

*Perception of Digital Integration and Companions for Older Communities in China in
Light of the COVID-19 Pandemic*

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Abstract

In the era of rapid aging and information superposition, accelerating the digital integration of the elderly and narrowing the digital divide of the elderly are the new requirements and actual contents of encouraging active aging in the digital society. Due to the ongoing pandemic COVID-19, the majority of the world's elderly population reported feeling socially isolated and having infrequent contact with others. The web-based social interaction platforms were the only means by which this segment of the population remained involved and could communicate, indicating that virtual communication has the ability to prevent or significantly reduce seniors' social isolation. It is essential to advocate for technology-based policies and initiatives that encourage internet use among the elderly in order to improve their social and emotional well-being; this could also assist in reducing depression among this demographic. In the older communities of China, a questionnaire survey and interviews were conducted to analyze their perception of digital platforms, experiences using the online social platforms during the pandemic, and their acceptance of such provisions for an engaging living environment and establishing an online and offline knowledge-sharing community. According to the respondents, the Chinese young-old with relatively high levels of education have good adaptability to modern society and demonstrate a strong willingness to share their experience and assist others after retirement using digital media. The majority of respondents regarded social interaction, digitalization, emotional support via digital companions, and self-fulfillment favorably, and had a positive opinion toward adopting current day technology for social and emotional well-being.

Keywords: Aging Population, Digital Divide, COVID-19, Chinese Elderly, Digital Companions

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Introduction

The current century has been a witness to a number of extremely complex challenges that have yet to be overcome, but there have also been numerous breakthroughs that have greatly improved the quality of life. With the continued technological advancements there has been a consistent rise in the numbers of the aging population globally as a direct result with longer lifespan due to improved healthcare systems and declining birth rates. An estimated share of 2.1 billion older people who are 65 years or above are expected to live globally by the year 2050 (*WHO, Ageing and health*, 2021). As living in a society that is transitioning into an aged one globally, there is a greater need in focusing resources to cater to the shortcomings that need immediate attention.

The advancement in media and technology has mostly been a key transformative element in this century and has resulted in enormous development in countless fields. Yet, it has been a bane for several due to the lack of knowledge and other capacities to use it to their benefit resulting in an evident phenomenon of a digital divide (Song et al., 2021). Digital divide due to aging has been a longstanding issue less discussed and even less worked upon in the past decade as the proportions are not regularly distributed. But during the pandemic, when getting outdoors for performing daily activities got a halt for months without a better alternative. The use of internet became imminent and only working solution for many tasks that could be previously done otherwise. The use of tele-medicine to the use of internet for entertainment and being connected with the friends and family became possible through this means. But the overarching presence of this meant a shadowed area of left-alones, who could not make use or take the benefit from the given opportunity during the rapid transition in the past two years of a pandemic.

The study of artificial intelligence is a subfield of computer science that aims to understand the fundamental properties of intelligence and develop a novel kind of intelligent machine that is capable of responding in a manner that is analogous to how humans would respond. A subset of artificial intelligence known as machine learning teaches computers to learn from prior outcomes, and this information is constantly fed back into the systems and machines that are constantly improving themselves based on the generated dataset. Robotics, language recognition, picture recognition, and other forms of recognition, as well as natural language processing and expert system research are all included in this field of study. While these advancements are the widely used in our daily life activities and have successfully transformed and reduced accidents due to human error, a greater scope of applications related to the aging market remains lesser explored. Further adding to the scope, the pandemic highlighted the heightened effects of social isolation and loneliness that emerged in the senior sections of the society as most elderlies who were considered to be more susceptible to the virus had to remain indoors for an indefinite period (Das, 2022). The study aims to analyze the changes in perception of using technology during the pandemic and their attitude towards using digital companions that can help in tackling the issues like loneliness and use them as part of assisted living strategies promoting aging in place. The preliminary study showed promising results as most of the respondents had developed a positive outlook towards the use of modern intelligent services to their benefit and wellbeing.

