Metaverse May Improve Long-Term Health Care Outcomes In Taiwan

Yi-Jung Lai
Department of Senior Service and Health Management
Chia Nau University
Chiayi, Taiwan
yrlai2007@gmail.com

Kai-Chun Hou*
Department of Digital Media Design
Asia University
Taichung, Taiwan
KaiChun.hou@gmail.com
(*corresponding author)

Kang-Ming Chang[#]
Department of Digital Media Design
Asia University
Taichung, Taiwan
changkm@asia.edu.tw
([#]equal contribution to the first author)

Abstract—**Because the growing population of aging has become an important issue around the world, governments around the world have successively proposed many long-term care measures. Among them, Taiwan has proposed the Long-term Care 2.0 plan, which provides multiple and continuous services ranging from family support, home, community to residential care. Furthermore, through a variety of outlets such as social participation, health promotion, caring visits and telephone greetings, health care professionals can continue to provide community long-term care services. Although the long-term care policy is well-conceived, there are still parts that cannot be implemented. For example, there are elders who are unwilling to receive care visits, and elders with limited mobility or who rarely go out. Although they are cared for by telephone, they are still unable to provide elder services. Through the brainstorming of experts and the latest metaverse technology, this study will propose a long-term care service model with the aid of metaverse. There are two application scenarios, one is with his family gathering, the other is social activity with other friends through the Metaverse. Metaverse has the potential to support the current long-term care service.**

Keywords—Long-term care; metaverse; Taiwan

I. INTRODUCTION

Population aging has become a great challenge all over the world, and many international organizations and countries have also proposed relevant policies and visions in response to aging issues. In 2016, the World Health Assembly adopted the "The Global strategy and action plan on aging and health 2016–2020: towards a world in which everyone can live a long and healthy life", and proposed strategies to support the well-being of older persons and their caregivers through adequate and equitable provision of services and assistance (World Health Assembly, 2016).

Many countries have also developed their own long-term care policies in response to aging care. Each country has different long-term care services. Generally, the goal of long-term care is to compensate for functional decline and reduce the burden of care for families. The government tends to focus on the poor, but Germany chose to popularize long-term care services in 1996. The applicant's level of long-term care dependence is assessed by the medical team of the social insurance program. Japan also follows this model, Japan has the world's largest aging population, with 27.7% over the age of 65. Japan is more generous with benefits, as long-term hospitalization was covered by health insurance before it was implemented in 2000, and social services were greatly expanded. These service levels must be maintained and made generally available to all who meet the eligibility criteria. Therefore, efforts to control costs after implementing long-term healthcare insurance have only had a marginal effect. This suggests that it would be more efficient and equitable to introduce public long-term healthcare early, before benefits are expanded due to temporary policy decisions (Ikegami, 2019).

In 2015, the Japanese government changed its main strategy from a high-risk strategy to a community-based population strategy by reforming the Long-term Care Insurance Act. The Act focuses on community-based care and social determinants of health. The bill was inspired by a social engagement intervention. These interventions were managed by local volunteers and held once or twice a month in public spaces within walking distance of community members' homes. Seniors can meet and interact with others through enjoyable, relaxing, and sometimes educational programming with low costs. Studies show

that these activities can halve the incidence of long-term care needs and reduce the risk of dementia by about a third. Evidence also suggests that financially vulnerable older adults are more likely to participate in such interventions (Harris-Kojetin et al., 2019).

In 2017, 86.5% of Japanese municipalities implemented these interventions (Saito et al., 2019). The long-term care of the United States is dominated by personal private insurance (Brown & Finkelstein, 2009). According to a report, in 2016, there were approximately 65,600 long-term care providers in the United States, providing fee-based, government-regulated long-term care services, serving more than 8.3 million people. These service units are distributed in different institutions with various services. There are four main service types, the first is in the community, such as adult day service centers in the community; the second is in the home, with family health agencies, hospice agencies or family and friends; the third is the institutional system, such as nursing homes or skilled nursing facility; The fourth are residential nursing companies (Harris-Kojetin et al., 2019).

In China, the population is ageing rapidly, surpassing many Asian countries such as India and Indonesia, as well as high-income countries in Europe and North America. In 2015, it was estimated that by 2050, the number of elderly people (≥65 years old) will reach 366 million (26.1%). The long-term care system in China is characterized by a rapid growth of the residential care sector, slow development of home and community services, and increased private sector participation. But a shortage of long-term care workers and weak quality assurances are worrying. China is piloting social insurance long-term care financing models across the country, along with programs that combine health care and long-term care services; the effectiveness and sustainability of these pilots remains to be investigated (Feng et al., 2020). Different countries in the European region have different approaches, but all share the following challenges (1) the availability and adequacy of supply of long-term healthcare service, (2) the quality of formal home care and residential services, (3) the availability of informal care-givers employment, and (4) the fiscal sustainability of the national system (Greve, 2017).

