ELDERLY SAUDI ARABIANS' PERCEPTIONS AND ATTITUDES TOWARDS USING AMBIENT ASSISTED LIVING TECHNOLOGIES

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Abstract- The growth in the ageing population is rapidly increasing and their care cost will be a challenging issue in the future. The number of elderly people worldwide (defined as those age 60 years and older) was 202 million in 1950; this number has since quadrupled to reach 841 million, and is expected to triple again by 2050. Moreover, the elderly population in the Kingdom of Saudi Arabia (KSA) is expected to increase by 2055. These demographic changes raise a number of challenges related to their quality of life, including social communication and care, health, autonomy and utilisation of institutional services. These challenges require novel approaches to dependable self-adapting technological innovations. Ambient Assisted Living (AAL) aims to improve the quality of life for elderly people and provide them with technologies and services that support their daily activities, and help them to live longer and stay at home independently. The aims of this research are to review Ambient Assisted Living Technology, to provide examples of technologies and applications, and to examine attitudes and perceptions of elderly people towards using AAL technologies in KSA by using a quantitative analysis. The results show that elderly Saudi Arabians are willing and intending to accept and use AAL technologies.

Keywords- Ambient Assisted living, Elderly People, Ambient Intelligent, Kingdom of Saudi Arabia

I. INTRODUCTION

The World Ageing Population Report in 2013 stated that the number of elderly people was 202 million in 1950; this number quadrupled in 2013 to reach 841 million, and is expected to triple again by 2050 [1]. The basis for defining elderly people, or senior citizens, varies. The definition can be classified into three categories: 1) chronology, 2) change in social role, and 3) change in capabilities.

The chronological age is the most common system in practice as outlined by the World Health Organisation (WHO). WHO and the United Nations define elderly as people 60 years and above [1][2]. Further, in many countries with high incomes, they refer to elderly people as those whose age is over 65, and consequently is the age for qualification for social security benefits [3]. However, the current research will refer to elderly people as those who are 60+, according to the retirement policy in KSA [4].

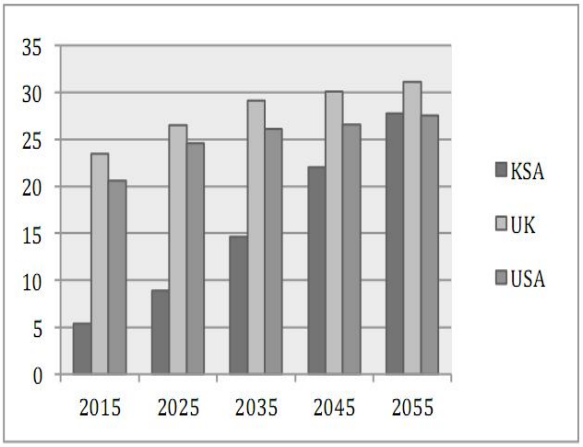


Fig. 1: Projected Ageing Population in KSA, UK, USA (In Percentage)

The United Nations estimates that by 2055, the 60+ elderly populations will increase by 27.8% in KSA, 31.1% in the United Kingdom (UK) and 27.5% in the United States of America (USA), as shown in Fig. 1. These demographic changes raise a number of challenges related to their quality of life, including social communication and care, health, autonomy and utilisation of institutional services [5].

These challenges require novel approaches for dependable self-adapting technological innovations. AAL is advocated as a potential form of technology, which can evolve to meet the requirements of individuals as the needs and circumstances of the elderly change. This paper is structured as follows: Section II presents the health sector in KSA. Section III discusses the state of the art of AAL technologies. Methodology and results are discussed in Section IV. Section V provides the discussion. Finally, the conclusion and future work are presented in Section VI.

II. HEALTH SECTOR IN KSA

The Ministry of Health (MOH) in KSA is the main provider of health care services. It provides Primary Health Care (PHC) services through a network of healthcare centres, which included 2,259 centres in 2013. The MOH supervises and manages 38,970 beds [6]. The Home Health Care Program is implemented by 180 hospitals with 33,813 beneficiaries [6]. The percentage of elderly people who attend PHC is approximately 20.7% [7]. On some occasions, this leaves, elderly people being unable to be allocated beds at the hospitals [8]. Therefore, AAL technologies are advocated to overcome these problematic issues faced by elderly people.

