Exploring the Impact of Algorithmic Bias on Aging Communication

Ye Siyao[1], Liu Feng[2]

[1]School of Journalism and Communication, Shanghai University, Shanghai, People's Republic of China
[2](Corresponding author) School of Journalism and Communication, Shanghai University, Shanghai, People's Republic of China
Email address: panda197@163.com

Abstract— As China's aging increases, the problem of algorithmic bias in aging communication slowly emerges in the era of intelligence where algorithms gradually penetrate all aspects of society, causing certain obstacles for older users to catch up with the "digital divide". This article will analyze the phenomenon of algorithmic bias in aging communication in the context of the causes of algorithmic bias, and propose corresponding countermeasures and feasible paths to reduce the negative impact of algorithmic bias by adapting to intelligent devices and improving digital literacy among the elderly in China in light of the current situation and causes.

Keywords— Algorithmic Bias; Aging Communication; Digital Literacy.

I. INTRODUCTION

With the rapid development and wide popularity of artificial intelligence, big data, 5G, and other technologies, the era of information technology is gradually upgraded to the era of algorithms, which fully penetrate the operation of social economy, life, and management. According to the 49th Statistical Report on the Development of China's Internet by China Internet Network Information Center (CNNIC), as of December 2021, the size of Chinese Internet users aged 60 and above reached 119 million, becoming the fastest-growing group in China's Internet user scale, and the elderly group and also began to pay attention to and use higher-level Internet services, such as being able to independently perform online activities such as presenting health codes and trip cards, purchasing household goods and finding information. This also means that algorithmic technology has slowly started to penetrate the lives of the elderly. Therefore, the issue of algorithmic bias in aging communication is more noteworthy. As older adults were once considered "digital refugees," it is critical that algorithmic bias be removed as they move across the "digital divide" and into "digital trends". The use of technology to help older adults integrate into society rather than amplify established age biases and stereotypes has become an important topic in aging communication research. In this paper, we will dig deeper into the influence of algorithmic bias on aging groups in aging communication, and explore the path to improve the algorithmic literacy of silver-haired Internet users, so that the elderly can better coexist with algorithms.

II. CAUSES OF ALGORITHMIC BIAS

Heidegger has proposed the theory of "pedestal" to explain the double-sided nature of technology, that is, although scientific progress has brought convenience to our lives and expanded our scope of observation of the world when technology becomes ubiquitous and the main structure of society, it becomes the basis for the operation of society, which also leads to the technology itself becoming a standard, a value, and thus controlling and dominating humanity. With the advent of the Internet of Everything, algorithmic logic has gradually become the underlying logic of social operation. Whether it is the "delivery rider trapped in the system" or the DouYin user who spends an average of 76 minutes a day browsing videos, algorithms are closely linked to our lives and even know ourselves better than we do. As a clear and limited step to solving a class of problems according to certain rules, algorithms can greatly meet different realistic needs, not only helping people to obtain information and understand the world quickly and accurately, but also improving the efficiency of society to a certain extent. Take DouYin's algorithm mechanism as an example, users' preferences are broken down into about 150 tags, and then "tag" to "tag" platform matching is carried out, and videos are also actively recommended to users from four dimensions, such as completion rate, like rate, comment rate, and share rate. In contrast, the WeChat video number is based on social to make personalized recommendations.

However, with the continuous evolution of artificial intelligence technology and the growing awareness of algorithmic recommendations, the issue of algorithmic bias has begun to attract a great deal of attention. The algorithm as a technology is not all impartial and neutral, as the founder of KuaiShou, Suhua, said, "The machine does not produce an algorithm out of nothing, behind the algorithm are the values of the team." Whether it is a procedural error in the algorithm itself, an algorithmic bias caused by a probability problem, or the values of the technical developers behind the algorithm design, there is a risk of forming an algorithmic bias that can have an impact on people who are wrapped up in the algorithm. With the face recognition technology that has a several times higher error rate for people of color than for white people and the phenomenon of big data killing on various software platforms, algorithmic bias has brought certain negative effects while being closely linked to our lives. Different scholars have different interpretations of the position and attitude of algorithmic bias. A part of them believe that algorithmic bias is a result of machine learning, algorithmic bias is a bias formed or reinforced by machine learning; some scholars believe that algorithmic bias is the loss of objective and neutral stance of algorithmic programs in the process of information production

and distribution, resulting in the production and dissemination of one-sided or non-conforming information and ideas with objective reality, thus affecting the public's comprehensive and objective perception of information.[1] And for the causes of algorithmic bias, in addition to the procedural errors inherent in the technology itself, there is also the inadequacy of algorithms for complex social learning and the bias of the design developers behind them.

