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Shaping the Elderly's Avatar-in-Reality

Ilhan BAE

Abstract

Super-aged societies experience a large increase in the proportion of elderly with limited mobility who face significant challenges accessing transportation. Telecommunication services, namely video calling, has structural limitations in meeting the mobility needs of an aging population. In order to address the limited mobility of the elderly, this study suggests an alternative telecom model to utilize the opposite party as an avatar: a remote-controlled video-call transporter who under the user's control moves to the user's desire location. This alternative telecom model is defined as real avatar service. To highlight the utility of real avatar service, this study first explores the structural limitations of enhancing passenger transport and telecommunications to address the challenge of limited mobility faced by a growing elderly population. Then, inspired by theories of media determinism, it designs an alternative telecom model to shape the avatar-in-reality. Finally through a literature review, it demonstrates how shaping the elderly's avatar-in-reality is a useful alternative, functionally distinguished from existing telecom services and transportation, for enhancing the mobility of the elderly.

Keywords: mobility, aged society, elderly, real avatar service, McLuhan, Kittler

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Introduction

Korea became an aging society in 2000 and an aged society in 2018, when its population of individuals over 65 years of age exceeded 14 percent of the total population. Korea's aging rate is the fastest in the world, and if this trend continues, Korea is expected to become a super-aged society by 2026, when the proportion of its elderly population (over aged 65) will reach 20.8 percent (Statistics Korea 2019).

This super-aging trend leads to an expansion of the transportation-vulnerable population, presenting great challenges to the mobility of the elderly. Korea's transportation vulnerable surpassed 15.22 million, or 29.4 percent of the total population, at the end of 2019. The total *transportation vulnerable* population of Korea in 2019 was 8.30 million, of which more than half were elderly (aged 65 or older), an increase of 4.9 percent compared to 2018 (Ministry of Land, Infrastructure and Transport, Korea Transportation Safety Authority 2020).

With their decreased mobility due to the weakening of the their physical and mental functions, the elderly experience many challenges to their mobility relative to other age groups (Yu 1999). Providing improved mobility to Korea's growing elderly population is critical for maintaining the competitiveness of Korean society (Oh et al. 2016). The mobility to access a desired destination is an essential element in the quality of life, social functioning, and physical and mental health of human beings (Oxley et al. 2010). This is because even for the elderly with impaired mobility, maintaining a freedom of movement increases economic activity and reduces the burden on other generations. Mobility is a fundamental activity allowing the elderly with reduced socioeconomic activity levels to live independent lives. In addition, studies have shown that for the elderly, who are more likely to feel alienated, whether one has secured an independence of mobility has a close relationship with one's satisfaction in retirement (Burns 1999).

Most of the countermeasures to the restricted mobility of the elderly are generally categorized in two ways. One is a physical solution to increase the supply of easily accessible transportation for the elderly, such as the purchase

of electric wheelchairs, providing free subway tickets, and supplying wheelchair accessible taxis. The second is the augmentation of online meeting solutions, such as video calling and social network service (SNS), to lessen the demand for mobility for social activity, thus allowing the elderly with mobility challenges to socialize in cyberspace. This may include such things as a government lowering of the mobile communications fees for the elderly or the provision of smartphone technology classes for seniors.

This study originated from the critical perspective that there ought to be alternative ways beyond previous transportation and telecommunication services to assist the growing elderly population with limited mobility. This present study argues that overcoming the weaknesses of the existing telecom models can present an alternative to addressing the elderly mobility issue. Most advanced telecom services, such as mobile video calls or virtual reality meeting spaces, which can deliver a vivid sense of reality, commonly lack the ability to allow the user to control the opposite party. For instance, one can communicate with a distant opposite party by voice or video call. However, if that opposite party does answer a call, one must physically visit the party for communication. Ordinary telecom services in terms of their technology or business model do not support user control of the opposite party, such that the opposite party will act according to the user's will. This lack of control over the opposite party in existing telecom services leads people to visit the opposite party for direct control there.

This study suggests a new type of telecom model that assures a user will exercise full control over an opposite party, allowing the opposite party to effectively represent the user's presence and will in a distant location. The distant opposite party thus controlled to assume a user's social role seems to fit the popular concept of *avatar*.

The concept of avatar originated from Hinduism, where it refers to the material appearance of a god. People today commonly associate the concept of an avatar with an online persona representing a given user in video games or SNS. Such online user characters can be categorized as an "avatar in cyberspace" (Stojnić 2015). As people widely use avatars in cyberspace, the avatar is regarded as a social extension of a user and legally protected as private property (Day 2010).

However, there exists another form of avatar other than a user character in cyberspace. This is a form of "avatar-in-reality" that possesses a physical body. The film Avatar (2009) shows a stereotypical avatar-in-reality. The film depicts an alien planet in the 22nd century. The main character with a paralyzed lower body selects a new life by connecting to the body of an alien, much superior than a human being in physical abilities. When this main character is connected to the alien body from a distance, he still maintains his human consciousness, but achieves an new body that can freely run and act as a warrior of an alien tribe. Avatar's record-breaking box office draw reflects the universally empathetic appeal of a story about taking control of another body in order to overcome a given physical condition.

It is only natural that people with physical limitations in their given body should dream about having remote control over another body in order to deal with an urgent situation. This type of avatar-in-reality would be especially useful for the elderly, who are challenged to visit distant locations for social interaction or pleasure.