III. THE STATE OF THE ART

A. Introduction

Ambient Assisted Living (AAL) "relates to intelligent systems of assistance for a better, healthier and safer life in the preferred living environment and covers concepts, products and services that interlink and improve new technologies and the social environment, with the aim of enhancing the quality of life for all elderly people in all stages of their life" [9]. The origins of AAL can be attributed to home automation and assistive domesticity [10]. The overall goal of AAL solutions is to employ the Ambient Intelligent (AmI) concept and technologies to empower elderly people with specific needs, to improve the quality of life, to support their daily activities, to live longer in their domestic environment and to stay at home independently [11]. Considerable research has been undertaken to study, innovate and develop AAL solutions and ambient intelligence technology to assist elderly people to live independently and longer [12][9][13], and to improve their quality of life, yet reduce the cost of the public health system [14][15]. The use of sensors and communication devices in AAL can provide elderly people with the means for independence [12][16][17] while maintaining their safety and comfort [18]. Ambient intelligence is an emerging discipline that applies sensors and sensor networks, pervasive computing, and artificial intelligence to make the environment sensitive to the needs of the elderly population. "The International Summit Conference on Independent Living in 1999 adopted what is known as the Washington Declaration. This states that '…all human life has value and ... every human being should have meaningful options to make choices about issues that affect our lives'. 'Independent living' is therefore closely associated with the words 'choice and control' and is usually applied to both the environment in which someone lives and the assistance they might need in order to go about their daily lives" [19].

B. AAL Technologies

Many technologies and projects have been designed and deployed as smart environments that can assist elderly people in living independently [20]. Recent AAL advancements include smart homes, assistive robotics, mobile devices, e-textile and wearable sensors [21]. The concept of the smart home is to allow facilities to provide home care for elderly people in an encouraging and cost-effective manner. All smart homes can be placed into different categories depending on the equipment and systems installed. The main benefits of smart homes are improving comfort, performing medical rehabilitation, supervising mobility and physiological parameters, providing therapy, delivering convenience, improving security, and saving energy [22][23]. For example, an assisted living smart home provides elderly people with the help necessary to be independent; it can take action when unusual activities happen, such as contacting a nominated career [24]. Many technologies and projects have been deployed and tested, such as the LOBIN project, which maintains the location and measures the respiratory rate of elderly people in medical environments remotely [25]. GatorTech Smart House locates its occupants and manages the environment, and assesses their mobility in an attempt to improve lifestyle [26]. HOME project uses infrared and biosensors to deliver information to healthcare specialists about elderly people living in the house [27]. Assistive robots can provide help with daily activities, such as bathing, eating, toileting, dressing, mobility, navigating, delivering therapy and home maintenance, and monitoring [28]. Meng and Lee (2006) defined the assistive robot as a collaboration between a user and a device to perform some physical activities in the user's environment. Alternatively, it is a tool that assists and supports users in their activities in hospitals or in their homes [30]. Floor Cleaning Robots cleans floors for elderly people, [31], while Mamoru is a robot that helps elderly people in their daily activities [32]. These are just some examples of technologies that have been deployed and tested. Mobile health system is an application that monitors users' health. It uses biosensors to gather and analyse data. It is a terminal device that has an application installed to connect with a tele-monitoring service remotely [33]. Studies have examined these mobile apps, such as Heart Saver, which is a portable medical device that monitors a real-time ECG and detects cardiac pathologies. MEDIC is a software architecture, which manages and enables sensor networks to predict diseases through PDAs and mobile phones [25]. OnkoNet is an agents-based architecture, which helps consumers cope with the difficulty of using medical care services via mobile devices [27]. Berglin (2013) described a smart textile as a textile structure that responds to stimuli from its environment. The technique uses a monitoring unit to react to stimuli. However, in a more complicated situation, a processing unit can be used to increase its capability to analyse data. Sensors, actuators, and the controlling unit are the essential parts of the smart textile system. The main idea of the smart textile is to design textiles with smart accessories and computing power to assist its users. Many examples of these technologies have been implemented and tested; for instance, BIOTEX is a biosensor made using e-textiles, which assists elderly people to detect sodium, pH and conductivity and measure physiological parameters and the chemical composition of sweat [25]. 'Magic' monitors the heart rate and breathing in people while they are conducting their day-to-day activities. MERMOTH Project is a piece of clothing that measures skin temperature and respiration using a respiratory

inductance plethysmograpgy method [35]. Oricalco Smart Shirt is an etextile woven into ordinary fabric, which when heated, removes the creases in the fabric. SOFTswitch is a fabric that uses textile pressure sensors to decrease the electronic resistance [36]. Wearable systems are designed to be worn throughout regular day-to-day activities. Wearable sensors can be attached onto clothing and jewellery, or accessories such as torso belts, gloves, harnesses or arm, forearm and wrist bands [26][37]. Wearable designs, however, are constrained by size, weight, and power consumption [38].