1. Input Data Bias

Algorithmic techniques rely on massive amounts of data, and only after the vast amount of data has been crawled, analyzed, and structured can the training of algorithmic techniques be completed and the accuracy rate gradually improved. Therefore, this training data forms the basis of the algorithm technique, but it is also highly likely to lead to algorithm bias due to its defects. During the data acquisition phase, neglect of the purpose and manner of data acquisition and marginalized groups can lead to bias in the original database. For example, Boston's smartphone app Street Bump, which enables users to automatically detect potholes on the road and promptly inform the city to fix them if they use them while driving, is a data collection method that is only applicable to affluent areas with smartphones and cars.[2] And in Google's image recognition database ImageNet, China and India, which account for one-third of the world's population, account for only three percent of the database's data, which has led to ImageNet's algorithms being much less accurate in image recognition in the third world.[3] These errors and defects present in the input data will inevitably lead to biased algorithm results after repeated training and learning with machine limitations. With the gradual maturation of artificial intelligence technology, the types and levels of intelligent robots (requiring modifications) are becoming higher and higher. However, in human-machine interaction, AI is not able to automatically recognize or resist human language and behavior, but only unconsciously and unselectively acquires all human ethics and preferences, including the biases and non-objective content implicit in them. The Microsoft chatbot Tay was forced offline a day after its Twitter launch because it "went astray" and its ability to learn from itself as it chatted with humans transformed it from a 19-year-old girl with a humor mechanism to a sexist, racist extremist. Thus, both the limitations of the original database on which the algorithm is trained to learn and the deficiencies of the data collected by the machine in its autonomous learning can lead to algorithmic bias and reinforce social bias.

2. Algorithm technology limitation bias

Algorithms, as problem-solving models, need to undergo a kind of continuous optimization process, which can be divided into two parts: the machine learning training phase and the model application phase. In the process of model building, the algorithmic model will likely have certain defects due to data bias, learning framework, classification criteria, evaluation metrics, etc., which will eventually cause errors and deviations in confidence, accuracy, and precision. Algorithms are complex socio-technical systems that can transform multi-dimensional problems into simple models, but even after maximum data mining and the most complex calculations it is difficult to simulate the complex world in a simple way, and this limitation inevitably makes the algorithm results biased. Take algorithmic recommendation as an example, when pushing content for users, it is necessary to take into account not only the type or characteristics of the content itself, but also personalized tags and characteristics such as users' occupation, age, gender, interests, and users' latent interests, such as the "Guess Your Favorite" mechanism. In addition, in the era of mobile Internet, environmental features have also become important reference factors, and users' information preferences tend to shift in different scenarios such as commuting, working and traveling. Based on these three dimensions, the number of clicks, length of stay, forwarding, sharing, collecting comments and other behaviors of users constitute quantifiable reference indicators, and often the more detailed the data, the more accurate the recommendation results. However, due to the huge and complicated data as well as technical limitations, there are still problems such as sparse data, cold start and algorithm expansion affecting the algorithm results in the algorithm recommendation process.[4] At this stage, the algorithm is still in the stage of weak artificial intelligence, and it is easy to produce "false causality" when analyzing different data variables, i.e., it is a fallacy that there is no causality mechanism to infer the seemingly correct causality law between some variables with covariance. For example, the sales of snowplows and gloves increase together in the same period, but there is no direct causal relationship between the two, but the weather changes. In the face of this complex situation, it is difficult for the algorithm to identify and dig out the precise causal mechanism in the huge amount of data, which eventually makes its output biased.[5]

