ISSN: 2508-7894 © 2022 KODISA
KJAI website: http://acoms.kisti.re.kr/kjai
doi: http://dx.doi.org/10.24225/kjai.2022.10.2.1

Research related to the development of an age-friendly convergence system using AI*

Won ro LEE[1], Junwoo CHOI[2], Jeong-Hyun CHOI[3], Minsoo KANG[4]

Received: September 13, 2022. Revised: September 20, 2022. Accepted: October 11, 2022.

Abstract

In this paper, the research and development aim to strengthen the digital accessibility of the elderly by developing a kiosk incorporating AI voice recognition technology that can replace the promotional signage currently being installed and spread in the elderly and social welfare centers most frequently used by the digital underprivileged. It was intended to develop a converged system for the use of bulletin board functions, educational functions, and welfare center facilities, and to seek ways to increase the user's digital device experience through direct experience and education. Through interviews and surveys of senior citizens and social welfare centers, it was intended to collect problems and pain Points that the elderly currently experience in the process of using kiosks and apply them to the development process, and improve problems through pilot services. Through this study, it was confirmed that voice recognition technology is 2 to 6 times faster than keyboard input, so it is helpful for the elderly who are not familiar with device operation. However, it is necessary to improve the problem that there is a difference in the accuracy of the recognition rate according to the surrounding environment with noise. Through small efforts such as this study, we hope that the elderly will be a little free from digital alienation.

Keywords: Elderly, Kiosk, AI, Social Welfare Centers, Technology

Major Classification Code: Artificial Intelligence, etc

1. Introduction

This study conducted a study on developing convergence kiosks to increase the experience of elderly users of kiosks, which are continuously increasing due to COVID-19 and rising labor costs. The theoretical background of the spread of non-face-to-face servicescan be said to be based on 1) the government's strong containment and quarantine policy due to COVID-19, 2) the acceptance of non-face-to-face technology by social members, and 3) human needs and values for health and safety (Jun, 2020). Due to this flow, even facilities that are used every day, such as cafes,

*This work was supported by the research grant of the KODISA Scholarship Foundation in 2022.
1 First Author. CEO, NASCALLAB, Korea.
Email: nascalab@gmail.com
2 Second Author. Professor, Dept. of Medical IT, Eulji University, Korea. Email: chlwnsdn456@naver.com
3 Third Author. Director, LG Uplus corporation, Korea.
Email: nevergiveup@lguplus.co.kr
4 Corresponding Author. Professor, Dept. of Medical Bigdata, Eulji University, Korea. Email: mskang@eulji.ac.kr

restaurants, and fast food restaurants, are rapidly being replaced by non-face-to-face services such as Kiosk. A kiosk is a small, free-standing physical structure that displays information or provides a service. (TechTarget, 2005). However, there is a digitally marginalized class that is not familiar with rapid social change and the latest technology, and the elderly, the disabled, the low-income class, and the farmers and fishermen are the four most vulnerable groups. It is known that the information vulnerability of the elderly is the most discussed. As the world becomes increasingly digitized, the "digital divide", an information gap caused by differences in information or technology utilization between generations and social classes, cannot be avoided. Since it has recently expanded to various digital devices such as PCs, smartphones, and kiosks, the information gap may become more serious if the devices are not handled well. The digital divide phenomenon is accompanied by a phenomenon called "digital lag" in which digital technology cannot keep up and is alienated. This is because, when alienated from digital technology, the information gap deepens, and as the information gap grows, it becomes difficult to follow digital technology, and as people avoid digital devices, the vicious cycle repeats, in which they are further alienated from digital technology, and the information gap becomes larger (Kim, 2020). According to the "2021 Digital Information Gap Survey Results" by the Ministry of Science and ICT and the National Intelligence Service (NIA), the overall level of digital informatization among the elderly among the information-vulnerable is 64.3% in 2019, 68.6% in 2020, and 69.1% in 2021. Although the overall figure has risen due to this, it is the lowest among the vulnerable groups compared to other vulnerable groups such as marriage immigrants (89.5%), North Korean defectors (89.4%), and the disabled (81.7%) (Ministry of Science and ICT, 2022).

Currently, the Republic of Korea is entering a super-aging society at the fastest rate in the world. As of 2020, the number of people aged 65 and over is 8,125,000, accounting for 15.7% of the total population. According to data from the National Statistical Office, by 2025, the population aged 65 and over is expected to account for more than 20.3% (Lee, 2020).