Smart wearable systems (SWS) might embrace a variety of wearable or attached devices containing sensors, actuators, power supplies, smart fabrics, wireless communication networks (WCNs), multimedia devices, processing units, decision support, user interfaces, software, and algorithms to capture data. The role of such a system is to measure the vital signs of the user, including skin and body temperature, heart rate, arterial blood pressure, blood electroencephalograms (EEGs), electrocardiograms (ECGs), oxygen saturation (SpO2), and respiration rate [26].

For example, MOPET is a wearable technology, which monitors the wearer's fitness activities [25]. Smart vest is a wearable device, which gathers certain bio-signals to monitor a wearer's psychological state. EmoSense is a watch-like device, which monitors skin temperature, electro dermal activity and cardiac frequency [37]. LifeGuard is a wearable system designed for use in space. It monitors respiration rate, heart rate, body movement, and oxygen saturation of the wearer [35].

IV. METHODOLOGY AND RESULTS

A. Research Methodology

Research methodology is defined as a way to answer or solve research questions [39]. Research approaches can be classified into three approaches: quantitative, qualitative and mixed approaches [40]. Based on the aim of this research, a quantitative method approach was used to analyse and evaluate the predictive outcomes and results. This research involved the use of primary data. Quantitative research creates numerical data and is correlated with a positivist posture and beliefs that reality is measured by questions, allowing single and multiple responses and a scale representing a set of options. Questionnaires were delivered to participants via:

1) an online questionnaire using qualtrics.com, targeting elderly people in the general population, and
2) E-mails sent to retirement committees to include more retired participants age 60 years and above.

Table 1: Cronbach's Alpha

Reliability Statistics	
Cronbach's Alpha	N of Items
.715	39

1) Data Collection: A questionnaire was designed in order to extract attitudes and perceptions of elderly people regarding the level of acceptance of the use of AAL technologies in KSA, and a pilot was tested by the researchers. The questionnaire was available in English and Arabic languages. The questionnaire was designed of three types of questions; firstly, three questions using a Likert scale measurement; the Likert scale (consisted of a five-point scale: strongly agree:5 to strongly disagree:1), secondly, four Yes/No questions, and finally, six multiple options questions. It was expected would take approximately fifteen minutes to complete. The questionnaire was divided into four main sections: 1) demographics of participants, 2) culture and social interactions, 3) AAL technologies, and 4) professional carers.
2) Data Analysis: The data was tabulated, classified and arranged as per the study objectives. Then, it was coded using computer-aided software and subjected to quantitative analysis. Quantitative data were analyzed through descriptive statistics in the form of frequencies and percentages using the computer-aided software Statistical Package for Social Sciences (SPSS) version 20 and Microsoft Excel software. Cronbach's alpha measures the eliability of the questionnaire. We conducted a Cronbach's alpha test, and the results are shown in Table 1. The alpha value for the entire questionnaire is 0.715; this means that the formulated questionnaire is acceptable.

B. Results and Findings

This section provides the frequencies and descriptive statistics related to the demographics of participants who completed the questionnaire. All the positive responses were added together meaning the strongly agree values were added to the agree values similarly with all the negative responses; strongly negative and negative were reported as one value.

a) Demographic of the participants: The total number of responses was 194. According to the descriptive analysis, male respondents were the majority (63.9%), while 36.1% of participants were female. The age group 60–69 years old made up 72.2% of respondents, the age group 70–79 made up 18.6%, and 9.3% of respondents were above 80 years old. This indicates that the age group between the ages of 60–69 contained the most participants in the study. 94.3% of the participants were Saudi, while 5.7% of the participants were Non-Saudi.

Table 2: Demographics of Participants (n=194)

Variables		Frequency	Percentage
Gender	Male	124	63.9
	Female	70	36.1
Age Group	60–69	140	72.2
	70–79	36	18.6
	80+	18	9.3
Nationality	Saudi	183	94.3
	Non-Saudi	11	5.7
Current living status	Living alone	17	8.8
	Living with family members	160	82.5
	Living with relatives	14	7.2
	Living with friends	2	1
	Living in social care home	1	0.5

Most of the participants live with their family members (82.5%), while 8.8% of them live alone (see Table 2).