The impact of aging on the society

The aging of our population is a problem that not only has repercussions for our society but also for our day-to-day lives. According to Chinese custom, the majority of individuals have

a significant responsibility to take care of their family members, particularly elderly family members who are experiencing difficulties due to a disability or chronic ailments. The elderly individuals are dependent on their caretakers for assistance and to help them maintain their day-to-day living. This existing circumstance revealed that there is a potential to enrich both the experiences of the elderly and carers by creating a convenient and comfortable living for them. This would be beneficial for everyone involved. Aside from that, the solution can begin with the prevention of and reduction in the severity of the symptoms before the old people obtained the chronic conditions (McKee et al., 2002). In this study, we explored five areas in which the aging population has exposed societal challenges. Besides that, there has also been a significant rise in the need for residential care services and medical care for the elderly, specifically for the management of chronic conditions.

Implications for the economy- With an aging population and a slipping employment rate, mainland China and its special administrative regions like Hong Kong will have a sliding social capital and a shortage of labor. This could also lower overall productivity. At the same time, dependency ratios will climb, leading to a corresponding increase in the expenses of social security. In addition, there is a growing expectation placed on people of retirement age to keep working, despite the growing number of opportunities available to retirees.

Spending more money on welfare services- Some elderly adults who are retired or who do not have family caregivers require assistance from social security. The cost of welfare benefits (such as the Old Age Allowance) and the burden of social services, amenities, retirement protection, medical and long-term care services are both expected to rise in tandem with the growth of the elderly population.

Healthcare system overstretch- According to the findings of the Census and Statistics Department, approximately seventy percent of the older population residing in the neighborhoods of Hong Kong (HKCSD, *Population Census Summary Results. Hong Kong: Census and Statistics Department, 2011*) is affected by at least one chronic illness. Both the demand for and the cost of providing medical care to senior patients for the management of chronic diseases have seen significant increases in the recent years in the country (Fang et al., 2015).

Rising demand for services for the elderly rising- The necessity for adequate support services for the elderly is increasing as a consequence of the growing demand for community support services and residential care services spurred on by an aging population (NHCPRC. *National Health Commission of the People's Republic of China; 2019. Policy Interpretation of Notice on Strengthening Elderly Care*).

Impact on the families- It is projected that the number of elderly persons who require care will continue to increase in the coming years. The number of elderly people who are retired is on the rise, and it is also anticipated that the number of elderly people who must rely on family members for care will increase.

Two of the impact factors are deeply explored that could guide the following design, striving to make life easier for the people and society as a whole. Factors considered were that there has been an upsurge in the demand for services aimed at the elderly and how to tap the potential market. The second aspect considered for the study is how it affects the families and how the assistance of digital companion can relieve them. There are two models of seniors

living conditions based on location, one is seniors living in their homes, usually accompanied by caregivers (with or without family members). And the other model is living in an institutional setting like elderly care homes etc. For senior people who choose to remain in their homes as they age, the concept of "aging in place" refers to a model of aging in which the family has facilitated living conditions and the members of the family are able to provide care for the elderly. It is a model in which older people belong to families with a middle-class income or higher and are taken care of by family members or domestic helpers. This is a preferred model, despite the fact that this model requires heavy reliance on members of one's own family to provide care, which can be challenging at times for those providing care. The second model involves the elderly people living in nursing facilities that are specifically designed for the aged. This model is characterized by the fact that the elderly people live there. Its core service objective is to provide nursing home facilities and services to seniors 65 and older who are unable to live at home for personal, social, health, or other reasons. The growing demand for services for the elderly has brought attention to the necessity of effective support services (He et al., 2019).

Artificial Intelligence (AI) revolutionizing elderly care

Diseases that affect the elderly require prompt diagnosis and continued supervision by trained carers, but we are not training enough medical professionals or caregivers to fulfill the rising demand for health care services. As a result of this circumstance, healthcare practitioners are beginning to automate certain aspects of the care pathway using artificial intelligence (AI). Artificial intelligence (AI) may now be found at every step of the treatment pathway, from the intelligent surveillance of biometric information to the early identification of disease (Fang et al., 2015). Patients and their families have begun receiving assistance from artificial intelligence in order to better grasp the treatment options available to them. The effectiveness of clinical treatments for various disorders is also being improved with the assistance of artificial intelligence. The care given to older people is being transformed by AI (Tomita et al., 2010). According to the information available in the market industry, there are a great number of smart devices on the market with functions that are created specifically for people of advanced age. There are four broad categories of available products (Sanyal, 2018). a) *Home monitoring*- When it comes to the care of older patients, there is always a requirement for round-the-clock monitoring and a prompt diagnosis. b) *Supported daily living with technology*- To individualize the care provided to each elderly customer through the use of machine learning analytics and wearable sensors. c) *Assisted detection of falls by smart devices*- Check for abnormalities in their biometric data using the built-in feature of the gadget that is driven by AI. Additionally, use the device to detect a significant or severe fall and sound an alarm. d) *Virtual companions*- The shortage of trained carers who are able to assist elderly patients who live alone and need support with their everyday activities.

