mention it	No, I don't have

CONCLUSION

THANK YOU FOR YOUR PARTICIPATION

I would like to express my gratitude for your acceptance in participating in this research. Thank you very much for your time to answer the questions attached to this file. This participation will support this research in reaching the demanded results of designing smart homes to support the elderly's independence. This research is aiming to design safe, attractive, and usable smart interiors; and actively involved the elderly in the design process

Appendix B: Research technique booklet Turkish version

RIZA FORMU

Türk toplumundaki 65 yaş üstü katılımcıların bilgilendirilmiş rıza formu

[Esas Araştırmacının Adı]: *Heba tallah Ibrahim*
[Üniversitenin Adı/Bölüm]: *İzmir Ekonomi Üniversitesi / Tasarım Çalışmaları Tezli Yüksek Lisans Programı*
[Projenin Başlığı]: *Yaşlanmaya Bağlı Fiziksel Eksikleri Azaltmaya Yönelik Etkileşimli Evler Tasarlamak*

İzmir Ekonomi Üniversitesinde "Tasarım Çalışmaları Programında" yüksek lisans derecesi için çalışan bir içmimarım. Araştırmamı ileri yaşlarda akıllı teknolojik alet kullanımı ve ev tasarımı konusunda yapıyorum. Bu araştırma akıllı iç mekânların, ileri yaşlarda bağımsız yaşamaya devam etmelerine olan desteği yansıtmaya odaklanmaktadır.

İletişim

Katılımcılar herhangi bir sorusu olduğunda, araştırmacıya ulaşmakta serbesttirler:
İsim: Heba tallah Ibrahim
E-mail adresi: hebaemad10@gmail.com
Telefon numarası: +905446777281

Yöntemler

Katılımcılar görüşme için istedikleri metodu tercih edebilirler.
1. Görüşme, araştırmacı ile bir görüntülü arama aracılığıyla çevrimiçi olarak yapılabilir.

2. Görüşme, araştırmacı ile görüntülü arama yerine sesli arama aracılığıyla da yapılabilir.

3. Katılımcılar çevrimiçi olarak yapmayı tercih etmezlerse görüşme katılımcının herhangi bir sorusu olması durumunda araştırmacıya danışmak kaydıyla katılımcının aile üyelerinden birisi tarafından bütün temel bilgileri öğrenmesiyle uygulanabilir.

RIZA FORMU

Türk toplumundaki 65 yaş üstü katılımcıların bilgilendirilmiş rıza formu.

Rıza Sertifikası

İleri yaşlarda teknolojik alet ve akıllı ev kullanımına yönelik olan bu çalışmaya katılmak için davet edildim ve önceki bilgileri okudum veya bana başkası tarafından okundu.
Gönüllü olarak bu çalışmaya katılmak için rıza gösterdim ve hakkımda toplanan bilgilerin ve görsel verilerin kullanılmasını onayladım.

Katılımcının Yazılı Adı _____
Katılımcının İmzası _____
Tarih _____
(Gün/ay/yıl)

Araştırmacının İfadesi

Olası katılımcıya bilgi kağıdını tam olarak okudum ve elimden geldiğince katılımcının aşağıdakilerin yapılacağını anladığından emin olmaya çalıştım

1. Görüşme sorularını cevaplamak.
2. Defteri doldurmak.
3. Bir bilişsel harita çizmek

Katılımcının çalışma hakkında sorular sormaya izinli olduğunu ve katılımcı tarafından sorulan tüm sorulara elimden geldiğince eksiksiz ve doğru olarak cevap verdiğimi onaylarım. Kişinin rıza göstermeye zorlanmadığını ve rızanın gönüllü ve özgürce verildiğini onaylarım.

Bu rıza formu bilgilendirmesinin bir kopyası katılımcıya verilmiştir.

Katılımcının Yazılı Adı _Heba tallah Ibrahim_____
Araştırmacının İmzası ___hebatallah_____
Tarih _____
(Gün/ay/yıl)

Önemli Not: Katılımcılar hakkında herhangi bir kişisel bilgi paylaşılmayacak, yalnızca araştırmacı bu bilgileri bilecek ve araştırmada (gerektiği takdirde) katılımcıların adlarından adları ve soyadlarının baş harfleriyle bahsedilecektir.

