ISSN: 2586-7342 © 2020 KODISA & KJFHC
KJFHC website: http://www.kjfhc.or.kr
doi: http://dx.doi.org/10.13106/kjfhc.2021.vol7.no5.1.

A study on improvement of elderly welfare service focusing on the user of AI and the IoT

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Received: October 17, 2021. Revised: November 04, 2021. Accepted: November 30, 2021.

Abstract

The aging of the population has a fundamental impact on the national economy, including decline in productive population, atrophy of available funds, slowdown of technological innovation, slowdown of economic growth, and decrease in vitality of society as a whole. Increase of elderly population would lead to increase in elderly welfare consumers, which would also lead to increase the demand for elderly welfare services. However, due to the continuation of the low birth rate, there is a great shortage of human resources who can handle this. In such a situation, the main goal of the elderly welfare system in the future should aim to actively try to design effective policies, prepare systems, and implement services for the problems of the aged society, and to find ways to expand the finances, manpower, methods, and facilities necessary for the welfare of the elderly. Elderly welfare services in Korea have been changed and developed in accordance with socioeconomic changes such as industrialization and urbanization. This study examines the changes in elderly welfare services in Korea by the flow of times and presents a method which utilizes artificial intelligence and Internet of Things in services for the elderly welfare consumers to improve both quality and efficiency.

Keywords: Aging Society, Elderly Welfare Service, Artificial Intelligence, IoT

Major classifications: Public Health, Health Policy and Economy, Management

1. Introduction

Korea is rapidly becoming a super-aged society in the world. It entered an aging society in 2000, entered an aged society in 2017, and is expected to enter a super-aged society in 2025(Statistics office, 2019). According to “World and Korea’s Aging Population Status and Prospect”, the proportion of the elderly population over 65 in Korea will reach 37.5% in 2045, it would lead the country that has the highest proportion of the elderly population in the world. The aging of the population

has a negative impact on the national economy (Košir & Šoba, 2016), such as decline in productive population, atrophy of available funds, slowdown in technological innovation, a slowdown of economic growth, and decrease in vitality of society as a whole. In particular, along with the expansion of public expenditures related to the elderly, medical expenses would increase, and the burden on the younger generation for supporting the elders would also increase. Looking at the current trend, the number of elderly people to be supported per 100 productive population in 2017 was 18.8 whereas the number is expected to be 102.4 in 2067 which is more than five folds (Statistics office, 2019).

An increase in the elderly population would lead to increase in the elderly welfare consumers, which would also lead to increase in the demand for elderly welfare services. However, due to the continuation of the low birth rate, there is a great shortage of human resources who can handle this. In such a situation, the main goal of the elderly welfare system in the future should aim to actively try to design effective policies, prepare systems, and implement services for the problems of the aged society, and to find ways to expand the finances, manpower, methods, and facilities necessary for the welfare of the elderly. Elderly welfare services in Korea have been changed and developed in accordance with socioeconomic changes such as industrialization and urbanization. In this study, we will look at how the elderly welfare services in Korea have been developed in different eras and will present a method to improve quality and efficiency of the services for elderly consumers by utilizing artificial intelligence and Internet of Things during the development of the services. Unlike existing elderly care services, this can be a new way to support multiple elderly people at the same time and to provide personalized services according to their lifestyles or types of diseases.

2. Literature Review

2.1 Definition of the Elderly Welfare

The elderly welfare is a field of social welfare as a social effort to promote the stability and welfare of the elderly. While there are various definitions for the elderly welfare, the core of the effort is to provide salaries and services necessary for all seniors to maintain a life above the minimum standard, to meet social needs, to prevent and solve problems in life, and to adapt to old age and achieve social integration. Such effort may refer to all of the organized and professional activities provided by regardless of the public or private sectors. The issues dealt within the elderly welfare include not only economic issues, but also various needs such as health, care, leisure, cultural, psychological, social, and political desire.

2.2. Changes and Development of Elderly Welfare Services by Era

The elderly welfare systems in Korea have been continuously developed in accordance with socioeconomic changes such as industrialization and urbanization (Jo, 2016). The history and development of welfare for the elderly in Korea over time are as follows.

In the 1960s, social welfare laws related to the elderly welfare were enacted. However, the basis of the welfare systems for the elderly was very weak. During this period, the national and social interest mainly focused on economic development and security for poverty alleviation and political stability. Thereby neither the public nor the government were aware of the need for social welfare. In addition, the traditional idea of filial piety was socially respected, and the average life expectancy and the number of the elderly population were not serious enough to recognize the elderly problem. Accordingly, the elderly welfare in this period was limiting and the assistance in rescuing from the poverty was provided to a small number of the elderly.

