An experiment of Life-support network for elderly people living in a rural area

Jun Sasaki, Keizo Yamada, Michiru Tanaka and Yutaka Funyu

Abstract**—** *In order to provide comfortable and safety life for every people in the world, information technologies will be useful in a rural area as well as in a metropolitan area. This paper proposes a new concept of Life Support Network (LSN) for elderly people living in a rural area. The network is a type of Intranet, which incorporates a safety confirmation system, a remote healthcare system, an emergency information system and other useful daily network services in the closed life area. We developed a part of the experimental LSN system and carried out a field experiment in a typical rural town "Shiwa" in the Iwate Prefecture in Japan. The system has two sub-systems of the safety confirmation system and the remote healthcare system. We clarified that the experimental LSN gave the feeling of safety to the elderly people living in the rural area.*

Keywords**—**Information System, Healthcare System, Welfare System, Telemedicine

I. INTRODUCTION

INFORMATION technologies have been developed for mainly business use in a metropolitan area. As a result, the population in a metropolitan area has been increasing continuously. On the other hand, the decreasing of population in a rural area becomes a severe problem because the elderly people cannot live there with comfortable and safety feeling. The rate of elderly people who lives alone is 19.7 % of all over sixty-five years old people in Japan and the rate is still increasing [1].

Information technologies are required more in a rural area than in a metropolitan area. Our goal is to construct an ideal rural area where every people can live with high-quality of life and can feel safety, healthy and valuable time by using information technologies. We think there will be two approaches to realize the ideal rural area as follows.

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J. Sasaki is with Faculty of Software and Information Science of Iwate Prefectural University, Iwate, 020-0193 JAPAN (corresponding author to provide phone: +81-19-694-2568; fax: +81-19-694-2569; e-mail: jsasaki@iwate-pu.ac.jp).

K. Yamada is with Faculty of Software and Information Science of Iwate Prefectural University, Iwate, 020-0193 JAPAN (e-mail: k-yamada@iwate-pu.ac.jp).

M. Tanaka is with Faculty of Software and Information Science of Iwate Prefectural University, Iwate, 020-0193 JAPAN (e-mail: m-tanaka@iwate-pu.ac.jp).

Y. Funyu was with Faculty of Software and Information Science of Iwate Prefectural University, Iwate, 020-0193 JAPAN (e-mail: funyu@iwate-pu.ac.jp).

(1) Top-down approach: A governmental office decides to invest a large budged for attraction of enterprises or for housing land development to the rural area. As the industry and population would be increase, the ideal rural area will be achieved by the tax income increasing.
(2) Bottom-up approach: By citizen joining to social services such as medical service, welfare service and social security service, the governmental official cost for them would be decreased. The ideal rural area will be achieved by the social-service cost down.

We consider the (2) Bottom-up approach will be better than (1) Top-down approach, because the budged investment for the (1) top-down approach is difficult recently in our country.

The prerequisites for the ideal rural area by the Bottom-up approach can be listed as follows.

- Active persons who lead the construction of the ideal rural area exist,
- basic infrastructures such as a high-speed information network exist,
- communities to cooperate to social services exist.

This paper proposes a new concept of a Life Support Network (LSN) for elderly people living in a rural area. In the LSN described in section 3, the active persons, infrastructures and communities are system managers who contribute positively on the life-support services, Intranet and life supporters such as neighborhoods, families, doctors, home helpers etc., respectively.

We developed a part of the experimental LSN system and carried out a field experiment in a typical rural town "Shiwa" in the Iwate Prefecture in Japan. Our trial in Shiwa town will be successful because all prerequisites exist.

The trial system has two sub-systems of a safety confirmation system and a remote healthcare system. We clarified that the experimental LSN gave the feeling of safety to the elderly people in the rural area

II. CURENT LIFE-SUPPORT TECHNOLOGIES FOR ELDERLY PEOPLE

We can find some interesting life support systems for elderly people in Japan. For example, there is a living observation system by using kettle with telecommunication functions, which is named "i-pot" [2]. In the system, when the elderly client uses the electronically-equipped kettle that has telecommunication functions, the system sends a text message to a remote family member's cellular phone. If the elderly client seems to have not used the kettle for many hours, the contact

person is alerted and can call the elderly client to confirm his/her safety.