Mülakat Soruları:

- **Genel Sorular "geçmiş, yaş aralığı, vs.":**

1. Bana kendinizden söz edin (geçmiş, yaş)?

Eğitim geçmişi	Yaş aralığı			
	65+	70+	75+	80+

2. Evinizde yalnız mı yaşıyorsunuz yoksa arkadaş veya akrabanız var mı? Arkadaş veya akrabaysa kim olduğunu belirtin?

Evet yalnız yaşıyorum	Bir akrabayla yaşıyorum / Kimdir?

3. Halen çalışıyor musunuz, yoksa emekli oldunuz mu? Hala çalışıyorsanız işinizden ve işinizde kaç saat harcadığınızdan bahsedin?

Evet, hala çalışıyorum/işinizden bahsedin	Hayır, emekli oldum

- **Katılımcının Sağlık Durumu:**

4. Görme, duyma konusunda bir sorun yaşıyor musunuz? Veya herhangi bir sağlık sorununuz var mı?

Evet/ Bahsedin "aşağıda işaretleyin."					Hayır yok
Görme	Duyma	Fiziksel Sorun	Özel sağlık Sorunu	Diğerleri	

❖ Bu sağlık sorunun yaşlılığa bağlı olup olmadığını söyleyin. Değilse sebebini açıklayın.

Evet, yaştan dolayı	Hayır, lütfen açıklayın

5. Sağlık sorunlarınız varsa, doktorunuzu ne sıklıkla ziyaret edersiniz? Haftalık, aylık..?

Haftalık	Aylık	İhtiyaç durumunda

6. Herhangi bir fiziksel sorundan dolayı evde hareket konusunda sıkıntı yaşıyor musunuz?

Evet, fiziksel sorunum var/bahsedin	Hayır, böyle bir sıkıntım yok

❖ Hareket etmekte zorlanmak ve kaslarda zayıflık gibi günlük ihtiyaçları yapmakta sizi etkileyen durumlar.

- **Katılımcıların Günlük Faaliyetleri ve Bağımsızlık Durumları:**

7. Günlük yaşamsal faaliyetler veya günlük rutininizden bahsedin?

Yürümek	Hareket	Ev işleri	Yemek hazırlamak	Diğerleri

8. Bütün faaliyetlerinizi yalnız ve bağımsız bir şekilde yapabiliyor musunuz? Yoksa yardıma ihtiyacınız var mı?

Evet	Hepsi için yardıma ihtiyacım var	Bazı faaliyetler için yardıma ihtiyacım var/belirtin

9. Evinizin herhangi bir kısmında daha fazla vakit geçiriyor musunuz?

Oturma odası	Yatak odası	Mutfak	Banyo	Balkon	Diğerleri

10. Mobilyalarınızın kullanımında herhangi bir zorluk veya teknik problem yaşıyor musunuz? Yaşıyorsanız belirtin.

Evet, Lütfen açıklayın	Hayır yaşamıyorum.

11. Eviniz için yenilemeler hakkında öneri veya tavsiyeleriniz var mı? Varsa belirtin.

Evet, Lütfen açıklayın	Hayır, yok

- **Katılımcıların teknolojiyle alakaları "uygulamalar, cihazlar, akıllı ev":**

➢ **Kişisel kullanım:**

12. Herhangi bir sosyal medyaya üye misiniz? Eğer ise, en çok hangi platform ve neden?

Evet				Hayır, sosyal medya kullanmıyorum
Facebook	Twitter	Instagram	Diğerleri	

❖ Kaç saat kullandığınızı belirtin.

0-1 saat	1-2 saat	2-3 saat	3-4 saat	Daha fazla/ Lütfen belirtin

13. Ne tür kişisel teknolojik alet kullanıyorsunuz?

Telefon	Tablet	Laptop	Diğer	Kullanmıyorum

➢ **Uygulama/Yazılım**

14. Günlük yaşamsal faaliyetlerinizi daha rahat ve bağımsız bir şekilde yapmanıza yardımcı olacak bazı telefon uygulamaları/yazılımları kullanıyor musunuz? Evetse, adını ve işlevini belirtin. Hayırsa "uygulamaları bilmediğinizden mi yoksa kullanmayı tercih etmediğinizden mi" olduğunu belirtin.