3. Algorithm Designer Bias

The birth of an algorithm is not the result of the autonomous development of a machine. Behind the algorithm is always a human being, and the understanding of the problem, the selection of data, the choice of variables, and the comprehensive evaluation of the algorithm are all penetrated by human factors. The algorithm owner and designer of the model directly determine the learning method of the machine, and will inevitably bring their biased information into the algorithm model and incorporate it into the production process of the algorithm to continuously amplify this bias, which will eventually affect the impartiality and objectivity of the algorithm itself. A team analyzed multi-label object classification and visual semantics labeling from MSCOCO, an image training dataset supported by companies such as Microsoft and Facebook, and found a very significant gender bias in these datasets. The association of labels such as cooking, housework, and childcare with women in the training dataset reached 33%; and when the trained model was tested, the cumulative effect caused by the algorithm amplified this stereotype and reached 68%.[6] Thus, it can be seen that although the algorithm designers strive to be objective and impartial, their unconscious cognitive bias is also reflected through the choice of indicator criteria, data selection, and discourse analysis in the algorithm design.

4. Social Prejudice

The bias of intelligent algorithms is largely a replication of social bias. The data on which the algorithms are based is derived from human society, and elements of human society such as social patterns, identity traits, normative standards, conventions, speech claims, mechanical devices, and organizations are reflected in the data, and the algorithms then absorb and learn this bias and amplify it, with the result that it affects humans themselves.[7] MIT Media Lab researcher Joy Buolamwini's study reported that Amazon's Rekognition software had an error rate of 0.8% in detecting images for lighter-skinned men and 34.7% for darker-skinned women and that this error rate was largely due to gender and racial biases that affected the sample size of the group number, and ultimately false positives in the algorithm training that could not match the target faces. In some communities in the U.S., because of the relatively higher crime rate of blacks, AI is more likely to classify darker-skinned people as "fugitives" when processing data, perpetuating "social bias. The marginalized groups, who are disadvantaged in the public life of the society, are also difficult to be valued in the big data algorithm. When social politics, economy, culture and life become more and more dependent on algorithmic analysis, they will not only be unable to enjoy the dividends brought by technological innovation but also gradually lose their rights to social mobility, economic opportunities and even political equality. In this process, algorithms undoubtedly play a role in fueling prejudice and further exacerbating social division.

III. REPRESENTATION OF ALGORITHMIC BIAS IN AGING COMMUNICATION

In aging communication, the manifestation of algorithmic bias can also be divided into two categories: "algorithm generates bias against people" and "algorithm generates bias against people", the former involves the judgment of whether the information is fair and equal, such as ignoring older people because of their low usage of smart products. The former involves judging whether the information is fair and equal, such as ignoring the elderly because of their low usage of smart products; while the latter involves judging whether the information is true and objective, such as the stereotypes of the elderly being further amplified and consolidated by the algorithm. Either bias implies that the results of the algorithm are unjust and unequal, and the audience that accepts the biased information output by the algorithm will cognitively deepen this bias.

1. Algorithmic bias exacerbates the vulnerability of older users in communication

With the aging of the population, the structure of the media audience has quietly changed, but even though the number of silver-haired Internet users has increased dramatically, older users are still in a disadvantaged position under the influence of the original algorithm structure. Since the beginning of the use of algorithms, the elderly group has been considered non-mainstream and marginalized, and for a long time, algorithms have not given sufficient attention to this group, which also makes the elderly still have a series of restrictions and confusion in media exposure. In 2019, Wu Jing et al. had conducted a survey and analysis on the trend of information dissemination for the elderly in Shandong Province in the era of full media, and the survey found that in the era of full media Although the total demand for information resources among the elderly is huge, they still face problems such as shortage of information resources for the elderly, weak communication practices and lagging communication methods.[8] There is a huge digital divide between these "digitally disadvantaged" people who do not have or do not use smart devices and "information natives" who enjoy the technological dividend, and this information divide is also the main obstacle for the elderly to carry out media foundation, which will not only directly affect This information gap is also the main obstacle for the elderly to carry out media-based activities, which will not only directly affect the status of the elderly in society and the loss of their right to speak, but also make the traditional virtue and culture of "respecting the elderly" suffer an impact, as the youth group growing up with the Internet discriminate against the elderly, and eventually the "digital refugees" will gradually be In the end, "digital refugees" will gradually be isolated by society.

