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Definition of the general requirements for the interface design

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Executive Summary

This deliverable provides a detailed set of general requirements to enhance usability of Wetakecare system, being one of the results of the Task1.3. “Definition of the interface design”. Firstly, a review of the state of the art of tele-rehabilitation and systems to training at home is provided, covering key issues related to usability, among others effectiveness, efficiency, learning and satisfaction. Secondly, general guidelines of usability of these systems and general recommendations of usability are explained. Finally, a complete set of usability requirements are detailed and coded for each of the main components of Wetecare system, namely web platform, mobile solutions (smartphone or tablet), television interface, kinnect and remote control.

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1 Introduction

1.1 Objective

The **objective** of Delivarble D1.4. is support the development of Wetakecare components following general usability guidelines and previous experiences on systems for tele-rehabilitation and home training, to adapt the interaction to the needs and capabilities of older persons.

1.2 Older persons capabilities

With the aim to provide general design requirements for older users, we first should know which ones are their specific characteristics, in order to adapt the technology and the interfaces to them. Thus, in this report we first present a short overview obtained from W3C in which we mention some changing abilities of older users that we should take into account when designing interfaces for them.

1.2.1 Ageing and hearing loss

Table 1. Ageing and hearing loss

Impact	Prevalence
Audio can be difficult to discern	47% of people 61 to 80 years
Higher pitch sounds can be missed	93% of people 81+ years

Hearing starts to decline at around 50 years and affects a person's ability to hear higher pitched sounds as well as discern the foreground from background audio such as music or other sounds.
Some hearing loss is experienced by 47% of people 61 to 80 years and 93% of people over 81 years.
Moderate or severe hearing loss or profound deafness is experienced by 20% of people aged 61 - 80 and 75% of people over 80.

1.2.2 Ageing and vision decline

Table 2. Ageing and vision decline

Impact	Prevalence
Decreasing ability to focus on near tasks	16% of people 65 - 74 years
Changing colour perception and sensitivity	19% of people 75 – 84 years
Decreasing contrast sensitivity	46% of people 85+ years

Vision decline includes:

- Decreasing ability to focus on near tasks, including a computer screen
- Changing colour perception and sensitivity - less violet light is registered, making it easier to see red and yellows than blues and greens, and often making dark blue and black indistinguishable
- Decreasing contrast sensitivity from pupil shrinkage - resulting in the need for more light and higher contrast (an 80 year old typically has 80% less contrast sensitivity than a 20 year old)

Vision decline often starts in a person's mid-40s with, for example, 86% of Australians over 40 for example require reading glasses to correct for near vision. Significant vision loss affecting everyday life is estimated to affect 16% of people 65 to 74 years, and 46% of those over 85 years in the UK.

1.2.3 Ageing and physical decline

Table 3. Ageing and physical decline

Impact (Motor skill decline can result from many conditions including arthritis and Parkinson's Disease)	**Prevalence** (Conditions most commonly reported)
Difficulty using mouse or keyboard	**Arthritis** At least 50% of people over 65 affected
Difficult to click small areas	**Essential tremor** Affects up to 20% of people over 65
Strain from non-ergonomic tasks	**Parkinson's Disease** Approximately 4% of people over 85 affected

Motor skill decline impacts on dexterity and can result from many conditions, for example arthritis with associated joint stiffening and reduced fine motor control, and essential tremor or Parkinson's Disease with associated hand trembling, making mouse use difficult or impossible for some and also affecting keyboard use. In particular, older people with physical impairments may have difficulty clicking small links, selecting radio buttons, and using many fly-out or pull-down menus.
Arthritis is estimated to affect at least 50% of people over 65; essential tremor (one of many forms of tremor) is estimated to affect up to 5% of those over 40 and up to 20% of people over 65; and Parkinson's affects around 4% of those over 85.

1.2.4 Ageing and cognitive decline

Table 4. Ageing and cognitive decline

Impact. Navigation, comprehension, and task completion can be affected by:	**Prevalence** (Conditions most commonly reported)
Short term memory problems	**Dementia:** 1.4% of people 65-69 yrs 24% of people 85+ yrs
Difficulty with concentration	**Mild cognitive impairment (MCI) is more common:** Around 20% of people over 70 years are estimated to experience MCI
Distraction from movement or irrelevant material	
Difficulty coping with	

Cognitive decline is also common, though only dementia and mild cognitive impairment are commonly reported. While Dementia (including Alzheimer's disease) is experienced by some older people (1.4% of people 65-69 years increasing to 24% of people over 85 years in the UK), forms of mild cognitive impairment (or MCI) are much more common, affecting over 20% of those over 70 years in the UK. MCI can result in:

- short term memory limitations (which may result in a person forgetting the purpose of a website visit if they lose orientation on the site)
- concentration and distraction issues (consider the volume of information on some pages, and the multiple animated advertisements that are sometimes present)

2 State of the art of telemedicine, rehabilitation systems and similar systems

Along the last 20 years, there have been several approaches to improve usability of rehabilitation, tele-therapy, tele-training and telemedicine systems, for home and hospital environment, from professionals and users point of view.

However, most of these studies are only focused on effectiveness and safety requirements, without analyzing other issues like cognitive limitations related with memory, comprehension or attention; or emotional issues as motivation or aesthetical appearance.

There are different recommendations for assessing telemedicine systems (Chant et al., 1996) and for its design, too (Michaud et al, 2010). In fact, usability plays a critical role in the acceptance and efficacy of telemedicine applications (Beith, 1999; Wilson et al., 2007).

Next, the main requirements and methodologies related with effectiveness, efficiency, safety, learning, feedback, engagement and satisfaction are described.

2.1 Effectiveness

In England, a series of research studies are exploring the effectiveness of assistive technologies in the care of older individuals (P. Bower, M. Cartwright, SP. Hirani et al. 2011). The Department of Health Whole System Demonstrator program, set up in 2009, performed a randomized controlled trial of telecare and telehealth in chronic illness management and the largest such study conducted in the UK. The study used a broad range of tele-health technologies. Initial results have recently been published and show **effectiveness of telecare and telehealth.** (A. Steventon, M Bardsley, J Billings et al., 2012)

A recent analysis demonstrated that medical monitoring improved therapeutic compliance in patients with different illnesses. (F. Cappucio, S. Kerry, L. Forves, 2004). Besides, Some studies like K. Daniel et al. (2009) argue that effective medical monitoring systems must be unobtrusive and efficient, incorporating multiple functions, and provide real-time feedback and wireless communication with data evaluation systems.

On the other hand J. Huang (2011) considers that identifying motivating and effective method of encouraging people with motor disabilities to perform exercises is crucial in helping them retain or enhance their motor control and increase their independence. For this, J. Huang propose a kinect system.

Recently, Wii Fit training has received significant attention by healthcare professionals as an individual training tool. Some researchers have reported validity and reliability of the Wii Fit system for use in stand-alone applications or in combination with other devices. Other reports, however, indicate potential harm following use of the Wii gaming system.

On the other hand, clinicians and therapist have reported that the Wii gaming system is a valuable device for rehabilitation purposes (M. Fitzpatric, L Harding, M. Rodenbeek, 2010). Although most computer gaming systems have been associated with depression (J.B. Weaver, D. Mays, S. Weaver et al. 2009), Rosenberg et al. (2010) reported that use of the Wii gaming system improved depressive symptoms and cognitive performance. This latter finding may have been due to the significant increase in activity required for Wii games compared with other computer games. Others have investigated potential benefits of Wii Fit training in motor skills and postural control. Multiple case studies have reported improvements in dynamic balance control, and performance on the Berg Balance Scale and Timed-Up-and-Go Test.

The **Wii Fit system** can potentially be used at home by individuals at risk of falling to reduce this risk. (H. Bateni, 2012). K. Sato et al. (2014) examine the effect of a newly developed “exergame” on health benefits such as muscle strength and body balance of older persons. “Exergames” are a new type of videogames, which involve physical motion of the players. They developed a new exergame program for using Microsoft

Kinect motion sensor. The exergame developed in this study was found to be effective in improving muscular strength of lower extremities.

Gerling et al. (2012) created **guidelines for full-body interaction in games** for older persons. Therefore, they conducted two studies; the first one investigates the performance of a given set of gestures. The results show that traditional gesture movements should be limited for older persons. Based on those results, a game was implemented using a Microsoft Kinect for gesture recognition and is evaluated during the second study. It is shown that this game, which uses gestures that are suited for older persons, has a positive effect on the participants.

2.2 Safety and comfort

The concept of **risk assessment and risk management** would appear to be a **key component** when considering the use of assistive technology as part of the care-planning process in frail older people. The concept of risk goes beyond physical components, such as falling or getting lost, and should include psychosocial aspects such as diminished wellbeing or loss of self-identity (L. Robinson, 2007).

D. Stefanov et al. show that the primary objective of a smart house is to enhance comfort, energy saving, and security for the residents in the house. Smart houses will have a strong, positive, and emotional impact on persons with physical disabilities and older persons, improving their quality of life, giving them privacy, and making them feel that they live in an ordinary house, not in a hospital or in a special nursing home.

Gerling et al. (2010) discusses **game design guidelines for developing safe** and usable **games** for older persons. The major guidelines, which are mentioned in this paper, are: older persons should be able to play sitting and standing, no extensive or sudden movements should be required, players should be able to adjust the level of difficulty individually and the game should give constructive feedback to avoid frustration.

K. Sato et al. (2014) explain that the application of game contents meant for general consumers to older persons could cause various problems related to risk management or differences in motor function. Therefore, developing games for seniors and presenting them as a system for improving various physical functions could mean that training elements could be increased so that games not only are fun but also offer considerable benefits to older persons.

2.3 Efficiency

In 2004 World Health Organization declared that E-health is one of the main pillars for improving public health in the entire world (B.E. Dixon, 2007). E-health has established connection between medical science and engineering. Some of the main reasons of creating electronic health seem to be Interaction ability between information systems, saving time and money and improving access to the services. TeleNursing and Telemedical, using telecommunications technology improve tasks like taking care of patients by nurses (L.M. Camarinha-Matos, 2004).

According to the National Center for Biotechnology[2] one of the objectives of E-health is to increase efficiency in health care, which leads to a decrease in costs and increase in quality simultaneously.

2.4 Learning

Medvedev et al. (2008) show that older people are afraid of telemedicine systems due to their limited computer skills. Otherwise, Finkelstein et al. (2004) explicitly pointed out **it is not correct to assume that older individuals, who are not previously exposed to current technology, cannot be trained to use such technology**. They stated that the major problem with this target population is not their inability to use technology, but their initial reluctance to try it on their own. Indeed, their results showed that patients can use telehomecare with moderate levels of training. Liddy et al. (2008) reported that most patients and all

[2] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1761894/

caregivers found the technology easy to use and useful. Besides, some studies described improved systems, to increase the usability and effectiveness.