Evet/ uygulamanın adını veya işlevini belirtin				Hayır, kullanmıyorum / sebebini belirtin
Hareket algılama uygulaması	Sağlık bakımı	İlaç hatırlatması	Diğer	

➢ **Teknolojik aletler:**

15. Ev gereçleri dışında evinizde teknolojik cihazlar kullanıyor musunuz? Örn. Sensörler. Evetse, cihazın adını belirtin. Hayırsa, "uygulamaları bilmediğinizden mi yoksa kullanmayı tercih etmediğinizden mi" olduğunu belirtin.

Evet / cihaz adını belirtin				Hayır, kullanmıyorum / sebebini belirtin
Sensörler	Kameralar	Akıllı izleme cihazları	Diğerleri	

❖ Teknolojik cihazlar kullanıyorsanız, ne kadar kullandığınızı belirtin.

0-1 saat	1-2 saat	2-3 saat	3-4 saat	Daha fazla/ kaç saat olduğunu belirtin

16. Evinize güvenlik faktörünü arttırmak için kamera ve sensör gibi yeni cihazlar takmak hakkında düşünceleriniz nedir? Cevabınız "hayır" ise sebebini belirtin.

Evet	Hayır, tercih etmiyorum/ sebebini belirtin

17. Teknolojik cihazlara sahipseniz kullanırken herhangi sorunlarla karşılaştınız mı?

Evet ise, zorluğu 1'den 5'e kadar puanlayın					Hayır	Teknolojik cihazlara sahip değilim
1	2	3	4	5		

En az için 1 , en fazla için 5

➢ **Akıllı Ev Kavramı:**

18. Akıllı ev kavramı hakkında herhangi bir geçmiş bilginiz veya düşünceniz ve bağımsız yaşamaya devam etmenize nasıl yardımcı olacağı hakkında bilginiz var mıdır?

Evet, lütfen açıklayın	Hayır, lütfen açıklayın

19. Akıllı ev kavramı hakkında hiçbir fikriniz yoksa hakkında yeni şeyler öğrenmeyi mi ya da yenilikçi teknolojilerle uğraşmamayı mı tercih edersiniz?

Evet, uğraşmayı tercih ederim.	Hayır, uğraşmamayı tercih ederim/Belirtin

20. Evinizin tasarımını yeni teknolojik cihazlar kullanarak geliştirdiniz mi? Ya da evinizde bağımsız kalmanıza destek olacak ev dolaşımında veya mobilyalarda ufak bir değişiklik yaptınız mı?

Evet, yaptım; Lütfen açıklayın	Hayır, yapmadım

21. Evinizi yardım olmadan bağımsız yaşamanıza destek sağlayacak bir akıllı eve dönüşüm yapmayı tercih eder misiniz?

Evet, tercih ederim; Lütfen açıklayın	Hayır, tercih etmem/ sebebini belirtin

22. Teknolojiyi insan yardımı yerine (ihtiyacınız varsa) size yardımcı olmak için kullanmayı tercih eder misiniz?

Evet, tercih ederim	Hayır, tercih etmem

23. "Güvenlik, hareket algılama, sağlık bakımı…" gibi yeni akıllı sistemler ekleyerek evinizde tadilat yapma imkanına sahip olmanız durumunda bu tadilatları kabul eder misiniz yoksa etmez misiniz? Etmezseniz sebebini finansal, psikolojik, teknik veya başka sebeplerden olup olmadığını belirtir misiniz?