The implementation of an avatar-in-reality system does not necessarily require futuristic biotechnology that would connect one human's consciousness to another body, as in the film Avatar. A functioning avatar-in-reality is feasible by upgrading the existing telecom model to allow video call users to take full control over the opposite party.

Despite the applicability of existing technology, such an alternative telecom model to create an avatar-in-reality has not been implemented. To prove the utility of an alternative telecom model to create an avatar-in-reality—which would be very useful in an aging Korea society—this study first explores why the existing public transport and telecom services models do not meet the mobility needs of the elderly. Inspired by the media theories of Martial McLuhan and Friedrich Kittler, who declared that the medium reconstructs humanity, this study presents an alternative telecom model that would allow a video call user to control two types of opposite parties, a mobile machine or another person, so that they function as an avatar-in-reality.

Finally, this study demonstrates how an alternative telecom model to utilize an opposite party as an avatar-in-reality would enhance user mobility, for it substitutes the need to physically visit a location and is functionally

closer to actually transporting people. Previous studies in robotics have shown that an alternative telecom model that controls a remote mobile robot to assume the role of avatar-in-reality is functionally closer to transporting people. Therefore, an alternative telecom model that controls another human, who has superior mobility relative to a mobile robot, as an avatar-in-reality, would even further enhance a user's mobility. This study hopes to demonstrate that creating an avatar-in-reality for the elderly offers an alternative method of enhancing the mobility of the elderly, and thus maintaining the competitiveness of an aging Korean society.

Current Mobility Situation among the Korean Elderly

In Korea, 15.7 percent of the population, or 1 in 6 citizens, is aged 65 or older (Statistics Korea 2019). And this aging trend is accelerating. In 2040, the proportion of the population of the elderly aged 65 or older in Korea is expected to be 33.9 percent, and one out of three citizens is expected to be elderly. A more serious phenomenon is that by 2040, the proportion of the relatively young elderly (65–74 years old) decreases among the elderly group, while the proportion of super-aged (aged 75 or older) becomes the majority at 51.5 percent (Figure 1). In other words, in Korean society, not only will the current aging trend continue, but from the 2030s, super-aging within the elderly cohort will accelerate in earnest.

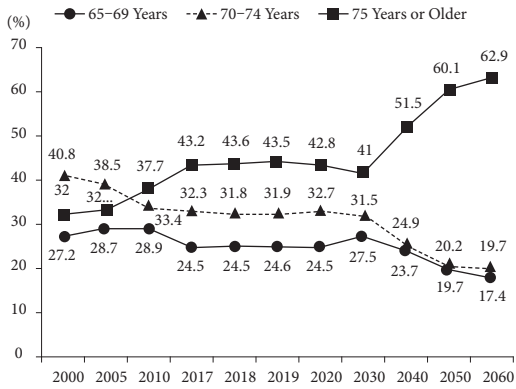

Figure 1. Composition ratio of the elderly (65 years or older) by age group

Source: Statistics Korea (2019).

The super-aging of the elderly means that the number of super-aged people whose independent mobility is challenged will increase significantly. The aged have a slower reaction speed as their physical function is reduced, and the risk of traffic accidents due to attention deficit is very high compared to other age groups (Ji and Koo 2009).

Cognitive abilities, such as attention, memory, and decision-making, decrease with age (Ponds et al. 1988). Most elderly are likely to experience severe mobility restrictions at the end of their biological life due to the reduced phsycial and judgmental functions, the risk of accidents, and reduced income. In the super-aged society facing Korea, the proportion of elderly who depend on wheelchairs or assisting devices for their mobility-impaired bodies, and those who can hardly leave their place of residence, will naturally increase.

Existing strategies for responding to the emerging mobility challenges of the elderly in a super-aged society generally focus on two areas: passenger transport and telecom services. Yet enhancing passenger transportation and telecom services alone will not suffice to address the limited mobility issues of a growing elderly population.

One strategy of using passenger transportation to address the issue of elderly mobility is to enhance the quantity and quality of transport services for elderly passengers. For example, as the proportion of elderly drivers involved in traffic accidents increases due to the aging population, voices are calling for the regulation of driver's licenses for elderly drivers. The OECD (2001) has recommended increasing the supply of transportation services by continuing to allow driving as long as a certain level of safety is met, rather than unilaterally restricting the mobility of the elderly. Others have suggested that in order to enhance the mobility of the elderly, the transportation infrastructure should be reorganized, and related laws and regulations should be reformed to ensure the accessibility of the elderly to public transportation (Wong et al. 2017). Meanwhile, fully autonomous vehicles that do not require direct driving have the potential to make a significant and positive impact on the mobility and quality of life of older people (Pettigrew et al. 2019).

Yet it is difficult to resolve the mobility problem of the elderly by strengthening passenger transportation services due to the following three constraints. First, there is a restriction in mobility due to physical aging, which limits access to transportation services. Even if accessible means of passenger transportation exist, their utilization by the elderly with impaired mobility will be generally poor. For example, among elderly tourists, those who are uncomfortable walking tend to avoid public transportation such as trains, buses, and subways, opting instead for personalized transportation (Rosa 2020). The dissemination of ADAS (advanced driver assist systems), or fully autonomous driving technology, is expected to help the elderly by relieving the burden of driving and enhancing independent mobility. However, because some elderly are unable to travel long distances independently, it will be difficult for advanced transportation services such as autonomous vehicles and air taxis to become a fundamental solution to the mobility problems of a super-aged society.

