INTRODUCTION

This article has been inspired by a film: 'Robot & Frank' (2012)[1]. The film was depicting an elderly man (Frank) who was suffering from memory loss, dementia and depression. A robot will completely change his life and recover him from what we call as 'senile inactivity'[2] that strengthens fatal diseases of old ages and ultimately accelerates casualties[3].

In fact, the term 'robot' can't characterize the robot in the movie. S/he is an embot, a term we created to characterize robots with apparent empathy[4]. We say empathy, not emotions, that is because one can have and know his/her emotions, but to read and interpret others' emotions matches another set of skills. For one thing, an embot requires theory of mind skills, which means ability to think about others' mental states[5]. For instance, "if I do this what would s/he feel?" Such a question corresponds to theory of mind.

Thus, upon reflecting on the film, we as a cognitive scientist specialized in social implications of AI (the first author) and a biomedical engineer practically working on health applications of Internet of Things (IoT) in the field (the second author) decided to pen a paper about the future of gerontology and health applications of IoT. We realized that an embot will indispensably be associated with the bourgeoning research on psychological AI, artificial psychology and artificial emotions. That is why we also included them into our discussions.

Although the film imagines gerontological companionship on the basis of robots, we have another field closer to e-health and e-care, that is the health applications of IoT. Considering the likely health problems of elderly populations, smart home furnitures and wearable devices are expected to collect daily data to track health status of the elderly. Thus before imagining embotic companionship, we need to be able to track the health conditions of the elderly. That is why, in our study we are focusing on health applications of IoT rather than robots[6].

Secondly, we would like to draw our readers' attention to anti-surveillance literature, criticizing the technological 'intrusions' to our private lives especially including the notion of big data (e.g. Gezgin, 2018; Lyon, 2014). However, in the case of elderly and babies, the situation is different: Surveillance is desirable as it is instrumental for good health and well-being. Nevertheless, we are against unauthorized uses of elderly people's data for corporate purposes. Thus, we propose to host these data on decentralized servers.

Thirdly, gerontological uses of IoT are usually discussed with reference to health problems, but we propose that IoT applications for elderly can also be useful to make their lives less miserable in psychological terms. Thus, diverging from assisted life studies which revolve on developing technical devices to help ailing people to survive (remember Stephan Hawking), we propose that IoT has the potential to make elderly people's life more enjoyable. That is why, we propose the term 'assisted aging' which do not assume the existence of ailing people at any ages, but aging people only who expect to enjoy life like any of us at older ages.

With these points in mind, we scanned hundreds of articles from health, engineering and social science fields to offer an interdisciplinary account of gerontology, internet of things and assisted aging. A careful reader will notice that a significantly high number of the references we used for this article is conference papers. In academic works, journal articles are preferred over conference papers which are not expected to be as meticulously reviewed as journal articles. However, for a cutting edge topic such as health applications of IoT, this is an inevitable situation, as the number of journal articles is significantly lower than that of conference papers. This also testifies to the freshness and heat of an emerging research area.

In our article, we naturally move from the most general to the most specific: We start in the next section with mostly technical accounts of health applications of IoT followed by the relevant social science research. Our next step will be the portrayal of gerontological research with regard to IoT. Then we will move to a brief presentation of psychological AI, artificial psychology and artificial emotions. Our final step will be about assisted living and assisted aging.

The article consists of 5 major sections: In the first section after introduction, we review mostly technical accounts of health applications of IoT. In the second section, we introduce mostly social science-oriented research on health applications of IoT. In the third section, we present and discuss gerontological research on IoT. In the fourth section, we focus on yet another relatively new term which is 'psychological AI'. We show how this will be central to future IoT for gerontological purposes. Finally, we reflect on assisted living studies to develop our notion of assisted aging.

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[1] This is the IMDB page of the film: https://www.imdb.com/title/tt1990314/

[2] This is a rarely used, but practical term.

[3] In gerontological community, some of the researchers avoid the term 'elderly' claiming that it implies ageist discrimination. We disagree with this point and prefer to use this word as it is handy for free flowing discussions.

[4] In robotics literature, the term 'embot' is used to refer to embedded robots (e.g. Gigras & Gupta, 2011; and Kim et al., 2009), however we use it in another way.
Embedded systems and programming are already necessary to build mobile robots (e.g. service robots, submarine robots etc.) and increasing dominance of embedded system usage may likely fade out the term 'embot' for 'embedded robots'.

