Journal of Theoretical and Applied Information Technology
20th February 2016. Vol.84. No.2

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

DEVELOPMENT OF DATA COMMUNICATION SYSTEM FOR VIRTUAL HOSPITAL SCHEME BETWEEN PUBLIC HEALTH CENTERS AT REMOTE AREAS AND REGENCY PUBLIC HOSPITAL BASED ON RADIO FREQUENCY COMMUNICATION

[1]S. HAWIBOWO, [2]SUNARNO, [3]M. M. WARUWU, [4]R. WIJAYA

[1,2]Department of Engineering Physics, Faculty of Engineering, Universitas Gadjah Mada, INDONESIA

[3,4]Production House Unit, Faculty of Medicine, Universitas Gadjah Mada, INDONESIA

E-mail: [1]singgih@ugm.ac.id, [2]sunarno@ugm.ac.id, [3]morymw@gmail.com, [4]rwijaya80@gmail.com

ABSTRACT

The existence of inpatient public health centers in remote areas needs to be supported with a data communication telemedicine system. The system includes remote station at each public health center which consists of telemedicine sensors such as the blood pressure monitor, the body temperature sensor, the electrocardiograph, the psych meter, and the heart rate monitor. The sensor circuits are connected to a modulator frequency shift keying (FSK) transceiver (Tx/Rx), and an antenna. The data is sent wirelessly to the base station. The base station device which is a computer-based control center was placed in a regency public hospital. The base station consists of an antenna, Tx/Rx, FSK demodulator, a PC (personal computer) with software. The results of the communication system test at Gunungkidul regency indicate that the accuracy level of the real time data measurement transmission has an average of 95 % at a distance of 0-40 km. The average of the successful data text transmission reached 97.6%. For the image data transmission, the received image quality decreased to 93.9% at a distance of 5 km and 55.3 % at a distance of 40 km. Variations of this quality degradation caused by distortion and interference of the frequency. The successful rate of the data transmission was sufficient for the purposes of early diagnosis, except for image data transmission remains to be improved.

Keywords: *public health centers, radio frequency, data communications, virtual hospital*

1. INTRODUCTION

The inpatient public health centers require high availability of the power supply system and the data communication systems. This need increases for remote areas and disaster prone areas. A virtual hospital system based on radio frequency communication is very beneficial to public health centers located in isolated areas, due to the limited cell phone signals. Such locations can be found for example in Gunungkidul regency at Yogyakarta province, so it can be used to represent the situation of remote areas.

Availability of access to health services in the Gunungkidul regency can be characterized by the ratio of the number of public health center per total population of approximately 1 (one) public health center to serve about 24 thousand people. Inpatient care facilities are required to support the improvement of health services in the district. The inpatient public health centers require the support of sufficient data communication system.

With an increase in population, providing basic health care to the people, especially in rural areas is the main objective of health administrators. A virtual hospital system is the possible way to solve this problem with the support of new advanced technologies. This paper discusses the state of the art and the major issues in virtual hospital systems such as secure transmission of data and design of patient monitoring. This paper will conclude by discussing future challenges of the domain.

2. LITERATURE

2.1 Medical Applications

Wireless communications technologies are used to support a variety of electronic health applications to transfer medical data and patient information. [1] Medical or health care applications

Journal of Theoretical and Applied Information Technology
20th February 2016. Vol.84. No.2

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

provide patient monitoring, diagnostic, therapy and imaging functions. [2] The advent of wireless technologies in medical environment significantly enhances the aforementioned objectives of medical applications and offers several advantages. Firstly, it provides remote monitoring and physical rehabilitation applications that help to ease the operations of medical staff. Secondly, it improves patient's mobility, which speeds up the recovery process after surgical procedures. Thirdly, it reduces medical expenses due to earlier discharge from hospital. [3]

2.2 Radio Communication System

Radio communication system emits an electrical signal in the form of information that serves the conversation, music, images, scientific data, and others. This signal waveform is complex and always changing, but the frequency spectrum of the signal is usually limited to a certain wide field. Radio frequency waves have a specific frequency and wavelength. An antenna of radio frequency has the same physical size to a half the wavelength or more for a reasonable efficiency. [4]

2.3 Virtual Hospital

Virtual hospital is an integrated development of various medical devices technologies and databases of various diseases and methods of treatment in a communication network.

The basic concept of virtual hospital is a medical device in the desired area in a data communication network. All medical devices will be equipped with the integrated doctor network communications and will act as decision makers on the condition of patients who have been diagnosed with a telemedicine device. The block diagram of Virtual Hospital Scheme was shown in Figure 1 and Figure 2. [5]

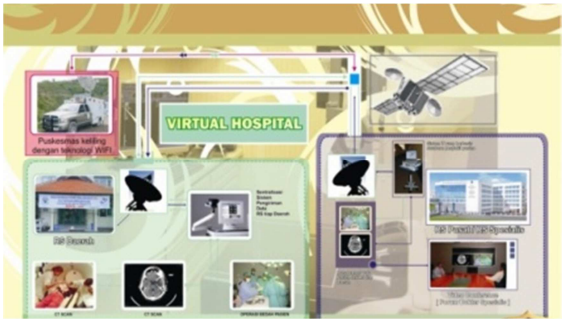

Figure 1 Virtual Hospital Scheme [5]