Second, mobility limitations resulting from environmental risks prohibit the growth of physical transport. Sustainable transportation, which limits carbon emissions in response to increasingly severe climate change, is emerging as a hot topic in the transportation industry. Sufficiently

satisfying the growing mobility demands of the elderly through the expansion of personalized and automated transportation comes with a high environmental cost. Increasing environmental and conservation imperatives are expected to limit the transport options of the growing elderly population.

Third, there are the mobility limitations posed by health risks to the elderly. With the COVID-19 pandemic of 2020, the health risks of long-distance travel have increased. In particular, because of their greater vulnerability, the elderly are experiencing severe mobility restrictions due to the coronavirus outbreak. With the COVID-19 not disappearing and threat of a similar pandemic ever present, there remains the possibility that national governments will continue to place restrictions on international travel.[1] In summary, sufficiently solving the mobility demands of the elderly by enhancing transport services and technological innovation is hampered due to the physical toll of aging, environmental costs, and health risks.

Another strategy for responding to the mobility restrictions of the elderly focuses on telecom service. Simply put, this approach seeks to help elderly be more receptive to telecom services to lessen their need for mobility. With the 2020 coronavirus pandemic, the world has experienced an unprecedented traffic paralysis, with people refraining from domestic and international travel, or even leaving their homes. Amidst this global emergency, telecom services that replace the need for mobility have taken the spotlight. *Untact* is a newly coined word floating about South Korea to describe IT services, such as video conferencing, online shopping, etc., that substitute for physical mobility. Face-to-face meetings have been severely restricted as a preventive measure against the coronavirus, causing an increased demand for video conferencing.[2] As a substitute for overseas travel, big-screen TV sales and Netflix subscribers have surged.[3] As a proxy

1. Berkeley Lovelance, Jr. and Jasmine Kim, "Dr. Fauci Says Coronavirus is So Contagious, It Won't Likely Ever Disappear," *CNBC*, July 31, 2020.
2. Paayal Zaveri, "Zoom's Stock Soars As It Reports Blockbuster Earnings with 355% Revenue Growth," *Business Insider*, September 1, 2020.
3. Bae Jeongwon, "Haeoe yeohaeng mot ga don gudeotda, anma uija saja" (No Foreign Tour, Let's Buy Massage Chairs), *Joongang ilbo*, August 12, 2020; Lee Hyunseung, "Aepeul, Amajon, Peiseubuk mi biktekeu, 2-bungi kkamjjak siljeok" (Apple, Amazon, Facebook, US Big Tech

for in-restaurant dining or in-store shopping, online shopping and food delivery orders are soaring.[4] The online class market is also growing rapidly for students who cannot attend classes in person.[5] Rather than visiting a hospital or doctor in person, the number of patients receiving prescriptions through telemedicine is also increasing significantly.[6] As it struggles with the coronavirus, South Korea is seeing increasing telecom services aimed at replacing interpersonal contact to meet the demand for goods and services thus far met through mobility and in-person contact.

Existing telecom services seem more effective at reducing the time, cost, and labor of physically transporting people. However, telecom services have clear functional limitations when compared to the user value of passenger transport services. Table 1 compares the values that telecom and passenger transport service provide users.

Table 1. Comparison of the User Value Provided by Telecom and Transport Services

User value	Telecom services	Transport services
Prearranged interaction	O	O
Non-arranged interaction	X	O
Independent mobility	X	O
Location-based physical experience	X	O

First, both telecom and passenger transport services commonly support users with prearranged interaction. For example, whether a user is in a video conference or at an offline meeting, there is prearranged interaction

2nd Quarter Good Revenue?), *Chosun biz*, July 31, 2020.

4. Im Sungbin, "Korona-e eumsik baedal georaeaek 84% neureotda" (Food Delivery Growth 84%), *Joongang ilbo*, June 3, 2020.
5. Jeong Myungseop, "Haeoe-neun eotteoke hana?" (How Do Foreign Countries Do It?), *Aju gyeongje* (Aju Economy), March 31, 2020.
6. Reed Abelson, "Doctors and Patients Turn to Telemedicine in the Coronavirus Outbreak," *New York Times*, March 11, 2020.

with the other party, who has already agreed to meet. Even if a student takes an online class or goes to school by bus, the functional aspect of the prearranged interaction in which the student takes the class from the arranged teacher is equivalent. In terms of saving time, costs, and labor, the pre-arranged interaction of telecom services generally has more advantages than that of passenger transport.

Second, non-arranged interaction refers to the ability of users to interact with people and the environment in a spontaneous manner that is not prearranged. Telecom service users have difficulties with non-arranged interaction, but the passenger transport user can freely have non-arranged interaction with remote parties and the environment. For instance, telecom users as video callers generally do not call another person without prearrangement. Therefore, it is not possible for video callers to interact with strangers who do not answer a video call. Voice-only phone calls from strangers, such as for marketing purposes, are somewhat accepted, but receivers still have an option to easily block an unwanted caller. In SNS, users mostly interact with acquaintances with homogeneous attitudes, and can hardly interact with strangers in a non-arranged way. In contrast, transport users are free to approach and interact with strangers or an unfamiliar environment. Passenger transport has an evident superiority over telecom services in terms of non-arranged interactions.