In the 1970s, social problems such as poverty of working class and income inequality emerged due to the rapid economic growth. As a result, people's interest in social welfare was raised. Additionally, urbanization and extension of life expectancy have raised more people in the interests of social welfare and needs for the elderly welfare. Also, from the emotional aspect, due to urbanization and deepening of the nuclear families, the increase in the elderly living alone, loneliness, alienation, and depression were publicly discussed. With such backgrounds, facilities related to the elderly welfare like elder schools were emerged and the necessity of the Elderly Welfare Act was emphasized.

The 1980s was a time when the institutional basis for the implementation of the elderly welfare system was laid with the enactment of the Elderly Welfare Act and the declaration of the Senior Citizenship Charter. As the Elderly Welfare Act was enacted and promulgated in 1981, welfare-related systems for the elderly were implemented. In 1982, the Senior Citizenship Charter was proclaimed based on the ideology of the Elderly Welfare Act.

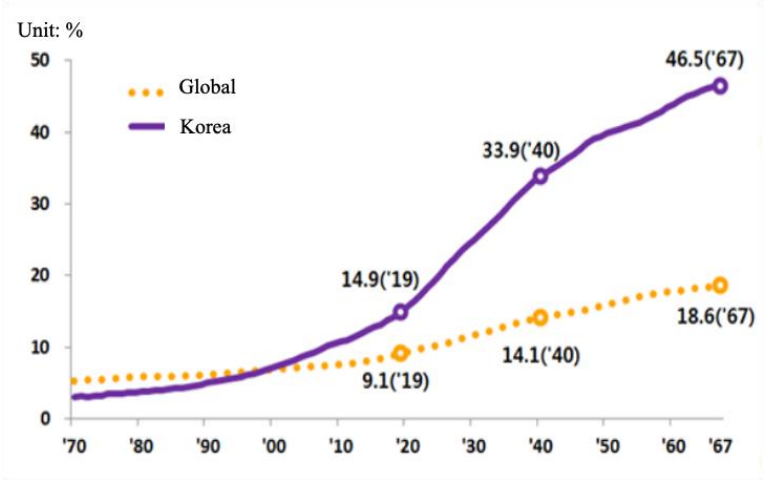

Figure 1: Trends in the composition of the elderly population in the world and Korea (Statistics office, 2019)

In the 1990s, as people became more interested in the preparation for life after retirement, private insurances related to aged life were appeared. In response to these social changes, welfare systems and services for the elderly were gradually expanded. Also, from 1998, the existing old-age allowance system was abolished and a senior pension was newly established, which was paid to the low-income seniors aged 65 and over.

In 2000, Korea entered the aging society. As an aging society, the necessity for the systems and facilities for the elderly were vastly expanded to cope with rapid increase of the elderly population and their various needs and desires. Accordingly, it became difficult to satisfy the needs of the elderly with only the existing passive welfare policies for the elderly, and privatization began to be emphasized in welfare due to the flow of neoliberalism. In the 2000s, welfare for the elderly continued to change and develop more rapidly.

Table 1: Change of the elderly welfare over time

Era	Main events
1960	Poverty rescuing aid
1970	Facilities for the elderly welfare emerged
1980	Elderly welfare act amended
1990	Senior pension was paid
2000	Diversification of elderly welfare facilities

2.3. Growing Demand for Home Care Service in a Super-aged Society

Welfare states such as Europe and Japan have long been implementing deinstitutionalization, normalization and integration due to the problems and limitations incurred from the high cost for the elderly welfare facilities and policies and limited beneficiaries. The elderly care policy in Korea, which focused on the in-facility protection for the elderly who had difficulty receiving family support and protection, is also being shifted to community-centric home care services, which are conducted in the welfare states. Home care services for the elderly has its significance since it provides the elderly with familiar environment to maintain an independent life in their own home, Particularly it is meaningful in aged societies since it reduces the governmental expenditures for rapid increase in the number of chronic diseases for which the government is responsible.

In 1993, the “Social Welfare Work Act” was amended and home-based welfare work was defined as a type of social welfare work. In the same year, the “Elderly Welfare Act” was also amended and the home welfare project was defined as a type of welfare project for the elderly. In addition, with the revision of the related law in 1997, a home care volunteer

training project was added to dispatch home care volunteers. In 2004, the government strengthened home welfare services by establishing a community support system for the elderly with dementia.