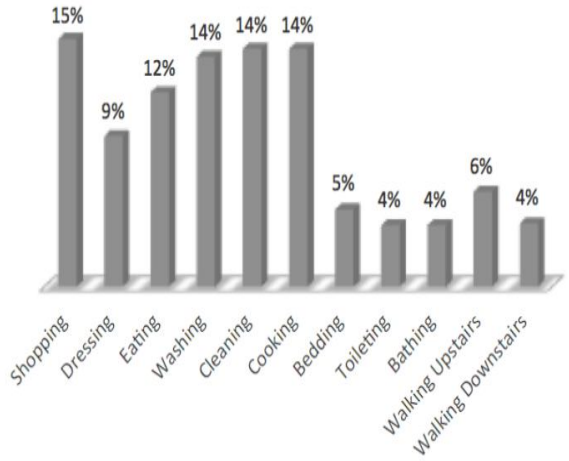


Fig. 2a: Daily Activities requiring assistance

b) Daily Activities: Shopping (15%) is the activity for which the most participants want to receive assistance. Cooking, washing and cleaning come in the second stage of importance to the participants with 14%. Eating and dressing are essential to elderly people with (12%) and (9%) respectivelly needing assistance as shown in Fig. 2a.

c) Perceptions and attitudes: The findings indicated that the majority of the elderly intend to use AAL technologies. The findings reveal that 46% of participants use Smart Devices (e.g. mobiles and Ipad. etc), whilst (30%) use Internt/Email and (24%) prefer using PC/Laptop as indicated in Fig. 2b. According to the questionnaire, it is quite evident that the majority 64% of the elderly agreed (52% agreed and 12% strongly agreed) that they would prefer to be assisted in their daily activities by technology communication rather than by human interaction (Fig. 3a). The study showed that 76% of participants liked (58% liked and 18% strongly liked) using AAL technologies, whereas only 47% liked to be visited by a carer. However, 39% of participants disliked to be seen by professionals compared with (8%) disliked using AAL technologies (Fig. 3b).

