An Effective TeleHealth Assistive System to Support Senior Citizen at Home or Care-Homes

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Abstract—**There has been an increase in the percentage of aging population in the UK, which has implications in all sectors from workforce, housing and care needs. The aim of this research work is to improve the healthcare and the quality of life for senior citizens and helping them live self-sufficiently at their own accommodation by developing a telehealth system that effectively communicates and monitors the daily needs of the senior citizens. In doing so, the burden from the healthcare system and the care-homes will be eased. This approach has a user-friendly application for the elderly to notify the care-home of their daily needs. The details of the senior citizens profile are stored in a cloud based database, hence the care coordinator can receive the notification, monitor the details, book/assign a service and notify the senior citizens with the date and time of the booked required service. The most common users' needs have been identified from the acquired data in the local community. This data has been used in meeting the users' needs and creating an appropriate applications for them. The developed system has a simple process that offers human interaction with an assistive technology created to make the life of senior citizens easy and independent.**

Keywords—Assistive Technology, Telehealth, Healthcare, Senior Citizen, Human Interaction.

I. INTRODUCTION

The world notices an increase in the percentage of aging population and this has implications in all sectors from workforce, housing and care needs. It is also stated that the people's life expectancy increased dramatically, and this trend will continue to raise more in the future. In the UK, the aging population is increased as a consequence of better health care system, longevity and reduced fertility. It is estimated that by 2034, population aged over 65 years will outnumber the population under 16 years. Therefore, the demographic will consist more of the elderly people in contrast with less young population. Thus, a significant number of senior citizens will be looking for assistance from a caretaker or a close family member to look after them [1], [2].

The ageing population will be in need for assistance in a form of a caretaker or a family member especially for the people with chronic diseases and/or disability. However, due

to the population structure shifts, the world will confront with two issues: the number of caretaker will not be enough to support the people in needs and the cost of care for elderly people will rise significantly. Therefore, as the population grows older, new smart approaches of assistance are needed to be implemented on one hand. On the other hand, the majority of the senior citizens would like to fulfil their life in their comfort home. It was argued that the life independence plays an important role not only for old people but also for people with disabilities or chronic diseases. In doing so, those that would like to remain at home and receive care at home will have a better quality of life as well. Moreover living at home with assistive technology can reduce the cost of a caretaker [1], [2].

Previous research has been done to implement technology as an assistant for elderly people as well for the caretaker. The work done is [2] enumerates some of the new intelligent systems for eldercare where robots and screen agents are incorporated as part of smart homes or as personal assistive devices. The work presented in [1] concluded that smart homes equipped with technology facilitates monitoring of its residents and increases the quality of life and is easy to use.

The use of smartphones and tablets has increased significantly and becomes more popular and essential part of our everyday life. Ttherefore, they will be a perfect tool to create a connection between the carers and the senior citizens. While the senior citizens enjoy an independent life in the commodity of their own home will request a caretaker only when necessary for a specific service. The senior citizens will have to press a button on their smartphones or tablets to send a notification to the care company. In this way the necessity of a care-home which needs plenty of staff to operate will be less viable. To be finalised, the application must be linked with a care coordinator that will respond to the user when needed. In this research study the most common users' needs have been identified from the acquired data in the local community. Based on the acquired data the study proposes an assistive technology that would be available to download from Apple store and Android store. The application will be easy to use with a friendly user interface.

II. RELATED LITERATURE

A. The Employment of Assistive Technology

Previous research showed that using a variety of robots or sensors like (pressure mats, or door sensors) connected to a message broadcast device that can alert a relative or a close family friend we can monitor the lifestyle and the safety of the elderly [3]. Moreover, the "human-device interaction" can detect, when for example, a person has fallen in the kitchen and send a robot to give the first aid to that person. On the other hand, while this solution may provide peace of mind regarding safety it doesn't offer the human interaction that is needed for daily task such as shopping, tasks around the house or even socialising.