Kleinberger et al. (2007) believe that accessibility, usability, **and learning are key features of AAL systems**. They emphasize that the disabled and older persons should be trained to use future technology interfaces, so that they might be capable of using personal healthcare devices without technical support. Beyond the primitive services, they outline adaptability, anticipatory human-computer interaction, heterogeneity, integration and, domain knowledge formalization as the key challenges for AAL success and acceptability. Likewise, Abril-Jiménez et al. (2009) propose a user interface framework based on adaptive interactions to enhance the usability of AAL systems.

Marinc et al. (2011) propose an interactive and architectural configuration approach for comprehensive AAL environments targeting different types of users based on the levels of technical expertise as expert, normal and impaired users.

On the other hand, when Gerling et al. (2012) compare gesture-based interaction using the Kinect with other gesture-based interfaces such as the Nintendo Wii Remote or PlayStation Move controller the **lack of a handheld controller becomes a clear advantage**. The use of the Kinect allows for more natural interactions and players (who are not familiar with traditional handheld controllers) are able to interact with the game directly. The lack of controllers can (if designed correctly) simplify the interaction, and allow for more natural mappings, which ease the entry into play if older adults lack gaming experience.

2.5 Motivation

Motivation is a key aspect to **ensure adherence to a program** (Maclean et al. 2002, Maclean et al. 2000, Chen, Neufeld et al. 1999), diverse authors have developed different methodologies to improve user adherence to the program such as gaming (Colombo et al. 2007) or incorporating design aspects to the prototypes that provide the appearance of the systems closer to an everyday appliance (Johnson et al. 2006).

Specifically, Johnson and Schmidt (2009) compare upper limb rehabilitation of simple movements with movements related with **videogames**, although muscular performance do not improve user feel engaged with the system and do not left the therapy. Videogames seems a good solution, but persons with cognitive damages (p.e. poststroke patients) show frustration when they were quickly eliminated from game (Muir et al, 1992).

Besides, some authors have measured motivation during rehabilitation processes with robotic systems to control the process effectiveness (Colombo et al. 2007), using several tools such as the Intrinsic Motivation Inventory (Plant, Ryan 1985; Ryan, 1982).

The last tendency is to use **Virtual Reality** (VR) for rehabilitation of lower limbs (Riener et al., 2006). Walker et al. (2010) describe the state of art of this technology, type of sensors, output interfaces, advantages, costs, etc.

Research has shown that playing games can have positive effects on the emotional and physical wellbeing of older persons, and can motivate them to maintain a basic level of activity (Y. Jung, K.J. Li, N.S. Janissa, W.L.C. Gladys, K.M. Lee, 2009). The latest generation of game input devices, such as Microsoft Kinect, provides an opportunity for motivating physical activity.

2.6 Satisfaction

Aesthetic can affect to usability; in fact, there is a relation between perceived usability and aesthetics (Tractinsky 1997; Tractinsky e t al., 2000; Kimn et al., 2003; Hartmann et al., 2008), although it is not true the sentence “what is beautiful is usable”.

2.7 Feedback

Feedback allows users to know their tasks performing, making easier to detect and control errors. Inside rehabilitation field, it is necessary to distinguish between “typical” feedback and biofeedback. There are different kinds of feedback: auditive, visual or tactile, but the **biofeedback** is the most used. However, the clinical evidence for a beneficial effect of biofeedback is controversial (Riener et al., 2006).

2.7.1 Sensory Feedback

Sensory feedback seems to be particularly effective (Carson and Swinnen, 2002). However, most of the researches compare one type of feedback with “do nothing” (f.e. Banz; 2008), so it is reasonable that “make something” is better than do nothing.

Banz (2008) check that users were more motivated and concentrated with visual feedback (although motor output did not vary) based on interaction torques. But an unsuitable use of visual feedback may impede recovery of balance (Bonan et al., Nelson, 2007.). On the other hand, Altschuler et al. (1999) checked that looking at mirror reflection improve motor functions of the hemiplegic limb, suggesting that visual feedback can substitute damage propioceptive input for functional recovery (Sathian et al., 2000; Stevens and Stoykov, 2003; Cauraugh, 2005.).

Positive effects has been detected when auditory feedback is used, combining external cues, such as rhythmic auditory stimuli, and pace movements of patients (Luft et al., 2004; Whitall et al., 2000; Thaut et al., 2002); or coupling active neuromuscular stimulation with bilateral movement training (Cauraugh and Kim, 2002, 2003a,b; Cauraugh, 2004; Cauraugh et al., 2005).

But the most extended feedback on the rehabilitation of lower limb is based on tactile and force data. Haptic feedback is an effective addition for increasing joint range of motion and force (Sveistrup, 2004). A Cochrane review show that force platform biofeedback do not improve balance, but it impact on stance symmetry when is combining with visual feedback. Following this approach, this platform can induce gait symmetry of patients (Allet et al., 2009; Brouwer et al., 2009; Yoon et al., 2010); and when propioception was impaired an additional source of information about one’s balance may be helpful in regaining standing stability and improving mobility (Nichols, 1997).

2.7.2 Biofeedback

Several research groups suggest the application of biofeedback principles for gait rehabilitation of patients with stroke (see review of Riener et al., 2009).

There are several types of biofeedback: joint movements, forces, electromyography (EMG), electroencephalography (EEG) and other physiological signals as heart rate (HR), galvanic skin response (GSR) or respiration rate (RR).

Inside joint movements, can be distinguished kinematic and kinetic measures. Motor functioning has been assessed using joint angles of the ankle (Mandel et al., 1990; Colborne et al., 1993) or the knee (Morris et al., 1999), the distance between left and right knee joints (Arurin et al., 2000), step length (Montoya et al., 1994), and stance duration (Femery et al., 2004). However, none of these joint moments has been used as biofeedback during walking (Riener et al., 2006).

On the other hand, motor performance was also detected using EMG recording (Petrofsky, 2001; Bolek et al., 2003), checking advantages on functional recovery of lower extremity for patients with hemiparesis (Nelson, 2007) Ground reaction forces and plantar pressure values have been also used(Batavia et al., 2001).

Moreover, it is frequent to combine different measures. For example, HR, HR variability and GSR has been used as feedback for some systems (Riener et al., 2009); HR, oxygen consumption and minute ventilation increase with training (Nash et al., 2004). More recently, several researchers are focusing on EEG singlas (Nelson, 2007).

These signals are processed and used as feedback, via visual displays (Bolek et al., 2003; Montoya et al., 1994), acoustic displays(Petrofsky, 2001; Batavia et al., 2011), or both (Colborne et al., 1993; Femery et al., 2004). Include, some research groups have also used vibrotactile displays to generate tactile impressions on the skin (Batavia, 2001). Moreover, the symbols of visual displays should be enough big (Rupp et al., 2009)

3 General usability requirements for home training

There have been developed some **guidelines**, addressing the following areas: variability in content; difficulty level and speed; consistent behavioural simplifications of real world objects; ability levelled interaction schemas; multimodal feedback; performance and progress feedback; user appropriate instructions. In particular for long-term usage, the variation in content becomes crucial. The variability in difficult levels is one of the most important aspects, and can be applied to various parameters such as content (e.g., similarity in pictures in Memory), contrast (e.g., distinct back- and foreground or a diffuse naturalistic milieu), or required precision for targets. (Pareto et al., 2008)[3].

These guidelines are in accordance with other ones (Hilton et al, 2000; Lövquist and Dreifaldt, 2006), except for realism is not required and behavioural simplifications are reasonable relative to real world experience. In fact, patients want clear **instructions** before the exercise and **instant feedback** during the exercise (Dreifaldt and Lövquist 2006).

The general design requirements are (Lovquist et al., 2006):

- **Reward system**: It increases, if it is efficient, the chance of keeping patient interest, and gives instant feedback about the progress. Scoring systems can be used combining with visual or auditory stimulus.
- **Difficulty**: It must be individually set. Engagement should be maintained, avoiding boredom but without cause frustration. Following Yerkes-Dowson law, there is an optimal performance level.
- **Multimodal feedback**: It is important, for the users, to get real time task-specific feedback when interacting with the interface.
- **Environment design**: Textures and structures should resemble **pleasant** environments.
- **Intuitive task**: Long explanations and a long time can provoke losing of patient interest.
- **New possibilities**: Create exercises based on patient needs and what they tell us.

In a study of tele-RHB system using a **touch interface,** they find the following **requirements** (Wilson et al., 2007):

- The **modal dialogue boxes** which appeared when users tried to record a new exercise caused navigation difficulties. It should be replaced by full-screen step-by-step wizard screens.
- The **tree-style navigation** (used to locate exercises recorded previously) was replaced by a calendar, after consideration of suitable metaphors for the target audience.
- To avoid user problems with input devices, it was added a touchscreen with bigger buttons and colors code for functions.
- **Labels**, explanations and images help to provide navigation clues.
- An on-screen keyboard was implemented to enable users to write diary notes and communicate.
- Kinematic feedback was provided through **graphs showing summary data for each movement variable** (e.g. shoulder flexion-extension; forearm supination-pronation).

[3] This guide could be interesting for defining software and feedback procedures.

4 General Design Issues

To begin with, we have included seven principles of "Design for All" (as, it includes older people) which might be helpful to be considered as a starting point summary (As identified by the Centre for Universal Design):

- **Equitable** Use. The design must be useful and marketable to any group of users.
- **Flexible** in Use. The design must accommodate a wide range of individual preferences and abilities.
- **Simple and intuitive** to use. The design must be easy to use and understand, regardless of the user's experience, knowledge, skills or concentration level.
- **Perceivable information**. The design must communicate necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
- **Tolerance of error**. The design must minimize hazards and the adverse consequences of accidental or unintended actions.
- **Low physical effort**. The design must be usable efficiently and comfortably and with minimum fatigue.
- **Size and space** approach and use. Appropriate size and space must be provided for approach, reach, manipulation and use, regardless of the user's body size, posture or mobility.

4.1 G.A.1. Adaptability (personalization, configurability, customization)

In order to adapt a service to the specific needs or preferences of the user, it is recommended to allow configuration of the system to the most appropriate media for the users' special needs, both for input to and output from the system. Thus the user interface should be adjustable to individual needs.