Many people dislike using such a kind of supervision system because of privacy concerns. In addition, there are occasional occurrences of false alarm messages being sent. Alternative safety systems with human behavior sensibility and high reliability are required in addition to sensor type systems [3].

In 2006, we reported on the development and operation of a "Mimamori" (meaning "watching over someone") network system for the elderly in the Village of Kawai in the Iwate Prefecture in Japan [4]. We developed the Mimamori network system during about one year and we have been carrying it out for over two years. The main feature of the system is conclusive safety monitoring of all users once per day. The other feature is an active self-transmission of information on elderly users' condition. About forty elderly persons are using the system. The users exhibited positive attitudes toward the system and voluntarily submitted their condition information. The final confirmation rate of their safetyfor everyday is still 100%. The rate includes confirmations by supporters when the elderly users forgot their transmissions.

In our development of the Mimamori system, an L-mode terminal from NTT was selected to be used. An L-mode terminal is a kind of a telephone with a touch panel display and the Internet connection function. When the elderly client touches the display, the terminal sends a message to the social welfare council and remote family members. Unfortunately, NTT has decided to stop producing the L-mode terminal in 2010.

We therefore proposed a new method to confirm elderly people's safety by using TV terminals instead of the L-mode terminals. The reason we chose TV terminals is that most elderly people in Japan watch TV routinely. According to a report by the NHK (Japan Broadcasting Corporation), elderly people, particularly those 70 years or older, watch TV for five hours or more a day on average. Namely, a general elderly person is watching TV everyday and spends their time for watching TV very much [5]. In our proposed system, elderly people can send a safety condition message through the TV, as was done with the L-mode terminals. This system is unique in that it has the function of enabling elderly people to actively send their own safety messages using the TV remote control device. Additionally, we added a remote healthcare function to the proposed system, because healthcare will be ever more important issues in the coming generation [6].

III. Proposal of Life-support Network

Fig.1 depicts the concept of the Life Support Network (LSN) we proposed.

Though the Internet is spreading to every part of the world, there are still problems with IT (Information Technology) literacy and security for the elderly. We propose a type of "Intranet" for a closed rural area to help support elderly life. We call this "Intranet" instead of Internet the Life Support Network (LSN). The LSN creates a constant connection between volunteers, home-visiting nurses, the regional hospital, drugstores and other life and health related organizations. The LSN is a high-security and high-speed network, which is like a Local Area Network (LAN) with an optical-fiber cable network. With current technology, it is possible to construct such a network within an appropriate budget [7].

Moreover, an elderly person can use the healthcare terminal in his/her home every day. Each person measures his/her vital data and confirms it through in a public facility such as a healthcare center connected with the LSN [8].

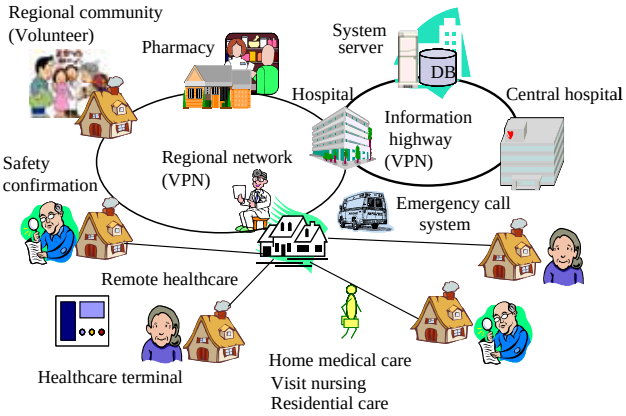


Fig.1 Life-support network

IV. Development of Experimental System

A. Background of the Development

As the concept of LSN is quite broad, we decided to focus on two specific important functions: the safety confirmation of elderly people living alone and remote healthcare. Then, we started a project to develop an experimental system as part of the LSN. We called the system "Yui Net," where "Yui" means "helpful relationship" in Japanese. The objective of the experiment was to evaluate the effect of the system on elderly people's life. "Yui Net" has two sub-systems: the safety confirmation system and the remote healthcare system. The development project consists of the NEC Group for the hardware development aspect, Iwate Prefectural University for software development, and the Town of Shiwa in Iwate Prefecture in Japan as the feasibility test field. We developed each system as an Web application on open source platform, which is available on the Virtual Private Network (VPN) in Shiwa town.