The research work presented in [4] debated that there are two main arguments for elderly people to use the assistive technology. On the one hand, it linked the first reason with the potential staff shortage in the near future and not enough qualified personnel. Their second argument refers to the fact that people like to live in their own homes and not being placed in care homes. The work in [4] distinguishes the health care technology in two main categories: physical assistive technology (exoskeletons and wheelchairs) and assistive social robots that communicate with the users.

It has been argued that within the assistive social robot's field, there are two types of robots: service type robots and companion type robots [3], [4]. While the first category supports human basic activities, help with the house maintenance and offer permanent surveillance to the people that need ongoing attention. On the other hand, companion robots have the main duty to benefit the welfare of their users. In this context, existing research empathise on an increasing positive acceptance from elders, more specifically at the level of mood and social connection [3]. Taking in consideration the affordability of the devices in cause some people might feel that they cannot afford these type of devices and sensors and the safety feature of these devices depends on the availability of another person at the other side.

The results in [5] show that (a) pointing performance of elderly was significantly influenced by size, spacing, and location of target, and (b) the performance was higher in audio tactile feedback condition. We expected that these results can contribute to the design of smartphone applications for elderly users. It was argued in [5] that recent developments in assistive technology such as electronic sensors, video monitoring and bed alerts will be likely to improve the life of elderly people, in terms of security, safety and living independently [4], [5].

The research work in [6] pointed out that assistive technology will be beneficial to elderly people living by themselves. To demonstrate that, they conducted a study on 67 elderly people to research the acceptability of TA. The study concludes a complex system of acceptability which combines product quality with the felt need.

However, the research work in [7] make a clear distinction between adoption and acceptance of technology. Firstly, adoption refers to a process where the user goes through multiple stages from becoming aware of the technology to the stage where the technology is a way of life. In contrast, acceptance is the attitude towards technology. Finally, that research work gives as an example a device purchased by a user but who needs time to adopt it and the full adoption will happen only after full acceptance.

The most recognized model related to technology acceptance is called TAM (technology acceptance model) introduced by Fred Davis [8]. This model is based on two cognitive beliefs: the perceive usefulness and ease of use the technology. [7] found a strong link between performance and ease of use. The authors argue that usefulness and the ease of use are main determinants for technology acceptance. For example, the work in [7] gave as an example a mobile phone received from a relative and not bought, where the usefulness was skipped; as a result, the elderly people will probably will not reach the adoption stage.

The research work in [7] talked about other technology acceptance model named MOPTAM (the mobile phone technology acceptance model) which is specifically designed for mobile device and considered the easiest device that can be used by senior citizens. While [4] presented two concepts related to assisting the activities of a daily living, in the name of personal assistance and technological assistance. While personal assistance refers strictly to help given to a person in needs by a family member, friend or a carer, technological assistance makes reference to the use of equipment in the daily activities of the disabled person.

Assistive technology is a broad term which describes any product or technology-based service that helps people with their activity limitations to have a normal life. Recently, other terms have appeared to describe technology that can assist people with disabilities or for elderly. Ambient assistive living is a term that describes sensors, interaction devices, actuators set in the house of the patient in order to monitor and react to his needs. As such application can be used in several ways from informing the caregivers to monitor the people with chronic diseases [9].

The research work in [10] debated that AT was welcomed by elderly people when was perceived as needed. Moreover, their study shows that buildings needs adaptation to accommodate the user's needs. To reinforce the needs of TA for elderly people, [11] argued that the UK confronting at the moment with o growing number of its citizens aged 65 and over and they anticipated 47% increase by 2026. However, the work in [4] argued that the use of TA will contribute to less hours of personal assistance. On the other hand, it was concluded that the necessity of including the care professionals in the process of developing new AT is crucial as they are important stakeholders. Another review from [12] finds that implementing AT can bring real benefits in terms of enhanced monitoring and surveillance activities. [13] has highlighted the importance for the elderly person to be in a constant contact with other people and in this way their cognitive functions are stimulated and also will prevent social isolation. It is recognised in many international studies that home care services for senior citizens will reduce the burden in health care system. Home care can be defined as supportive care provided in the patient's residential home by licensed healthcare professionals.