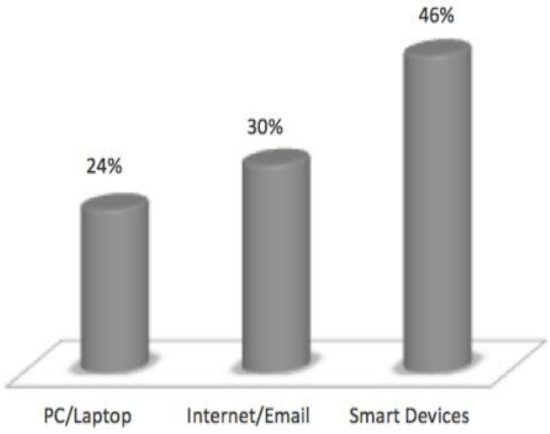


Fig. 2b: Preferences of technologies usage

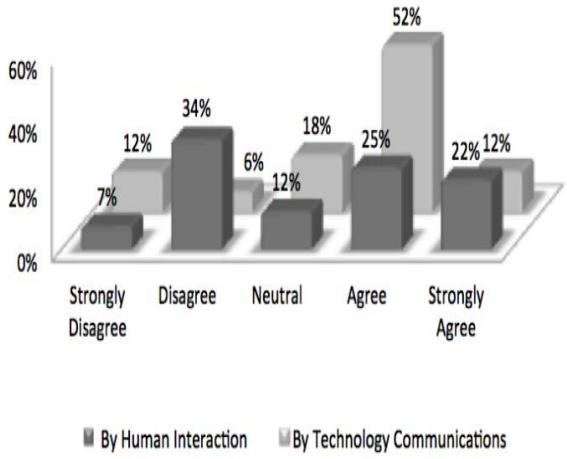


Fig. 3a: Assisting by technology or human Figure

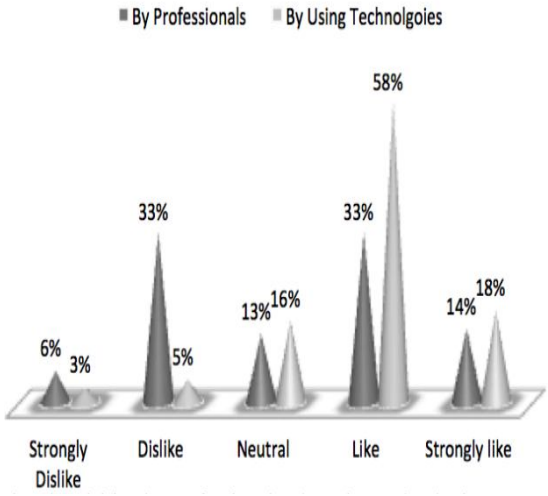
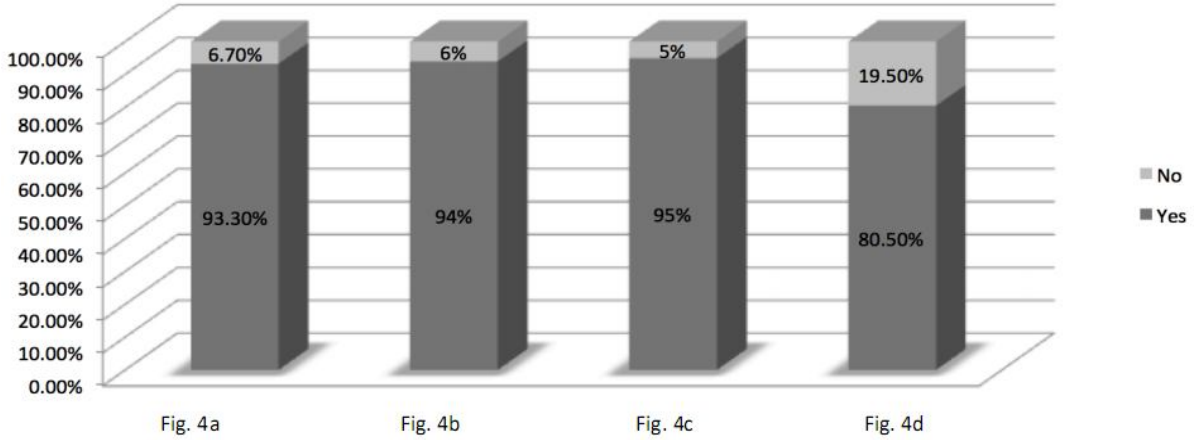


Fig. 3b: Visiting by professional or by using technologies



The analysis of the questionnaire as outlined in Fig. 4a to 4d also demonstrated the willingness of elderly people
towards using AAL technologies as illustrated as follows:

- 93.3% of participants wished to use technology that has a warning system to remind them to do some activities, such as taking medication or drinking water, as shown in Fig. 4a .
- 94% of participants agreed with having technology that immediately contacts the care provider by simply pressing a button, as presented in Fig. 4b.
- 95% of participants liked to have a technology that switches off appliances automatically when not in use (e.g., heater, microwave, stove), as illustrated in Fig. 4c.
- 80.5% of participants desired to be trained on new technologies that assist them in their daily activities, as described in Fig. 4d.

Fig. 5 presents the categories of AAL mentioned in the literature review and the results that were retrieved
from the questionnaire. The results show that a high percentage (75.2% on average) of participants would favoured to use the AAL technologies, such as smart homes, assistive robotics, mobile devices, e-textiles, and
wearable devices. 78% of elderly participants preferred using mobile devices, 78% of them wished to be assisted
by assistive robotics, 77% of participants would like to adopt the wearable sensors, 75% of participants are interested in equipping their homes with smart devices, and 68% of elderly would use e-textiles. These results are
shown in Fig. 5.