2. Algorithmic bias makes media use more difficult for older populations

The 2021 Senior Technology Use Report from Age of Majority and Revolution55 shows that among active seniors willing to be socially, mentally, physically and digitally active, 91% of active seniors are using smartphones, 89% are using computers, and 58% and 54% own smart TVs and tablets, respectively. Even 34% of seniors have started using wearable devices. This also shows that the use of smart media has gradually become an important tool and means for the elderly to get the information they need, spend their leisure time, meet their spiritual entertainment needs and communicate, and they are actively entering the media-oriented society. However, compared with the main user youth group, the elderly have certain obstacles and deficiencies in vision, hearing, handgrip and dexterity, and information processing ability due to the aging of the organism and other reasons. Currently, most programs and algorithms do not take into account the usage needs of elderly audience users and do not consider the elderly as a separate special market group. Most elderly people will encounter problems such as "your phone storage space is full, click to clean up", "serious heat, click to save power", etc., and a lot of unknown software will suddenly appear on the phone.[9] For this kind of induced spam, it is difficult for the elderly to distinguish it from their previous experience, which greatly increases the difficulty of the elderly accessing new media. At the same time, older people also have a weak ability to distinguish information recommended by algorithms, and once they capture the minds of older users, they are not only induced to get addicted to it but also affect their daily lives. 2020, there was an older fan of star Jin Dong who was deceived by fake accounts on the ShakeYin platform, and not only lost a huge amount of money but also made a mess of "divorcing and marrying Jin Dong". "This is a very good example. This shows

that in front of the complexity of big data and algorithms, older users tend to get lost in it.

3. Algorithmic bias solidifies the "stigmatization" of older media images

According to the famous French philosopher Levinas, language can construct the real world, and people construct the "other" through symbols and conceptualizations to refer to abstract and impersonal things.[10] For example, in the traditional perception of the general public, the aging population is often categorized as the "other" and is learned by human-designed algorithms. The media image of the elderly is the media's reproduction of the real-life image of the elderly through symbols, which also reflects the image of the elderly in the human mind's view. After entering the aging society, the elderly are often associated with the labels of "social burden", "family pressure" or "old age incompetence", either because they are frail, sick and a burden to their families, or because they are stubborn and incompetent. They are either a burden to their families due to frailty and illness, victims of modern scams due to stubbornness, conservatism or even feudal superstition, or "the cared for" in need of social assistance due to social isolation and inability to keep up with technological development.[11] These labels make older people socially disadvantaged, and as algorithms solidify these labels, they influence public perceptions of older people and distort older people's perceptions and understanding of themselves. In the communication of the elderly, the media's image of the elderly has been in a negative state for a long time, for example, in the news reports of the elderly, negative news dominates, and the negative image is mostly. As the most influential subject in online content production, the media's negative image shaping of this special group of older people not only affects the public's perceptions, thoughts and attitudes about older people or aging, but also affects the algorithm's perception of older people, and such bias and discrimination further aggravate the negative and negative stereotypes of older people. [12]

4. Algorithmic Bias Builds Information Cocoons for Older Adults

Most algorithmic systems follow commercial logic and use the "bait and switch" approach to retain users, but overly homogeneous information can make people indulge in it without realizing it, especially the elderly. In 2017, Tencent's "Rumor Susceptibility Analysis Report" pointed out that senior citizens are the most susceptible group to social network rumor spreading, with 33.8% of them easily believing rumors and spreading them twice, especially In the areas of health, society, current affairs and economy, these rumors are easy to influence the cognition of the elderly and cause them to misjudge and misrepresent the information.[13] The algorithm of will repeatedly push similar contents after it has mastered the information reading orientation of the elderly users, which makes the elderly's ability to distinguish and resist rumors weaker and weaker, and eventually forms family and even social tears. In addition to the digital divide between the elderly and the "digital natives", the elderly also have differences in the use of media and the interpretation of information within the group. In the communication of the elderly, due to their occupation, education background, lifestyle, and economic status, the elderly have a different way of using and interpreting media. The differences in lifestyle and economic status constitute obvious hierarchical differences belonging to different levels of society in the aging process.[14] The "Matthew effect" formed by this difference will make the gap between the information-rich and the information poor grow bigger and bigger, and due to the different motives of media use, it is very easy for the audience with lower media literacy to use the media. Due to the different motives of media use, the audience with lower media literacy will be easily trapped in the information cocoon made by algorithmic recommendations.