Evet, kabul ederim	Hayır, tercih etmem/ sebebini belirtin

Mülakat sorularının sonu, bir sonraki aşamaya geçiniz "seyir defteri"

SAĞLIK DURUMU

SAĞLIK SORUNUNUZU 1-5 ARASINDA DERECELENDİRİR MİSİNİZ

- 1 en az için
- 5 en çok için

Görmede bozulma		1	2	3	4	5
Evet :	Hayır yok:	Yorumlar:				
Duymada bozulma		1	2	3	4	5
Evet:	Hayır yok:	Yorumlar:				
Fiziksel Sorunlar		1	2	3	4	5
Evet:	Hayır yok:	Yorumlar:				
İlaçlar Düzgün Bir Şekilde Almak		1	2	3	4	5
Evet:	Hayır yok:	Yorumlar:				
Özel Sağlık Sorunları		1	2	3	4	5
Evet:	Hayır yok:	Yorumlar:				

GÜNLÜK YAŞAMSAL FAALİYETLERİ YAPARKEN BAĞIMSIZLIK DURUMU

YAPARKEN YARDIM GEREKLİ / VEYA BAĞIMSIZ	EĞER YARDIMA İHTİYACINIZ VARSA 1-5 ARASI DEĞERLENDİRİN / YORUMLAYIN ❖ 1 en az için ❖ 5 en çok için
Hareket etmek (Örn. Yataktan banyoya/ banyo içinde dolaşma) Evet: Hayır: Yapmam:	1 2 3 4 5 Yorumlar:
Kıyafetleri giymek/ çıkartmak Evet: Hayır: Yapmam:	1 2 3 4 5 Yorumlar:
Yemek hazırlamak/ yemek Evet: Hayır: Yapmam:	1 2 3 4 5 Yorumlar:
Ev işi (üyü yapma, toz alma, vs.) Evet: Hayır: Yapmam:	1 2 3 4 5 Yorumlar:
Egzersiz yapmak Evet: Hayır: Yapmam:	1 2 3 4 5 Yorumlar:

Seyir defteri

GÜNLÜK YAŞAMSAL FAAL.....

Merdiven çıkmak			1	2	3	4	5
Evet:	Hayır:	Yapmam:	Yorumlar:				
Hafif işler (masa başı, bilgisayar üzerinde, vs.)			1	2	3	4	5
Evet:	Hayır:	Yapmam:	Yorumlar:				

HİJYEN

YAPARKEN YARDIM GEREKLİ / VEYA BAĞIMSIZ			EĞER YARDIMA İHTİYACINIZ VARSA 1-5 ARASI DEĞERLENDİRİN / YORUMLAYIN				
Kişisel hijyen			1	2	3	4	5
Evet:	Hayır:		Yorumlar:				
Tuvaleti kullanmak			1	2	3	4	5
Evet:	Hayır:		Yorumlar:				
Duş almak/ banyo yapmak			1	2	3	4	5
Evet:	Hayır:		Yorumlar:				

Seyir defteri

Teknoloji Kullanımı

YAPARKEN YARDIM GEREKLİ / VEYA BAĞIMSIZ	EĞER YARDIMA İHTİYACINIZ VARSA 1-5 ARASI DEĞERLENDİRİN / YORUMLAYIN

Akıllı telefon kullanmak/ Tablet / Bilgisayar	1	2	3	4	5
Evet:	Hayır:	Yapmam:	Yorumlar:		

Akıllı telefon uygulamaları /yazılımları kullanmak	1	2	3	4	5
Evet:	Hayır:	Yapmam:	Yorumlar:		

Evde teknolojik cihazlar kullanmak	1	2	3	4	5
Evet:	Hayır:	Yapmam:	Yorumlar:		

İnternette gezmek	1	2	3	4	5
Evet:	Hayır:	Yapmam:	Yorumlar:		

Seyir defterinin sonu, bir sonraki aşamaya geçiniz "bilişsel haritalama"

BİLİŞSEL HARİTALAMA

Bilişsel Haritalama Seçimler ve Talimatlar

Bir sonraki sayfada, aşağıdaki seçeneklerden tercih ettiğiniz yöntemi seçerek bilişsel haritalama hakkında sorularla karşılaşacaksınız:

1. Bilişsel haritanızı çizin: Evinizi üstten görünümle harita gibi, şematik olarak çizin. İstediğiniz şekilde çizmekte tamamen özgürsünüz. Herhangi bir kural veya çizimin doğru veya yanlış bir yolu yoktur.
Her bölgede, (varsa) zorluk çektiğiniz yerleri işaretleyin. Evdeki günlük rotanızı çizin. Tam olarak anlamadıysanız ekteki örneği kontrol edebilirsiniz.