With an increase of research towards new technology destined to contribute in the care of senior citizens we see a lot of devices, sensors, pressure mats and bed alerts to give elderly the ability to feel secure and to live in their own home. The quality of life is different in the current years as jobs becomes more automatic, people are not working in coal

mines like they were before and in this way life expectancy for people over 60 has an index of 24 more years.

B. The Use of Smartphones

There is a significant increase in the usage, popularity and sales of smartphones in the current years. It provides the same functionality as a personal computer with the help of a variety of applications developed for specific reasons. At least three hundred thousand software applications have been developed with more than eight thousand software applications develop especially for the health sector. It is evident that the smartphone technology offers more benefits for the healthcare system but despite this without the right software application it can be only a powerful tool that cannot provide the means to a need. However, most of applications created for senior citizens do not generate familiarity as they are not created specifically for their needs [3]. Moreover, someone could argue that technology is perceived by senior citizens as intrusive, too complex to use and operate. Therefore, when designing technology for senior citizens the interface and familiarity of the design should have been taken in consideration. In the same respect, there is a gap between the abilities of the elders and the mainstream technology works. Hence, the developed new technology should be designed completely based on the needs and abilities of the senior citizens.

Another research study conducted by [14] captured and classified the smartphones applications according to their functionalities. The application targeted for patients are from management of chronic conditions like diabetes, sleep aid and monitor tools, fall detectors, and physical activity calculators. This indicates a strong foundation for the development of medical applications. Further analysis done by [15] to assess the quality of the applications developed for the health care system and underlined the app quality indicators that need to have in mind when developing an app. The main focus was on the functionality then the engagement of the applications followed by the information quality and design.

III. System Development

The main focus in the developed system is on the efficient communication between the carer application, coordinator application, the senior citizens application and the cloud based storage of the personal information of all the users and their required services. The developed system has the ability to work on different platforms, which allows it to function on different devices, inducing pc's, tablets and mobile phones. In addition to this, the developed application can function on IOS and android devices, so there is no limit for the user's accessibility.

The application needs to have a login system to protect from unauthorized access. There are two login pages, one for coordinators and carers allowing them to login with a username and password and the other login page is created for the senior citizens. The separate login page developed for the senior citizens due to their age, some senior citizens may not be able always to remember their username and password so they can use a login page which asks for their full name.

The application should send the required notifications to the carer and be able to receive back the time and date

booked for the required service. This is a functional requirement as it is important for the carer to know when they have been assigned services to be completed.

All the user's details need to be stored in a database with a clear log details. This includes the names, surnames, address, phone number, medical history and any other required details for the senior citizens. Profile details including address, age, medical history and gender should be inserted by the coordinator of the system. To limit users from creating their own account to prevent any duplication or wrong data entry. A server should store all the PHP files and to be able to connect to the developed database. This is a functional requirement to allow the system to be accessible from anywhere on any device, it needs to be on a remote server so it is easy to access.