4.2 G.A.2. Consistency and Standardization

It is recommended that the whole user interface should be consistent. Some recommendations about consistency are:

- G.A.2.1. Consistency of language would be applied so that the terms or labels used on the display, keyboard or control panel and any documentation are the same.
- G.A.2.2. Avoiding introducing synonyms.
- G.A.2.3. Consistency of effect should be applied so that the user perceives an action as having the same outcome regardless of mode or level within the system.
- G.A.2.4. Structure the visual display layout so that the user can predict where to find required information
- Standardization provides compatibility between systems. Thus, whenever appropriate, reference should be made to internationally recognized standards and guidelines. The connection between terminals and personal user interfaces (e.g. headphones) should be standardized.

4.3 G.A.3. Error Management

Some recommendations for getting a proper error management are the following:

- G.A.3.1. Allow the system to be configured by the user to allow longer than normal timeouts

- G.A.3.2. Provide simple error recovery and when this situation happens, put the user back where the error was committed.
- G.A.3.3. Provide visual or auditory feedback to allow users the opportunity to review entries
- G.A.3.4. Use error messages which do not blame the user
- G.A.3.5. Error messages should be displayed immediately after the user entry in which the error is detected
- G.A.3.6. Provide context sensitive error messages or help which will allow the user to recover from the source of the error.

4.4 G.A.4. Feedback

We highlight the following recommendations about the responses from the system to the user:

- G.A.4.1. Feedback should be continuous during the entire operation of the service
- G.A.4.2. Feedback should always be given in response to all user actions
- G.A.4.3. Feedback is important to let user know the system status.
- G.A.4.4. It should be possible for users to configure the system so that feedback is always given in a modality (visual, auditory, tactile) and timing appropriate to their needs
- G.A.4.5. It is mandatory to warn people before they initiate a task that will cause irretrievable data loss.
- G.A.4.6. When the operation is going to be lengthy (more than 15 seconds), such as retrieval task, or a complex search in a database, provide feedback on how long the operation will take, or visual feedback that the process is continuing.

4.5 G.A.5. Flexibility

If a system could be used by skilled users, it would be important to offer short cuts, more powerful command sequences, or codes that allow for quicker or more efficient operation. I.e. allowing a user to enter a short command rather than wait for a menu to be displayed visually or presented as speech output.

4.6 G.A.6. Response Times

Regarding to system responses and timeouts, some recommendations are the following:

- G.A.6.1. Response times should be as short as possible
- G.A.6.2. Unpredictable and variable response times are not acceptable (maximum variation +- 10%)
- G.A.6.3. In general, delays likely to be longer than 1 or 2 seconds should be supported by feedback.
- G.A.6.4. Ensure timeouts at any part of the interaction do not affect people who may be slower than normal in tendering control responses to system requirements, particularly if there are amounts of data to be assimilated /comprehended.

4.7 G.A.7. General Dialogue's styles

We provide three general recommendations for achieving a good "understanding" between the user and the system.

- G.A.7.1. Simplify interaction by reducing the number of commands to be remembered and the number of keystrokes to be entered
- G.A.7.2. Maintain compatibility with user's expectations and their experience with other systems

- G.A.7.3 Use self-descriptive procedures whereby the user can immediately perceive what to do.

4.8 G.A.8. General User support

- G.A.8.1. Provide user guidance appropriate to the user requirements and task complexity
- G.A.8.2. Provide clear and specific information to guide the user through the operational sequence, including how to recover from errors
- G.A.8.3. Include task sensitive messages that help the user proceed correctly, indicating the commands or syntax, or permitted range of values
- G.A.8.4. Ensure that the guidance given is accurate and up-to-date (in general it is most effective to tell the user “what to do”)
- G.A.8.5. Use familiar wording and short simple sentences

4.9 G.A.9. Help

- G.A.9.1. Multi-modal help should be provided where possible
- G.A.9.2. For simple systems with limited display capabilities consider providing help using speech output
- G.A.9.3. For more complex systems, provide help that is sensitive to the context and to the users’ task requirements
- G.A.9.4. Write the help information in short simple sentences and include what to do next and how to return to the main task
- G.A.9.5. Allow skilled users the option of switching off help prompts if they are not required
- Provide the availability of extended help modes

4.10 G.A.10. Tutorials

Three methods of training and guidance are described by: telling the user what to do (verbal methods), showing what to do (demonstration or guidance) and having the user practise under controlled conditions.

- G.A.10.1. Present step-by-step interface procedures to assist the user with specific problems
- G.A.10.2. Provide procedural demonstrations of interface procedures so that users can quickly learn simple operations
- The security issues regarding protection and privacy should be carefully designed. The following recommendations should be taken into account:

4.10.1 G.A.11. Privacy

Privacy should be ensured for public access terminals, for example if the Wetakecare will be used for more than one person.

4.10.2 G.A.12. Warnings

Warnings should be provided if the user make any error or some non-recoverable action.

4.10.3 G.A.13. Abstract Feedback

For passwords and other secure entries, display feedback of the entry with abstract meaningless, characters, such as “*”or “x”, showing only the number of characters introduced.

4.10.4 G.A.14. Privacy with assistive devices

When assistive devices are being used e.g. loud speakers or large print, the privacy of the information should be ensured.

4.10.5 G.A.15. Eavesdropping

Reduce the danger of eavesdropping by the provision of headsets instead of speakers.

4.11 G.A.16. Adjustability

This is the facility to position and re-position a module or a complete terminal to alter the setting to meet the specific personal requirements of the user. The recommendation would be to allow users to alter the setting such as volume, brightness and contrast so as to meet their personal preferences and to cater for changes in the environment.

4.12 G.A.17. Graphical User Interface (GUI)

Regarding to the graphical user interface it is recommended to use readily identifiable visual elements and icons in preference to abstract images

4.13 G.A.18. Colour

It can be found in the ETSI EG 202-116 guidelines a high number of recommendations regarding to the use of the colour on a display screen. We would highlight the following:

- G.A.18.1. Avoiding using colour from the opposite ends of the spectrum
- G.A.18.2. Use no more than five colours when coding information
- G.A.18.3. Use colours to structure the display and group categories of data
- G.A.18.4. Contrast radio should be maximized when selecting colour for background and foreground elements (black text on a white background provides the highest contrast ratio and optimizes visual processing for text).
- G.A.18.5. Avoid using very dark or very bright colours; keep the difference in average luminance between different visual task areas within a ratio of 10:1. Dark text on a light background is preferred with a brightness contrast of 70% to 80%
- G.A.18.6. Avoid shades of blue, green and violet for conveying information.
- G.A.18.7. It is important that the contrast between the keys/character and the background is high enough for visually impaired people to easily read the character of can distinguish the keys from the background. White on black is optimum.

We have also included in this document an interesting table in which recommendations are given about colour combinations for displays (see Table 5).

Table 5. Suitable colour combinations for displays (e.g. monitors).

Background	Colour of character/symbol							
	Black	White	Magenta	Cyan	Yellow	Green	Red	Blue
Black		+	+	+	+	+	-	-
White	+		+	-	-	-	+	+
Magenta	+	+		+	+	+	-	-
Cyan	+	-	+		-	-	+	+
Yellow	+	-	+	-		-	+	+
Green	+	-	+	-	-		-	+
Red	-	+	-	+	+	-		-
Blue	-	+	-	+	+	+	-	

4.14 G.A.19. Text

Regarding to the use of text we have collected some recommendation provided from the National Institute of Aging in USA[4].

- G.A.19.1. Limit the number of points you make. Stick to one to five messages in each section. Keeping your information brief can make it easier for users to stay focused.
- G.A.19.2. Put the key message first. Putting the main message at the beginning ensures that your users will see it.
- G.A.19.3. Keep paragraphs and sentences short. Paragraphs should express one main idea.
- G.A.19.4. Sentences should be simple and straightforward, Choose words your users know. Minimize jargon and technical terms. Write in simple language. Give specific instructions; tell users exactly what to do.
- G.A.19.5. Define unfamiliar terms. If you need to use a term that older adults do not know, define it when you use it.
- G.A.19.6. Space. Allow sufficient white space to ensure an unclutched look. Put a space between paragraphs.
- G.A.19.7. Allow enough space around clickable targets, such as links and buttons, so that each one is easy to target and hit separately.
- G.A.19.8.Typeface. Use a sans serif and not condensed typeface. Arial is the most commonly used sans serif font, but Tahoma and Verdana are also widely available and were developed specifically for the screen.
- G.A.19.9. Type size. Make it easy for users to change the text size directly from the screen.
- G.A.19.10. Type weight. Use medium or boldface.
- G.A.19.11. For headings, increase the size and weight or use a colour. If you use bold for body text, make headings stand out with size or colour.
- G.A.19.12. Capital and lowercase letters. Put all text in uppercase and lowercase letters. Never use all capitals, all capitals take up more space, it is also more difficult to distinguish different letters in capitals.
- G.A.19.13. Avoid using italics. Italics are hard to read, especially online.
- G.A.19.14. Text align / Justifications. Left-justification type is best for older adults. Left-justification allows an even left margin and an uneven right margin.

4.15 G.A.20. Labels and abbreviations

We have selected the following recommendations:

- G.A.20.1. Use full words that accurately describe the control or display's function. Avoid abbreviations, unless usability testing confirms they are acceptable
- G.A.20.2. Abbreviations can be used if they are familiar to the user group, however, icons can be more language independent. Use symbols, icons and pictograms to overcome language difficulties when identifying controls or displays or to give guidance
- G.A.20.3. Use established graphical symbols for common functions

[4] http://www.nia.nih.gov/health/publication/making-your-website-senior-friendly

- G.A.20.4. Ensure printed material is clear and legible and easily understood by the users.
- G.A.20.5. When using small displays ensure that there is adequate space on the display for the labelling of soft keys.
- G.A.20.6. In order to help blind and visually impaired people and people with learning difficulties, it is important that the control for adjusting the volume is clearly labelled, so that it is easy to find and to understand the use of the control

Where using a specific system is complex, older users may have difficulty remembering specific sequences of operations and a small reminder card on the system can be very helpful.

4.16 G.A.21. Menus

We next present some recommendations for the menu dialogues design.

- G.A.21.1. The main menu should be available and it should always be possible to return to it easily and quickly
- G.A.21.2. Give the menu a title that clearly and unambiguously indicates the contents and give the menu options informative names which relate to the users task and are distinctive form the menu labels.
- G.A.21.3. Group de options in a way that is meaningful to the user, in groups that cover all possibilities. If conventional ordering for options is possible, the most frequently used options should be placed first. If no logical order or no frequency order exists, and users are likely to know the names of the desired options, options should be placed in alphabetical order.
- G.A.21.4. Avoid using cascading menus for frequent, repetitive commands.
- G.A.21.5. Limit the number of options to less than 10. If more options are required arrange them into meaningful groups that can be accessed as a next level menu.
- G.A.21.6. Limit the hierarchy of menus to 3 levels. If more levels are required, provide navigational cues to the current level and navigational aids to assist backtracking, and/or returning to a main menu.
- G.A.21.7. Avoid automatic scrolling for menus
- G.A.21.8. A pop-up menu should only contain commands that apply to the selected object or objects and its context, rather than commands grouped by function
- G.A.21.9. In a sequence of screens, menus should always be displayed in the same location
- G.A.21.10. It is preferable to build a menu structure with more items in the beginning and at the end than in the middle: 8x2x2x8 will produce better results than 2x8x8x2.
- G.A.21.11. The user should be able to step back up the menu structure in a single action, and either goes back one step at a time or directly to the top. If the menu is large provide a map of its levels.

