Adapting a Virtual Assistant Device to Support the Interaction with Elderly People

Manuel Bolaños[1] [a], Cesar Collazos[2] [b] and Francisco Gutiérrez[3] [c]

[1]Universidad de Nariño, Grupo Galeras.net, Pasto, Colombia
[2]Universidad del Cauca, Grupo IDIS, Popayán, Colombia
[3]Universidad de Granada, E.T.S. of Computer and Telecommunication Engineering, Granada, Spain

Keywords: Social Isolation, Technological Isolation, Elderly, Virtual Assistant.

Abstract: Some authors agree that the elderly suffer social and technological isolation, or even exclusion, due to their aging condition, a situation that could worsen in the future, as the trend of higher population growth in the world, so some studies are needed to identify the expectations of such population in terms of the usage and adoption of technology; so, new technological developments implement specific requirements that help them to adapt to their use. This paper presents a study developed for evaluating the technological acceptance of smart virtual assistants by the elderly people. Such a study involves the design and the implementation of a recreational strategy to remember the taking of medications, considering some experiences in the development and implementation of technology for this kind of users.

1 INTRODUCTION

The elderly people face a series of prejudices that make their integration difficult to the new challenges that are found in a digital society, which several studies determine how they adapt to their daily life (Ronning & Solvberg, n.d.), aging takes place in the social context in which the elderly people is living, and today such a population is into a digital environment in which they should have access to all the possibilities that technology offers, in order to participate with greater capacity in a society in which new technologies are increasingly prevalent in different areas of daily life (Loos *et al.*, 2012), in the same way the editors affirm. "It is essential that we recognize the differences and the similarities between younger and older people using new media such as websites, but we also have to pay attention to the various sub-populations, especially within the broader group of senior citizens. Individual differences increase as people age" (Loos *et al.*, 2012).

When reaching a certain age, the fundamental objectives of the elderly people are to have a good state of health, well-being and tranquility of life, guaranteeing in some way to be physically and mentally active (da Silva et al., 2009). This is important considering that one of the main problems of the elderly people is memory loss. Memory loss involves dealing with problems in development and social integration of the elderly people. Due to changes in cognitive processes, the elderly people show notable differences in the way they manifest such changes. Although, there is no scientific evidence available to indicate the relationship of some aspects of cognitive functioning with age, there are two general topics on cognitive aging that are still being investigated: "the first one is that different cognitive variables have different patterns of relations with age, and the second one is that there is large variation in cognitive performance across people at any given age, such that the differences associated with age correspond to only a small proportion of the total variation that exists across people" (Salthouse, 2010).

Stereotypes of culture against aging have an effect on the general well-being and quality of life of the elderly people. Such stereotypes influence how they

[a] https://orcid.org/0000-0002-3077-415X
[b] https://orcid.org/0000-0002-7099-8131
[c] https://orcid.org/0000-0001-6629-7597

291

see themselves, and how they see others, which can affect their social integration. (Dionigi, 2015).

According to the review of 2015, there were 901 million people over 60 years of age or older, which represents 12% of the global population. Such a situation is growing at a rate of 3.26% per year (United Nations, 2015). Currently in developed countries, the number of the elderly reaches 24% (Klimova & Poulova, 2018); in addition, people of 65 years of age or older are expected to represent at least 25% of the European population in 2020, increasing to 40% between 2010-2030 (Shore *et al.*, 2018). According to the review of 2019 from the world population outlook (United Nations, 2019), the fastest growing group are people over 65; therefore, it is expected that by 2050, one in six people will be over 65, representing 16% of the population. In this vein, In North Africa and West Asia, Central and South Asia, East and Southeast Asia, and Latin America and the Caribbean, this population is expected to double by 2050. At that moment in time, in Europe and North America, one in four people would be 65 or older.

The remarkable population growth of the elderly people requires that technology developers pay more attention on these types of population. Every day it is more common that people use different technological devices, either as work items, distraction or for health. Fortunately, the increase in the development of technological assistance devices for the elderly people allows researchers to understand more about how such a population can improve the quality of life for that type of user. In this way, understanding the different forms of adoption and non-adoption of technology, as well as their social impact is important in this historical time. (Neves & Vetere, 2019). Thus, the development of new technologies is necessary, in order to guarantee in some way that older adults will have something that motivates them to use them.