Third, independent mobility in this study refers to the ability of a transportation user to move to a desired destination or the ability of a telecom user to project a message to a desired recipient. Transportation users can naturally go almost anywhere if independently mobile, though previous telecom services, such as video conferencing, voice call and SNS, do not support users having independent mobility, i.e., the capability to subjectively send message to a specific recipient. Only passenger transport supports user independent mobility.

Fourth, location-based physical experience refers to a user physically experiencing services and environments at a specific place. This can include food enjoyed in restaurants, breathing fresh air in high mountains, physical therapy, etc. Location-based physical experience is not possible with telecom services because it can be implemented only when a person actually

physically visits a specific location.

To summarize the value that telecom and transport services provide users, telecom services are functionally similar to passenger transportation services only in terms of prearranged interaction, such as meetings and shopping. On the other hand, passenger transportation has absolute advantages in terms of non-arranged interaction, independent mobility, and location-based physical experience.

It seems clear that both enhancing transportation and telecom services are not adequate solutions to the limited mobility of the elderly. Transportation services for the elderly will not suffice to sustain the mobility of an elderly population due to the effects of physical aging, and the environmental and health risks it poses. Table 1 shows how telecom services have been thus far functionally inferior to passenger transportation in terms of user value. Therefore, telecom services shaping the *untact* society have structured restrictions to sufficiently lessen the mobility needs of the elderly.

In conclusion, the increasingly limited mobility of aging Korean society will not be adequately resolved by such teleportation strategies as increasing the volume of taxis for the handicapped, nor by such telecom strategies as lowering mobile telecom fees for elderly.

Designing an Alternative Telecom Model

It is necessary to find solutions to the mobility issues facing the elderly that are different from the existing passenger transport and telecom service approaches. As an alternative to limited mobility of the growing elderly population, this paper proposes an alternative telecom model to give users the capability of interacting with remote places by controlling an opposite party who carries a video-call apparatus—a video-call transporter, in other words.

If an elderly telecom user controls a video-call transporter, moving it at their will, that user can subjectively interact with a remote situation through video streaming via a video-call transporter. Functionally, a telecom user controlling a video-call transporter creates an avatar-in-reality. It is similar

to the situation of Jake Sully, the handicapped main character in the film *Avatar*, remotely controlling an alien body, thus giving him freedom of mobility to interact with alien tribes. I define this alternative telecom model for controlling video-call transporters, effectively making them avatars-in-reality, as Real Avatar Service (RAS).

The idea behind RAS is that people may achieve enhanced mobility through innovative combinations of human and media technology. This approach to augment human capability by media technology has been a hot issue in media studies. Media researchers Marshall McLuhan and Friedrich Kittler are representative visionaries on how a medium can reshape humanity. In *Understanding Media* (1964), McLuhan wrote how every medium or new technology is an extension of the human body. He believed television to be an extensions of the eye, radio an extension of the ear, the automobile an extension of the leg. As any technological medium functions as an extension of the human body, the advance of a specific technological medium causes an unbalanced extension of the human body, and is used to reshape humanity. His idea on media might be summarized: *we shape our tools and then our tools shape us*. For instance, young people who always use smart phone to work and interact online might be defined functionally as a different species, with abnormally advanced brains and senses, compared to their parent's generation, which mainly used mobile phones for voice calls.

Friedrich Kittler (1999) developed a human-centered theory of McLuhan by suggesting more radical post-human views that *so-called man* is determined by its media technological apparatuses. For Kittler, humanity in modern society is substantially a product of the media technology that people adopt. He argued that old concepts for humanity should be abolished by the determined condition of media technology. Therefore, human has already been reshaped as post-human, and so we should newly define ourselves by the technical standards of adopted media apparatuses.

These views of media determinism commonly reflect the idea that humans can be functionally reshaped as augmented beings through media technology. In accordance with the ideas of media determinism, this study shows that elderly people with limited mobility can be reshaped as highly mobile humans according to how they adopt media technology.

Theoretically, the design of RAS allows users to interact with any remote place as a substitute for physically visiting it.

Therefore, this study aims to prove the research question whether shaping the elderly's avatar-in-reality can enhance elderly people's abilities as mobile subjects compared to existing telecom and transport service strategies. To design RAS and prove its superiority, the present study first highlights that existing telecom services have limited scope for user control, which blocks the ability to shape an avatar-in-reality.

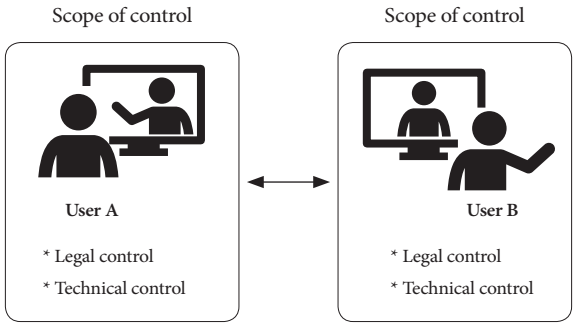

Figure 2. Diagram of a video conference

Source: Author.