4.17 G.A.22. Query Language

It is also known as a question and answer style. Some recommendations are:

- G.A.22.1. Ask only one question at a time
- G.A.22.2. Keep the sequence of questions compatible with any user model

4.18 G.A.23. Form fill-in dialogues

We next summarize some recommendations related to this special type of question and answering dialogue.

- G.A.23.1. Related fields should be adjacent and aligned with a blank space for separation between groups.
- G.A.23.2. Use alignment to create a feeling of order and comprehensibility.
- G.A.23.3. Indicate the maximum length of data entry fields, provide feedback (both visual and auditory) if user tries to exceed this maximum
- G.A.23.4. Mandatory and optional fields should be clearly distinguished. Where possible, place mandatory fields first
- G.A.23.5. For fields where information is required in a particular format, indicate the format required. If possible accept several input styles.
- G.A.23.6. Default values should be displayed if possible
- G.A.23.7. Use clear and meaningful titles for fields.

4.19 G.A.24. User Prompting

Prompts are system initiated messages or dialogues requesting the user to perform a particular action . We highlight the following recommendations:

- G.A.24.1. Inexperienced users will require a greater degree of prompting than experienced users. For experienced users, prompting might be provided as an optional aid.
- G.A.24.2. Prompts should indicate the nature of the input required from the user (“Please answer yes or no”) and the type of data to be entered.
- G.A.24.3. Prompts for data or command entry should be displayed in a standard location next to the entry field
- G.A.24.4. Users should have the option that prompts are presented both visually and aurally simultaneously, and the content should be exactly the same, to avoid any kind of interference.
- G.A.24.5. The user should be allowed to interrupt the auditory prompts.
- G.A.24.6. Speak directly to users. Choose wording for user prompting in the active voice rather than in the passive voice since sentences in the active voice are easier to understand. Use “press ENTER to continue” rather than “the user should press ENTER to continue”
- G.A.24.7. Use positive statements. “Begin speaking after the tone” is better than “Do not speak until after the tone”
- G.A.24.8. Use an active verb structure and address the user. “Connect the battery to the terminal” is better than “The battery should be connected to the terminals”
- G.A.24.9. When prompting the user towards a sequence of steps follows the same sequence in a wording of a prompt message. Use “Enter log-on sequence before running programs” better than “Before running programs, enter log-on sequence”

4.20 G.A.25. Multimodal Interaction

Multimodal interfaces can achieve more natural an effective human-computer interaction. In particular, a range of several modalities can be used to overcome many of the interaction problems that people with different disabilities may have. Basic recommendations regarding multimodality are the following:

- G.A.25.1. Where possible, allow users to select from a range of presentation modalities
- G.A.25.2. Ensure that the information presented to the different sensory channels is congruent.

- G.A.25.3. Consider multimodality to overcome adverse environment constraints

4.21 G.A.26. Input Components

We include here some general recommendations obtained from ETSI EG 202-116 applying to most input devices.

- G.A.26.1. When choosing a specific input technology, designers should be aware of the typical failure rates for the technologies under consideration and, equally, the likely human error rates in using that technology within the range of tasks expected.
- G.A.26.2. When choosing a particular input technology, designers should be aware of the limitations particular technologies present to older people. In general, the following recommendations should be taken into account:
    - G.A.26.2.1. Avoid simultaneous manipulation, e.g. pushing and rotating
    - G.A.26.2.2. Avoid making the user to hold a control in a specific position for periods of time.
    - G.A.26.2.3. Offer alternative input modalities for visually-impaired users when employing pointing and continuous input devices.

4.22 G.A.27. Output Components

Next we present a number of output components recommendations from ETSI EG 202-116 applying to all platforms considered in Wetakacare project. Apart from a set of general recommendations, we have added a specific subsection which contains general recommendation for visual displays, as all interfaces we are dealing with (TV, tablet) provide a visual display. However, in the deliverable D1.5, we include a collection of more specific requirements for each interface.

- G.A.27.1. Select output components that are appropriate to the information requirements of the task (see Table 6)
- G.A.27.2. Whenever possible provides redundant alternative output customizable by the user.
- G.A.27.3. Ensure display selected meets relevant standards
- G.A.27.4. When choosing particular output technologies, designers should be aware of the limitations different technologies present to different older user profiles. In general:
    - G.A.27.4.1. Choose a modular solution so that alternative output devices can be used;
    - G.A.27.4.2. Ensure critical warning signals are both audible and visible

Table 6. Summary of output information requirements.

Type of Information	Output Requirements
Status	Display needs to show continuing state, use non-intrusive optical signal.
Warning	Demand user attention with auditory tone, flashing light, or provide centrally positioned text message.
Feedback	Provide rapid acknowledgement of action, such as audible tone, lamp flash, change of display, tactile feel such as click action of keys.
Numeric	Use numeric digital display, consider how to show rate of change, such as dials and clockface, and use of graphs or tables.
System Prompt	System needs input/response from user. Use audible signal to gain immediate user attention. Use specific speech or visual message to instruct user. Place visual message central to user's line of sight. Allow user to cancel message if no longer required. Integrate display/controls to give soft-key interface or to prompt use of function keys.
Text	Use small panels or speech output for text messages. For text documents use sufficiently large alphanumeric display, consider CRT or flat panel display. Needs to conform to accepted standards affecting legibility and safety.
Pictorial	Use high quality graphics display with rapid display rate to show digitized visual images.

4.23 G.A.28. Visual displays (General)

According to the recommendations from ETSI EG 202-116 we next summarize some general recommendations for visual displays.

- G.A.28.1. Contrast and brightness should be adjustable by the user
- G.A.28.2. The characters should be well defined and easily distinguishable
- G.A.28.3. The screen should be free of glare and reflections

In addition, in ETSI EG 202-116 is pointed out that visual displays should meet a set of requirements defined by organism such as ISO 9241-3 (1992) or European Directives [90/70/EEC].

4.24 Summary

Table 7. Summary of General Design Issues

Requirement	Description
G.A.1.	Adaptability (personalization, configurability, customization)
G.A.2.	Consistency and Standardization
G.A.2.1.	Consistency in language
G.A.2.2.	Avoiding synonyms
G.A.2.3.	Consistency in actions
G.A.2.4.	Consistency in the visual display structure
G.A.3.	Error Management
G.A.3.1.	Longer timeouts configuration
G.A.3.2.	Simple error recovery
G.A.3.3.	Visual/auditory feedback to review entries
G.A.3.4.	Not blame the user in error messages
G.A.3.5.	Error messages displayed immediately
G.A.3.6.	Context sensitive error messages
G.A.4.	Feedback
G.A.4.1.	Continuous feedback

G.A.4.2.	Response to user actions feedback
G.A.4.3.	System status feedback
G.A.4.4.	Configurable feedback
G.A.4.5.	Warning feedback
G.A.4.6.	Delay feedback
G.A.5.	Flexibility
G.A.6.	Response Times
G.A.6.1.	Short
G.A.6.2.	Not variable (max. variation 10%)
G.A.6.3.	Feedback in delays longer than 1 or 2 sec.
G.A.6.4.	Adjust timeouts
G.A.7	General Dialogue's styles
G.A.7.1.	Reduce number of commands to enter
G.A.7.2.	Compatibility with other systems
G.A.7.3.	Self-descriptive procedures
G.A.8.	General User support
G.A.8.1.	Provide user guidance
G.A.8.2.	Clear and specific information
G.A.8.3.	Task sensitive messages
G.A.8.4.	Accurate guidance
G.A.8.5.	Familiar wording
G.A.9.	Help
G.A.9.1.	Multimodal help
G.A.9.2.	Speech output help
G.A.9.3.	Sensitive to the context help
G.A.9.4.	Simple and short sentences
G.A.9.5.	Switching off help prompts
G.A.10.	Tutorials
G.A.10.1.	Assistive procedures (specific problems)
G.A.10.2.	Learning procedures (simple operation)
G.A.11.	Privacy
G.A.12.	Warnings
G.A.13.	Abstract Feedback
G.A.14.	Privacy with assistive devices
G.A.15.	Eavesdropping
G.A.16.	Adjustability
G.A.17.	GUI: not abstract images
G.A.18.	Colour
G.A.18.1.	Avoid using colours from the opposite ends of spectrum
G.A.18.2.	No more than five colours
G.A.18.3.	Colours to structure display/group categories
G.A.18.4.	High contrast (background/foreground)
G.A.18.5.	Avoid using very dark or very bright colour
G.A.18.6.	Avoid shades of blue, green and violet
G.A.18.7.	High contrast (characters/background)
G.A.19.	Text
G.A.19.1.	Limit the number of messages (1 to 5 max. in each section)
G.A.19.2.	Key message first
G.A.19.3.	Use short sentences
G.A.19.4.	Direct and simple language
G.A.19.5.	Define unfamiliar terms

G.A.19.6.	Enough space between paragraphs
G.A.19.7.	Enough space around clickable targets
G.A.19.8.	Typeface: sans serif and not condensed (Arial, Tahoma and Verdana are ok)
G.A.19.9.	Type size: easy to read
G.A.19.10.	Type weight: medium or boldface
G.A.19.11.	Headings: increase the size and weight/colour
G.A.19.12.	Capital and lowercase letters
G.A.19.13.	Avoid using italics
G.A.19.14.	Text align and left-justification
G.A.20.	Labels and abbreviations
G.A.20.1.	Avoid abbreviations when possible
G.A.20.2.	Use icons, symbols and pictograms
G.A.20.3.	Use established graphical symbols
G.A.20.4.	Printed material legible and understandable
G.A.20.5.	Enough space in small displays for labelling of soft keys
G.A.20.6.	Control for adjusting volume clearly labelled
G.A.21.	Menus
G.A.21.1.	Main menu available (return easy)
G.A.21.2.	Clear Menu title
G.A.21.3.	Logical option groups
G.A.21.4.	Avoid cascading menus for frequent ops.
G.A.21.5.	Limit menu options (less than 10)
G.A.21.6.	Limit menus hierarchy (maximum 3)
G.A.21.7.	Avoid automatic scrolling
G.A.21.8.	Contextual pop-ups menus
G.A.21.9.	Menus displayed in the same location
G.A.21.10.	Structure (8x2x2x8 better than 2x8x8x2)
G.A.21.11.	Single action to step back
G.A.22.	Query Language
G.A.22.1.	One question at a time
G.A.22.2.	Sequence of questions
G.A.23.	Form fill-in dialogues
G.A.23.1	Adjacent and aligned related fields
G.A.23.2.	Alignment
G.A.23.3.	Indicate maximum length of data entry fields
G.A.23.4.	Distinguish mandatory and optional fields
G.A.23.5.	Indicate the format required
G.A.23.6.	Default values should be displayed
G.A.23.7.	Clear and meaningful titles for fields
G.A.24.	User Prompting
G.A.24.1.	Greater degree of prompting for inexperience users
G.A.24.2.	Indicate the type of data to be entered
G.A.24.3.	Prompts displayed next to the entry fields
G.A.24.4.	Simultaneous visually and audio prompts
G.A.24.5.	Interrupt the auditory prompts
G.A.24.6.	Speak directly to the users
G.A.24.7.	Use positive statements
G.A.24.8.	Use active verbs structure