[5] For an overview of theory of mind, see Astington & Jenkins (1999); Bretherton & Beeghly (1982); and Selcuk et al (2018).

[6] For the study of home-based robots, a new area is emerging which is called 'domotics' derived from the root of 'domus' meaning home. Domotics corresponds to "the science that is concerned with the study of technologies that are designed to improve the quality of life at home (...)" (Russo, 2018, p.2). So far, the term 'domot' for home-based robots is not used in academic circles or in relevant practice. However in the future it may enter our dictionaries.
For more information about domotics, see Kanemura et al., 2013; Russo, 2018.
Similar terms abound. For instance, Ray (2014) employs a new term 'Home Health Hub Internet of Things (H3 IoT)' to refer to home-based IoT systems to monitor elderly people's health, while Maksimović, Vujović & Perišić (2016) use the term 'DIY (Do It Yourself) Healthcare' for the IoT Healthcare System.

AN OVERVIEW of HEALTH APPLICATIONS of IoT

Gomes et al (2015) states that "The Internet of Things (IoT) paradigm allows small and resource constrained devices to send data through complex networks like the Internet. Bringing the IoT paradigm to the healthcare area, we can expand the connected health vision, enabling new Personal Health Devices (PHD) to share health information directly through the Internet" (p.200).

On the other hand, wearable technologies are "devices whose embedded sensors and analytic algorithms can track, analyze and guide wearers' behavior" (Schüll, 2016, p.1), whereas personal health technologies are "near-body devices or applications designed for use by a single individual, principally outside healthcare facilities" including "blood pressure or blood glucose monitors purchased in pharmacies, fitness monitors such as FitBit and Nike+ Fuelband, through (...) drug pumps and implantable medical devices" (Fox, 2017, p.136).

As a starting point, let us remind that the terms such as telehealth, e-health, e-care, and m-health are not identical with gerontological applications of IoT. That is because of the fact that the IoT applications are mostly fixed and home-based and they correspond to Internet-enabled home furniture together with other more mobile self-quantification tools such as smart watches and sensors. M-health for instance requires the use of mobile phones, while IoT can be mobilized without mobile phones. E-health and e-care are usually delivered through internet, but collection of health data is more advanced and complicated through IoT. Likewise, Chi & Demiris (2017) list videos, web-based interactive platforms, telephone-based technology and remote monitoring as examples of telehealth tools, which do not necessarily involve sensors to collect health data. We will provide more details about gerontological applications of IoT, but before that, we need to offer a review of the relevant literature as a background to our main and ultimate discussion.

As the closest academic and practical neighbors to our discussion, self-tracking research (e.g. Brabazon, 2015; Ha, 2016; Lupton, 2015, 2014; Lyall & Robards, 2018; Pantzar & Ruckenstein, 2015; Paré, Leaver & Bourget, 2018; Stragier et al., 2016) and self-quantification movement (e.g. Hagen & Kasperowski, 2017; Lupton, 2016; Till, 2014) cover people's tracking and quantification of their own physical properties such as walking or running distances, sleep patterns, food intakes etc. However, they are not identical with our coverage, since in health-related uses of IoT, the person is not necessarily active. In other words, the tracker or quantifier is not necessarily tracking/quantifying himself/herself. Although some aspects of health-related IoT can benefit from self-initiated data collection, in the case of age-related diseases (for example due to memory issues) one may be unable to collect his/her own data. Another related term is health literacy (see Dumit et al., 2018), however the contents and coverage of this term have to be updated and expanded to match health applications of IoT.

Before we proceed, we would like to state that even in the best case of health-related IoT, we definitely need human doctors to interpret the health data collected by the devices. That is because machines can have errors that we couldn't even think of, and human life is so valuable that it can't be left to the cold algorithms of non-human processors. The claims that IoT can bring error-free health data is naive (e.g. Moosavi et al., 2014), as even human doctors can commit errors. Exemplarily, it is likely to misdiagnose rheumatological diseases since the symptoms highly overlap. The misdiagnosis rate of rheumatoid arthritis is very high (39.3%) according to a descriptive, cross-sectional study (Gomez et. al. 2015).

The IoT devices are limited by their design and designers' assumptions. For example, the design assumptions dictate what can be considered as noteworthy data and be recorded and what can't be. E.g., whether the frequency of fast food meals in a person's diet can be considered as data and recorded depends on whether the case at hand involves obesity, but not hearing problems. As meals and hearing problems are considered to be unrelated, meal data will not be recorded for hearing problems. But in the future it may be likely that scientists can discover reasonable and theoretical links between meals and hearing problems.