The developed applications have also non functional requirements for the senior citizens for examples: it should not contain bright and powerful colours. The developed applications need to be a user friendly and suitable for the senior citizens. If the system is in bright colours, the elderly might find it uncomfortable for their eyes on one hand. On the other hand, if it is not easy and user friendly, this may lead to refuse using such innovative. The login system for the elderly should contain username and password easy to remember. This requirement is important as having a username and password for the elderly which is too difficult for them to remember will cause issues starting with them not being able to login. Figure 1 shows the general use case for the coordinator, carer and the senior citizens.
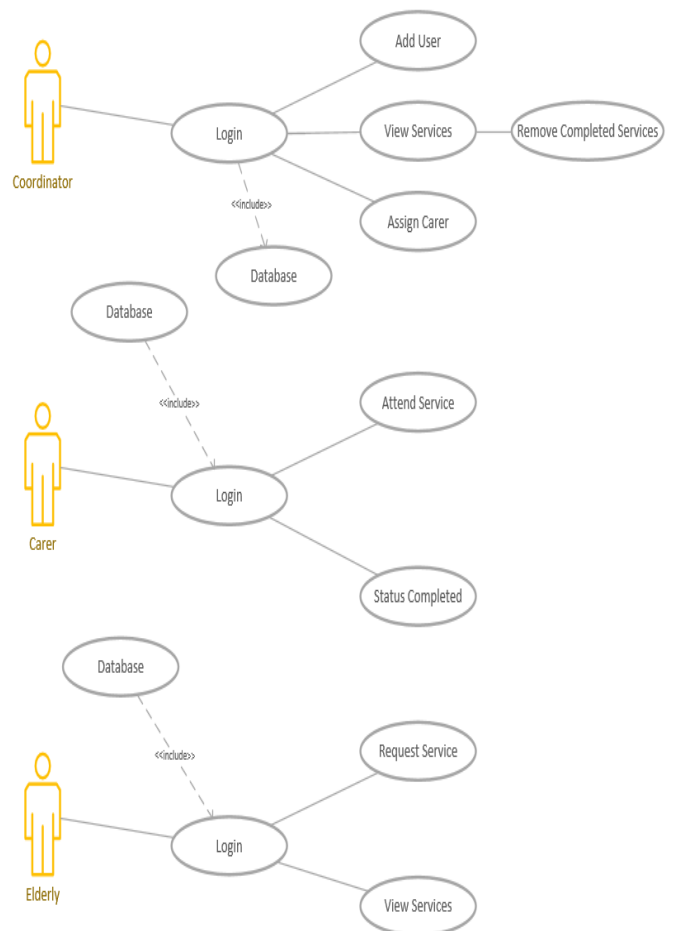

Fig. 1. The general use case.

IV. DATA AND RESULT ANALYSIS

A. Data Description

A questionnaire survey has been conducted on random people aged 60 or over from the local community to find out what are the main needs of senior citizens who would like to live a self-sufficient life in their own home. The findings of the collected data provide important information about the most relevant and suitable options for senior citizens and an appropriate design of the developed applications. The analysis of the first set of questions provided the needs of the senior citizens that should be considered during the development of their applications, it allowed us to create suitable buttons within the applications that can be used easily to request the required service from the carer. All the services and the user details are being stored in a database. The database is stored in a properly secured cloud as it will contain the senior citizens; for example: their ID number, name, age, phone number, address and medical history, etc. It also has the details of the carers and the administrators; for example: ID number, name, phone number, account type, username and password, etc. Finally, it contains the service details that can be requested by the senior citizens.

B. Result Analysis

Six main buttons have been created which cover the main needs that senior citizens may request from the carer in contact. The analysis of the acquired data demonstrated that the senior citizens will need help with their shopping, housework, companionship, social activities and to have the prescription for the medicine renewed or brought to them. Figure 2 shows the most common needs/service for the senior citizens which include: companion, medicine, socialize, housework, meals, shopping, personal care, exercise. It is clear from the figure that on the last place of the chart is the personal care then the meals. While in the first place is the shopping needs.
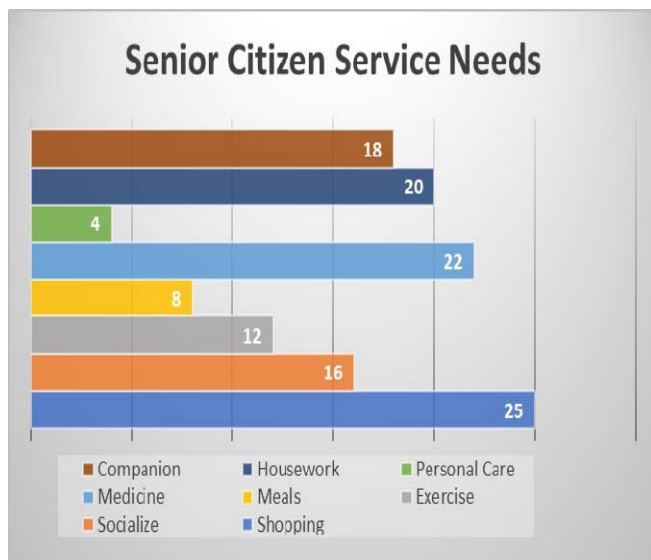
Fig. 2. The senior citizens service needs, which include: Companion, Medicine, Socialize, Housework, Meals, Shopping, Personal Care, Exercise.