G.A.24.9.	Steps sequence: the same wording sequence in a prompt message
G.A.25.	Multimodal Interaction
G.A.25.1.	Multiple presentation modalities
G.A.25.2.	Congruent info. in different channels
G.A.25.3.	Multimodality in adverse environments
G.A.26.	Input Components
G.A.26.1.	Aware of typical failure rates for the technologies
G.A.26.2.	Aware of the technological input limitations for older users
G.A.27.	Output Components
G.A.27.1.	Appropriated output components for the task
G.A.27.2.	Redundant alternative output
G.A.27.3.	Standard display
G.A.27.4.	Aware of the technological input limitations for older users
G.A.28.	Visual Display
G.A.28.1.	Customizable contrast and brightness
G.A.28.2.	Easily distinguishable characters
G.A.28.3.	Screen free of glare and reflections

5 General Web Requirements

Next we present a set of general requirements that should be taken into account when designing web interfaces for older people. Some of these requirements have been extracted from W3C[5] and National Institute of Aging[6].

5.1 G.W.1. Standards

- G.W.1.1. Structure Standard: XHTML (eXtensible HyperText Markup Language[7]), which allows producing modularized markup languages and includes Semantic Web support.
- G.W.1.2. Presentation standard: CSS 2.0 (Cascading Style Sheets)[8] will be implemented to define the presentation of XHTML structured documents. The Style Sheets will be used as standard for user agents and browsers. The basic idea of implementing CSS standard is to enable the separation of document content (written in XHTML or a similar markup language) from document presentation.
- G.W.1.3. Accessibility standards: it will comply with accessibility guidelines of WAI-AA and CWA 15554:2006 [24] in order to guarantee access to the service and the information for users with access difficulties.

5.2 G.W.2. Page Layout

- G.W.2.1. Standards page design should be used (Web 2.0 and Web Content Accessibility Guidelines (WCAG 2.0)[9])
- G.W.2.2. Minimum screen resolution: Width: 102.4 cm (1024px) / Height: 76.8 cm (768 px).
- G.W.2.3. Consistent layout design across the site to improve the familiarity with the web site.
- G.W.2.4. Structure it has to be consistent when the users make zoom on the interface.
- G.W.2.5. Avoid overload structure, layout design it has to be as clean as possible.
- G.W.2.6. Simplify the interface, reducing the number of elements in the screen.
- G.W.2.7. Symbols and icons set must be the same throughout the site.
- G.W.2.8. The same set of navigation buttons must be used in the same place on each page.
- G.W.2.9. Avoid using features that may distract attention, such images and advertising that not are relevant to the task.
- G.W.2.10. Use high-contrast colour combinations such as black type against white background.

5.3 G.W.3. Web Navigation

- G.W.3.1. Use consistent navigation throughout the site.
- G.W.3.2. Explicit step-by-step navigation must be used whenever possible.
- G.W.3.3. Structure navigation to ensure that the fewest possible clicks are needed to achieve a given task.

[5] http://www.w3.org/TR/WCAG10/
[6] http://www.nia.nih.gov/
[7] http://www.w3.org/TR/xhtml1/
[8] http://www.w3.org/TR/CSS2/
[9] http://www.w3.org/TR/WCAG/

- G.W.3.4. Breadcrumb design has to be clear and must specify where the user is in each moment.
- G.W.3.5. Incorporate “Back” buttons and make sure that behaves predictably.
- G.W.3.6. Incorporate “Previous page” and “Next page” buttons for pagination components.

5.4 G.W.4. Web Menus

- G.W.4.1. Make menus easy to use
- G.W.4.2. Do not use pull-down or fly-out menus and menus that require users to slide the mouse and click all in one movement.
- G.W.4.3. We recommend to use a tabbed menu with a minimum space between each tab of 0.8 cm (8px). G.W.4.4. Do not use menu with more than three levels, the ideal menu has to be two levels.

5.5 G.W.5. Web Text

- G.W.5.1. Typeface: Use a sans-serif typeface, we recommend the Arial font family because is the most commonly used sans-serif font today.
- G.W.5.2. Type size: The minimum text size must be 1.2 cm (12px). Allow users to change text size directly from the screen easily.
- G.W.5.3. Type weight: Use medium or boldface type face, do not use condensed typeface.
- G.W.5.4. Capital and lowercase letters: Put all text in uppercase and lowercase letters. Never use all capitals (All capitals take more space and it is also more difficult to distinguish different letters in capitals), text in uppercase and lowercase is easier to read. Avoid using italics, there are hard to read, especially online.
- G.W.5.5. Heading: Use heading hierarchy in descending order of importance. [h1, h2, h3…h6] increase the size and weight or use a colour to give it more relevance. If you have to use bold for the body text, make headings stand out with size or colour.
- G.W.5.6. Justification: Left-justified type is best for older people, left-justification allows an even left margin and an uneven right margin, lines start at the same place on the left side of the screen but do not always end at the same place on the right.
- G.W.5.7. Paragraphs: Allow sufficient white space on the interface to ensure an uncluttered look. Put a space between paragraphs (minimum 1.2 cm [12 px]). Allow enough space between the lines of the paragraph to make text readable and understandable (minimum 1.4 cm [14 px]).
- G.W.5.8. Background/Contrast: Background must have a luminosity contrast ratio of at least 5:1, use dark type or graphics against a light background. Avoid patterned background. Allow users to change the contrast directly from the screen easily.
- G.W.5.9. Colour: Use high-contrast colour combinations, such as black type against a white background. Avoid layering shades of the same colour, such as dark blue type on a light blue background. Do not use colours that clash, for example dark blue on red is very difficult to read. Do not use yellow and blue and green in close proximity, the differences in these colours are difficult for many older people to see, use colours to group information visually.

5.6 G.W.6. Web Links

- G.W.6.1. Descriptions of the links should be clear and precise, write easy -to-read links that help users predict what will happen next.
- G.W.6.2. Use actions words when the link is about taking an action. Avoid: “My account”, use instead: “Go to my account”

- G.W.6.3. Use words that are meaningful and understandable on their own, if you use "Click here", make the link include words that describe what will happen when the user clicks on that link. Avoid: "Click here for more information", use instead: "Click here for more information"
- G.W.6.4. Links should be obviously clickable, using colour and underlining is the most common way of doing that, do not underline anything that is not a link.
- G.W.6.5. Make visited links change colour.

5.7 G.W.7. Icons and buttons

- G.W.7.1. Icons and buttons are easier to find when they are large, bright and in a color that contrasts with background.
- G.W.7.2. Use large buttons that do not require precise movements to activate.
- G.W.7.3. The buttons and icons should stand out, colors must be different from the color of surrounding text.
- G.W.7.4. Make buttons obviously clickable.
- G.W.7.5. Give a suitable name for the buttons, related to their actions.

5.8 G.W.8. Forms

- G.W.8.1. Grouping form elements: A form where different elements are well organized with similar ones grouped together is easier for everyone to use and it can be particularly helpful for users with cognitive or learning disabilities. The <fieldset> and <legend> tags allow you to layout and organize a large form with many different areas of interest in a logical way.
- G.W.8.2. Forms should have a title that specifies its role.
- G.W.8.3. Create a logical tab order through form controls, the "tabindex" attribute allows to set the tab order of elements.
- G.W.8.4. Do not use automatic tab jumps between fields.
- G.W.8.5. Specify the required and not required fields.
- G.W.8.6. Form fields should be associated with labels to describe their purpose.
- G.W.8.7. Avoid code or technical jargon for error messages, the error messages should provide an indication of the problem and offer advice on how it might be corrected.
- G.W.8.8. Give a suitable name for the buttons on the form, related to their actions.
- G.W.8.9. Ensure that the user will never have to provide the same information twice.
- G.W.8.10. Show all of the errors on the form itself so the user doesn't have to remember what the errors were in order to correct them.
- G.W.8.11. Show an error icon in the summary of errors and repeat that icon after each field that is filled in wrong. The user immediately associates the icon with the errors and can quickly find them in the form.

5.9 G.W.9. Data Tables

- G.W.9.1. In the data tables should identify the cells that function as a header by TH element, thereby providing a structure and meaning to information in the table.
- G.W.9.2. Do not uses images or graphics to indicate data, it is better to use text.

5.10 G.W.10. Media Content

- G.W.10.1. Illustrations and photographs: Make sure that pictures relate to the text, visuals should support the text rather than being decoration, which can be distracting. Include pictures of older people when talking about, or to, older adults.
- G.W.10.2. Animation, video and audio: Use short segments to reduce download time on older computers.
- Provide transcripts of video and audio for accessibility.
- G.W.10.3. Text alternatives: Provide text alternatives for all animation, video, and audio. Put Alt-text tags with meaningful descriptions on images so that a screen- reader can tell a visually impaired user what the image shows.

5.11 G.W.11. Scrolling

- G.W.11.1. Do not uses automatically scrolling text.
- G.W.11.2. Do not allows pages with horizontal scrolling.
- G.W.11.3. Minimize vertical scrolling.
- G.W.11.4. Avoid bars, rules, and other horizontal features that may suggest the bottom of a page when there is actually more below.

5.12 Summary

Table 8. Summary of General Web Requirements.