The aging society shows qualitative changes in the composition of the population, such as the number of single elderly households and elderly households living alone. The elderly living alone are mostly psychologically, socially, physically and economically vulnerable. Accordingly, the state or local governments are taking protective measures such as visiting nursing and care for the elderly living alone and safety confirmation. However, it is difficult for the manpower required for visiting nursing services to meet the service demand due to the increase in the elderly population.

In 1960, when the traditional ideology of filial piety was socially respected and the average life expectancy and the number of elderly people were not serious enough to be recognized as a social problem. However, since Korea is approaching the gate of super-aged society at the fastest rate in the world, it is necessary to equip with new practical model for elderly welfare services.

3. Methodology

The aging population is a serious social problem. Elderly care services using AI and IoT are attracting attenstions as a solution the problem of insufficient manpower for the care of the elderly due to the rapidly aging population.

Artificial intelligence is a technology that realizes human learning bility, reasoning ability, perceptual aibility and natural language understanding ability through computer pograms (McCarthy, 2007). In other words, it allows computers to mimic the intelligent behavior of humans. Tasks such as analyzing an image captured by a computer through a TV camerato find out what it is, or listening to a human voice and converting it into a sentence aver very complex and impossible without the introduction of artificial intelligence theory (Kang, 2019). Such image and voice recognition are the core technologies for character recognition and robotics engineerings. In modern days, attempts are being made to introduce artificial intelligence elements in various fields of information technology and use them to solve problems in the fields (Kang, 2019).

In the United States, the elderly welfare is realized by using artificial intelligence solution called CarePredict. This service figures out the patterns in the daily life of an elderly and provides a function to inform them in advance of health problems by periodically checking their physical condition.

Table 2: Definitions of AI by different scholars

Scholar	Definition
McCarthy (2007)	An intelligent computer program developed by scientific and engineering technology to be used as an intelligent machine
Hutton (2011)	A machine with the ability to predict the future of its environment and respond accurately to it
Russell & Norvig (2002)	A rational agent that thinks like a human, acts like a human, thinks rationally and acts rationally
Sangsu Lee (2018)	A set of software, logic, computing, and philosophy that aims to make computers perform functions thought that only humans could do, such as recognizing the meaning of letters and words, learning, and recognizing facial expressions
Kayong Moon (2018)	A field of science that studies methodology or feasibility of creating intelligent beings with ideal intelligence, or the intelligence created by systems

IoT, which plays a key role in Industrie 4.0, refers to a service that collects information and communicates through internet connections between tangible and/or intangible objects existing in the world, people and things. The core elements are sesonrs, cloud and big data. These allow data are collected by and exchanged between sensors and information are generated in the middle of the porcesses are stored as big data in the cloud thereby making the analysis and/or utilization of the information easier and ready-to-use. One advantage of the IoT is the automation with minimal human intervention. This allows things to operate more intelligently, and judgments and reactions can be made automatically according to certain

preset rules. With the IoT, information is shared through the interaction of all things, and ultimately, better services can be provided to people. Currently, IoT is widely used in various fields in daily life such as smart farms, smart homes, smart cars and in high-tech fields. In medical field, a sensor can be attached to a patient to measure and record the patient's health status from time to time which enables quick and easy initial respones to patient's sudden sudden health issues.

IoT can also be utilized in the field of the eldery care services such as installation of sensors in elderly households to manage daily life and provide quick response in case of an emergency. The data collected by the sensors can be be monitored in real time on mobile devices of each care service provider. If no movement is detected for a certain period of time or if there is an abnormality in temperature, humidity, or illumination, it can be quickly responded by immediate check and/or reporting to 119 . The use of IoT can not only provide more timely services, but also efficiently manage a large number of elderly people with a small number of care workers, which can greatly contribute to resolving the imbalance in the supply and demand of care workers.

4. Result

4.1. Home care support function with minimal facility care

Countries such as the United States, Europe and Japan prefer home care over nursing facilities. In a super-aged society, one of the prerequisites for making the life of each elderly person more leisurely and prosperous is supporting the elderly that they can continue their life in the place where they have been living for a long time . In other words, it is important to minimize the facility cares and prepare a system that advocates for people to spend their time at places where they were born and raised, where they have had raised their children, where they have engaged in professions, where they have had old friends, where they have had memories within familiar sceneries. Advances in artificial intelligence and the Internet of Things enable the elderly to receive personalized services while staying at home.