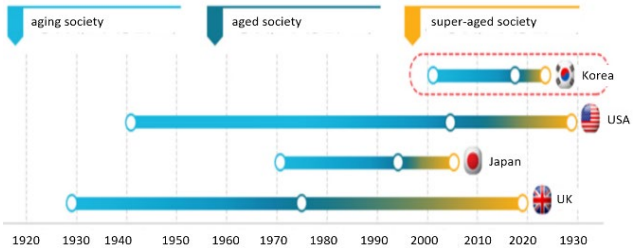


Figure1. Distribution of Aged Society by Country

This study focuses on elderly and social welfare centers (398 senior welfare centers, 466 general welfare centers, 254 disability welfare centers, as of 2020) used most by the elderly, who are the most vulnerable to information, and replaces the currently installed and spreading publicity signage. By developing a convergence kiosk for bulletin board function, educational function, and welfare center facility use, research and development methods to increase user experience to enhance digital accessibility through direct experience and education.

1.1 Research scope and methods

This research and development were conducted with a focus on about 1,200 welfare centers nationwide, mainly used by the elderly, who are digitally underprivileged. Currently, many welfare centers are using digital signage for educational information, announcements, and policy promotion. This study, based on the digital signage function, provides direct use and experience functions through kiosks such as welfare center facility use and program application, fast food restaurants, and cafes, It is in the development of a convergence kiosk that can provide education and experience by subdividing digital devices in various situations step by step using the app emulator function for kiosks such as restaurants, hospitals, transportation, and finance. It is based on the judgment that it is possible to increase the user experience of the elderly through direct use, education, and experience at frequently used facilities. It effectively implements three functions in one device to provide the maximum effect to welfare centers operating on a limited budget. In addition, by incorporating voice recognition technology to enable interactive services, he sought to develop a system that allows users to select menus and place orders easily. Regarding the derivation of difficult or inconvenient matters, an interview was conducted with a welfare center official. Based on this, the problems arising from the viewpoint of the elderly were supplemented and presented.

2. Theoretical Background

<Current Status of Kiosk Supply in Korea(estimate)>

Field	number of operating units(estimate) 2019	2021
1. Common Field	181,364	183,459
a. Unmanned administrative civil service	3,964	4,613
b. Bank	133,390	127,509
c. Hospital	35,333	41,312
d. Traffic	8,290	9,382
d. University	507	643
2. Private Sector	8,587	26,574
a. Cinema	1,930	2,281
b. Supermarket	1,178	1,738
c. restaurant business	5,479	21,335
d. convenient for living	-	1,200
Sum	189,951	210,033

* Source: Korea Intelligence and Information Society Agency, Reconstruction of Kim Sang-hoe's Room

the reaction of older people to the use of kiosks (Unit:%)

	proficiency	not proficient
Total	88.5	11.5
50 years	76.3	23.7
60 upper	66.1	33.9

*2021 Survey Source: Gyeonggi Research Institute

Figure 2. Current Status of Kiosk Supply in Korea and the reaction of older people to the use of kiosks

2.2 Understanding the elderly

Digital signage refers to a digital media service that delivers various information and advertisements through text or images in public and commercial spaces through a digital display that can be controlled through a network (Yoo, 2016). It is installed in many companies and public institutions, and the number is continuously increasing. Specifically, digital signage is one of the media that has rapidly jumped, with an average annual growth rate of 15.2% from 2011 to 2016. According to OMDIA global market research company, the global digital signage market demand in 2021 will reach 6.34 million, 23 compared to last year. %, and it is expected to reach 7 million units in 2024(Yonhapnews, 2021). A Kiosk refers to an unmanned terminal installed so that the public can easily use it through the automation of information services and tasks. It is an unmanned information terminal installed in public places such as government agencies or local organizations, banks, department stores, exhibition halls, etc., and provides traffic information, reservations, various guidance information, and how-to-use facilities. Such a kiosk should be able to attract the attention of passersby and draw attention and should be easy to use in consideration of the user's age, educational level, and the diversity of socioeconomic levels. In addition, the interface and navigation of the kiosk should be intuitive and visual, and interactive elements considering interaction with the user should be reflected (Byung et al., 2008). Kiosks are increasingly being used in food stores, cafes, franchises, and restaurants for unmanned ordering, unmanned storage and certificate issuance at hospitals, unmanned ticket sales at major train stations and bus terminals, and even for reservations at welfare facilities and sales of meal tickets. is getting wider In addition to the preference of the MZ generation, who are the main users, the number of kiosks is increasing explosively as cuttingedgetechnology, non-face-to-face,and labor cost reduction are added. there is also (Kyunghyang Shinmun, 2022) Asthe kiosk spreads, the elderly complain of inconvenience in using it. The information-vulnerable group is defined by the Ministry of Science and ICT as those who cannot purchase social services or have difficult conditions and are classified into the disabled, the elderly, the low-income class, the farmers and fishermen, and the elderly. The elderly suffer from various problems with using digital media due to deterioration of physical, cognitive, reaction, motor, memory, and learning abilities.