A. The development and current situation of Taiwan's long-term care policy

In the latest report on the global elderly population published by the United Nations, Taiwan is ranked third in the world after South Korea and Singapore (Nation, 2019). In 1993, the proportion of the elderly over 65 years old in the total population reached 7.1%, officially entering the national threshold of aging defined by the United Nations. In 2018, the ratio of the elderly to the population has reached 14.5%, thus, Taiwan is becoming an aged country. According to estimates by the National Development Council, it is expected to increase to 20.7% by 2025, which is close to the super-aged countries with an elderly population ratio of 21%. The overall population structure is rapidly trending toward aging, and the number of people in need of long-term care has also increased. In order to

develop a perfect long-term care system, the Executive Yuan approved the "Ten-year Long-term Care Plan" (referred to as LTC 1.0) in 2007, promoting the long-term care business, and based on the principle of "local aging", a number of home-based services and community services were established. However, due to the lack of understanding of the services of LTC 1.0, coupled with many factors such as limited service objects, insufficient budget, and shortage of service personnel, the promotion of LTC 1.0 has not been effective. Based on the problems that occurred during the promotion of LTC 1.0 and the long-term care demand arising from the increase in the disabled and demented population, the Executive Yuan approved the "Long-term Care 10-Year Plan 2.0" (referred to as LTC 2.0) in December 2016 and implemented in January 2017.

The LTC 2.0 has been, with the goal of "find, see, and use", providing a variety of continuous services ranging from family support, home, community to residential care, and universal care. service system, with establishment of an overall care model for the community (Teng et al., 2019). LTC 2.0 actively promotes the pilot plan of the overall community care model, developing innovative services, building a community-based health care team system, and extending services to hospital discharge preparation services, home medical care and other services. In addition, LTC 2.0 also increases the flexibility of the existing services of LTC 1.0, expanding the service targets from 4 to 8, and the service items from 8 to 17 (Yang et al., 2019).

In the LTC 2.0, the government divides all services into ABC three levels, in order to integrate the resources and care mode of the community as a whole and strengthen the connection between various services. LTC2.0 establishes a community-based care-oriented community and is expected to improve the quality of life of those with long-term care needs and caregivers. "ABC Levels" are the core of LTC 2.0, implementing the long-term care policies of "community aging" and "local aging". Level A represents a community-integrated service center, which can be called the "LTC flagship store". There must be two service providers: "home service" and "day care". The Level B – LTC store, is a complex service center. It is a unit that provides one of the services of home care, community care, and institutional care. Level C - Alley LTC Station, is where long-term care needs can get shared meals, health promotion, and delaying disability services. The goal of LTC 2.0 is to have at least one A in every town, at least one B in every high school district, and at least one C in every three villages, and there will be round trip transportation available by transportation vehicles (Ministry of Health and Welfare, 2021).

The following example is the operation mode of Level C - Alley LTC Station. The content of this service refers to the Health Bureau of Kaohsiung City Government, Taiwan. The services, methods and contents are as follows:

TABLE I. LEVEL C - ALLEY LTC STATION IN TAIWAN (HEALTH-BUREAU, 2021)

Service Items	Service method and content	
social engagement	productive activities	Gardening, caring for relatives, volunteering, house cleaning, shopping, etc.
	common activity	Participate in educational classes, play chess or cards, sing, or play musical instruments, travel, outdoor fitness activities, participate in arts and cultural activities, etc.
	social activities	Going out to visit others, talking on the phone with others, etc.
health promotion	1. Blood pressure and body temperature will be measured by volunteers at fixed points and recorded in parallel. 2. Conduct health seminars and health education publicity 3. Lead elders in dynamic activities such as music rhythm, health exercises, and physical fitness. 4. In cooperation with health clinics and local medical resources, we provide simple health care services and medical consultation, bone density testing, free clinic activities, etc. 5. Cooperate with government policies to promote disease prevention and flu vaccination, etc.	
care visit	1. Subjects: Living alone, disabled and living alone, dual-parent families, depressed individuals, lack of family or social support. 2. Visiting process: establish relationships, collect information, understand the life experience, preferences, and expertise of the elders, observe whether the living environment of the elders is safe, and write the visit records.	
	3. Elements of the visit: continuous and regular care, resources connection, and companionship.	
phone hello	1. Subjects: Elders who are unwilling to receive care visits, elders with limited mobility or who rarely go out, and elders who rarely go to Level C Station to participate in activities. 2. Visiting process: To understand the current living situation of the elderly, in order to facilitate the provision of follow-up services, provide welfare information and referral services if necessary, and write a telephone interview record form. 3. Hello Topics: health, expressing emotions, current status of family members, economy, welfare information provision, invitation to participation bases, drug use status, current use resources. 4. Visit elements: regular care, expressing concern, making connections	