The Shiwa town and the Local Authorities Satellite Communications Organization (LASCOM) of the Japanese Support Organization supported our project by funding the development. We would like to thank Shiwa town and LASCOM for their contribution.

B. Safety Confirmation System

Fig. 2 shows the structure of the safety confirmation system. The television with STB (Set Top Box) and the Intranet environment are set up in the home of an elderly person who is living alone. The Web server with the developed support system is located at Iwate Prefectural University.

Fig. 3(a) shows the display on the TV monitor when first powered on in the morning. We can see display is divided into two sections. The left-hand section represents the current TV

program and the right-hand section represents the top page of the Web-based safety confirmation system. This page shows a brief message, below where there are four response buttons to select from.

(1): My condition is good.
(2): My condition is a little bad.
(3): I will be absent tomorrow.
(4): Please call me.

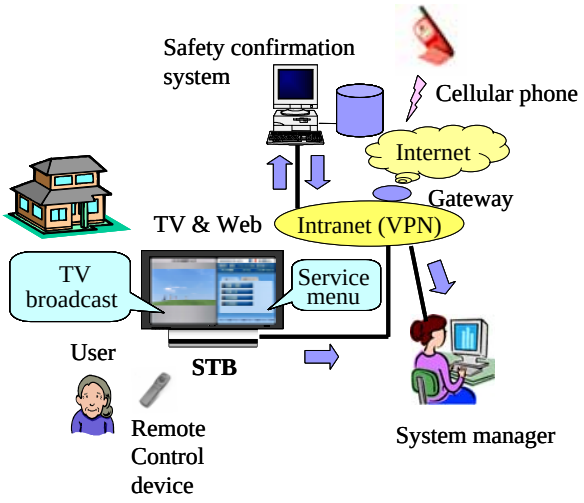
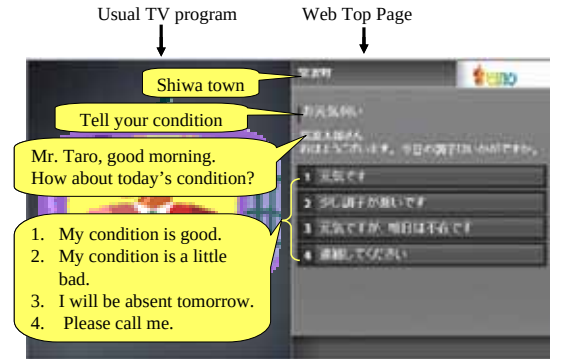


Fig.2 Safety confirmation system



(a) Selecting condition

(b) After selecting condition

Fig.3 Sample of the TV display

The user can easily select a button using the remote control device of the STB. After the user selects his/her current condition, the Web page displays a confirmation message as shown in Fig. 3(b). After the user presses the close button, the TV screen reverts to display the usual broadcast program. The information selected by the user is transmitted to the healthcare center or/and the remote family member as Intranet data for display on a PC and a text message for display on a cellular phone.

If the user does not use the system to report their condition in the morning, the contact life supporter (home helper, care provider, family member, neighbor, etc.) calls him/her to confirm the his/her condition.

C. Remote Healthcare System

Fig.4 shows the structure of the remote healthcare system that we developed.

A healthcare terminal called the "health checker" and a PC with ID card reader for the data sending and user authentication functions are installed in the user's home and public facilities such as the healthcare center, governmental office, or hot spring houses, etc. The user can measure his/her vital data such as blood pressure, heart rate, electrocardiogram, body fat ratio and internal organ fats every day.

The specific items measured may be determined according to user's health condition and interest. Infrared rays transmit the measured vital data stored in the health checker to the PC automatically. Then the PC transmits them to the server located at Iwate Prefectural University through the Intranet. Some commercialized remote healthcare services are offered by application service providers (ASPs). Actually, we adopted a Toshiba ASP service as well as our developed application for remote healthcare users in the experiment [9].

If a user measures his/her vital data at a facility, the system transmits the data to the same user file in the same database. All the data from the user can be input and accessed from anywhere.