Based on that, we can draw a conclusion that the senior citizens are still able to prepare their own meals and take care of their personal hygiene. The second question was "what is the favorite colours?" to find out what colours will be used in the design of the buttons, images and the landing page of the application. Figure 3 shows the results obtained, where the majority votes went for green and blue. While the least favorite is the red.
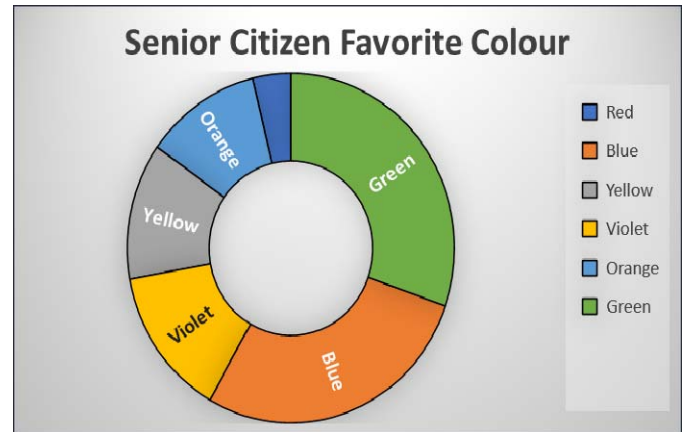
Fig. 3. The senior citizens favorite colours.

The senior citizens were asked as well about their favorite gadget. This question provided an insight of the senior citizens preferences about the technology and enable us to see what will be the main platform that should be considered during the development process of the applications. Figure 4 shows the results obtained from this questions, where the majority votes went for the tablets with 44%, 31% for the smartphones and 25% for the laptop. Hence, the developed application was designed to have the best functionality on the tablets as the majority of the senior citizens prefer the tablet over a smartphone or laptop. Of course the developed application will be adaptive and can be used on the other devices as well.
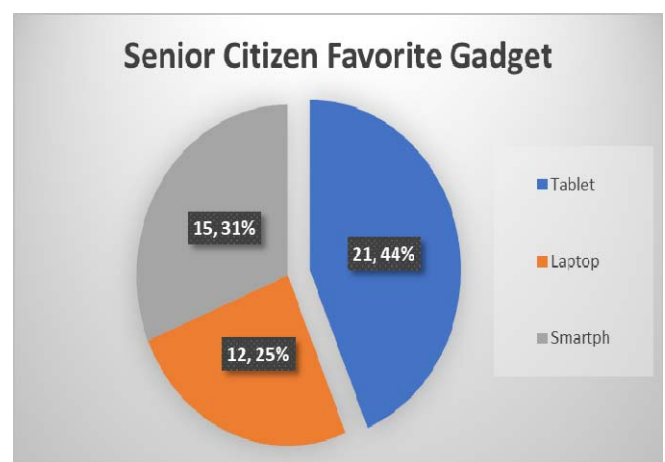
Fig. 4. The senior citizens favorite gadgets.