2. Ya da, söz konusu örneği takip edip evinizde günlük yolunuzu çizebilir ve her bölge hakkında ne düşündüğünüzü, her bölgede karşılaştığınız zorlukları ve evinizde en çok nerede vakit geçirdiğinizden bahsedebilirsiniz.

3. Önceki seçeneklerden hiçbirini tercih etmezseniz, evinizde günlük yolunuzun ne olduğunu ayrıntılı olarak anlatabilir ve bu seçeneğe ekli soruları cevaplayabilirsiniz.

Önemli Not: Araştırmacının günlük rutininizi anlamasına ve görselleştirmesine yardımcı olmak için lütfen evinizin fotoğraflarını çekebilir misiniz? Eviniz için bir gözden geçirme videosu kaydetmek de mümkünse, bu durum minnet ve teşekkürler karşılanacaktır.

BİLİŞSEL HARİTALAMA

Bilişsel Haritalama Birinci Seçim

1.Bilişsel haritalamanızı çizin "Evinizi kabataslak olarak çizin" evinizi aklınızda bildiğiniz şekilde çizin, "istediğiniz şekilde çizmekte tamamen özgürsünüz" herhangi bir kural veya çizimin doğru veya yanlış bir yolu yoktur.

Haritanın altında zamanınızı en çok nerede geçirdiğinizden bahsedin

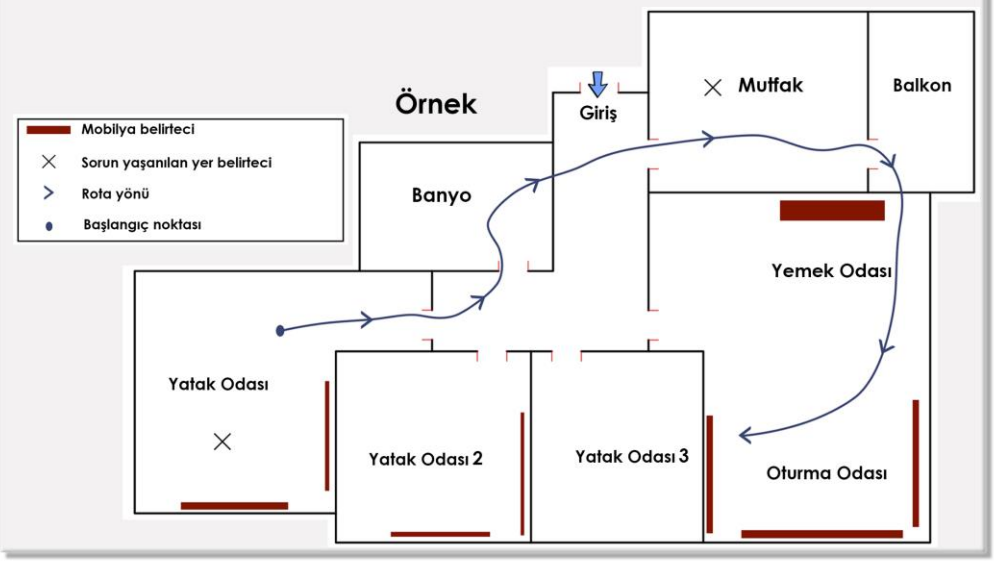
Her bölgede:

1. Varsa zorluklarla karşılaştığınız yeri işaretleyin ve haritanın altında sorunun ne olduğunu ayrıntılarda belirtin "mobilyada mı yoksa başka bir şeyle mi"?

2. Mobilya yerlerini belirtin

3. Evinizdeki günlük rotanızı çizin. Tam olarak anlamadıysanız ekteki örneği kontrol edebilirsiniz.

Not: Örnekteki gibi bir harita çizmenize gerek yoktur; bu yalnızca konsepti daha iyi anlamanız için gereklidir.