However, it is possible to acquire information technology even in old age through continuous education and lifelong learning (Hwang, 2020). According to the “2021 Digital Information Gap Survey Report” from the Ministry of Science and ICT, the level of access to digital informatization among the elderly was 93.1% (0.3%P↑ compared to 92.8% in the previous year). The level of digital informatization competency was 53.9% (0.2%P compared to 53.7% in the previous year). ↑), the level of digital informatization utilization was 72.3% (1.1 %P↑ compared to 71.4% the previous year) (Ministry of Science and ICT, 2022). It can be seen that the overall figure has gradually increased over the years. This leads to the digital divide phenomenon, which can lead to inequality. Therefore, there is a need to improve it through direct experience and education through major facilities so that people can become accustomed to digital media.

2.3 Understanding of speech recognition technology

To implement a voice-based interactive service, STT (Speech to Text) and TTS (Text to Speech) engines are required. STT (Speech To Text) and TTS (Text To Speech) technologies use STT to recognize what the other person said, convert text into speech and send it out through TTS. (Kim, 2022). Of course, an NLU (Natural Language Understanding) module is needed to generate an answer with refined information by grasping the meaning of the natural language decomposed between STT and TTS. In this series of processes, it can be said that the difference in recognition rate determines the service quality of the corresponding domain.

3. Study contents

3.1 Major Problems and Improvement Plan

3.1.1 Problem of Kiosk Size for Senior Users

The multifunctional kiosk planned to be developed through this study must be equipped with a large monitor with good visibility for the digital signage function and additional devices (thermal printer, QR + RF reader, IC card reader, etc.). In addition, considering that the main users are the elderly, the touch screen monitor size is not suitable for the 180cm standard of the existing adult standard in terms of user convenience. Considering the average height of 70 years old (165cm for men, 152cm for women) as to the National Statistical Office (2019) and that older people have a more curved waist, it is necessary to adjust the overall height of the multifunctional kiosk to 170cm or less. It is necessary to design the monitor and enclosure of “Touch Screen Monitor 32” if possible. In other words, it is necessary to proceed with the design so that you can freely press the Touch Button by raising your arm even under 160cm.(KOSIS, 2021)

3.1.2 Problems in implementing three functions with one kiosk device

On one main PC, notices, bulletin boards, signage functions for public relations for senior citizens and social welfare centers, convenience facility reservations, meal ticket sales, etc., are available through kiosks, food stores, cafes, franchises, restaurants, unmanned orders, hospitals, etc. It is necessary to implement three functions without inconveniences, such as unmanned storage and certificate issuance at the train station and unmanned ticket sales at major train stations and bus terminals, etc., for education and experience. Of course, when selecting a monitor with multiple HDMI ports, three functions can be solved by changing the external input mode.

3.1.3 Expenses to purchase content for experiential education

When proceeding through the purchase of content for information education kiosks, a separate cost is incurred. Additional content purchase costs occur when the kiosks are spread according to the service area. To solve this problem, content for free trials produced by the public service sector of telecommunication companies and public institutions is searched in advance. The other content is implemented to enable experience and education by implementing the Android App in Kios through the emulator function. Need. Java-based independent programs can ensure compatibility by running them on a virtual machine similar to an emulator. Also, Android can run the OS itself as a virtual machine on top of the Linux kernel. In fact, emulators and virtual machines are essentially the same technology, but emulators can mimic the behavior of certain other devices, so functionality can be implemented. When using the emulator function, it is implemented to enable various digital education by running the Android App without the cost of purchasing the contents separately(Kim, 2003).