The last question was about the social media and to consider the usage of social media at this age segment and to see what extra features or social media implementation can be adapted/considered in the development of the tele-healthcare system. Figure 5 shows the use of the social media, where the majority say yes for using the social media. Figure 6 illustrates the favorite social media platform for the senior citizens. The majority of the votes go for the Facebook platform.
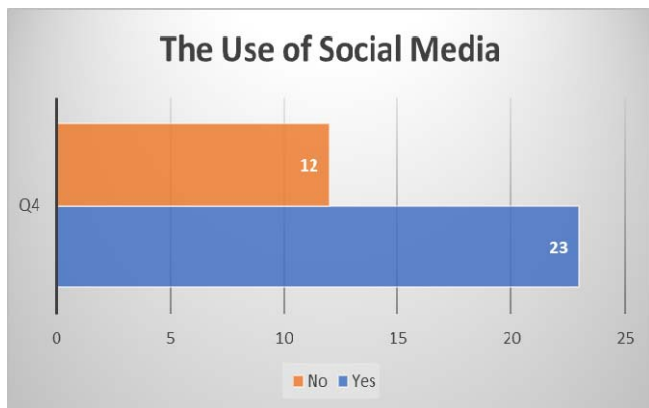

Fig. 5. The senior citizen service needs: the use of the social media.

Some of the common comments made by the senior citizens include: the help with shopping should be performed by the carer on a weekly basis. It was noticed that the senior citizens need someone to give them hand during their shopping. To meet this need the coordinator can set a carer to perform the shopping task with the senior citizens on a weekly basis e.g. every Tuesday or over the weekend if it is appropriate.
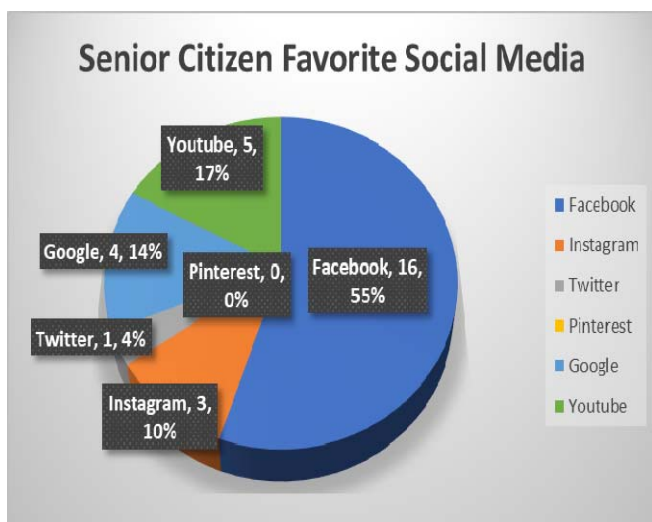

Fig. 6. The senior citizen service needs, the favorite social media.

V. Conclusion

This research work considered the senior citizens opinions to help them living a quality of life at their own accommodation. The most common users' needs have been identified from this research study through acquiring data from the local senior citizens community. Based on the acquired data, the study proposed an assistive technology that support senior citizens at homes and care-homes. The application will be easy to use with a friendly user interface. The importance of the proposed research work comes from the fact that there has been an increase in the percentage of aging population in the UK, which has implications in all sectors from workforce, housing and care needs. Therefore, the aim of this research work is to improve the healthcare and the quality of life for the senior citizens and helping them live self-sufficiently at their own homes by developing a telehealth system that communicates and monitors the daily needs of the senior citizens. In doing so, the burden from the healthcare system and the care-homes will be eased. This approach has a user-friendly application for the elderly to notify the care-home of their daily needs. The details of the senior citizens profile are stored in a cloud based database, hence the care coordinator can receive any issued notification, monitor the details, book/assign a service and notify the elderly with the date and time of the booked required service. The most common users' needs have been identified from the acquired data in the local community. The developed system has a simple process that offers human interaction with an assistive technology created to make the life of senior citizens independent.

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