Additionally, there may be recording errors which reminds us the age-old but mostly concluded fight between behaviorism and cognitivism in psychology: If we (or any IoT) device recorded what they observe only, the reasons and especially the motives will be left out of equation which can completely alter the interpretation of the recorded data [7]. We have an excellent example for this: Google Flu Trends was hailed as a successful attempt to use big data to predict flu epidemics on the basis of Google search terms. The big data cheerleaders claimed that it predicted the epidemics faster and more accurately than the health authorities. Later on, it was found that it was not the case. Google Flu Trends were completely wrong. The error was due to the fact that taking search terms as a proxy for the sickness was wrong, as people were searching flu on the net, not because they were sick, but also because they find the related news interesting. Secondly, to make the situation even worse, Google's auto-complete function misleads people who don't intend to search 'flu', to search it (Harford, 2014). To conclude, for various reasons we agree with Cahill et al. (2011)'s position: "Technology is only one part of the solution, and does not replace person centered interaction/care" (p.13).

Secondly, data protection is very important as the release of private health data can lead to discrimination at the hands of insurance companies and pharmaceutical companies, as well as profit-making corporations and authoritarian governments. In the future, they can find it costly and meaningless to support people with serious illnesses. In that sense, data privacy is directly related to citizenship rights and before all, human rights.

[7] Of course, by considering data trends, we can make certain inferences, but this will rarely include the human motivation behind the behaviors. That is why observation data need to be complemented by self-reports on the underlying motivations.

According to Hassanalieragh et al (2015), health applications of IoT will help medical practice to be proactive rather than reactive. Usually, medical profession operates on post facto mode, whereby people visit the doctors after they got sick. This is what is meant by ‘reactive practice’, whereas regular monitoring of people’s health conditions, they propose, will allow doctors to intervene at earlier stages of sickness. Thus, medical practice will move from disease management to health management which is consistent with the main argument of this paper, as will be explained in the final section of the paper. For example, people will have an ‘Early Warning Score’ which will make it easier and faster to identify the diseases (Anzanpour et al., 2015). Secondly, medical practice will be more personalized which will bring more positive health outcomes for the people. Finally, Hassanalieragh et al (2015) argue that cost of health will be reduced which is a point to be discussed in the next section.

SOCIAL SCIENCE-ORIENTED RESEARCH on HEALTH APPLICATIONS of IoT

Technical accounts of health applications of IoT are mostly positive ignoring the social divisions. Uncritical IoT cheerleaders rarely discuss class and in broader terms SES (socioeconomic status) differences with regard to technology use. In fact, digital divide in various forms bring health disparities which are closely associated with SES and allocation of community resources (Hong et al., 2017).

Who will pay for health-related IoT devices? In a class society, not all elderly can buy the assistive technologies. It should be state’s responsibility to financially support the needy. Although its advantages for people’s health are to be noted, personalization brought by IoTs has the danger to throw state’s financial, moral and social responsibilities to each individual, which means de facto privatization of health services in economic terms. In that sense, Lupton (2013)’s socially critical views are highly relevant and noteworthy:

“In the discourses and practices of digitized health promotion, health risks have become increasingly individualized and viewed as manageable and controllable as long as lay people adopt the appropriate technologies to engage in self-monitoring and self-care. With the advent of the big data produced by digital technologies and the use of sophisticated algorithms to manipulate these data, it has become ever more convenient to focus attention on personal responsibility for health states. The digitalized health promotion phenomenon, therefore, operates as one dimension of the progressive withdrawal of the state in many developed countries from attempting to challenge the social and economic factors causing ill health and disease and efforts to promote social justice” (p.2).

In other words, digitalization of health movement may lead to an asocial interpretation of health problems which serves ideological functions favoring the dominant classes, where social and economic bases of sicknesses are ignored. For example, the public health priority in the case of socially and economically disadvantaged people getting sick at old age due to exposure to toxic chemicals in their lifetime should be clearing of the toxic environment to save younger generations, rather than watching them getting sick and then equipping them with health applications of IoT. So IoT should not hinder the authorities to inquire and aim at the antecedents of sicknesses. A focus on the consequences at the expense of antecedents can be too late and before all, misplaced.