Figure 2 shows the scope of control in a video conference as a sample of existing telecom services. Legal control in the above diagram means that a user has legitimate ownership, license, or permission to use the media-terminals. Technical control refers to the ability of a telecom user to independently operate and move media-terminals at will. In terms of scope of controls, each user exerts legal and technical control over only the video terminal in front of them. From a legal standpoint, user A does not have control over user B's terminal, another's property. Both users A and B can project their visual presence only after both parties agree on a video-call meeting. This lack of control over the opposite party is universal across telecom services. Avatar-in-reality is commercially implementable only in

cases where users have legal and technical control over the opposite party, thus, existing telecom services do not meet the prerequisite of shaping avatar-in-reality.

This author designed RAS for an alternative telecom model wherein a user exerts legal and technical control over the opposite party, something other telecom services do not support.

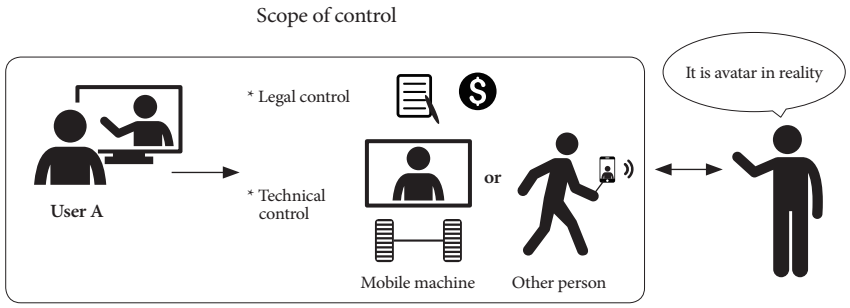

Figure 3. Diagram of two types of Real Avatar Service

Source: Author.

Figure 3 shows this alternative telecom model, in which RAS expands a video call user's legal and technical controls to include the opposite party. The RAS model is similar with ordinary video call in terms of two-way video telecommunication to reveal a user's identity through a separated video terminal. However, RAS is distinguished from ordinary video call service because only one party exerts legal and technical control over the opposite party, while the opposite party is not allowed to independently exert legal and technical control.

To have legal control over an opposite party, RAS users should achieve ownership, license, or explicit permission over that opposite party. For RAS users to legally control an unspecified opposite party in various places, a business model whereby RAS users pay in exchange for control over an opposite party is required.

Technical control of RAS can be largely categorized by two types of

opposite party: mobile machine or another human transporting a video-call apparatus. RAS users may utilize mobile machines to transport a video-call apparatus to their desired destination. Alternately, RAS users can direct another person to take on the role of video-call transporter. Technical controls vary depending on whether users control mobile machine or other persons for remote activity.

Therefore, it seems reasonable to category RAS model by two types of opposite party; one is unmanned RAS to control mobile machines; the other is manned RAS to control another person to assume the role of avatar-in-reality. These two types of unmanned and manned RAS allow users to subjectively send a virtual subject to a desired real location.

In conclusion, the design of the RAS model is distinguished from existing telecom services, for it allows users to exert legal and technical control over an opposite party. Having a readily available avatar-in-reality is merely the stuff of science fiction; it can be achieved with an alternative telecom model using existing video-call technology.

Cases of Two RAS Models

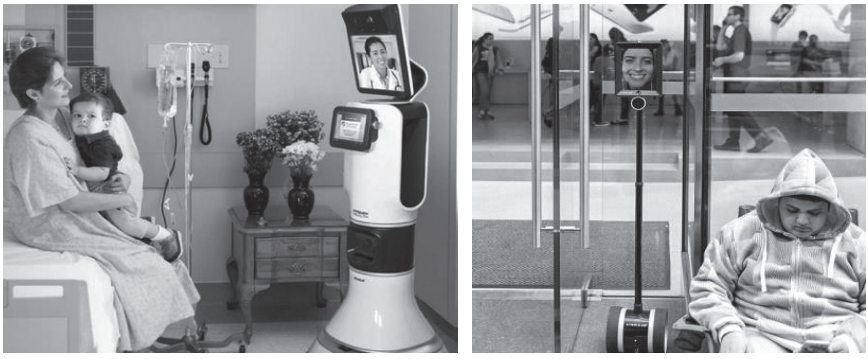

Figure 4. Examples of robot-based Real Avatar Service; telemedicine (left) and remote line-up (right)

Sources: Intouchhealth.com (left), https://finance.yahoo.com/news/meet-lucy-robot-waiting-line-iphone-6s-now-165528436.html (right).

An unmanned RAS refers to a telecom user directly controlling a mobile machine (mobile robot, autonomous vehicle, drone, etc.) to transport a video-call apparatus to a desire location. Currently, unmanned RAS has not been very popularized, but in robotics, there exist sufficient cases of commercialization to prove their utility.

The telepresence robot is a prime example of an unmanned RAS system, and one that is emerging in the robot service market. A telepresence robot refers to a mobile robot platform with a built-in video-call apparatus to substitute for direct visits by remote users/operators. When the remote operator is connected to the telepresence robot, they take the lead in social participation through the self-mobility of the wheeled robot platform, as opposed to stationary video-call services.

The use of telepresence robots for distance education, telemedicine and remote work is increasing (Kristoffersson et al. 2013). According to one study, there is no significant difference in work efficiency between communication with telepresence robots controlled by remote operators and real people. One study showed that in the case of a doctor incorporating a remotely controlled medical telepresence robot into their hospital room rounds, patient satisfaction was equal to that of interacting with the actual doctor in person (Ellison et al. 2004). Sampsel et al. (2011) showed that when a teacher provided guidance to a nursing school student via a telepresence robot, the student perceived it as if a real teacher were teaching on the spot. Another study showed that after the prolonged operation of telepresence robots in offices, both remote robot pilots and co-workers working in the office perceived as if they were all working physically in the same space (Lee and Takayama 2011).