3.1.4 Voice recognition service configuration technology

The voice recognition service was reviewed using Google Cloud API (Application Programming Interface). First, STT and TTS function implementation was implemented by issuing an API key for the Cloud Speech API and installing Cloud SDK (Software Development Kit). The biggest advantage of the Google Cloud Voice API is that the recognition rate of STT is over 95%. This API can operate in both batch mode and real-time mode. It is also stable against side noise in the audio, and in some languages, it is possible to filter out inappropriate words. This system is based on a deep neural network (DNN) and has the advantage that it can be improved over time. For natural language processing technology, a voice conversational service was applied using Dialogflow, a natural language processing platform based on machine learning developed by Google. Voice conversational service using Dialogflow consists of the following process. Play is the minimum service unit of voice recognition, and it interacts with the user to determine the intention and gives an appropriate answer or command. Intent means the user's intention expressed to operate the function of Play. It adds the flow of conversation as an essential component of the play, analyzes and investigates the content the user wants to ask, and writes and saves the appropriate answer. When a user requests a service, it matches the intent of the service and provides an answer.(Sudiatmika, 2021)

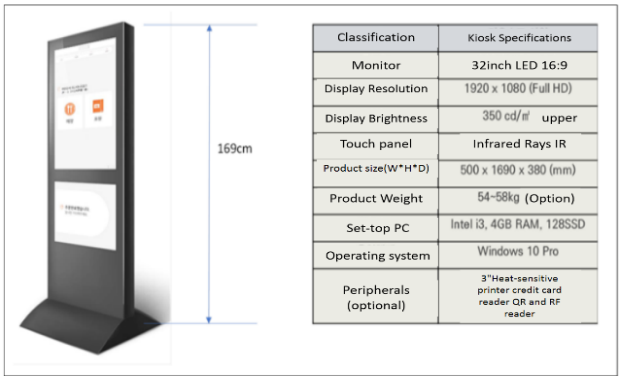
Next, you need to configure the Entity. The entity is a group of words set so that desired information can be extracted from the user's words or sentences to lead conversations appropriately. The entity plays a role in determining what kind of value the parameter of conversation intent will have. (SK Tel 2022) Through this process, it is possible to provide an optimized voice recognition service.

3.1.5 Professional manpower solution for Digital Signage screen design

The signage function for notices, bulletin boards, and publicity of senior citizens and social welfare centers requires regular experts for periodic screen production or an expert to apply dynamic images to increase visibility. However, most elderly and social welfare centers do not have professional manpower due to problems such as manpower and expectations.

4. Result

First of all, this study examines the issues that may occur in the process of using the kiosk by the elderly in the process of developing an improvement plan through interviews and actual situation surveys with seniors and social welfare centers, which are major facilities used by the elderly. We tried to improve the problem through application and trial services. To solve this problem, it is necessary to provide a template for each theme for screen production without an expert. It is necessary to apply for the program so dynamic effects such as image slides, text slides, and various widgets can be expressed. In addition, it is necessary to implement it without specialized knowledge by making it possible to create, change, delete, and remotely upload in real-time with a smartphone. The design of products to be developed and released through this research is as follows.



Classification	Kiosk Specifications
Monitor	32inch LED 16:9
Display Resolution	1920 x 1080 (Full HD)
Display Brightness	350 cd/㎡ upper
Touch panel	Infrared Rays IR
Product size(W*H*D)	500 x 1690 x 380 (mm)
Product Weight	54~58kg (Option)
Set-top PC	Intel i3, 4GB RAM, 128SSD
Operating system	Windows 10 Pro
Peripherals (optional)	3"Heat-sensitive printer credit card reader QR and RF reader

Figure 3. The design of products to be developed and released through this research

5. Conclusion

In this study, notice, bulletin board, signage function for publicity, reservation of convenience facilities, and meal ticket sales of senior citizens and social welfare centers were used for convenience facilities use through kiosks, unmanned orders at food stores, cafes, franchises, and restaurants, and orders at hospitals. The kiosk was developed for the elderly by combining three functions, such as unmanned storage, certificate issuance, and unmanned ticket sales at major train stations and bus terminals, for education and experience. For the above study, he analyzed the problems of the current systems. He set the direction for research and development with the opinions of field personnel and field inspections on the methods that can induce the maximum effect at the minimum cost. As there is no national standard for design and planning, the Seoul Digital Foundation's “Aged-friendly digital accessibility standard (video content 1.0, mobile web ·◌ app 1.0) ” was referred to. The standard is composed of 10 guidelines each. The main contents are simple and clear compositions to not confuse users, secure readability with clear text or menu structure, convenient service step shifting function, repetitive use function, etc. Efforts were made to reflect the standard draft by suggesting the convenience of use.

As a result, the main reasons for developing an age-friendly convergence kiosk for the elderly are as follows. First, it should be applied to the consideration of the physical characteristics of senior users. It must be accessible from 160 cm below, and the size of the entire image and text needs to be enlarged by 15% compared to the current size. Second, function movement between kiosk contents should be free and convenient. Considering that the main users are the elderly, there should be no inconvenience in switching functions. Third, the content needs to be implemented, so that experience and education are possible by implementing the Android App on the kiosk through the emulator function. Fourth, the convenience of use should be pursued by applying voice recognition technology. Fourth, it should be easy to produce notices, bulletin boards, and public relations by providing templates for each theme for screen production.