B. Metaverse and LTC

Due to the maturity of software and hardware and driven by the popularity of online games and social platforms, Metaverse is based on the technology constructed by virtual reality, with multi-person connections for social interaction as the core concept. The sci-fi situation of the original novel becomes more realistic (Sparkes, 2021). To reduce the impact of the virus and the epidemic all over the world, not only the entertainment industry, but also VR has begun to be applied in the business and social fields (Rospigliosi, 2022), and even the education industry has paid attention to how to make younger students become involved in Learning in Immersive Environments (Kavanagh et al., 2017). It can be said that the post-epidemic era is coming, and the digital transformation of various industries has led to an increase in demand, which has accelerated people's progress towards the virtual world, such as remote working, distance learning, video games, multimedia entertainment, and various social interactions. Compared with other technologies, virtual reality (VR) and augmented reality (AR) technologies have gradually become popular and mature and thus, will be used as solutions (Ning et al., 2021). The most significant difference between Metaverse and video games is not just entertainment.

Metaverse includes many community elements for real players to interact in the virtual world, and it also advocates the need for the integration of virtual and reality. Users will perform a variety of interactive behaviors in the virtual environment through virtual avatars, such as concerts (Martín, 2018), or cultural tours (Kim, 2021). The importance of virtual avatars is indescribable. Some scholars have found that while real players operate virtual avatars, virtual avatars also affect the psychological state of people in the real world (Merola & Peña, 2010).

In medical applications, European scholars designed a VR digital interactive system to encourage more people to take the initiative to vaccinate against COVID-19, which improved the willingness of adults to vaccinate (Mottelson et al., 2021), and even designed the system so it has become a game. It has also successfully attracted young people to be vaccinated (Vandeweerdt et al., 2021). For the application of the elderly, some studies have pointed out that a virtual interactive environment can be used as a platform interface to construct a presence environment, which has substantial benefits for the elderly in sports training while enhancing the enjoyment and energy (De Bruin et al., 2010). For long-term care, more and more studies have mentioned that technology is used as an auxiliary tool to solve the reduction and limitation of the elderly's mobility, cognitive ability, and social interaction. Among them, 66 elderly people with an average age of 80.5 years old accepted virtual reality. The score was very high; most of them gave positive feedback, 76% of the subjects said they wanted to try again, and there were no negative side effects (Appel et al., 2020). In addition to virtual reality, some scholars have proposed to use augmented reality to improve the well-being of the elderly (Lee et al., 2019). Research has shown that the appearance of different avatars increases the positive attitude of users to engage in certain behaviors (Merola & Peña, 2010). VR itself is an emerging technology in the consumer market that will create many new opportunities for research. It provides a highly immersive laboratory environment tightly integrated with reality. The experience mode in the virtual space is also very different from the traditional multimedia way. Therefore, it is worth exploring the new behavior patterns of people in the virtual environment.

The goal of this study is to propose a novel long-term healthcare approach with the aid of the metaverse for Taiwan's Long-term Care 2.0 through the feedback of experts to find the applicable scenarios and propose suitable solutions. These solutions will be used for the follow-up implementation of the Metaverse on long-term care.

II. METHOD

A. Application scenarios collections

Two experts on long-term healthcare were involved. With the brainstorming of the two experts, suitable long-term health care scenarios with metaverse are proposed. Both experts have more than 15 years of work experience in long-term health care.

B. Constructing metaverse scenarios design

Through expert opinions, this research uses Blender 3D software to design a long-term metaverse situation map, supplemented by the virtual characters provided by the Ready Play Me platform to represent multiple real users entering the metaverse. The scenes and objects in the context are from the CGtrader platform Royalty Free License (Royalty Free License). This is based on experts' descriptions and designed for back-and-forth discussions in future scenarios. This 3D scenario design covers some of the metaverse concepts proposed by Roblox (2021), including friends - family gatherings and social worker home care, identity - an avatar interacted each other by actual users, immersive - based on demands change of immersive virtual scenes, anywhere - users can log in without space constraints and transform into virtual characters, variety - a variety of activity possibilities, low friction - users can synchronize their feelings with each other, civility – a particular culture due to specific ethnic groups, such as family birthdays, home care services, etc.

III. RESULT

There are two scenarios. Illustrations of both scenarios are in the following figures:

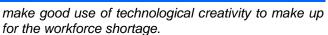### A. Scenario 1: Family Reunion

Children and grandchildren worldwide celebrate their grandfather's birthday through the metaverse environment (family members break space restrictions and enter the metaverse platform to celebrate their elders' birthdays in a virtual environment. The younger generation can instantly play musical instruments and generate various virtual congratulations).