There is also a perception that human-controlled telepresence robots representing remote pilots deserve some universal rights similar to real humans, beyond simply being tools for remote tasks. As a result of the robot field test conducted by the Korean public, Bae Il-han (2017) showed a considerable level of acceptance in guaranteeing the constitutional rights of a human-controlled telepresence robot representing remote pilots as if the person were on site. In 2015, a woman in Sydney, Australia placed a telepresence robot in a queue to buy a new iPhone in front of an Apple store.

The people waiting in line allowed the remote queuing and purchasing by telepresence robots even though the female robot pilot was not on site.[7] Van Delden and Bruijne (2017) examined the reaction of the public to a telepresence robot by inserting it into various everyday scenarios, such as serving as a soccer referee, purchasing alcohol at a discount store, visiting an art gallery, and taking a train.

According to one study (Bae and Han 2020) on the acceptance of telepresence robots by the elderly, the elderly want to use robots as much as the younger generation. The elderly participants in this study, who experienced the telepresence robot, fully understood the utility value of the robot, which took the role of a surrogate at remote locations. In another study, elderly residents of nursing homes demonstrated their willingness to utilize their own telepresence robots independently and to operate them when going out to visit acquaintances or art museums (Beer and Takayama 2011).

Figure 5. Example of an unmanned Real Avatar Service to control a drone (left) and vehicle (right)

Sources: http://www.humanmedialab.org/blog/bitdrones (left), Ackerman (2019) (right).

Autonomous cars and drones can also be used as unmanned platforms of RAS that send virtual subjects to a desired destination. Bae Il-han has

7. Jenni Ryall, "A Robot Named Lucy is Lining Up to Get an iPhone 6S in Australia," *Mashable*, September 24, 2015.

experimented with the possibility of a vehicle-based unmanned RAS by incorporating a video conferencing function into a prototype car (Ackerman 2019). Vertegaal et al. (2015) demonstrated a drone-based unmanned RAS. This latter incorporated a small drone with a video conferencing function to combine flying mobility with a virtual subject. If mobile robots, drones, and autonomous cars are widely commercialized to take on the roles of avatar representing remote users, the unmanned RAS will help to enhance mobility for the transportation vulnerable.

Despite the rising interest in RAS using unmanned transportation, its popularity has been limited at this stage for the following three reasons. First, the unmanned means of transportation that can be used for RAS are still significantly less maneuverable than humans, and inconvenient to use in daily life. Humans can move around obstacles in their daily lives and access any place or person using various means of transportation. By contrast, telepresence robots can only roam on a flat surface and cannot maneuver around ordinary obstacles such as stairs and thresholds, so most of them are only available on a single floor of a building. In the case of drone, permitted flight zones and flight durations are severely limited in the everyday spaces a user would want to use. Autonomous cars can be accessed wherever there is a roadway, but those vehicles designed to transport passengers are too large to personally reach and interact with people indoors.

Second, the number of unmanned means of transportation available for RAS is too small. In the case of telepresence robots, the only unmanned transportation that has been commercialized, the cumulative number of globally distributed robots is estimated at less than 50,000 as of 2019. Using drones and autonomous vehicles for RAS is still in the testing stage.

Third, public access to unmanned RAS is structurally closed by the absence of a business model. In order to popularize robot-based unmanned RAS, unspecified users should be allowed to freely access telepresence robots in needed locations and to pay fares. However, most robot owners control and operate telepresence robots for the specific tasks of a closed group, not for public access or business. For example, telepresence robots installed in elementary schools are for non-commercial use by distant teachers who have the permission of the principal.

In sum, past studies on robotics have shown that robot-based unmanned RAS can work efficiently as an alternative to in-person visits. Telepresence robots, a representative example of unmanned RAS, have proven their utility in various fields, and the elderly are as eager as the younger generation to adopt such robots. However, the social impact of a robot-based unmanned RAS is still limited due to the restricted mobility of wheeled robots, shortages in supply, and the absence of a business model for public access.

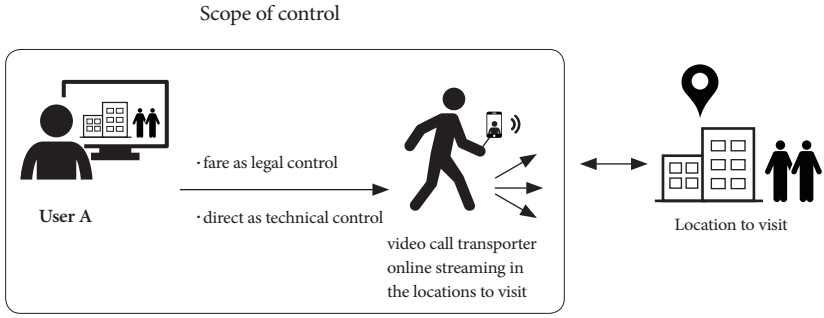

Figure 6. Detailed diagram of manned Real Avatar Service

Source: Author.