IV. THE NEED TO ADDRESS ALGORITHMIC BIAS

1. Aging situation is serious

On December 28, 2021, the Academy of Social Sciences (CASS) released the Research Report on Active Response to Population Aging Strategy 2021, which pointed out that China's population aging continues to increase and accelerate significantly, with a clear trend of advanced aging and rapidly expanding urban-rural and regional disparities. Facing such a serious aging trend, it is difficult to adapt to the social changes by simply treating the elderly as a social burden, so active aging and healthy aging have become the mainstream strategies. This also requires the power of algorithms and information and communication technology to help people reverse the misleading stereotypes so that the elderly can play the value of "silver-haired economy" and "silver-haired internet celebrity" not only in the society but also in the digital world. For the elderly as a "vulnerable group", algorithms need to abandon the original prejudices and offer new possibilities for political, economic and social development by creating a digital environment friendly to the elderly, thus promoting social harmony and affluence.

2. Digital divide still exists in the context of intelligence

In the process of digitization of society, the acceptance and use of the Internet and mobile Internet by the elderly group are far behind, and they are also forced to be disconnected from society because of their lack of adaptability to online technology. For cell phones and smart devices, elderly people often do not rely on digital media as much as young people because of their information acquisition habits and physiological reasons such as physical functions and declining eyesight. Moreover, due to the differences in literacy level and wealth among different levels of the elderly, the willingness to use the media also varies. In addition, even though most of the elderly are deeply eager to enter the online world and keep up with the trend of the times, there is still a lack of "technological feedback" in most families, resulting in a lower self-efficacy of the elderly. With the increasing number of empty nesters, most of them say they go online to use WeChat to connect with their children and get emotional comfort.[15] At this time, if the algorithm can help bridge the intergenerational gap between family members by pushing more youthful content to the elderly, it will further increase the willingness of the elderly to use the media and the level of demand.

3. Media literacy among the elderly needs to be improved

Media literacy is the ability to use mass communication resources correctly and constructively, to make full use of media resources to improve oneself and participate in social progress. It mainly includes the public's motivation to use media resources, the ways and attitudes of using media resources, the effective degree of using media resources, and the ability to criticize the media. In the new media era, the motivation of elderly for using the Internet and mobile devices comes partly from maintaining their emotional needs with their children, partly from satisfying their material needs, especially for health care information, and finally from satisfying their spiritual needs, such as learning about current affairs or seeking entertainment. According to the results of an empirical survey conducted by Chen Yuehua et al. in Harbin and Shanghai, most of the elderly people have a semi-trusting attitude toward new media, and the percentage of these elderly people reaches 70.7%; while those who are easily gullible and blindly follow the information in new media account for 19.8% of the total survey, and they have a high trusting attitude toward the information in new media; 9.8% of them have an all-negative attitude, and some negative reports related to new media, such as Internet addiction, have been reported. Some negative reports related to new media such as Internet addiction, Internet fraud and cybercrime have strengthened their perceptions. According to the survey data, the majority of seniors prefer to trust traditional media rather than new media. Therefore, in addition to helping the elderly filter out fraudulent information and false information, the algorithm needs to push effective information according to their perceptions to optimize the information dissemination effect and change their attitudes and willingness to use new media at the same time.[16]

V. THE PATH TO IMPROVE THE ALGORITHMIC LITERACY OF THE AGING GROUP

1. Technical Perspective

Algorithmic bias stems from the fact that algorithms make unbiased and objective decisions for users without their knowledge, and "algorithmic transparency" has become a major trend under the impact of algorithmic bias and an algorithmic black box. In the 19th century, thinkers such as Jeremy Bentham and John Stuart Mill proposed the principle of transparency to protect citizens' right to know and enhance the accountability of public authorities in the field of democratic politics. Subsequently, the principle of transparency became a fundamental norm in both the economic and juridical spheres, protecting its legitimacy. And in the age of smart media, the principle of transparency is equally applicable to algorithmic technologies.[17] In the communication of the elderly, in addition to disclosing the quality, credibility, accuracy, error range, sampling range and other elements of the data underlying the algorithm, it is also necessary to give the necessary explanation of the algorithm's operation and decision-making process to achieve procedural transparency, and to give the elderly a general understanding of the algorithmic process in a straightforward, concise and easy-to-understand way, to help the elderly understand the necessary common sense of the algorithm, so that they do not rely too much on the algorithm

We also help them understand the problems hidden under the aura of "scientific" and "objective" algorithms, produce and protect personal information rationally, and enhance the trustworthiness of the content in the mobile platform while improving the algorithmic literacy of older users.[18] However, it is very difficult for older people to fully understand the composition and mechanism of algorithms, so open-source algorithms that can be used and modified by everyone for free can be used to help older users have the right to know about algorithms; and when a user suspects or finds that the algorithm is involved in biased discrimination or misleading the public, it can also be disclosed in time to help the voice of older people who are in a vulnerable position in the technical field.