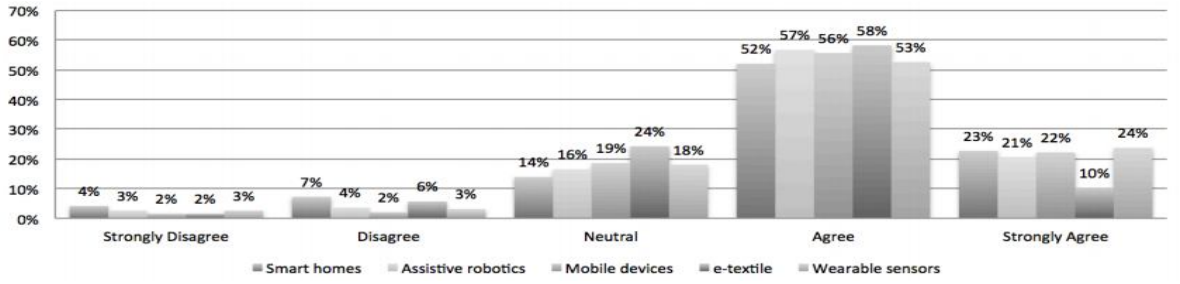


Fig. 5: AAL technologies

V. DISCUSSION

In this study, we investigated the willingness and intentions of elderly people in the KSA to accept and use
AAL technologies. We found that most elderly people have positive attitudes towards technology indicated
sophisticated interests in adopting and using AAL technology. Amr et al. (2014) stated that Saudi Arabian culture has traditional social values compared to other countries, which are completely different regarding taking care of
elderly people. Thus, as shown in Table 2, only 8.8% of the elderly live alone. Hence, AAL technologies provides elderly people with a major benefit: to live independently by increasing their autonomy and assisting them with daily activities that support promoting the independence of elderly people in their own homes or preferred
environment[18][42][43]. Communications and Information Technology Commission (CITC) in KSA conducted a survey of 1,324 citizens in order to understand the adoption of smart devices. This survey showed that a significantly high percentage (82%) of mobile users have access to smart devices [44]. It is

surprising that elderly Saudi Arabians are overall willing and intending to use AAL technologies. However, the study reveals that there is a considerable number of elderly (n=91, 46.8%) still wanting to be assisted by human interaction and 7.4% who wished to be visited by carers. This indicates that some of them are still unconvinced about the benefit of AAL technologies. 80.5% of the elderly who participated in this study (n=156) are agreeable when it comes to being trained on new technologies. This is a good indicator to motivate health care providers to deliver AAL technologies to elderly people, and that AAL technologies are ready to be adopted and accepted by the elderly of Saudi. A review of the literature reveals no studies regarding AAL technologies in KSA, which demonstrates the need for researchers to conduct more detailed studies in this area. Results showed that Saudi could benefit from AAL technologies and increase the elderly's independence and decrease the health costs.

VI. CONCLUSION AND FUTURE WORK

Ambient Assisted Living Technology could be an essential part of providing elderly people with the independence of living, the extension of life and decrease the cost of healthcare. The current study used a quantitative approach to investigate the perceptions and attitudes of elderly people in the Kingdom of Saudi Arabia regarding the use of AAL technologies. The participants were 60 years old and over. An online questionnaire was the instrument used for this study. The results show that participants need assistance with shopping (15%), cooking (14%), washing (14%) and cleaning (14%). They preferred using smart devices (46%) comparing with other devices such as PC/Laptop. Further, 64% of participants like to be assisted by technologies rather than by human (47%) and 76% of participants liked using AAL technologies rather than professional visits (47%). The findings demonstrated that the elderly are significantly willing and intending to accept and use AAL technologies. They showed that AAL technologies have potential to be adopted by the elderly. Overall, the results showed most of elderly people were not resistance to using AAL technologies and are ready to be trained in AAL technologies. Future work should focus on a large number of samples and emphasize the results of more qualitative studies. These could be in the form of, for example, interviews and focus groups with elderly people and healthcare providers so that researchers are able to discover deeper and more tangible insights into the perceptions and attitudes.

REFERENCES

[1]. [1] United Nations, Department of Economic and Social Affairs, Population Division (2013). World

[2]. Population Ageing 2013 Report. [Online]. 2013. United Nations publication. Available from:

[3]. http://www.un.org/en/development/desa/population /publications/pdf/ageing/WorldPopulationAgeing20

[4]. 13.pdf. [Accessed: 12 January 2016].

[5]. [2] WHO, 'Health statistics and health information systems Definition of an older or elderly person Proposed Working Definition of an Older Person in Africa for the', The World Health Organisation, 1875. .

[6]. [3] F. Butsch, D. Flugsicherung, and G. Dfs, 'Mental health of older adults, addressing a growing concern', 2013.

[7]. [4] H. M. Alsufiani, T. A. Kumosani, D. Ford, and J. C. Mathers, 'Dietary patterns, nutrient intakes, and nutrional and phusical activity status of Saudi older adults: a narrative review', J. Aging Res. Clin. Pract., vol. 4, no. 1, pp. 2–11, 2015.

[8]. [5] E. Klima, A. Jainszewska, and S. Mordwa, 'Elderly people and their quality of life- challenges for geogtaphy', Sp. - Soc. - Econ. 04/2014; 13173-189, 2014.