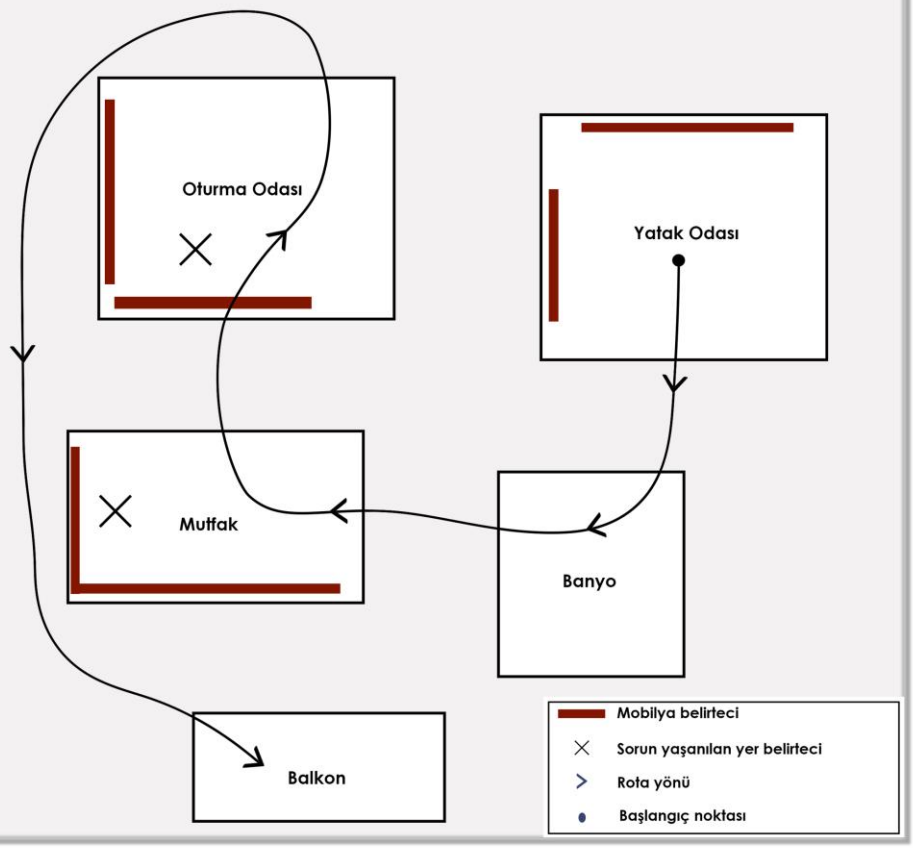
Bilişsel Haritalama İkinci Seçim

2. Söz konusu örneği takip edin ve bir sonraki sayfada evinizdeki günlük rotanızı çizin ve her bölge hakkında ne düşündüğünüzü, her bölgede karşılaştığınız zorlukları ve evinizde en çok nerede zaman geçirdiğinizi belirtin.