“Digital should be equal in front of everyone, ” he says. The government has prepared and operated various legal and institutional systems to bridge the digital divide since 2011, and it is continuously expanding. (Hyunjung Kim, 2020) To bridge the information access gap and information use and utilization gap, these policies are being pursued with a focus on informatization education, welfare system establishment, and information access improvement. However, as shown in the statistical data of the Ministry of Science and ICT, the improvement for the elderly, the most vulnerable group, is very minimal, and the continuous development of smart devices is inevitably frightening for the elderly. The purpose of this study is to develop a system that can help the elderly to strengthen their access to digital devices by developing a fusion-type kiosk for elderly-friendly elderly and social welfare centers for welfare centers. It will also contribute to cost reduction by implementing the three functions into one system in terms of the most efficient operation within the limited budget of the welfare center.

Since voice recognition technology is 2 to 6 times faster than keyboard input, it can be helpful for the elderly who are unfamiliar with device operations. However, there is a difference in the accuracy of the recognition rate depending on the noise surrounding the environment. It is said that the kiosk is vulnerable in an environment where various noises are mainly used. In addition, the answer of the AI speaker is temporary because it is expressed only in voice, and people feel the pressure of having to start a conversation again once it passes. In voice recognition, technology research and service improvement on removing noise in a noisy environment and allowing users to reproduce only the desired part are areas that need to be supplemented in the future. It is hoped that small efforts such as this study will free the elderly from digital alienation a little. (Jeon, 2020)

References

Hankyung (2022). It's the last minute from the login ... Older people are 'non-face-to-face stress'. Retrieved Auguest 30, 2022, from https://www.hankyung.com/society/article/2021031413121

Hwang N. H. (2020). Older Adults and the Digital Divide: Current conditions and policy implications. *Korea Institute for Health and Social Affair* (KIHASA Publication No.2020-46).https://www.kihasa.re.kr/en/publish/paper/research/view?seq=35813

Jun, S. H., & Kim, J. H. (2020). Theoretical background and

prospects for the untact industry. *Journal of New Industry and Business, 38*(1), 96-116.

Kim J. W. (2003). Development of an Integrated Network Education System Using Ethernet Emulator. *Korea Evaluation Institute Of Industrial Technology*. (Ministry of SMEs and Startups Publication No. 1420022242)

Kyung-hyang Newspaper (2022). Preempt the 100 trillion unmanned terminal market Growing kiosk market conglomerates 'mouth-watering'. Retrieved September 10, 2022, from https://www.khan.co.kr/economy/markettrend/article/202205221202001.

Kim S. W., CHOI D. J., Song Y. M., & Moon I. Y. (2022). Design and Implementation of Voice-based Interactive Service KIOSK. *Journal of Practical Engineering Education,14*(1), 99-108.

KOSIS (2021). Age and Gender Population:2015-2021. Retrieved Auguest 30, 2022, from https://kostat.go.kr/wnsearch/search.jsp

Lim B. W., Cho D. H., & Cho Y. J. (2008). Playful Kiosk Interface Design Using Tactile Interaction. *Journal of the Korean Contents Association, 8*(5), 155-164.

Lee H. S., & Kwon S. H. (2020) Problems and improvement of the welfare system for the elderly in a super-aged society. *The Journal of Labor Law, 50,* 1-29.

Reporter Kim H. J. (2020). Digital must be equal in front of all. from https://www.sciencetimes.co.kr/news

Sudiatmika, I., & Ariantini, M. S. (2021). Digital Marketing Chatbot Using API Dialog Flow Case Studi ITB Stikom Bali, Jimbaran Campus. https://www.researchgate.net/scientific-contributions/Made-Suci-Ariantini-2167036810

TechTarget (2005). kiosk. Retrieved Auguest 30, 2022, From https://www.techtarget.com/whatis/definition/kiosk

Yoo, S. C., Min, J., & Hwang, H. H. (2016). The state and trend of digital signage research in Korea. *The Journal of the Korea Contents Association, 16*(10), 745-757.

Yonhapnews (2021). The digital signage market grows… Growth 23% this year over Corona. Retrieved October 27, 2022, from https://www.yna.co.kr/view/AKR20210511013200003

2021 Digital Information Gap Survey Report (2022). Retrieved September 10, 2022, from https://www.msit.go.kr/bbs/view.do?sCode=user&bbsSeqNo=79&nttSeqNo=3173457