The number of elderly living alone in Korea was 1.4 million in 2018 and is expected to be increased to 3 million by 2035 (Statistics office, 2019). Psychological anxiety and loneliness among the elderly living alone are major causes of dementia. Artificial intelligence caring robots and artificial intelligence speakers are able to provide various entertainment and information through functions such as conversation, singing and broadcasting. By installing artificial intelligence speakers in the homes of seniors who need care, they can have emotional conversations and reduce loneliness by listening to songs and acquirng information. This can help the psychological stability of the elderly and help prevent dementia. It also communicates with patients to remind them when to take medications and provide them with information needed to manage their disease. Caregivers can check whether they are taking medications properly or having meals regularly through the application, and if there is no movement for a certain period of time, a notification can be sent to the caregiver.

In the United States, the welfare of the elderly is realized by using an artificial intelligence solution called CarePredict. This service finds the daily life patterns of the elderly and provides a function to inform them in advance of health problems by periodically checking their physical condition. Basically, it collects and analyzes daily life data such as sleep, defecation, eating, walking, and sitting using a hand-held device. It is noteworthy that the analyzed data is not simply analyzed according to medical standards, but an individual's unique lifestyle is identified and analyzed. It is designed to alert a family member or caregiver if the lifestyle is different than the usual. It can even predict the degree of depression by calculating the time spent using the toilet and sedentary activity. This actually worked, and it was able to predict urinary tract infections 3.7 days earlier and two weeks earlier in prediction of depression than hospital diagnosis.

4.2 Prediction of Safety Risks through IoT Environment

It is difficult for the ones from outside of the house to grasp the situations and/or emergencies happening to the elderly living alone. Therefore, there is a need for a system that quickly detects and takes action. The multi-sensor-based sensing method proposed in previous studies have lower accuracy in situational recognition when an actual emergency occurs. Thus, it is urgent to provide the elderly welfare with general services by implementing real-time image collections through IoT environment and real-time monitoring on safety risks to the elderly at home and the detection of and quick responses to the emergencies through AI technology. This technology enables rapid response by detecting accidents of the elderly living alone in advance and allows to build a system that can report emergency situations to 119 and deliver them to the competent authority.

In the United States, AI solution called Qventus provides the ability to identify patients at high risk of falling. Qventus is

a strategic partner for transforming healthcare operations , it collects and analyzes real-time data from electronic medical records, types of medications being administered and records of vital signs and selects patients with high risk of falls and sends them to the nursing center. In fact, El Camino Hospital in California reported a 29% reduction in falls since the service was introduced.

Table 3: Trend of the elderly living alone

Year	Elderly living alone (Unit: person)
2010	1,066,000
2015	1,223,000
2018	1,445,000
2019	1,533,000
2020	1,661,000
2035	3,000,000

In Korea, a falling prevention solution using artificial intelligence has been developed. This solution uses camera to check face and joints in real time and it is designed to send call signal and video data to nurse agents and or family members when it is determined that the patient's movements are exposed to the risk of a fall. All of these processes are carried out by artificial intelligence algorithms. Preventing the health problems of the elderly in advance is a very effective way to improve the quality of life of the people and suppress the increase in medical expenses at the national level.

5. Conclusions and Implications

Elderly welfare services in Korea have been changed and developed in accordance with socioeconomic changes such as industrialization and urbanization. In the era of the 4th industrial revolution, AI and I0T are the mainstream, and robots equipped with artificial intelligence are being used in various fields. In particular, it has sufficient social values as a complementary element of the elderly welfare system in an aging society.

First, on behalf of the nuclear family and busy children, artificial intelligence robots can promote mental health through pleasant emotional conversations with the elderly. In other words, artificial intelligence robots can become friends and help relieve loneliness and depression in the elderly.

Second, it informs the elderly of when to take their medications, and in the event of an accident at home, emergency measures can be taken by contacting 119 or the person in charge, thereby preventing major accidents or lone death. In other words, the health status of the elderly can be checked 24 hours a day with AI robots and the IoT.

Third, it is possible not only to reduce the cost of expanding nursing facilities by enabling home care with minimal facility-cares, but also leading the elderly to a more emotionally and socially satisfactory life maintained in a familiar environment.

Fourth, at the national level, social costs can be reduced by easing the supply and demand of care workers to deal with the increase in the elderly population and reducing medical costs.

In an aging society, government becomes more responsible for the rapid increase in demand for the elderly welfare, and thus, efficient management is an important task in reducing social costs. Accordingly, along with the development of artificial intelligence and IoT technologies, it is necessary to continuously research and implement ways to apply them to welfare services for the elderly and expand them.

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