2 TECHNOLOGY FOR THE ELDERLY

Like other technological devices, virtual assistants have become an element of great help to integrate and keep people active, in addition to facilitating the different tasks that are performed day by day (Gutierrez *et al.*, 2017). Intelligent Virtual Assistants such as Alexa's Echo Dot developed by Amazon, Siri from Apple, Google Assistant from Google, Cortana from Microsoft, and Bixby from Samsung, among others, are commercially available with great acceptance in the consumer market (McLaughlin,

2020). Such a technology. It is becoming necessary elements to facilitate the tasks of people's daily lives. However, considering that aging is recognized as a period in which the person experiences numerous changes -due to lifestyle, and social and family system-, continuously influence the various areas of operation (Palloni & McEniry, 2007). Technology and its rapid progress should be used as a tool to reduce the social isolation of the elderly people, and the "digital divide" -as a sort of differences that exist between the societies- closely related with unequal exploitation of ICT must be minimized. Countries of the world do not have the same technological capabilities that allow their inhabitants to use them and keep up with other countries. The main idea is to provide friendly and easy-to-use devices and applications (Syeda & Kwon, 2017).

The elderly has some drawbacks with the use of technology. That is why today people find and are generating diversity of systems and applications adapted to such a type of users, in order to facilitate communication with their social environment, and serve as support for their daily tasks.

With the purpose of knowing the singularities of the design and implementation of technology for the elderly people, some experiences were reviewed, among which are:

Photo Alive, a Web design application, which uses simple and intelligent interfaces that allows family members to connect through different devices and technological means (Syeda & Kwon, 2017).
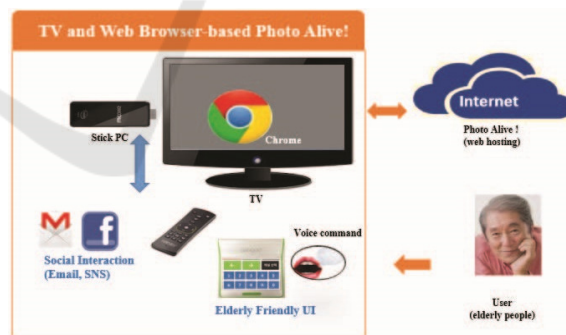

Figure 1: Photo Alive, Interface and interaction techniques.

SocialConnector, it is an ubiquitous system that allows the elderly to interact with other members within their social network using regular social networking services (Gutierrez *et al.*, 2017).

Voice Assistant to Remind Pharmacologic Treatment in Elders, it is a voice assistant that remembers the daily pharmacological dose using an autonomous system that functions without an Internet connection. However, there are some important
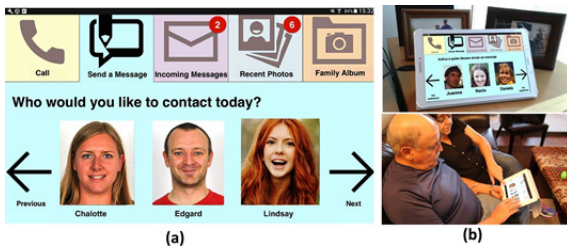
Figure 2: (a) Main user interface of SocialConnector for tablets; (b) interaction scenarios between the users and the system.
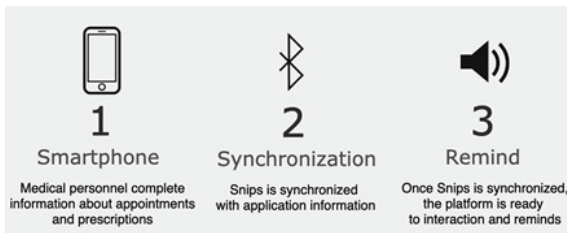

Figure 3: System overview, voice assistant.

restrictions derived from the context that limit the possible options (Jesús-Azabal *et al.*, 2020).

The Social Message Translator System, such a system translates social media messages in both directions and adapts the process, mediating the communication supported by social interaction applications and media such as Gmail, WhatsApp and Telegram (Rodríguez *et al.*, 2018).
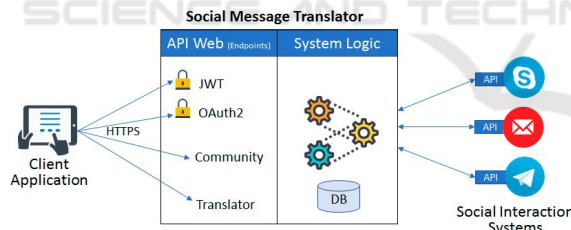

Figure 4: Structure of Social Message Translator.