[9]. [6] MOH (2013), 'Health Statistics Annula Book', Saudi Arabian Ministry of Health. [Online]. Available: http://www.moh.gov.sa/en/ministry/statistics/boo k/documents/1433.pdf. [Accessed: 12-Jan-2016].

[10]. [7] M. H. Al-Doghether, 'Prescribing in primary care for the older people', Saudi Med J 2004, vol. 966, no.

[11]. December, pp. 488–492, 2004.

[12]. [8] MOH. (2013) 'Facts Achievements Report', Saudi Arabia Ministry of Health. [Online]. Available:

[13]. http://www.moh.gov.sa/Ministry/About/Documents /NEW-1434-1430.pdf. [Accessed: 12-Jan-2016].

[14]. [9] The European Ambient Assisted Living innovation Platform, 'Ambient Assisted Living Roadmap', 2009.

[15]. [10] F.-R. Francisco and R. Paolo, 'Ambient Assisted Living', IEEE Comput. Soc., 2015.

[16]. [11] A. Queirós, A. Silva, J. Alvarelhão, N. P. Rocha, and A. Teixeira, 'Usability, accessibility and ambientassisted

[17]. living: a systematic literature review', Univers. Access Inf. Soc., pp. 1–10, 2013.

[18]. [12] J. Augusto and P. Mccullagh, 'Ambient intelligence: concepts and applications', Comput. Sci. Inf. Syst.,

[19]. vol. 4, no. 1, pp. 1–27, 2007.

[20]. [13] J. Nehmer, A. Karshmer, M. Becker, and R. Lamm, 'Living Assistance Systems - An Ambient

[21]. Intelligence Approach -', Proc. 28th Int. Conf. Softw. Eng., 2006.

[22]. [14] T. Kleinberger, M. Becker, E. Ras, and A. Holzinger, 'Ambient Intelligence in Assisted Living : enable

[23]. elderly people to handle future interfaces', Springer-Verlag Berlin Heidelb., pp. 103–112, 2007.

[24]. [15] R. Costa, D. Carneiro, P. Novais, and L. Lima, 'Ambient Assisted Living', 3rd Symp. Ubiquitous

[25]. Comput. Ambient Intell., pp. 1–10, 2008.

[26]. [16] M. Bick and T.-F. Kummer, 'Ambient Intelligence', Bus. Inf. Syst. Eng., vol. 2, no. 5, pp. 317–320, Aug.

[27]. 2010.

[28]. [17] J. a. Botia, A. Villa, and J. Palma, 'Ambient Assisted Living system for in-home monitoring of healthy

[29]. independent elders', Expert Syst. Appl., vol. 39, no. 9, pp. 8136–8148, Jul. 2012.

[30]. [18] H. Sun, V. De Florio, N. Gui, and C. Blondia, 'Promises and challenges of Ambient Assisted Living Systems', 2009 Sixth Int. Conf. Inf. Technol. New Gener., pp. 1201–1207, 2009.

[31]. [19] J. Morris, 'Barriers to Independent Living: A scoping paper prepared for the Disability Rights

[32]. Commission Jenny Morris June 2003.', 2003.

[33]. [20] O. Grady, J. Michael, O. Hare, and G. M. P. M. P. Greg, 'Towards evolutionary Ambient Assisted

[34]. Living systems', J. Ambient Intell. Humaniz. Comput. 1 15-29, pp. 0–32, 2010.

[35]. [21] P. Rashidi and A. Mihailidis, 'A survey on Ambient-Assisted Living tools for older adults', IEEE J.

[36]. Biomed. Heal. Informatics, vol. 17, no. 3, pp. 579– 590, May 2013.

[37]. [22] D. Ding, R. a. Cooper, P. F. Pasquina, and L. Fici-Pasquina, 'Sensor technology for smart homes',

[38]. Elsevier Irel. Ltd., vol. 69, pp. 131–136, 2011.