Aged people who live alone and require daily support as well as companionship are the target population for this service. Both offline and online retail establishments stock a wide variety of goods and services that may be purchased and are tailored specifically to meet the needs of senior citizens. Both the old person's family members and the elderly person themselves might do product searches online. There are a lot of functionalities that are shared between different goods that are made for elderly people. On the other hand, the product is tough for people who are not professionals to comprehend and purchase. Nobody, not even the elderly or their carers, is aware that there are goods available that can alleviate their difficulties. They are only conscious enough to acquire the thing because of their prior knowledge. If they have

never heard of the product through advertising, the newspaper, or the website, then they have typically lost the opportunity to assist the elderly people.

In addition, the majority of senior individuals that require care rely on their caregivers to perform research on available products and select the items that are most suited to meet their needs. The people who provide care are unaware of where they could look for a product that is helpful and valuable. In most cases, they will consult their circle of friends for product recommendations or approach the sales associates at the store directly for assistance. Therefore, the location of the shop and the products that are sold there become crucial aspects that determine whether or not elderly people will be able to obtain the helpful product. It turned out that the imprecise flow of information restricted the product alternatives knowledge that were available. Often senior people themselves are interested in enhancing their quality of life with the products, but they are unsure where to purchase them. A comparative study on the available commercially successful products were studied, identified under the beforementioned categories (Refer Table 1) (Sanyal, 2018).

Product Types		Product Name	Associated Functions
01	At home health monitoring	Biotricity	A medical diagnostic and consumer healthcare technology company dedicated to providing biometric remote monitoring solutions, is implementing device-level AI to improve its remote patient monitoring platform.
		CarePredict	AI is used to continuously detect changes in activity and behavior patterns for early detection of health problems.
		Amazon Echo Orbita Health	Voice-based virtual assistants are using AI to achieve medication adherence and care coordination for older people.
		Careangel	Further optimization of voice-based virtual assistants for nurses and caregivers as a target patient group.
02	Smart device assisted daily living	Apple Fitbit	A smart wearable biometric tracker for a wide range of people, including the elderly and geriatric patients. Elderly patients can use the device's built-in AI to check for inconsistencies in their biometric data, as well as detect and alert them to serious falls or severe falls.
		Aicare	Using machine learning analytics and wearable sensors to provide personalized care for each older consumer.
03	Smart device assisted fall detection	Xsens Kardians Qventus	Constructed artificial intelligence driven fall detectors.
		Starkey	Integrated artificial intelligence-driven fall detector in its hearing aid Livio AI.
		Dinsow Robobear	A virtual home helper for older people who live alone and need daily help and companionship.

04	Virtual companions	Mabu	It is a conversational robot that not only provides tailored conversations for each patient, but also access to hard-to-get treatment data.
		ElliQ	Keeping older people active and engaged by connecting them with their families and the outside world.

Table 1: Comparative study on the available commercially successful products, adopted from (Sanyal, 2018)

Methodology

Participants

The study was conducted through the analysis done by the recorded responses from the online questionnaire and semi-structured interviews with the older people themselves, family members and caregivers about their experiences during the pandemic and their perceptions regarding the integration of digital companions and technologies into their daily lives. A participatory design workshop to generate design features for the digital companions were conducted from the different stakeholders (n=9). An intensive questionnaire was prepared (29 close-end questions) to understand the perceptions and notions about the advent of the digital applications and raised usage of such technologies during the period of pandemic. The questionnaire was sent through online platforms and a total of ninety-two responses (n=92) were recorded between 20 May 2022 and 20 July 2022. The semi-structured interviews with the different end users also shed light on the adapted behaviors that the family members and the caregivers observed during the similar timeframe. The data collected were then analyzed and future recommendations were then generated for adopting such technological changes in the future. The data collected were then applied to generate design characteristics to develop features for smart companions for the seniors.