As you can see, the design of systems for older adults needs special specifications, which allow maximizing its usefulness and ease of use, so it is important to conduct studies to identify what are the expectations of this type of users in terms of use and technology adoption, so that they become the starting point for the design of new devices, applications, systems and in the particular case of this virtual assistants project, in which the implementation of features and specificities that help the older adults to easily adapt to their use (Ordonez-Ordonez et al., 2017).

Precisely, in order to verify the probability of use of some of the most common virtual assistants in the

market -such as Google Assistant, Siri, Cortana, among others-, a study was carried out to evaluate their functionalities and how these could be used to help the elderly people to strengthen their social ties with groups. from family and friends (Reis *et al.*, 2017). One of the important conclusions of such study is the set of relevant activities to interact with a greater number of people, for instance: making a basic and pleasant greeting, managing email, managing events on social networks, and playing games for elderly people.

3 CASE STUDY

There are different reasons for the elderly to use technological devices, but some of the main ones are the interaction with other people in their social environment and the ability to store and remember information. Devices such as Alexa and Google Home are very helpful and allow users to use countless voice commands that can not only make their lives easier, but also remove them from the social isolation they are often subjected to. However, although those intelligent devices learn as they interact with humans, such devices already come with a predefined design in their operation and interaction interface, which means that many elder people do not adopt these technologies for their daily activities.

That is why this research was carried out with the purpose of studying a case to determine the level of acceptance of Intelligent Virtual Assistants by the elderly in the city of Pasto -Nariño, Colombia-. In the research, focus groups were worked, which were a space of opinion to capture the feeling, thinking and living of individuals, causing self-explanations to obtain qualitative data (Kitzinger, 1995), focus group are a good tool to obtain information for their sensitivity to investigate knowledge, norms and values of certain groups (Barry et al., 2009).

3.1 The Focus Groups Experience

According to the characteristics of the research, the units of analysis are finite and intentional, so the units of work with respect to the elderly are of a non-probabilistic type with voluntary subjects, and with the purpose of having a diverse population sample, it was determined to select four different groups, conformed within each one by adults with similar characteristics in terms of their life habits.

- Group of elder people who remain in contact through some type of association.

- Group of elder people who practice sports and maintain daily routines.

- Group of elderly intellectuals (teachers, researchers).

- Group of people of different levels of education who belong to a nursing home.

The diversity of the groups is due to the fact that we want to find a horizon of common points and one of specificity points in various aspects.

The work plan to test the degree of acceptance of the virtual assistant with older adults corresponded to the following activities:

- A sample of older adults was selected (six for each group). Perform the installation and test of the system.

- A personal assistance profile was installed and designed using Amazon Alexa® for each group of older adults. Each profile with its access account and the appropriate agenda settings such as calendars, important date reminders, alarm reminders for taking medications and various activities, hobbies among others.

- The test was carried out with the different functionalities that the virtual assistant has implemented.

- After the system tests, the group responded to a semi-structured interview to determine the degree of acceptance of the virtual assistant.

- The test results were analyzed.

The type of instrument used was a semi-structured interview (the individuals knew in advance what they were going to ask and the consent was requested to be recorded in said interview), in which the members of the group were invited to answer questions such as: How comfortable did you feel when interacting with the personal assistant during the test? How do you consider the interaction with the device? Describe your experience highlighting the positive aspects, Describe your experience highlighting the aspects that you believe should be improved, among others.

In figures 5,6,7 and 8 the groups are observed in their work with the device.

The results obtained were satisfactory in terms of acceptance of the virtual assistant, the members of the four groups were impressed by the different things and functionalities offered by the device, and the most important thing for most is that they can interact with the voice, without needing of writing commands.

In Table 1, the most relevant positive aspects and some recommendations made by each of the groups to improve the device are recorded.

Figure 5: Group 1.

Figure 6: Group 2.

Figure 7: Group 3.

Figure 8: Group 4.