An alternative telecom model: manned RAS using another human as an avatar-in-reality is not yet commercialized as of 2020. The present study highlights the theoretical potentials of manned RAS. Figure 6 shows the manned RAS that allows a user to virtually approach a desired site by directing the video-call transporter: the interlocutor with a video-call apparatus. In this model, the user exercises legal control over a video-call transporter by hiring or paying a fare for the RAS. Technical controls on a video-call transporter can be implemented by a user directing the opposite party where to go and what to do there. The manned RAS user can virtually approach and act at the desired destination by paying and directing a video-call transporter.

Figure 7. Manned Real Avatar Service experiment that controls a local smartphone user to move at the user's direction

Sources: avatrip.co.

Figure 7 shows the experiment of a manned RAS controlling a local smartphone user to function as video-call transporter online streaming at the desired location. Manned RAS has greater potential for practical use and social ramifications than unmanned RAS in that it uses not mobile machines but other persons who can be commercially mobilized anywhere on earth. The advantages of manned RAS are as follows.

For moving in crowded everyday situations, a human is more practical than a mobile machine as a video-call transporter. Manned RAS has the mobility to approach and maneuver in areas people normally move. Mobile machines as robots are generally inferior in mobility as to avoid obstacles or maneuver up stairs. Second, the number of people available to serve as transporters of manned RAS is sufficient to even adopt crowdsourcing. As of 2020, there were 3.5 billion smartphone users worldwide (Statista 2021). This means that nearly half of humanity possesses a mobile video-call apparatus and is technically available to participate in manned RAS as a video-call transporter. Theoretically, therefore, manned RAS has the advantage of being able to adopt crowdsourcing: selecting the proper video-call transporter from a pool of candidates available in the place and specific time that users want. Third, the business model to support public access to

RAS is easily adoptable by a large enough number of human resources who can take on the role of avatar in various situations.

These advantages suggest that manned RAS has a better chance of being popularly commercialized. For instance, Baemin and Coupang, delivery operators in South Korea, launched and are successfully operating a crowdsourcing delivery service where ordinary persons participate in product delivery at a nearby location.[8] These cases show the potential of manned RAS to deliver not products but video calls, and that it may also adopt crowdsourcing to expand its service network through ordinary individuals.

In short, manned RAS that utilizes other humans is theoretically advantageous over unmanned RAS in mobility and the number of transport means. Manned RAS has more social ramifications than unmanned, allowing for a business model of crowdsourcing and public access.

RAS as Alternative to Mobility

As detailed in the above literature review, studies on telepresence robots have shown that unmanned RAS, even with the limited mobility and low number of robots, is functionally closer to the experience of an in-person visit. Those who encounter an unmanned RAS, regard the remote user who is controlling the telepresence robot as if they were physically present sharing the same local space, which is uncommon in existing telecom services. Unmanned RAS shapes a user's avatar-in-reality; existing telecom services just transfer a user's signal to an opposite party.

This distinguishing characteristic derives mainly from the independent mobility and non-arranged interaction that occur when unmanned RAS users control a mobile machine. A telepresence robot can independently move and spontaneously approach people for more comprehensive information. It can be reasonably inferred that local people would also

8. Jeong Min-ha, "Imgeum-eun julgo sigan-eun neulgo" (1.5 Jobs Rising during Corona), *Chosun biz*, September 8, 2020.

regard a human RAS controlled remotely by another person as that remote person were physically present, because independent mobility and spontaneous interaction are more efficiently accomplished in daily situations by controlling another person than by controlling a mobile robot. Thus, this study concludes that both unmanned and manned RAS provide independent mobility and non-arranged interaction, and as such are better proxies for in-person visits than are existing telecom services.

Table 2 compares the user value of telecom service, RAS, and passenger transportation. RAS appears to have advantages over telecom services while approximating the user value of passenger transport. It shows that RAS provides users with superior mobility relative to what telecom services provide. RAS provides independent mobility and related, non-arranged interaction. For example, in the existing telecom service of teleconferencing, users cannot coerce an opposite party to move the video-call apparatus or to spontaneously approach someone outside of the virtual conference room. By contrast, RAS users can control robots or another humans to move out of the conference room and contact other people in a non-arranged manner.

However, in comparison with passenger transport, RAS still lacks the user value of location-based physical experience. RAS is substantially an extension of telecom services. Physical experiences in real environments, such as eating at restaurants or receiving a shot at the hospital, are only available by transporting users to specific places.

RAS is functionally distinct from existing telecom services and passenger transportation. As it merges the functions of connectivity and transportation, RAS can better substitute for in-person visits compared to existing telecom services. If the purpose of visits does not necessarily require location-based physical experience, but needs independent mobility for non-arranged interaction, both unmanned and manned RAS would be appropriate alternatives to physical mobility and in-person visits. RAS shaping avatar-in-reality is functionally superior to existing telecom services and quite similar to passenger transport, except that RAS does not support a user's physical experience in reality. Past studies in robotics have revealed that people accept and interact with an unmanned RAS as if the remote user were present, which means the remote user has effectively been transported

to the local environment. Therefore, RAS users have a superior mobility to passenger transport users in that RAS users can theoretically move anywhere instantly by controlling an avatar-in-reality located in the desired destination. Passenger transport can hardly compete with RAS in speed and efficiency of mobility.