Apart from the economic and social forms of digital divide, a generational digital divide is pronounced as well, which is called as ‘grey digital divide’. That idea was inspired by the fact that elderly people are slower to adopt and use the cutting-edge technologies (Damodaran & Olphert, 2015). This may be due to a number of factors such as declining cognitive functioning and lack of peer pressure to use new technologies in contrast to the case of younger segments of the population. “Older adults are” considered as “digital immigrants”, as they were “born before personal computers and the IoT became part of everyday life” (Milovich & Burleson, 2018). In one way or another, this situation shows that an educational component should be present in gerontological uses of health-related IoT (cf. Minocha, McNulty & Evans, 2015).

Converging with this point, in their paper connecting digital divide discussions with IoT, van Deursen & Mossberger (2018) warn that

“The “Internet-of-Things” (IoT) promises social benefits across a range of policy areas, such as energy, health, transportation, public safety, and environmental policy, but attention to the skills needed by individuals who use it will be an important issue for public policy, in order to ensure full exploitation of these technologies and to avoid unintended consequences. We argue that comparative advantages of the IoT to people will vary based on differentiated skills and resources, enabling smaller groups of people to benefit, and disadvantaging others in new ways” (p.122).

A less discussed social asymmetry in this context is the one between the IoT designers and future IoT users. A participatory approach is needed to maximize usefulness and satisfaction associated with the designs for the targeted group. Leong & Johnston (2016) is an example to testify the success of a participatory design approach. The designers and elderly together develop a ‘networked robotic dog’ to assist the elderly (Leong & Johnston, 2016). In the same vein, Bengs, Hagglund & Wiklund-Engblom (2018) implement a user-centred approach first to identify the user needs such as “autonomy, competence, relatedness, physical thriving, security, pleasure and stimulation” (p.11) and then to develop the design that best matches the needs mentioned by the future users. In this context, Kopeć, Nielek & Wierzbicki (2018) propose a model of participatory design which is directly relevant for gerontological IoT.

NOTES on GERONTOLOGICAL RESEARCH ABOUT IoT

So far, the gerontological research and IoT studies are mostly unconnected, albeit that the links will be more visible in the near future. That is why, rather than providing a full-fledged section on the subject, we can just offer a few notes on this occasion.

According to Schulz et al. (2015), “Interest in technology for older adults is driven by multiple converging trends: the rapid pace of technological development; the unprecedented growth of the aging population in the United States and worldwide; the increase in the number and survival of persons with disability; the growing and unsustainable costs of caring for the elderly people; and the increasing interest on the part of business, industry, and government agencies in addressing health care needs with technology" (p.724).

Urinary incontinence, falls and insomnia are considered to be the most typical aging-related health problems (Nieto-Riveiro, 2018). Thus we expect gerontological IoT to focus on these three. However, falls appear to be the hottest to topic eclipsing the other two (e.g. Boissy et al., 2007; Choi & Youm, 2017; da Cunha, Baixinho & Henriques, 2018; Godfrey, 2017; Meachem & Phalp, 2016; Nguyen et al., 2018; Panicker & Kumar, 2015; Tang et al., 2018; Zhang et al., 2017). Other than falls, dementia is one of the most researched disease for gerontological IoT research and applications (Atee, Hoti & Hughes, 2018; Banerjee, 2018; Barrué, 2017; Enshaeifar et al, 2018; Gibson et al., 2018; Jenkins, 2017; Kwan, Cheung & Kor, 2018; Moore et al., 2013; Stranks, 2017; Tiberghien et al., 2012; Zanwar et al., 2018) followed in distance by research on Alzheimer's Disease (Maresova et al., 2018; Sharma & Kaur, 2017; Zanwar et al., 2018), Parkinson's Disease (Del Din et al. 2016a, 2016b), and depression (Kim et al., 2017).

The sources noted here are connecting gerontology with IoT, however they are mostly health-related, not tapping non-health related aspects of aging that have implications for elderly people's quality of life. In that sense, they are more inclined towards geriatrics (health of and medicine for the elderly), rather than gerontology covering social, normal psychological, cultural, developmental etc. aspects of aging. This research and practice gap is expected to be filled by new works in the near future.