Table 1: Positive aspects and recommendations.

	POSITIVE	RECOMMENDATIONS
1	It is a device that can help older people a lot to remember things that should be done like medical appointments, meetings.	The device should be wireless for added portability.
2	Alexa is very useful especially for reminding adults of things, since we are very prone to forget things, and also serves as a company.	The device is very useful when you are at home, but it would be much more useful if it were portable, not dependent on the electric current. It would be nice to be able to customize it, to have a more friendly way.
3	It is very useful for people who have memory problems, as it can remind them of different things such as taking medications, or simply that they require company to keep their cognitive skills active.	It would be important that the device could be taken everywhere, because adults are not going to stay at home all the time.
4	It would be very helpful to remember things such as where a receipt was left, or when it should be paid, it serves as a company and also serves to make some activities easier.	It must always be connected to the electric current. It would be good if it had a rechargeable battery to be able to take it to activities such as going out to exercise. It could be used as a decorative element if it had another shape.

Source: this research.

3.2 Adapting the Device: CuyAlexa

One of the important recommendations made by the members of the four groups, and which was evident in the development of research activities, is that the device, despite having an oral interface, requires that the interaction start with a specific protocol, in this case, the initiation word "Alexa", and many times the device does not understand what it is said, and it is very automatic, for example, in reminders and in the creation of task lists such as storing market purchases. It was also suggested that it would be good to be able to customize it with the purpose of making it a more friendly and even decorative element.

Based on the recommendations and the evidence in the field work, it was proposed to design "CuyAlexa" (Figure 9), which is the figure of a native rodent from this region and is known as "Cuy". It was designed in such a way that it could house the Amazon Alexa® device and thus look more friendly for adults in this region.

Figure 9: CuyAlexa, the physical device as a virtual assistant based on Amazon's Alexa Echo Dot.

3.3 A Medical Reminder: MediCuy

To approve the design of "CuyAlexa" a Skill was implemented which was given the name of "MediCuy" which can be used by older adults in a playful way, through a game that allows you to schedule your shot of medications, remind you to take them, and, in addition, somehow a few minutes later check if you really took the scheduled medication asking for a known saying, so that the virtual assistant tells you the first part of the saying and asks the user If you remember the end. Regardless of the user's response, the virtual assistant congratulates people for taking the medication and remembering the saying or invites you to immediately take your medication.

To implement the game, one of the recommendations made by the participating elderly people was considered. The recommendation was related to how to interact with the device. Every time the user wants to interact with the device, the user must pronounce the activation word "Alexa". In this

Table 2: MEDICUY "Medication Programmer".

VIRTUAL ASSISTANT	USER
	Opens Medicuy | Open Medicuy
Hello, I'm Medicuy, the drug-taking programming system designed for you. Do you want to schedule the taking of your medications?	Yes | Ok | It's ok | Ok | Of course | Forward | Continues |
All right, let's get started. First I need to know how many medications you want to schedule.	I want{cantidad} medicamento(s) | I want {cantidad} | I want to schedule {cantidad} |They are {cantidad}
VALIDATE AMOUNT IN INCORRECT CASE I'm sorry, I need a number of medications to be able to program.	
IN CASE CORRECT (CYCLE: i =1 to n) Excellent, let's go with the drug number i. What custom name do you want to place on this medicine?	{nombre_medicamento}
	REQUEST CONFIRMATION Let's schedule the drug nombre_medicamento, Please confirm!	Yes | Ok | It's ok | De acuerdo |Of course | Forward | Continues |
	TO CONFIRM what time you want to take the first dose of {nombre_medicamento}	{Hora_inicio} | I want to take the first dose at {Hora_inicio} | I'm going to take the first doses at {Hora_inicio}
	VALIDATE HORA_INICIO IN INCORRECT CASE I'm sorry, I don't understand the time of the first dose o {nombre_medicamento}	
	IN CASE CORRECT Thank you, now I need to know how often you need to take a dose of {nombre_medicamento}	{cantidad} {medida_de_tiempo}
	VALIDATE AMOUNT AND MEDIDA_DE_TIEMPO IN INCORRECT CASE I'm sorry, I need clarity as to the time of taking doses. I hope you'll tell me the number of hours or minutes to schedule your {nombre_medicamento}	
	IN CASE CORRECT Thank you, your {nombre_medicamento} has been programmed	
MEDICUY "playful reminder"	
VIRTUAL ASSISTANT	USER
2 MINUTES BEFORE…	
Hello, I remind you that in 2 minutes you should take your {nombre_medicamento}	Good | Ok | Thank you
AL MOMENTO	
It's time to take your {nombre_medicamento}	Good | Ok | Thank you
2 MINUTES AFTER (PLAYFUL INTERACTION)	
	I need your help, I don't remember this saying very well: {refran_parte_inicial}	{refran_parte_final}
	VERIFI VALIDATION IN BOTH CASE That's good| All right | Very close| Nada mal. Not bad. By the way, 2 minutes ago you took your{nombre_medicamento}?	Yes | No | I forgot it | I did not remember
	VERIFY ANSWER IF AFFIMATIVE excellent! IF NEGATIVE You must take your{nombre_medicamento} right now!	