Eligibility criteria and target user types

1. Adult who is 65 years of age or older and living with family members and/or needs to be taken care of.
2. Caregiver / friend/ family member who is 18 years of age or older
3. Living in the Mainland China or Hong Kong, HKSAR
4. Requiring the services of a nursing home or assisted-living facility

Discussion and Results

The overall aptitude of the respondents inclined positively towards using the technologies for the elderlies in mainland China during the period of pandemic that mostly kept them engaged indoors, helped in getting urgent treatments through tele-medicine and remain connected with the immediate family members, kins and friends among other benefits. The questionnaire was responded mostly by the family members (n=81, 88.04%) of the elderlies. Since the elderlies themselves are not acquainted using the technologies to a greater extent. The responses recorded were mostly from the caregivers and the family members. Also, as is mostly associated in the Asian cultural context, caregiving is generally linked with the female gender and similar observations have been made in the survey where majority of the respondents were female (n=49, 53.26%). There is a strong response recorded who live in their homes and very less responses came from users staying in nursing homes, this gives limited knowledge

about how the advanced technologies helped to deal with the pandemic in the institutional settings. On the other hand, the workshops conducted shows several key features on how the digital integration powered the daily activities for the elderlies and the care provider as well. The probability of accepting social robots were analyzed through the earlier mentioned methods and it can be inferred that majority of the respondents had a prior knowledge of such products and had a positive response towards the products and its adaptability. Certain functions were highlighted during the interviews conducted and are discussed in the next sections as future features that could be incorporated in the digital companions.

As a common observation that emerged from the study is that the health of the elderly declines and they have difficulties taking care of themselves, some of them will need to use long-term care services that are subsidized by the government or that they will have to pay for themselves. The vast majority of older people in Hong Kong and the mainland desire to continue to receive support from their families, friends, and neighbors while also aging in a setting that is comfortable and familiar to them. (The Elderly Commission undertook a consultancy study on residential care services for the elderly and published the results in 2009 as part of the Residential Care Services Final Report). Some studies concluded that the vast majority of seniors and their families prefer to remain in their own homes as they age, rather than in an institutional setting (Sinclair, 1992). Even in Hong Kong and the mainland China, nevertheless, this is the case. According to the findings of an investigation that was conducted with 435 elderly people in Hong Kong, 73.5% of the respondents indicated that they agree or strongly agree that home care services are superior to residential care services as a form of long-term care service (Das & Lau, 2022) (Lou et al., 2011).

Before working on with the design and the model outlook, at first for better user comprehension and demand analysis, appropriate user research was carried out through the use of participatory workshops and questionnaire as a preliminary feasibility study. From the interactive workshop, it was learnt that it was crucial for the respondents to be able to choose the appropriate product when purchasing products for the elderly, and that some respondents did not know where to acquire the appropriate product. This was one of the aspects that we explored. In addition, the initial evaluation of the dementia stage carried out by AI was deemed satisfactory by the users. Users also desired an intelligent system that would help them recommend the appropriate things for them to buy based on the traits and requirements of their individual profiles, since this would significantly enhance both the effectiveness and enjoyment of their shopping experiences. When it comes to selecting smart companion products, customers are more interested in purchasing pet-based items that have more compact specifications and touchscreens. Users also want karaoke functions to be included in smart companion products. During the course of the workshop, a participatory design process was developed in order to carry out design research, with the goals of identifying potential for subsequent design as well as user demands and pain points. The first thing that needs to be done is to come up with a solution for the product's design for the smart companion. In this stage of the research, the primary objective is to identify user pain areas that are amenable to improvement and to identify the preferences of older users for other characteristics of the product, such as the product's functionality, form, color, and material, among other things.