NOTES on PSYCHOLOGICAL AI, ARTIFICIAL PSYCHOLOGY and ARTIFICIAL EMOTIONS

In the previous section, we have seen that some of the most common and most studied aging-related diseases have psychological/psychiatric aspects. That is why, we propose that gerontological IoT devices should be based on a psychological model of AI rather than an engineering model per se. Psychological AI is inspired by human cognitive architecture, while engineering AI relies on efficiency considerations such as cognitive superiority[8]. Following the former model, the devices should be equipped with the ability to detect and interpret emotions and act according to them in order to be humanely efficient and effective in practice. Expertise in emotion recognition techniques such as 'face affect recognition', 'body gesture' (see Yu et al., 2008), 'emotional speech' and 'physiological monitoring' (Singhal, Mandhanya, & Verma, 2016) will be vital for the future versions of gerontological IoT.

Concisely stated, artificial emotions are "artificial counterparts of natural emotions" (Botelho & Coelho, 1998, p.449). However, a closer look at human emotions points out that in the case of AI, ability to interpret emotions and act accordingly are more vital than having emotions. Talanov & Toschev (2018) ask "How can we make machines actually feel emotions? Is there any option to make AI suffer, feel happiness, love, aggression, contempt, awe?" (p.1). For our point of view, these questions are too ambitious and unnecessary for an embot (i.e. apparently empathic robots). In their discussion of companion robots and artificial empathy, Baumgaertner & Weiss (2014) share a similar position:

"(...) emotions are not directly relevant in the ethics of human-robot interaction, particularly in the context of robot care-givers and human care-receivers. (...) What matters to care behavior is just the relevant behavior, not the source that drives the behavior" (p.1).

Baum (2017) rightly complains that most of the AI research and practice are based on capabilities rather than social impacts. In other words, the aim of the mainstream AI scholarship is creating artificial superhumans outperforming 'natural' human beings. Baum (2017) promotes the notion of 'beneficial AI' which are designed to be bring benefits to society rather than outperforming human beings. Although Baum (2017) is correct in his criticism, we disagree with his understanding of 'society' as society is not homogeneous. It consists of various social units and groupings with different interests and stakes in the advent and prevalence of AI. For instance, although AI is good news for capital owners as they can make even more profits, that is not the case for marginally employed working class people who would possibly lose their jobs to AI machines.

ASSISTED LIVING and ASSISTED AGING

According to Tiberghien et al. (2012), "Ambient Assisted Living (AAL) consists of a set of ubiquitous technologies embedded in a living space to provide pervasive access to context-aware assistive services. It can for example enhance ageing in place by helping elderly people with their Activities of Daily Living (ADL)" (p.212).

Although we agree with the underlying philosophy of above statements, we argue that the term 'assisted living' does not specifically point out the elderly people and gerontological uses of IoT in particular, while the terms such as 'active aging' (e.g. see Lewy, 2015) appear to be misnomers as the elderly are not really active by themselves in some cases, but assisted to be active. Secondly, unlike the claims that the terms 'assistive technology' and 'gerotechnology' are used interchangeably in the relevant literature (Mallat, Yared & Abdulrazak, 2015), the former can refer to technologies for any age group while the latter specifically corresponds to old age. 'Gerotechnology' (or 'gerontecnología' in sources in Spanish language) responds to the needs of 'a society that is in a rapid process of aging' (Rubio Pastor, Plaza García & Orive Serrano, 2017, p.140), rather than a sickness or disability that requires assisted technology for any age. Thus they don't

[8] In cyberpsychology research, the notion of psychological AI gained another meaning as well, but this new meaning needs to be supported by further research and hands-on practice. Here is the second meaning of psychological AI: "The ''psychological AI'' (...) can administer on-demand personalized psychotherapy, psycho-education, and health-related reminders through several conversational platforms, such as SMS, Facebook Messenger, and various Web browsers" (Gaggioli, 2017, p.402-403).
AI'fication of psycho-education makes sense, but that of psychotherapy is a moot question as many forms of psychotherapy require human empathy and other related humane properties (see Kolby, 1986; Luxton, 2014).

always coincide.

The e-kitchen including the fridge, oven and drawers can provide us information about the elderly people's dietary program:

"A fridge can act as an input agent, collecting information through integrated technology, which allows detecting all the goods inside it. This same fridge can also act as an output agent by emitting alerts when some specific item is missing or almost over. It can also emit alerts when expirations dates are near" (Rodrigues & Pereira, 2018, p.855).