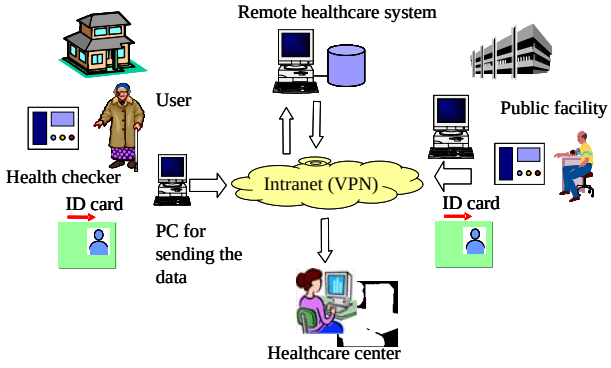


Fig.4 Remote healthcare system

A health service center can see their data by logging in to the system. Fig. 5 shows an example of the display the manager sees. Red colored cells in the table show that the vital data is outside of normal values. In the experiment, the health service

center used our originally developed system because Toshiba could not provide the management service yet.

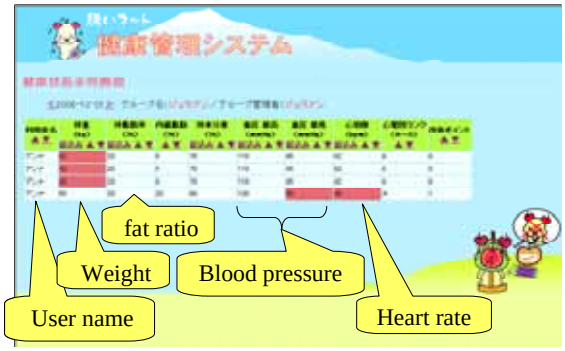


Fig.5 Example of display for health manager

V. Experimental Results

A. Experimental method

We carried out the experiment from December 18th in 2006 to February 9th in 2007. We selected and requested the participation of three persons (male aged 80, female aged 82 and female aged 76) (average age: 78.5 years) who are living alone in Shiwa to use the safety confirmation system. The users sent their condition information through the system every day by using the remote control device of the STB. We selected and requested the participation of three different persons (male aged 73, male aged 59 and male aged 82) (average age: 71.3 years) in Shiwa to use the remote healthcare system. We set up the remote healthcare system in each office of three public facilities located in Shiwa. There, any person who has an ID card can use the remote healthcare system from anywhere. Table 1 shows the categories and numbers system users in the experiment.

Following the experimental period for the systems, we visited Shiwa and obtained the users' opinions on the system by way of discussion and a survey questionnaire.

Table 1. System users in the experiment

Name of system	Category of users	Number of users
Safety confirmation system	Home user living alone	3
	Family user living apart from the home user	2
	System manager	6
Remote healthcare system	Home user	3
	User in three public facilities	36

B. Safety confirmation system

Regarding the operability when using the safety confirmation system, two home users answered "comprehensible" and one female home user answered "incomprehensible." Two users said the TV screen display is easy to understand and they hope to continue using it. The system managers responded that they were able to operate the system. Family users living apart from the home users felt a "feeling of safety" regarding the home users.

We confirmed that users could use the system with little difficulty and the life supporters and their families experienced a feeling of safety by checking the information sent from the user every day by a text message on a cellar phone and web page input data.

Other opinions on the safety confirmation system were as follows:

- The response of the STB is a little slow.
- A period of adjustment to the operation is necessary in order to use it easily.
- An emergency call function is very important and necessary.

Responsible organization and optimal management in the case of a lack of safety information are issues which remain to be resolved.

C. Remote healthcare system

Sixty percent of all users said the remote healthcare system was "comprehensible" and easy to use, including the health checker and PC for measuring and data sending, respectively.

We confirmed that the users could operate the system comparatively easily and they could take interest in their own health condition by using the remote healthcare system.

Other opinions on the remote healthcare system were as follows:

- The accuracy of the health checker is a little doubtful.
- Time is necessary to learn the measurement method of the health checker.
- The electrocardiogram was not transmitting easily.
- After the password is input, the screen display is slow to advance.

Though, any health manager was not joined to the experiment because the role and the responsibility of the health manager were unclear. It is remained as the future work.