Requirement	Description
G.W.1.	Standards
G.W.1.1.	Structure standard: xHTML
G.W.1.2.	Presentation standard: CSS 2.0
G.W.1.3.	Accessibility standards: WAI-AA, CWA15554:2006
G.W.2.	Page Layout
G.W.2.1.	Standard page design: WCAG 2.0
G.W.2.2.	Minimum screen resolution
G.W.2.3.	Consistent layout
G.W.2.4.	Structure consistent when making zoom
G.W.2.5.	Clean layout, avoid overload
G.W.2.6.	Reduce number of elements in screen
G.W.2.7.	Consistency in symbols and icons
G.W.2.8.	Navigation buttons in the same place
G.W.2.9.	Avoid elements that may distract attention
G.W.2.10.	High contrast colour combination
G.W.3.	Web Navigation
G.W.3.1.	Consistent navigation
G.W.3.2.	Explicit step-by-step navigation
G.W.3.3.	Ensure the fewest possible clicks
G.W.3.4.	Clear breadcrumb design
G.W.3.5.	Add “Back” button
G.W.3.6.	Add “Previous page” and “Next page” buttons
G.W.4.	Web Menus
G.W.4.1.	Menus easy to use
G.W.4.2.	Avoid “pull-down” or “fly-out” menus that require users to slide the

	mouse and click in one movement
G.W.4.3.	Use tabbed menu, minimum space between each tab 8px.
G.W.4.4.	Ideal menu: two levels
G.W.5.	Web Text
G.W.5.1.	Typeface: sans-serif (Arial)
G.W.5.2.	Type size minimum 12px.
G.W.5.3.	Type weight: medium or boldface
G.W.5.4.	Capital and lowercase letters
G.W.5.5.	Heading hierarchy
G.W.5.6.	Justification: Left-justified
G.W.5.7.	Paragraphs: minimum space between paragraphs (12px.) and lines (14px.)
G.W.5.8.	Background/contrast: 5:1
G.W.5.9.	Colour: high contrast combinations
G.W.6.	Web Links
G.W.6.1.	Precise link description
G.W.6.2.	Use action words in action links
G.W.6.3.	Use meaningful words in links
G.W.6.4.	Clickable link appearance
G.W.6.5.	Make visited links change colour
G.W.7.	Icons and buttons
G.W.7.1.	Icons and buttons large, bright and colour contrasting with background
G.W.7.2.	Use large buttons
G.W.7.3.	The buttons and icons should stand out
G.W.7.4.	Clickable buttons appearance
G.W.7.5.	Button names related to their actions
G.W.8.	Forms
G.W.8.1.	Grouping form elements
G.W.8.2.	Appropriated form title
G.W.8.3.	Logical tab order
G.W.8.4.	Not use automatic tab jumps between fields
G.W.8.5.	Specify the required fields
G.W.8.6.	Associate a label to a form
G.W.8.7.	Avoid technical jargon for error messages
G.W.8.8.	Appropriated names in form buttons
G.W.8.9.	Avoid duplicities
G.W.8.10.	Show error messages
G.W.8.11.	Provide an error icon
G.W.9.	Data Tables
G.W.9.1.	Appropriated table structure
G.W.9.2.	Do not use images or graphics in tables
G.W.10.	Media Content
G.W.10.1.	Illustrations and photographs
G.W.10.2.	Animation, video and audio: provide subtitles and avoid heavy videos
G.W.10.3.	Text alternatives: include alt-text tags on images
G.W.11.	Scrolling
G.W.11.1.	Avoid automatic scrolling text
G.W.11.2.	Do not use pages with horizontal scrolling
G.W.11.3.	Minimize vertical scrolling
G.W.11.4.	Avoid bars, rules and other horizontal features

G.W.12.	Web platform services

6 General TV Requirements

Next we present a set of general requirements that should be taken into account when designing TV interfaces for older people. These requirements have been extracted from previous experience of IBV in other projects related to TV platforms.

6.1 G.T.1. Input Components

- G.T.1.1. Usable remote-control. Any aged person with sight problems, or with handling small objects problems, shows a lack of dexterity that makes scarcely usable remote-controls with many buttons (and a lot of functionality for each button). This should be taken into account to either redesign remotes modeling them like some mobile phones features where the keypads are limited, but still allow navigation through the menu offered in the display. The most common TV input device is a remote control that has four movements keys (right, left, up, down), a selection button and numbers from 0 to 9.
- G.T.1.2. Telephone service. Another possibility would be to design systems, such as the telephone service that can accept voice commands, which will facilitate access.
- G.T.1.3. Speech recognition.The way in which television contents are usually enjoyed (i.e. at a certain distance from the screen, and perhaps seating so that it is not possible to take advantage of supporting surfaces), it prevents to think that it is possible to equip the television sets with pointing devices as precise as the mouse; in this way, you might try to compensate writing difficulties, with the possibility of speech recognition options / keywords, associating a telephone service that enables the user voice recognition input.

6.2 G.T.2. Multimodal Interaction

The use of the voice interface can obviously facilitate mainly those with visual dysfunctions, that prevent an easy way to use a normal remote control, but it may imply greater difficulties for those who have trouble hearing or articulating the words because of a dental prosthesis. In any case, the multi-modality should allow more possibilities that users can have to choose, according to their preferences.

The experience of enjoy contents or interactive applications can be more or less involving both because of multi-modality, and also by being able to have access to a range of services that currently use only people with a '"literacy computing", or because of the possibility to rapidly deal with practices that usually require a lot of time, resources and displacements.

6.3 G.T.3. Contents

- G.T.3.1. Provide procedural step-by-step guides
- G.T.3.2. Give assistance for acronyms, abbreviations, and foreign language text
- G.T.3.3. Use well understood terminology
- G.T.3.4. Be very careful about the confusion of a double negative

6.4 G.T.4. Menus and Navigation

- G.T.4.1. Avoid using a fast text key when a select key will do
- G.T.4.2. Provide a numerical navigation to all functions and links

- G.T.4.3. Scrolling. On TV scrolling may be slow and important informations risk to be hidden below the fold if users don't intuitively understand that the page continues. Scrolling should be used only in the detail area in the centre of the page.
- G.T.4.4. Navigation has to be set up to progress from left to right and the left side of the screen is the best place to position the main menu to leave it stationary. The vertical spacing, that is really valuable in TV “landscape” screen, should be preserved for content.
- G.T.4.5. It should be possible to exit the application from any pages
- G.T.4.6. “Back” button should always be provided
- G.T.4.7. Add affordances indicators or highlights to selectable and navigable items
- G.T.4.8. Help users in distinguish between focusable and not-focusable elements
- G.T.4.9. Make the default control active and focused
- G.T.4.10. Highlighting scheme and navigation elements should remain consistent across the application
- G.T.4.11. Use loading message and make “progress” message meaningful

6.5 G.T.5. Response times

- G.T.5.1. Response to a user action should be demonstrated in a timely manner (between 1/10 of second and 1 second). Fast time responses are required and TV users are much less inclined to accept interface misbehaviour than desktop users.
- G.T.5.2. Avoid time-critical user response

6.6 G.T.6. Graphical User Interface (GUI)

- G.T.6.1. Use numbers as shortcuts. As a general principle of design applications in which visual content is predominant, it should be remembered that indicators such as numbers (typically used for voice applications menus) can be useful shortcuts in the design of graphical user interfaces, because they facilitate the use of remote control, TTS rendering of contents used in a single mode and the vocal selection of very articulated.
- G.T.6.2. Consider the distance from the viewer to the screen. Designing for display on a large television are commonly known as 10-foot interface, it refers to the approximate distance, 10 feet which is about 3m, from viewer to the screen. This viewing experience differentiates the design guidelines which should be considered when designing interface for this environment compared to a 2-foot user interface for computers devices.

6.7 G.T.7. TV Display

- G.T.7.1. Amount of information displayed. Despite its size, TV screen display less information and the viewer's perception is that the TV is smaller than a computer monitor. The apparent size depends on how far away your eyes are from the screen: the greater the distance, the smaller it looks.
- G.T.7.2. Interface elements size. To make easy readable menus, buttons, text fonts and so on everything in the TV interface has to be four time larger than in a desktop user interface.
- G.T.7.3. Overscan. TV manufactures must set aside margin along the outside of the normal screen size that are not used to display the TV signal. The extra space is detected to features such as closed-captioning, and also adjusts for picture anomalies that occur at the screen edges. Unfortunately, there is no standard for the amount of reduction so the amount of overscan varies by manufactures. Overscan area must be taken into account when designing a TV GUI and to handle it an extra 10% margin has to be provided and it's better to avoid using layout use absolute positioning.

6.8 G.T.8. TV Colour

- G.T.8.1. Avoid using pure white because it cause vibrancy or image ghosting. The strongest white used for television display should have a value of around 95%, or 240/240/240 in RGB terms
- G.T.8.2. Avoid bright reds, oranges and white because they cause particularly bad distortion
- G.T.8.3. Avoid using large spanning gradients because they may result in banding

6.9 G.T.9. TV Privacy and User Experience

- G.T.9.1. Usually it's a not a single-user environment. The 10ft GUI user experience places the display across a room far away from the viewer, so anyone who comes into could be able to see the content displayed on the screen. This fact can cause privacy matter.
- G.T.9.2. TV screen and the viewing experience is a mix of computer and TV
- G.T.9.3. Platform constraints limit functionality
- G.T.9.4. Watching TV is a leisure activity and often user's attention is not fully focused on it.
- G.T.9.5. TV user expects an interface intuitive that he could navigate easily even without looking the input device. The complexity of the interface has to be proportionate to the added value of the services provided. Users are willing to make an extra effort only if the “reward” is high.

6.10 G.T.10. TV Interaction design

- G.T.10.1. The GUI has to guarantee users quick access to content and functionalities.
- G.T.10.2. Common tasks should take as few cursor movements as possible, whereas less used ones can require more button presses.
- G.T.10.3. TV interface requires simple and visible navigation tools and the use of any non-functional eye candy has to be avoided.
- G.T.10.4. Consistency. In TV interface design the lack of space should be balanced by simplicity in concept, functions and visuals and consistency of the element behaviour.

6.11 G.T.11. Readability

- G.T.11.1. Avoid lightweight fonts or fonts with both very narrow and broad strokes
- G.T.11.2. Apply anti-aliasing to increase readability
- G.T.11.3. Add more leading
- G.T.11.4. Light text on dark background is slightly easier to read on TV compared to dark text on light background
- G.T.11.5. Break text into paragraphs to no more than 90 words
- G.T.11.6. Avoid distracting background elements
- G.T.11.7. Minimum text size should be 18 pt on 720p resolution

6.12 G.T.12. Layout

- G.T.12.1. TV are always in “landscape” (16:9 aspect ratio) so the available space runs left-to-right rather than top-to-bottom

- G.T.12.2. To avoid a cluttered and confusing design provide more space between elements on the page than on a desktop interface using a combination of larger margins and more padding.