Source: this research.

way, the user calls the device only when he/she is going to program the taking of medications, and once the device is finished, it activates automatically according to the programmed schedule. The game can also help strengthen memory, stimulating imagination, activating attention, developing concentration, and generating positive emotions in the elderly people. The game was intentionally programmed to improve mood and receptivity to new technological environments. Table 2 shows the user interaction with the "MediCuy" system through the Virtual Assistant.

To evaluate the degree of acceptance of "CuyAlexa" and "MediCuy", each of the elderly people who were part of the focus groups will test their operation for several days, and one of the existing Technological Acceptance Models will be used, after analyzing each one of them to define and adapt the most suitable for the purpose of the research.

4 FUTURE WORK

The design of "CuyAlexa" and the implementation of the recreational strategy for medication programming "MediCuy" were developed based on some of the suggestions and comments of the elderly people who participated in the facus group. However, it is necessary to evaluate the level of technological acceptance of the design of "CuyAlexa", as well as the operation of "MediCuy"; in this vein, a test phase will be developed soon with such a population. In this way, the elderly people in the focus group will interact with the device and the strategy playfully, scheduling their medication and testing how the strategy works. The results obtained will be analyzed, and then, a re-design stage will be developed, allowing older adults to participate to refine the requirements they consider should be implemented in "MediCuy". Thus, such activities allow identifying new play strategies that somehow facilitate the development of their daily activities and allow them to interact with other people.

5 CONCLUSIONS

Elderly people who were part of the focus groups consider the different functionalities of the virtual assistant very useful and interesting since it can facilitate some of their daily activities. However, they

claim that it would be better if the interaction was a little more friendly.

The recommendations made by the elderly people served as the basis for the physical design of "CuyAlexa", and for proposing, designing and implementing a recreational strategy to remember the taking of "MediCuy" medications.

The evaluation process must be developed to determine the level of acceptability of both "CuyAlexa" and "MediCuy", and then carry out a co-design stage that allows older adults to directly propose the specific characteristics that they would like to be implemented

Technology is becoming a fundamental pillar of help in the different contexts of the daily life of the elderly people, so it is necessary to identify the specific requirements that must be implemented in the systems for this type of users.

Smart virtual assistants facilitate the development of work, recreational and even health-related activities for elderly by reducing human-machine interaction thanks to its oral interface.

Like any technological system, those designed for the elderly people must also meet specific requirements that facilitate their use and acceptance by this type of users.

Technological acceptance models must be created that adapt to elderly people, and focus on the tasks in which they use it, and thus, be able to measure with greater certainly the intention of use and the need they have of the technology.

ACKNOWLEDGEMENTS

REFERENCES

Barry, M., Steyn, H., & Brent, A. (2009). *The use of the focus group technique in management research : the example of renewable energy technology selection in Africa. June 2016.*

da Silva, T. A., Cereda Cordeiro, R., & Ramos, L. R. (2009). Factors associated to quality of life in active elderly Fatores associados à qualidade de vida em idosos ativos. In *Rev Saúde Pública* (Vol. 43, Issue 4). http://www.ibge.gov.br/series_estatisticas/exibedados.php?idnivel=BR&idserie=POP300

Dionigi, R. A. (2015). Stereotypes of Aging: Their Effects on the Health of Older Adults. *Journal of Geriatrics*, *2015*, 954027. https://doi.org/10.1155/2015/954027