According to the questionnaire, the responses highlighted that the majority of elderly people live with their families, but that there are also many elderly people who live alone. As a result, when designing a product, both the appearance and the functionality of the product need to be acceptable to elderly people and their families. When designing for older people to assist avoid dementia, it is important to remember that they require companionship and

everyday engagement, therefore aspects such as communication, entertainment, and shopping must be taken into account while the design and interfaces should be able to assist them in narrowing down their options. Additionally, when designing products for seniors, one should place an emphasis on safety first, followed by functionality and lifestyle considerations (García-Vázquez & Rodríguez, 2009). Also, the majority of users do not have a positive experience when purchasing products geared for seniors; consequently, the suggested design needs to assist users in enhancing their shopping experiences and selecting the appropriate products. From the responses, the majority of old people live together as a couple with their children, around 90% live with their own family or caregivers, while about 10.42% live alone. 70% of responders would take the elderly on a regular stroll, 45% would engage in conversation with them, and 40% would play games with them for amusement. The purpose of the questionnaire was to gain insight into respondents' experiences with purchasing things for seniors. The majority of respondents stated they did not know how to choose the proper products, while some said there were so many options that they did not know what to choose and where to get relevant things for older people, and others claimed that some products felt too outdated. They cited three primary reasons: to keep the elderly in the family safe, to prevent disease in the family, and to promote the health of the elderly. Some respondents also reported that they purchased related products to enhance their personal caregiving experience with the elderly. They have frequently purchased daily essentials (goggles, crutches, bath-chairs, calendars) for the senior members of their families, followed by household furniture, massage items, and entertainment products (radios, stereos, tablets, etc.).

Design integration intervention for digital companions

Currently available popular companionship products are mostly separated into pet and monitor display models. However, they all possess the ability to monitor and communicate. In the case of pet products, they are mobile and capable of interacting with the user through facial expressions and sounds. The design orientation of intelligent companion products is classified into four categories: companionship, entertainment, health advice, and user behavior analysis (observation). To stimulate the memory of the elderly, the companionship feature primarily solicits information about the user's family members and displays family photographs. In terms of entertainment, engagement with older users is improved by playing music, reading the news aloud, engaging in interactive storytelling, and performing karaoke. To promote the health of the elderly, simple exercises such as standing up, hand clapping, and stretching are recommended as health advice. Lastly, the device's camera enables the observation of the elderly's daily behavior, allows them to conduct video conversations, and provides product and service recommendations based on the elderly's gathered daily behavior (Refer Table 2).

Application areas	Suggested functions	Benefits for preventing dementia
Companionship	<ul style="list-style-type: none"> • Ask questions related to their family • Display the photos of the family members 	<ul style="list-style-type: none"> • Improving the elderly mood and focus, the ability to use these applications was affected by the severity of dementia • To recap the elderly memory

Entertainment	<ul style="list-style-type: none"> • Play the music & songs • Play games (family photo quizzes) • Read out the news • Interactive storytelling • Karaoke 	<ul style="list-style-type: none"> • Improving the level of depression and increasing engagement • Activating the elderly brain and recap the memory • Distracting users and reducing wandering behavior
Health Guidance	<ul style="list-style-type: none"> • Providing the guidelines for remaining healthy • Simply Exercise (Stand up, clap hands) 	<ul style="list-style-type: none"> • Improving the living habits and body health
Initial Evaluation/Observation	<ul style="list-style-type: none"> • Providing the product, service, and activities suggestion • Reminder • Data collection • Video call 	<ul style="list-style-type: none"> • Connecting the elderly with family members • Improving emotional well-being and quality of life • Reduced stress

Table 2: Design characteristics for the digital companions

Conclusion

According to the data collected from the survey, Chinese retirees in their 60s and 70s who have relatively high levels of education are able to adapt well to modern society and exhibit a strong willingness to share their experiences and offer assistance to others through the use of digital media after they have reached retirement age. The vast majority of respondents had a positive attitude toward adopting modern technology for the purpose of improving their social and emotional well-being (Steptoe et al., 2015). These respondents held positive views regarding the importance of self-fulfillment, social interaction, digitalization, and emotional support provided by digital companions. Since personnel shortage has been a constant disadvantage in the senior service sector, the promotion of such companions can definitely reduce the burden on the caregivers. The range of functions that can be attained through these means can be further explored while strictly considering the data sharing policies and privacy issues related to using AI. To be regarded a true companion robot, the path of future research must be toward active companion robots that can initiate conversation, provide recommendations based on user behavior, and form a deep connection with the user. The active companion must offer the user a novel experience. It enables the user to encourage the elderly to utilize the product and strengthens the bond between the user and companion.

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