6.13 G.T.13. Help

A written help trigged by a button it's useful to support users and it could be displayed automatically on the first access

6.14 Summary

Table 9. Summary of General TV Requirements.

Requirement	Description
G.T.1.	Input Components
G.T.1.1.	Usable remote-control
G.T.1.2.	Telephone service
G.T.1.3.	Speech recognition
G.T.2.	Multimodal Interaction
G.T.3.	Contents
G.T.3.1.	Provide step-by-step guides
G.T.3.2.	Explain acronyms, abbreviations and foreign language text
G.T.3.3.	Use well understood terminology
G.T.3.4.	Avoid double negative
G.T.4.	Menus and Navigation
G.T.4.1.	Avoid using a fast text keys
G.T.4.2.	Provide numerical navigation for all functions and links
G.T.4.3.	Scrolling
G.T.4.4.	Provide left to right navigation
G.T.4.5.	Exit button
G.T.4.6.	Back button
G.T.4.7.	Distinguish navigable items
G.T.4.8.	Focus the user
G.T.4.9.	Make default control active
G.T.4.10.	Keep consistency in navigation elements
G.T.4.11.	Provide meaningful messages for feedback
G.T.5.	Response Times
G.T.5.1.	Provide short response times
G.T.5.2.	Avoid time-critical user responses
G.T.6.	Graphical User Interface (GUI)
G.T.6.1.	Use numbers as shortcuts
G.T.6.2.	Distance from the viewer to the screen
G.T.7.	TV Display
G.T.7.1.	Amount of information displayed
G.T.7.2.	Interface elements size
G.T.7.3.	Overscan
G.T.8.	TV Colour
G.T.8.1.	Avoid using pure white
G.T.8.2.	Avoid bright reds, oranges and white
G.T.8.3.	Avoid using large spanning gradients
G.T.9.	TV Privacy and User Experience
G.T.9.1.	Not a single-user environment
G.T.9.2.	TV experience: mix of computer and TV
G.T.9.3.	Platform with limited functionality

G.T.9.4.	Leisure activity for users
G.T.9.5.	User expectations: intuitive and easy to use
G.T.10.	TV Interaction Design
G.T.10.1.	Provide quick access to content and functionalities
G.T.10.2.	Easy access to common tasks
G.T.10.3.	Simple and visible navigation
G.T.10.4.	Consistency
G.T.11.	Readability
G.T.11.1.	Avoid lightweight fonts or fonts with both very narrow and broad strokes
G.T.11.2.	Apply anti-aliasing
G.T.11.3.	Add more leading
G.T.11.4.	Contrast: Light text on dark background
G.T.11.5.	Break text into paragraphs
G.T.11.6.	Avoid distracting background elements
G.T.11.7.	Minimum text size (18pG.T. on 720p resolution)
G.T.12.	Layout
G.T.12.1.	“Landscape” (16:9)
G.T.12.2.	Provide enough space between elements
G.T.13.	Help
G.T.14.	TV Services

7 General portable interface (mobile, tablet) requirements

Next we present a set of general requirements that should be taken into account when designing Mobile interfaces for older people. Some of these requirements have been extracted from M. Mehrban and M. Asif (2010); Nur Rahmah, Zulkifli (2010) and A. Olwal et al. (2010).

7.1 G.P.1. Tablet services

The portable interface will be used to access contents and the possibility of interact with the TV will be also assessed.

7.2 G.P.2. Text

- G.P.2.1. The selection of fonts is based on readability factor to ease reading and ignore the unnecessary like very narrow or decorative fonts.
- G.P.2.2. Avoid using too many different types of fonts.
- G.P.2.3. User large font size: 12pt to 14 pt are fonts proposed for body text. 16pt or more is recommended to partial eye sight.
- G.P.2.4. Use bold only to highlight a keyword or title
- G.P.2.5. Do not use only capital letters.

7.3 G.P.3. Layout

Three types of layout could be considered within a mobile phone interface:

- G.P.3.1. List layout. The elements are shown on a list
- G.P.3.2. Grid layout. The elements are divided into a grid.
- G.P.3.1. Dock layout. The elements could be accessed in a horizontal menu at the top of the screen with an enlarged preview of the active option in the center.

7.4 G.P.4. Interaction Design

- G.P.4.1. Common tasks should be easily accessible
- G.P.4.2. Clear organization of information content on a screen.
- G.P.4.3. Users should be provided with feedback in every action.
- G.P.4.4. Add visual feedback for pressed buttons

7.5 G.P.5. Menus and Navigation

- G.P.5.1. Avoid deep hierarchies' menus
- G.P.5.2. Provide consistent navigation mechanisms
- G.P.5.3. Provide site map, navigating bars and orientation information during the interaction
- G.P.5.4. Ensure links are identifiable and recognizable.
- G.P.5.5. Avoid scrolling
- G.P.5.6. Provide users dedicated buttons for the most important functions

7.6 G.P.6. Graphical User interface

The following components could be found in most GUI in mobile phones:

- G.P.6.1. Labels. Use for labelling text input areas or images.
- G.P.6.2. Soft buttons. Activates a function when the corresponding physical button underneath the on-screen label is pressed.
- G.P.6.3. GUI Buttons. Iconic buttons that the user navigates to and then activates (not directly accessible with dedicated physical buttons)
- G.P.6.4. List for display the elements in a list view
- G.P.6.5. Text area.

7.7 G.P.7. Colour

- G.P.7.1. Avoid bright, fluorescent or vibrant colours.
- G.P.7.2. Maximize the contrast between foreground and background. Avoid similar colours adjacent to another.
- G.P.7.3. Ensure that all relevant information related with colour is also accessible without colour.

7.8 G.P.8. Touch screen

- G.P.8.1. Provide enough space between options
- G.P.8.2. Include few options in order to avoid touch interaction mistakes.
- G.P.8.3. Provide auditory, visual and vibration feedback in tactile inputs

7.9 G.P.9. Personalization and customization

- G.P.9.1. Contrast level, colour adjustment, variety of colour selection.
- G.P.9.2. Alarm and ring tones settings: personalized tones and volume
- G.P.9.3. Provide the user with choice to switch between different modes (personalized settings)

7.10 G.P.10. Content

- G.P.10.1. Minimize the unnecessary screen information
- G.P.10.2. Display only basic information on the screen and highlight the essential information using simple and relevant graphics.
- G.P.10.3. Do not uses abbreviations.
- G.P.10.4. All labels should be simple and short sentences.
- G.P.10.5. Labels and icons should be self-explanatory and intuitive.

7.11 G.P.11. Icons

- G.P.11.1. Use simple, highly relevant icons and symbols with few colours and details.
- G.P.11.2. Use icons easy to understand.

7.12 G.P.12. Help

Providing the users with dedicated buttons to help them in problematic situations.

7.13 G.P.13. Zoom/scaling

A scalable user interface option could be added to address problems with poor vision. Both fonts and images should be scaled to improve legibility. Zoom in/out could be mapped to physical keys, GUI buttons or a customizable option in the global settings menu.

7.14 G.P.14. Input modalities

- G.P.14.1. The main input modalities in a mobile phone device would be touch interaction and physical keyboard.
- G.P.14.2. Consider including speech recognition as input modality.

7.15 Summary

Table 10. Summary of General Portable interface Requirements

Requirement	Description
G.P.1.	Mobile phone/tablet services
G.P.2.	Text
G.P.2.1.	Use fonts easy to read
G.P.2.2.	Avoid using different types of fonts
G.P.2.3.	Use large font size
G.P.2.4.	Use bold only to highlight keywords/titles
G.P.2.5.	Do not use only capital letters
G.P.3.	Layout
G.P.3.1.	List layout
G.P.3.2.	Grid layout
G.P.3.3.	Dock layout
G.P.4.	Interaction design
G.P.4.1.	Common task should be accessible
G.P.4.2.	Clear organization of information on the screen
G.P.4.3.	Feedback with every action
G.P.4.4.	Visual feedback in pressed buttons
G.P.5.	Menus and Navigation
G.P.5.1.	Avoid deep hierarchies in menus
G.P.5.2.	Consistent navigation mechanisms
G.P.5.3.	Site maps and navigations bars
G.P.5.4.	Links easy to identify and recognize
G.P.5.5.	Avoid scrolling
G.P.5.6.	Dedicated buttons for common functions
G.P.6.	Graphical User Interface
G.P.6.1.	Labels
G.P.6.2.	Soft buttons
G.P.6.3.	GUI Buttons
G.P.6.4.	Labels
G.P.6.5.	Text area
G.P.7.	Colour
G.P.7.1.	Avoid bright, fluorescent or vibrant colours
G.P.7.2.	Maximize contrast background/foreground

G.P.7.3.	Information accessible without colour
G.P.8.	Touch screen
G.P.8.1.	Provide enough space between options
G.P.8.2.	Include a few number of options
G.P.8.3.	Insert auditory and vibration feedback
G.P.9.	Personalization and customization
G.P.9.1.	Contrast level, colour adjustment, variety of colours
G.P.9.2.	Alarm and ring tones settings
G.P.9.3.	Personalized settings
G.P.10.	Content
G.P.10.1.	Minimize unnecessary screen information
G.P.10.2.	Highlight the essential information
G.P.10.3.	Do not use abbreviations
G.P.10.4.	Use simple labels and short sentences
G.P.10.5.	Labels and icons should be self-explanatory and intuitive
G.P.11.	Icons
G.P.11.1.	Use simple, highly relevant icons and symbols with few colours and details
G.P.11.2.	Use icons easy to understand
G.P.12.	Help
G.P.13.	Zoom/scaling
G.P.14.	Input modalities
G.P.11.1.	Main input modalities: touch, keyboard
G.P.11.2.	Speech recognition

8 General requirements of kinect interaction

8.1 G.K.1. Gesture control

- G.K.1.1. Give precise and simple instructions, most users have not experience with gesture control. Is important that the inexperience of the seniors is taken into consideration, to be able to give them an understandable and concise instruction manual.
- G.K.1.2. Consider mobility problems and range of motion of each body part.
- G.K.1.3. Calibrate the Kinect sensor sensitivity.
- G.K.1.4. Avoid unnecessary functions and visual stimulation. No fancy accessories of unnecessary extra functions.

8.2 G.K.2. Voice Control

- G.K.2.1. Concise feedback for voice control. It is important that the user receives exact feedback when using voice control, to tell him why the voice control was not successful or why it is not working and what the user needs to change to make it work. Acoustic feedbacks would be useful, because seniors are used to verbal communication.
- G.K.2.2. Voice-to-text messenger function. If any kind of chat will be incorporated into the application, a voice-to-text-messenger should be taken into consideration.