Fig. 1. *Family reunion in the metaverse.*

B. Scenario 2: Home Care

Social workers take care of the elderly living alone at home through the metaverse environment. Volunteers interact with the elderly in multiple virtual environments (house, pyramid, and universe) and play virtual interactive puzzle games such as cards and chess.

Fig. 2. *Social workers interact with the elderly living alone through technology.*

IV. DISCUSSION

After summarizing the above literature discussion and experimental methods, this study summarizes the following conclusions.

A. The current difficulty of realizing the metaverse.

In the face of the labor-intensive demands of long-term care, a metaverse constructed from virtual environments can provide new solutions in time and place. To achieve this goal, there must be three practical approaches

1) *Develop a variety of VR software or platforms and provide a serial mechanism to connect each other: at the present, the virtual reality application software related to long-term care in Taiwan is still insufficient. More manufacturers or services are still to be developed. In addition, social interaction is necessary for the metaverse, so the tandem services of these applications need to be constructed.*

2) *Software and hardware provide more affordable prices, requiring a lot of testing and platform trial operation: Even if the current VR-related software and hardware problems are relatively mature, the price is still not affordable for long-term care institutions, especially for large-scale procurement and application of similar institutions. In response to the diversity of long-term care services, related services have also developed a variety of needs. A lot of testing and feedback will help to establish the relevant platform.*

3) *The government encourages policies and conducts all-around publicity in combination with the four significant areas of industry, government, academia, and research: all circles have responded that the resources invested by the Taiwan government in long-term care should still be strengthened. However, in addition to the reinforcement of human resources, overall supporting measures are needed for the Metaverse long-term care service. We try to*

make good use of technological creativity to make up for the workforce shortage.

Although the software and hardware of virtual reality have been significantly upgraded in recent years, there are still several items to be overcome to realize the Metaverse long-term care system in Taiwan at this stage:

1) *Friendly and universal interface design: friendliness provides an intuitive and easy operation. The easy process does not mean simple design but must be understood and operated by the elderly interface design. A friendly interface has always been one of the focuses of technology products, but a too complicated interface for immersive devices can discourage people. Universal design means that the interface design can develop a suitable operation interface according to different cultures, ethnic groups, and service requirements.*

2) *Social workers' familiarity with software and hardware: social workers' or volunteers' understanding of the long-term care technology system will help promote the intelligence of the long-term care system, making it more convenient for training and application.*

3) *The elders' attempt with high-tech equipment: although the elderly in Taiwan highly accept implementing the communication software Line, the attempt of other new 3C technology products still needs to be promoted in all walks of life. When elders are willing to try more new services, this can also positively drive several innovative services of the Long-tern care Metaverse system.*

B. Feasibility and possible difficulties

It is difficult to have further contact with the elders who are unwilling to receive care visits, those with limited mobility or who seldom go out, and those who seldom go to Level C station to participate in activities. Social workers can usually only use telephone visits to care. Therefore, how to have more contact with the elderly or how to encourage the elderly to participate in social activities is an urgent problem that needs to be solved as soon as possible. The metaverse model proposed in this study can provide more diverse care service opportunities, as follows:

1) *Metaverse can solve the large amount of manpower required for long-term care. Combined with the design of translation software, volunteers from all over the world can participate in the care and care activities without worrying about the risk of disease transmissions.*

2) *In the metaverse, social workers or long-term care workers can provide more diverse care, reduce the rush of traffic, and increase the time and frequency of "face-to-face" interactions.*

3) *In the metaverse, care recipients can choose the character appearance and interactive environment in the virtual world, and they can also choose different*

types of interactive groups, which helps to improve the motivation and opportunities of the elderly to participate in social activities.

4) For the elderly with limited mobility, the metaverse model proposed in this study allows the elderly to choose different interactive scenarios and participate in a variety of social activities or travel activities, so that the elderly can go wherever they want without being restricted by movement.

From the above points, it can be seen that the metaverse model proposed in this study will be able to provide long-term care systems to solve the problems of insufficient care manpower, transportation, and improving the motivation of the elderly to participate in social activities. However, while smart and digital technologies make life more convenient, they also bring more "technological pressure" to many elderly people. Many elderly people lack technology and Internet knowledge, cannot learn the complex operation of smart devices, have a reduced ability to accept new things, have inner fear or resistance, and lack opportunities and places to learn. These are all issues that a practical metaverse model must overcome.

V. CONCLUSION

This article proposed two scenarios on long-term health care with metaverse technology. Although there is no actual clinical implementation, it is believed that the Metaverse is very important for long-term care as long as the technical difficulties are gradually solved, and the professional knowledge of the Metaverse for caregivers is well developed.

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