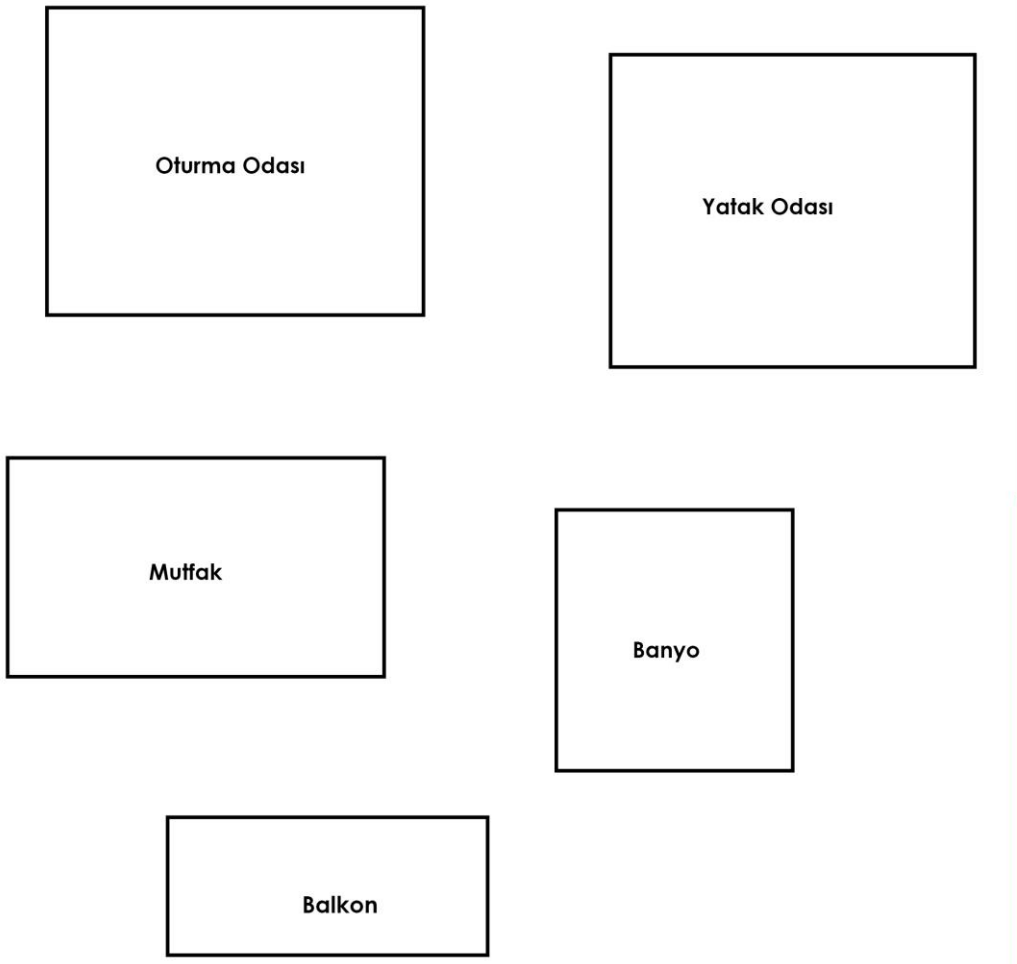
zorlukla karşılaşıyorum (Örn. Mutfakta) ----------

Karşılaştığım problem (Örn. Dolap yüksekliği) ----------

En çok zamanımı geçiriyorum (Örn. Oturma odasında) ----------



BİLİŞSEL HARİTALAMA



BİLİŞSEL HARİTALAMA

Bilişsel Haritalama Üçüncü Seçim

3. Önceki seçeneklerden herhangi birini tercih etmezseniz, evinizdeki günlük yolunuzun ne olduğunu ayrıntılı olarak açıklayabilir ve bu seçeneğe ekli soruları cevaplayabilirsiniz.

1.Evinizdeki günlük yolunuzu anlatır mısınız?

Örneğin, her zamanki yolum yatak odasından başlıyor (genellikle yataktan kalkmakta zorluk çekiyorum), sonra banyoya ve sonra mutfağa ve orada dolapların yüksekliği ile uğraşırken zorluk çekiyorum.

2. Evinizde en çok nerede vakit geçiriyorsunuz?

Oturma Odası	Yatak Odası	Mutfak	Balkon	Diğer

3. Evinizde yürürken herhangi bir zorluk yaşıyor musunuz? Cevabınız evet ise, nerede ve ne olduğunu belirtin?

Evet, nerede olduğunu belirtin	Sorun nedir	Hayır, herhangi bir sorunla karşılaşmıyorum

4. Herhangi bir yorum, özel not veya tavsiyeniz var mıdır?

Evet, Belirtin	Hayır, yok

SONUÇ

KATILIMINIZ İÇİN ÇOK TEŞEKKÜRLER

Bu araştırmaya katılmayı kabul ettiğiniz ve zaman ayırdığınız için çok teşekkür ederiz. Bu katılımın sonuçları, ileri yaşlarda bağımsız yaşamı desteklemek için gereken kıstasları anlamak için kullanılacaktır. Bu araştırma kapsamında, ileri yaşlardaki bireylerin tasarım sürecine aktif olarak dahil olduğu güvenli, çekici ve kullanılabilir akıllı iç mekanlar tasarlamayı amaçlanmaktadır.