Gutierrez, F. J., Muñoz, D., Ochoa, S. F., & Tapia, J. M. (2017). Assembling mass-market technology for the sake of wellbeing: a case study on the adoption of ambient intelligent systems by older adults living at home. *Journal of Ambient Intelligence and Humanized Computing*, *10*(6), 1–21. https://doi.org/10.1007/s12652-017-0591-4

Jesús-Azabal, M., Rojo, J., Moguel, E., Flores-Martin, D., Berrocal, J., García-Alonso, J., & Murillo, J. M. (2020). *Voice Assistant to Remind Pharmacologic Treatment in Elders* (pp. 123–133). Springer, Cham. https://doi.org/10.1007/978-3-030-41494-8_12

Kitzinger, J. (1995). Qualitative Research: Introducing focus groups. *BMJ*, *311*(7000), 299. https://doi.org/10.1136/bmj.311.7000.299

Klimova, B., & Poulova, P. (2018). *Older People and Technology Acceptance Blanka* (Vol. 1). Springer International Publishing. https://doi.org/10.1007/978-3-319-92034-7

Loos, E., Haddon, L., & Mante-Meijer, E. A. (2012). *Generational use of new media*. Ashgate Publishing Ltd.

McLaughlin, M. (2020). *What a Virtual Assistant is and How it Works*. Retrieved March 30, 2020, from https://www.lifewire.com/virtual-assistants-4138533

Neves, B., & Vetere, F. (2019). *Ageing and Digital Technology Designing and Evaluating Emerging Technologies for Older Adults: Designing and Evaluating Emerging Technologies for Older Adults*. https://doi.org/10.1007/978-981-13-3693-5

Ordonez-Ordonez, J. O., Bravo-Torres, J. F., Sari-Villa, O. D., Ordonez-Morales, E. F., Lopez-Nores, M., & Blanco-Fernandez, Y. (2017). Stimulating social interaction among elderly people through sporadic social networks. *2017 International Caribbean Conference on Devices, Circuits and Systems, ICCDCS 2017*, 97–100. https://doi.org/10.1109/ICCDCS.2017.7959698

Palloni, A., & McEniry, M. (2007). Aging and Health Status of Elderly in Latin America and the Caribbean: Preliminary Findings. *Journal of Cross-Cultural Gerontology*, *22*(3), 263–285. https://doi.org/10.1007/s10823-006-9001-7

Reis, A., Paulino, D., Paredes, H., & Barroso, J. (2017). Using intelligent personal assistants to strengthen the elderlies' social bonds: A preliminary evaluation of amazon alexa, google assistant, microsoft cortana, and apple siri. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *10279 LNCS*, 593–602. https://doi.org/10.1007/978-3-319-58700-4_48

Rodríguez, F., Ochoa, S. F., & Gutierrez, F. J. (2018). Seamlessly Mediation of Social Interaction Services Respecting Communication Preferences. *Proceedings*, *2*(19), 1249. https://doi.org/10.3390/proceedings2191249

Ronning, W. M., & Solvberg, A. M. (n.d.). *View of Older Adults' Coping with the Digital Everyday Life*. Seminar.Net - International Journal of Media, Technology and Lifelong Learning. Retrieved January 30, 2020, from https://journals.hioa.no/index.php/seminar/article/view/2307/2135

Salthouse, T. (2010). *Major Issues in Cognitive Aging*. Oxford University Press. https://books.google.es/books?id=LfEJCAAAQBAJ

Shore, L., Power, V., de Eyto, A., & O'Sullivan, L. W. (2018). Technology acceptance and user-centred design of assistive exoskeletons for older adults: A commentary. *Robotics*, *7*(1), 1–13. https://doi.org/10.3390/robotics7010003

Syeda, M. Z., & Kwon, Y. M. (2017). Photo Alive! Application and method for intergenerational social communication. *International Conference on Advanced Communication Technology, ICACT*, 326–332. https://doi.org/10.23919/ICACT.2017.7890108

United Nations. (2015). *World Population Prospects - Population Division - United Nations*.

United Nations. (2019). *Perspectivas de la Población Mundial 2019*. https://population.un.org/wpp/Publications/Files/WPP2019_PressRelease_ES.pdf