8.3 G.K.3. Movements

- G.K.3.1. Do not demand for unnecessary and/or dangerous movements.
- G.K.3.2. Do not demand for fast and expressive movements.
- G.K.3.3. Extensive or sudden movements should be avoided. Additionally, the player may not be asked to lean backwards in order to trigger certain in-game actions to take age-related physical limitations such as decrements in posture and balance into account. (K. Gerling et al. 2010)

8.4 G.K.4. Games

- G.K.4.1. Creating a design that is suitable for end users will guarantee its use.
- G.K.4.2. The simplicity and ease-of-use of controllers, displays and software is a basic requirements. Ease-of-use should not be confused with simple or boring games.
- G.K.4.3. Customizability according to functional abilities (physical and cognitive) is essential for use by the older persons.
- G.K.4.4. It must be kept in mind that many older persons may have problems with balance and/or mobility when the idea is to work with their bodies.
- G.K.4.5. Professionals consider video games motivating and suitable for their interventions.
- G.K.4.6. It is recommended that therapeutic intervention specialists or family members be able to customize the options, reducing the need for the older person to make adjustments.

- G.K.4.7. The games themes should not be specifically for older persons, but based on their preferences and adaptable to their functional abilities.
- G.K.4.8. Bring users closer to outdoor environments (parks, beach, etc.) because some of them cannot easily access in the “real life”.
- G.K.4.9. Due to the target audience’s lack of previous gaming experience, games should focus on simple interaction mechanisms and provide the player with constructive criticism to avoid frustration and foster an enjoyable player experience. (K. Gerling et al. 2010)

8.5 G.K.5. Training, instructions, difficulty levels and learning

- G.K.5.1. Instructions should be presented with the option of written and/or spoken mode (National Institute of Aging in USA).
- G.K.5.2. The mirror effect and the use of avatars increase the user learning process for older people.
- G.K.5.3. Level of difficulty should not be associated with ease-of-use. All players should have access to all levels of difficulty if they so wish.
- G.K.5.4. The level and intensity of training should be configurable to individual characteristics.
- G.K.5.5. Progressively increases in difficulty to avoid boredom.
- G.K.5.6. Having a history that allows monitoring users.
- G.K.5.7. Older players should be given the possibility of individually adjusting the level of difficulty and the game speed (K. Gerling et al. 2010)

8.6 G.K.6. Avatar

- G.K.6.1. Avatar configuration has to be simple.
- G.K.6.2. It is not necessary that exist many avatars, it can be several models and user select one of them.
- G.K.6.3. It is not necessary the avatar looks like the user.
- G.K.6.4. Avoid many aesthetic options.
- G.K.6.5. Always must be located in the same place on the screen.
- G.K.6.6. It should be possible to put the user name.

8.7 G.K.7. Posture/Position

- G.K.7.1. Offer exercises that users can do seated.
- G.K.7.2. Give exact feedback on how to correct posture/position. It is essentially necessary to correct the wrong posture or position of the seniors; to explain, how exactly it is done correctly and what effects the wrong posture can have.
- G.K.7.3. Demonstrate the correct posture position to the users.

8.8 Summary

Table 11. Summary of General Kinect Requirements

Requirement	Description
G.K.1.	Gesture control
G.K.1.1.	Give precise and simple instructions
G.K.1.2.	Consider mobility problems and range of motion of each body part
G.K.1.3.	Calibrate the Kinect sensor sensitivity
G.K.1.4.	Avoid unnecessary functions and visual stimulation
G.K.2.	Voice Control
G.K.2.1.	Concise feedback for voice control
G.K.2.2.	Voice-to-text messenger function
G.K.3.	Movements
G.K.3.1.	Do not demand for unnecessary and/or dangerous movements
G.K.3.2.	Do not demand for fast and expressive movements
G.K.3.3.	Extensive or sudden movements should be avoided
G.K.4.	Games
G.K.4.1.	Creating a design that is suitable for end users will guarantee its use
G.K.4.2.	Simplicity and ease-of-use of controllers, displays and software
G.K.4.3.	Customizability according to functional abilities (physical and cognitive)
G.K.4.4.	Many older persons may have problems with balance and/or mobility
G.K.4.5.	Professionals consider video games motivating and suitable for their interventions
G.K.4.6.	Customize the options
G.K.4.7.	The games themes should not be specifically for older persons, but based on their preferences and adaptable to their functional abilities
G.K.4.8.	Bring users closer to outdoor environments (parks, beach, etc.)
G.K.4.9.	Games should focus on simple interaction mechanisms and provide the player with constructive criticism
G.K.5.	Training, instructions, difficulty levels and learning
G.K.5.1.	Instructions should be presented with the option of written and/or spoken mode
G.K.5.2.	The mirror effect and the use of avatars
G.K.5.3.	Level of difficulty should not be associated with ease-of-use
G.K.5.4.	The level and intensity of training should be configurable
G.K.5.5.	Progressively increases in difficulty to avoid boredom
G.K.5.6.	Having a history that allows monitoring users
G.K.5.7.	Level of difficulty and game speed
G.K.6.	Avatar
G.K.6.1.	Avatar configuration has to be simple
G.K.6.2.	It is not necessary that exist many avatars
G.K.6.3.	It is not necessary the avatar looks like the user
G.K.6.4.	Avoid many aesthetic options
G.K.6.5.	Always must be located in the same place on the screen
G.K.6.6.	It should be possible to put the user name
G.K.7.	Posture/Position
G.K.7.1.	Offer exercises that users can do seated
G.K.7.2.	Give exact feedback on how to correct posture/position
G.K.7.3.	Demonstrate the correct posture position to the users

9 General requirements of remote control

9.1 G.R.1. Buttons size

- G.R.1.1. The buttons should be sufficiently large to enable older people press them without mistakes.
- G.R.1.2. The buttons should be sufficiently separated to avoid confusion.

9.2 G.R.2. Number of buttons

- G.R.2.1. The number of buttons should be the minimum required.

9.3 G.R.3. Functionality

- G.R.3.1. Each button must have a unique function.
- G.R.3.2. Avoid simultaneous pressing of multiple buttons to perform an action and pressing twice in succession (National Institute of Aging in USA).
- G.R.3.3. Avoid simultaneous manipulations, e.g. pushing and rotating.
- G.R.3.4. Avoid making the user hold a control in a specific position for periods of time.
- G.R.3.5. Avoid controls which limit or restrict the handedness or grip of the user.
- G.R.3.6. Controls should be designed to compensate for limitations in fine motor control (e.g. tremors) capabilities.
- G.R.3.7. Keys should be designed and arranged in such a way to avoid activation by mistake.

9.4 G.R.4. Shape

- G.R.4.1. Buttons should be shaped to assist finger positioning and button actuation.
- G.R.4.2. The control shape can influence on user perception
- G.R.4.3. Try to make it so the controller can be operated with one hand (National Institute of Aging in USA).

9.5 G.R.5. Visual and touch aspects

- G.R.5.1. Controls should have high contrast between letters control and the control background.
- G.R.5.2. Controls should have visual contrast between the controls and the body of the control box.
- G.R.5.3. Raised letters should be used.
- G.R.5.4. The symbols must be easily identifiable.
- G.R.5.5. The controls surface should not be slippery.
- G.R.5.6. Configurable sensitivity controls. Possibility of adjusting the sensitivity of the controls, to make them more or less sensitive.

9.6 G.R.6. Button force

- G.R.6.1. Controls should be movable with the minimum force required (within the constraints of the operation being performed)
- G.R.6.2. The minimal activation force will depend on control type.

9.7 G.R.7. Feedback

- G.R.7.1. Tactile feedback
    - G.R.7.1.1. The minimal thresholds to discriminate textures depends on particle size and high.
    - G.R.7.1.2. Control shapes should have angles in order to make easier its distinction for elder people. Elder people distinguish better circles and squares.
    - G.R.7.1.3. Tactile confirmation should consist in a go down movement when control is push.
- G.R.7.2. Auditory feedback
    - G.R.7.2.1. This feedback can involve spoken messages or only controls sounds related with pushing.
    - G.R.7.2.2. There should be an audio and visual indication when the controller is switched on or off.

9.8 G.R.8. Battery

- G.R.8.1. The battery should be easy to install or replace.
- G.R.8.2. Provide both an audio and visual indication of battery status.
- G.R.8.3. The control box should emit a 'beep' or tactile response when the charger is connected correctly.
- G.R.8.4. It should not be possible to connect the charger incorrectly.
- G.R.8.5. The charger should not be tricky to use or difficult to handle (i.e. small awkward parts can be difficult to assemble for someone with reduced manual dexterity).
- G.R.8.6. It should not be possible to connect the charger incorrectly.

9.9 Summary

Table 12. Summary of General Remote Control Requirements

Requirement	Description
G.R.1.	Buttons size
G.R.1.1.	The buttons should be sufficiently large
G.R.1.2.	The buttons should be sufficiently separated
G.R.2.	Number of buttons
G.R.2.1.	The number of buttons should be the minimum required
G.R.3.	Functionality
G.R.3.1.	Each button must have a unique function
G.R.3.2.	Avoid simultaneous pressing of multiple buttons to perform an action and pressing twice in succession
G.R.3.3.	Avoid simultaneous manipulations
G.R.3.4.	Avoid making the user hold a control in a specific position for periods of time
G.R.3.5.	Avoid controls which limit or restrict the handedness or grip of the user
G.R.3.6.	Limitations in fine motor control capabilities
G.R.3.7.	Avoid activation by mistake
G.R.4.	Shape
G.R.4.1.	Assist finger positioning and button actuation
G.R.4.2.	The control shape can influence on user perception
G.R.4.3.	Try to make it so the controller can be operated with one hand
G.R.5.	Visual and touch aspects
G.R.5.1.	High contrast between letters control and the control background
G.R.5.2.	Visual contrast between the controls and the body of the control box
G.R.5.3.	Raised letters should be used
G.R.5.4.	The symbols must be easily identifiable
G.R.5.5.	The controls surface should not be slippery
G.R.5.6.	Configurable sensitivity controls
G.R.6.	Button force
G.R.6.1.	Controls should be movable with the minimum force required
G.R.6.2.	The minimal activation force will depend on control type
G.R.7.	Feedback
G.R.7.1.	Tactile feedback
G.R.7.2.	Auditory feedback
G.R.8.	Battery
G.R.8.1.	The battery should be easy to install or replace
G.R.8.2.	Provide both an audio and visual indication of battery status
G.R.8.3.	The control box should emit a 'beep' or tactile response when the charger is connected correctly
G.R.8.4.	It should not be possible to connect the charger incorrectly
G.R.8.5.	The charger should not be tricky to use or difficult to handle
G.R.8.6.	It should not be possible to connect the charger incorrectly

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