As McLuhan and Kittler noted, the medium can reconstruct humanity (McLuhan 1964; Kittler et al. 1999). Along these lines, an elderly RAS user with impaired mobility can be transformed into a more maneuverable being by controlling a machine or another human as an avatar-in-reality. The research question, does RAS enhance the mobility of the elderly in a way superior to telecommunications and transport services, seems to be affirmative. This is why the elderly, usually not accustomed to new technology, still prefer to use telepresence robots to expand the scope of their social activities beyond the restrictions imposed by their aging bodies (Beer and Takayama 2011; Bae 2020).

Table 2. Comparison of User Value of Telecom Services, RAS, and Passenger Transport

User value	Telecom services	Real Avatar Service (RAS)	Transport services
Prearranged interaction	O	O	O
Non-arranged interaction	X	O	O
Independent mobility	X	O	O
Location-based physical experience	X	X	O

Discussion of the Effects of RAS

The scope of human activity has always been constrained by a person's physical condition. In a super-aged society, the low mobility issue of the elderly population is only worsened by the physical deterioration of the body. It would seem inevitable that aging gradually constrains the scope of

one's activity, and consequently the future of an aging Korean society will be a less active one. Supplying the elderly with more accessible transport and more extensive telecom services helps somewhat to alleviate the issue of restricted mobility. However, as the expanding transport-vulnerable elderly population uses more wheelchairs, it will be difficult for them to independently ride vehicles and airplanes. Further, they may be unsatisfied with short video calls with family or friends as a substitute for in-person visits. Thus, the mobility issue will not be adequately managed by the extension of existing transport and telecom services.

RAS is a proposed alternative means of more efficiently solving the mobility issue among the elderly in a super-aged society. Shaping the avatar-in-reality for the elderly means that the elderly user technically acquires not only a given body but also another body to represent the user's social role in a remote place. Whether that other body is another human or a mobile machine, the technical feasibility of an avatar-in-reality will offer the elderly an alternative way of life in reality.

Despite its proven advantages, RAS shaping avatar-in-reality has yet to be put into practical use. If the RAS adopts crowdsourcing from the billions of smartphone users for the role of avatar-in-reality, manned RAS will become another category of the telecom market.

The proliferation of RAS is expected to have the following effects on the super-aged Korean society. First, for the social activities of the elderly, one's physical condition will become a less significant factor. Just as online activities, such as SNS, blogging, and online gaming, is rarely affected by the user's age, offline activity using another person or mobile machine (avatar-in-reality) will not be obstructed by one's physical condition. RAS will allow the elderly and disabled to free themselves from the physical burdens of movement and be more active participants in the real world. This change will allow the elderly to be reshaped into augmented human beings, not unlike the one portrayed in the film Avatar (2009), in which the handicapped main character becomes an active warrior by connecting with alien body.

Second, it will facilitate the creation of new avatar jobs to fulfill the unsatisfied mobility desires of the elderly generation. In a super-aged society,

the elderly with weakened physical bodies will demand RAS more than younger people who have the independence to go anywhere. The increasing number of avatar jobs will benefit the elderly and handicapped in need of another body to move and act in remote locales.

Third, RAS supports the sustainability of a super-aged society. For instance, an elderly RAS user, connected to an avatar in a foreign country, makes a much smaller carbon footprint than the elderly who makes an airplane trip to a foreign country. RAS suggests a safer and more eco-friendly means of mobility that will lessen the detrimental environmental impact of a growing elderly population.

To summarize, RAS has the potential to blur the distinction between the elderly and younger generations, between the able-bodied and handicapped, in terms of mobility, for RAS provides elderly an alternative mobility that is not restricted by their physical condition. Also, RAS has the potential to create new avatar jobs. RAS can also help to lessen the carbon footprint of the mobility industry, and to enhance sustainability, satisfying the mobility of the growing elderly population in an eco-friendly manner. Therefore, the Korean government should attempt pilot RAS projects for elderly users, and institutionalize the ability for RAS users to have the legal rights of control when connected to an avatar-in-reality.

Conclusion

The issue of limited mobility among the elderly is becoming increasingly critical, not only in Korea but also around the world with the rapid increase in elderly populations. To overcome the mobility limitations of the elderly, policies that simply expand transportation and telecom services are insufficient for meeting the need for social engagement and independent mobility among the elderly. This paper has suggested RAS, which would employ an alternative telecom model to control another human or mobile machine as an avatar-in-reality, as an alternative solution to the mobility limitations of a super-aged society. By considering commercial cases in the service robot market, this paper has shown RAS models to be superior

to existing telecom services and closer to passenger transport. Notably, manned RAS using another person as an avatar-in-reality seems to awaken public awareness that the creation of a user's social avatar is possible, not only in cyberspace but in reality. RAS will have great potential to enhance the mobility of the elderly population in Korean society.

With the recent COVID-19 pandemic, Korean citizens have adjusted quickly to the reality of limited mobility in daily life. RAS can support an alternative mobility to replace in-person visits, not only for the mobility-impaired, such as the elderly, but also for a quarantined population. The author hopes that the concept of shaping an avatar as a proxy for in-person visits will lead to a transition in thinking, thereby diversifying the strategy to deal with the mobility issues of an aging Korean society.

This study has limited itself to introducing RAS models as an alternative for elderly mobility, but the RAS model has yet to be popularly commercialized. Therefore, the effect of RAS in shaping the elderly's avatar-in-reality has been partly inferred through a literature review, and has not been fully and quantitatively proven through field testing. A future study of the effects of RAS on elderly users will answer the limitations of the present study.

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