[39]. [23] M. Chan, D. Estève, C. Escriba, and E. Campo, 'A review of smart homes-present state and future
[40]. challenges', Comput. Methods Programs Biomed., vol. 91, pp. 55–81, 2008.
[41]. [24] N. Balta-Ozkan, R. Davidson, M. Bicket, and L. Whitmarsh, 'Social barriers to the adoption of
[42]. smart homes', Energy Policy, vol. 63, pp. 363–374, 2013.
[43]. [25] M. M. Baig, H. Gholamhosseini, and M. J. Connolly, 'A comprehensive survey of wearable and wireless
[44]. ECG monitoring systems for older adults', Med. Biol. Eng. Comput., vol. 51, pp. 485–495, 2013.
[45]. [26] M. Chan, D. Estève, J.-Y. Fourniols, C. Escriba, and E. Campo, 'Smart wearable systems: Current status
[46]. and future challenges', Artif. Intell. Med., vol. 56, no. 3, pp. 137–156, 2012.
[47]. [27] A. Arshad, S. Khan, A. Alam, F. Ahmad, and T. R, 'A study on health monitoring system: recent
[48]. advancment', IIUM Eng. J., vol. 15, no. 2, 2014.
[49]. [28] J. Broekens, M. Heerink, and H. Rosendal, 'Assistive social robots in elderly care: a review', Gerontechnology, vol. 8, no. 2, pp. 94–103, 2009.
[50]. [29] Q. Meng and M. H. Lee, 'Design issues for assistive robotics for the elderly', Adv. Eng. Informatics, vol. 20, pp. 171–186, 2006.
[51]. [30] D. Feil-Seifer and M. J. Matarić, 'Defining socially assistive robotics', Proc. 2005 IEEE 9th Int. Conf. Rehabil. Robot., vol. 2005, pp. 465–468, 2005.
[52]. [31] W. Patent and T. Office, 'A technical analysis of autonomous floor cleaning robots based on US granted patents', Eur. Int. J. Sci. Technol., vol. 2, no. 7, 2013.
[53]. [32] Y. H. Wu, C. Fassert, and A. S. Rigaud, 'Designing robots for the elderly: Appearance issue and beyond', Arch. Gerontol. Geriatr., vol. 54, pp. 121– 126, 2012.
[54]. [33] J. Morak, H. Kumpusch, D. Hayn, R. Modre-Osprian, and G. Schreier, 'Design and evaluation of a telemonitoring concept based on NFC enabled mobile phones and sensor devices', Inf. Technol.
[55]. Biomed. IEEE Trans., pp. 1–1, 2011.
[56]. [34] L. Berglin, 'Smart textiles and wearable technology', 2013.
[57]. [35] A. Pantelopoulos and N. G. Bourbakis, 'A survey on wearable sensor-based systems for health monitoring and prognosis', IEEE Trans. Syst. Man Cybern. Part C Appl. Rev., vol. 40, no. 1, pp. 1–12, 2010.
[58]. [36] M. Engin, A. Demirel, E. Z. Engin, and M. Fedakar, 'Recent developments and trends in biomedical sensors', Meas. J. Int. Meas. Confed., vol. 37, pp. 173–188, 2005.
[59]. [37] E. McAdams, A. Krupaviciute, C. Gehin, E. Grenier, B. Massot, A. Dittmar, P. Rubel, and J. Fayn, 'Wearable sensor systems: the challenges', 2011 Annu. Int. Conf. IEEE Eng. Med. Biol. Soc., pp. 3648–3651, 2011.
[60]. [38] C. N. Scanaill, S. Carew, P. Barralon, N. Noury, D. Lyons, and G. M. Lyons, 'A review of approaches to mobility telemonitoring of the elderly in their living environment', Ann. Biomed. Eng., vol. 34, no. 4, pp. 547–563, 2006.
[61]. [39] C. R. Kothari, Research methodology, methods and techniques. {New Age International (P) Limited,
[62]. 2004.
[63]. [40] J. W. Creswell, 'Research design.', SAGE Publ. Int. Educ. Prof. Publ., vol. 86, pp. 71–72, 2003.
[64]. [41] M. Amr, A.-H. El-Gilany, K. Sallam, and T. Shams, 'Characteristics of patients with dementia attended
[65]. in a tertiary outpatient clinic in Eastern region, Saudi Arabia', J. Psychiatry, vol. 17, no. 6, 2014.
[66]. [42] A. Grgurić, 'ICT towards elderly independent living', Aal Forum 2012, pp. 1–8, 2012.
[67]. [43] M. Peruzzini and M. Germani, 'Designing a usercentred ICT platform for active aging', 2014 IEEE/ASME 10th Int. Conf. Mechatron. Embed. Syst. Appl., pp. 1–6, Sep. 2014.
[68]. [44] CITC. (2015). 'ICT Report: Mobility in Saudi Arabia', 2015, Communications and Information Technology Commission, Saudi Arabia. [Online]. Available: http://www.citc.gov.sa/English/Reportsandstudies/ Reports/Documents/IT%20007%20E%20-%20IT%20Report%202014.pdf

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