Likewise, the house door equipped with sensors can tell us the frequency of exit. The e-shower can provide us information about self-care habits. E-cleaner can tell how clean the house is. TV and PC can provide us information about viewing habits. E.g. suicidal people usually search the net to find an 'appropriate' method. Similar search terms can warn the system to send medical staff to home. Anumala & Busetty (2015) add that microwave oven can bring out food consumption data while smart TV can provide data about physical inactivity level. Furthermore, smart beds can be used to "for elderly patients with impaired mobility" (Hong, 2018, p.1).

A similar term is 'technologies of healthy aging' (see Crandall, Cook & Schmitter-Edgecombe, 2016), however, what we propose is not only for health but well-being in general. Such an understanding has non-health implications as well. In that sense, we agree with Baldissera & De Faveri (2016):

"Most initiatives in this area are intrinsically focused on providing health-care services to senior citizens. However, a broader perspective of the aging process is required, which is conceptually described as "active aging"" (p.68).

Another term is aging-in-place (see Goonawardene, Leong & Tan, 2018) which means aging at non-hospital and non-nursery settings such as home. Although useful to some extent, such a term focuses on only one aspect of the assisted aging experience which is home-basedness. Another term with a focus on home-basedness is the notion of smart homes. Smart homes "which incorporate environmental and wearable medical sensors, actuators, and modern communication and information technologies, can enable continuous and remote monitoring of elderly health and wellbeing at a low cost" (Majumder et al., 2017, p.1). Again we prefer the notion of assisted aging rather than smart homes for the very same reason. Nevertheless, we can note the list of benefits for the elderly compiled by Kon, Lam & Chan (2017):

"Smart home technology provides benefits for the elderly in six primary categories: safety, health and nutrition, physical activity, personal hygiene and care, social engagement, and leisure. Safety is about detecting and mitigating, if not removing, hazards from the user's environment. Social engagement relates to the smart home functions that allow the elderly to combat social isolation, such as by connecting the elderly with friends and family. Leisure activities are about how a smart home can allow users to spend their free time. Physical Activity relates to the concept of movement from the user, such as having them engage in non-sedentary activities. Nutrition and Health is related to the monitoring of a user's state of health. Personal hygiene and care encompasses the ways that a smart home can improve the user's well-being and assist in his/her daily activities" (p.1095).

Although assisted aging is mostly home-based (see for instance Thapliyal, Nath & Mohanty, 2018), we need to recognize elderly people's need and willingness for short- and long-distance mobility. Thus home-based IoT for health purposes need to be complemented with mobile health devices. These devices can be materialized through upgrading mobile devices such as mobile phones and smart watches as well as through what we call as 'IoT'ization of traditional assistive devices. For example, Gill et al. (2017) propose 'IoT'ization of canes used by people with mobility problems, and develop 'a hybrid sensorized cane, capable of measuring loading, mobility and stability information' (p.216). They rightly argue that such a cane will be instrumental for early recognition of movement-related disorders and daily management of chronic diseases. Likewise, Eskofier et al. (2017) present the uses of smart shoes to monitor and assess gait and mobility, and identify any movement and coordination problems.

CONCLUSION

In this article, we presented health applications of IoT both through technical and social science accounts. Then we narrowed our general outlook in favor of gerontological uses of IoT. While technically it is reasonable to celebrate the advances in gerontological IoT, social and economic disparities are to be noted as well. In the next section, we introduced less well-known notions such as psychological AI, artificial psychology and artificial emotions. Our final and main topic involved terms such as assisted living, aging in place, healthy aging and ultimately assisted aging. The ideas portrayed in this paper will be awaiting the findings of relevant empirical studies and theoretical discussions for refutation or corroboration.

To conclude, our notion of assisted aging is based on the following statements:

1. IoTs will be indispensable in our lives, especially in old age.

2. We need a more comprehensive gerontological approach to aging, not only a health-focused, geriatric approach only, which also includes non-health aspects of elderly people's quality of life.

3. We need to recognize not only technical but also social dimensions of IoT, ceaselessly questioning our assumptions about society and social justice, not accepting social parameters as given.

4. From a public health perspective, rather than considering gerontological IoT as a panacea, we need to focus on short-, mid- and long-term antecedents of sicknesses.

5. In the gerontological IoT design processes we need to be participatory and user-centric.

6. As gerontological IoT requires human-IoT interaction and since geriatric issues frequently involve psychological/psychiatric elements, human-friendly and age-friendly designs will be more common, which will require advances in psychological AI, artificial

psychology and artificial emotions[9].

7. Gerontological IoT can't completely replace human health and care professionals.

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