VI. Conclusion

This paper discusses the strategy for the ideal rural area toward solving the high-aged society problem. Then, we propose a new concept of a Life Support Network (LSN) for elderly people living in a rural area. We developed two experimental sub-systems as parts of the LSN and carried out a field experiment in a typical rural area, Shiwa in Iwate Prefecture in Japan. We clarified that the experimental system, called "Yui Net," obtained a satisfactory evaluation by the users and good feasibility with expected effects in the field.

In order to promote "Yui Net," we propose to construct a responsible organization and optimal management in the case of a lack of safety information. How to effectively use the vital data obtained from the users in the town also remains an issue to be resolved.

"Yui Net" is the first step in constructing the LSN concept. We are going to construct a human operational system and develop other life support systems such as emergency call system and regional community system by participation of citizens toward the ideal rural area.

REFERENCES

[1] Cabinet Office, Government of Japan, "The 6th life and international comparison investigation result summary concerning consideration of senior citizen", http://www8.cao.go.jp/kourei/ishiki/h17_kiso/index.html (2005).
[2] Zojirushi Corporation, "Mimamori Hotline", http://www.mimamori.net (2005).
[3] Shinagawa, Y., Kishimoto, T., Ohta, S., "Development of an automatic alarm system for elderly living alone", *Japan Journal of Medical Informatics*, Vol. 26, No. 1, pp.1-12(2006).
[4] Yoneda, T., Ogawa, A., Sasaki, J., Funyu, Y., "Development and operation of mimamori network system for elders in Kawai Village, Iwate Prefecture", *Personal computer users' application technology association*, Vol. 16, No. 3, pp:31-38(2006).
[5] NHK Bunkin, "Investigation at national life time of residents", *NHK broadcasting culture research institute*, http://www.nhk.or.jp/bunken/research/life/life_20060210.pdf (2006).
[6] NTT Communications, "Senior citizen in the world", http://www.koreisha.com/tokei.html(2001).
[7] Komine, Y., Nakazono, M., Ikaruga, S., Iwamoto, S., Sato, T., "Residential network in rural area neighboring city", *Journal of City Planning Review*, Vol.; No. 230, pp: 77-82(2001).
[8] Sasaki, J., Wano, K., Yoneda, T.,Kamata, H., Mizunuma, Y., Funyu, Y., "A medical consultation support system to reduce time and costs for life-style related disease", *Japan Journal of Medical Informatics*, Vol. 26, No. 1, pp.13-22(2006).
[9] Toshiba, "Health support service (in Japanese)", http://t-hcs.jp/aag/t-hcs/ (2007).

Jun Sasaki received the B.S. and M.S. degree from Iwate University, Iwate, Japan in 1979 and 1981, respectively. And he received the Ph.D. degree from Tohoku University, Miyagi, Japan in 1993.

After he was working in NTT laboratories from 1981 to 1998, he moved to Iwate Prefectural University in1998. His current research interest is construction method of medical and social information systems in a rural area.

He is an associate professor in Faculty of Software and Information Science of Iwate Prefectural University.

Keizo Yamada received the B.S., M.S. and Ph.D. degree from Kyushu Institute of Technology, Iizuka-shi, Japan in 1995, 1997 and 2000, respectively.

After he was working in Kyushu Institute of Technology from 2000 to 2006, he moved to Iwate Prefectural University in 2006. His current research interest is software development methodology.

He is an assistant professor in Faculty of Software and Information Science of Iwate Prefecture.

Michiru Tanaka received the B.S. and M.S. degree from Soka University, Tokyo, Japan in 1997 and 1999, respectively.

His current research interests are information security system by using mobile phone.

He is a guest teacher in Faculty of Software and Information Science of Iwate Prefectural University.

Yutaka Funyu received the B.S. from Tohoku University, Miyagi, Japan in 1962.

After he was working in companies of Kawasaki Steel, CSK and Yokogawa , he moved to Iwate Prefectural University in1998. He was a professor from 1998 to 2008 and a vice president from 2006 to 2008 of Iwate Prefectural University. His current research interest is modeling method of information systems.

He is a guest professor of Advanced Research Institute on Software Strategies in Iwate Prefectural University.