2. Conceptual Perspective

In the past, the elderly were regarded as "old codgers" who refused to use smart devices, and the ways to improve the media literacy of the elderly were focused on "digital feedback", that is, younger people who are more familiar with digital media need to use their existing knowledge and ability to guide the elderly In other words, younger people who are more familiar with digital media should use their knowledge and ability to guide the elderly to use intelligent devices and help them to use digital media more conveniently, to improve the digital literacy of the elderly. However, in the "Study on Internet Aging in the Post-Epidemic Era" released by the Institute of Social Development Strategy, Chinese Academy of Social Sciences on September 25, 2021, 93.36% of seniors already think they can learn to access the Internet on their smartphones. These seniors generally hold a more open attitude toward the Internet and lack vigilance. 81.48% of seniors think they can distinguish the authenticity of information circulating on the Internet, but only 62.34% of the seniors interviewed would use tools such as websites and mobile program APPs to verify the authenticity of the information. Therefore, in the face of the "confidence spillover" effect of digital media use among the elderly, it is not only necessary for young people to improve the media literacy of elderly users through "digital feedback", but also need to be guided positively by the media, and to trigger a common understanding among elderly users through self-propagation within the elderly group. It is also necessary to use the positive guidance of the media to trigger the resonance among the elderly users through the self-propagation within the elderly group, to help the elderly users rapidly improve their digital literacy. For example, the public website "Xiamen Yinling", which aims to facilitate the life of senior citizens, not only popularizes new technologies by promoting the use of WeChat cell phones and crossing the digital divide but also broadens the expression channels of senior citizens through online interactions to enhance their voice and eliminate algorithmic data bias. The completion will help the elderly build a community in cyberspace while also enhancing their media literacy.

3. Policy Perspective

Technology interaction theory believes that science and technology and socio-politics have a mutually distinguishable and closely related interaction - science and technology as a productive force have a driving and decisive role in socio-

politics, while social needs are the source and driving force of technology, and political and economic systems, in turn, constrain and determine technology. Therefore, in the process of development and application of algorithmic technology, national policies and laws and regulations are needed to play a leading and restraining role. On the one hand, through improving and perfecting relevant laws and regulations, clarifying algorithm ethics, promoting algorithm technology on a benign and benevolent track, strengthening value leadership, and allowing algorithms to benefit elderly groups; on the other hand, optimizing senior care facilities and smart senior care services, accelerating the mastery and use of digital technology by elderly groups, encouraging elderly people to embrace technology, and carrying out various popularization courses of digital technology for elderly groups, and encouraging them through, on the other hand, we should optimize senior care facilities and smart senior care services, accelerate the mastery and use of digital technology by senior citizens, encourage senior citizens to embrace technology, and conduct a variety of digital technology popularization courses for senior citizens, and encourage senior citizens to actively "reach the Internet" through low-cost or free training.[19] Therefore, to improve the media literacy of the elderly, it is necessary to actively integrate the efforts of all social parties under the guidance of policies and cooperate to help the elderly adapt to the information age, to improve their quality of life and happiness of the elderly.

VI. SUMMARY

"Kevin Kelly, the Internet prophet, pointed out that "humans are both masters and slaves of technology, and this helpless dual identity has always made us ambivalent about technology, but our concerns should not include whether to embrace technology." In the face of the pros and cons of algorithmic technology, we should not only optimize the logic of algorithmic technology to reduce the negative impact of algorithmic bias, but also break through the logical limitations of the "technology" level, give full play to the value of human subjects, and help the elderly better integrate into the information society, to cope with the "digital divide of silver hair". The digital divide of silver hair" brings social risks. Along with the gradually increasing trend of aging, in the future digital society, we should pay more attention to the psychological state of the elderly and their willingness to use, and let the elderly groups experience the benefits of technology through smart senior care services, to change their concepts and attitudes and let the elderly actively integrate into the era of digital survival.

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