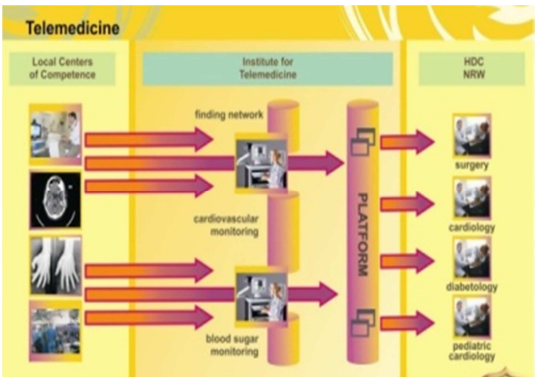

Figure 2 Telemedicine Virtual Hospital Scheme [5]

3. METHODOLOGY

3.1 The Remote Station

The remote station were placed at each public health center consisting of telemedicine sensors such as the blood pressure monitor, the body temperature sensor, the electrocardiograph, the psych meter, and the heart rate monitor. The sensor circuit was connected to the modulator frequency shift keying (FSK) transceiver (Tx/Rx), and an antenna. The block diagram of the remote station was shown in Figure 3. [6]

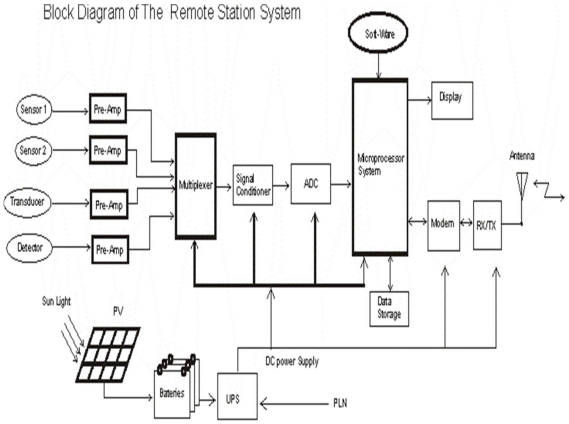

Figure 3 Block Diagram of Remote Station [6]

3.2 The Base Station

The base station device which is a computer-based control center was placed in a regency public hospital. The base station consists of an antenna, Tx/Rx, FSK demodulator, a PC (personal computer) with software. The block diagram of the base station was shown in Figure 4. [6]

Journal of Theoretical and Applied Information Technology
20th February 2016. Vol.84. No.2

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

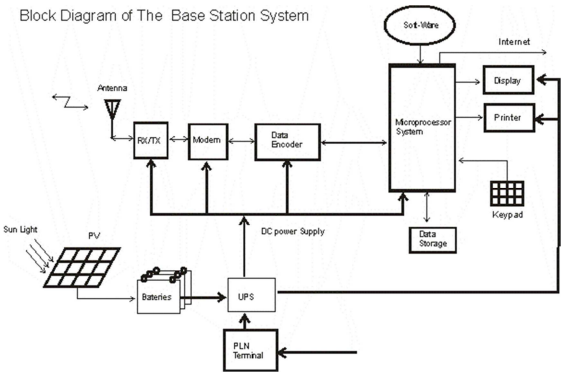

Figure 4 Block Diagram of Base Station [6]

3.3 Text and Image Data Transmission

Text and image data transmission from the remote station to the base station was described as shown in Figure 5.

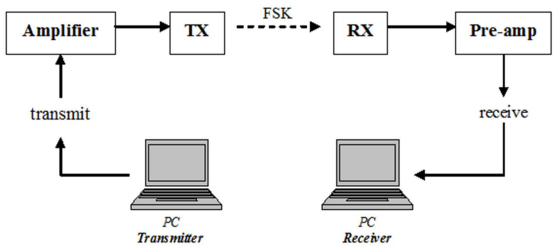

Figure 5 Text and Image Data Transmission

3.4 Testing and Evaluation

The stages of development are:

1) Create and instrumentation system compiled on the basis of the developed model.
2) Creating a program for the purposes of control and collection of data as well as developing a data management system.
3) Test in simulation stages to obtain the level of accuracy and speed of data access from multiple remote data sources.
4) Revise the model developed on the basis of the data obtained and re- testing the system to obtain the results as expected.
5) Reporting the results of the research is a model of the proposed system, the level of accuracy of the data and information obtained during research for development purposes.

4. RESULT AND DISCUSSION

4.1 Data Communication System Test

The characteristics of data communication system are asynchronous serial data transmission, using a transceiver device simplex transmission direction in the frequency 144.148 MHz (Amateur radio frequency band). The communication system test results indicate the accuracy level of the real time data measurement transmission reached an average of 95 % at a distance of 0-40 km.

4.2 Text data transmission

Text data transmission was done by software MixW with RTTY (radio teletype) transmission mode.

Table 1 The Successful Transmission Percentage of The Text Data at Various Distances Communication

distance (km)	Percentage of acceptance of the text data (%)	Error (%)
1	100	0
5	100	0
10	100	0
15	97	3
20	98	2
25	96	4
30	98	2
35	94	6
40	95	5
average	97.6	2,4

The average of the successful data text transmission reached 97.6%. The successful rate of the data transmission was sufficient for the purposes of early diagnosis.

4.3 Image data transmission

Image data transmission was done by software MixW with Slow-scan television (SSTV) mode. The results of image data transmission was shown in Figure 6.

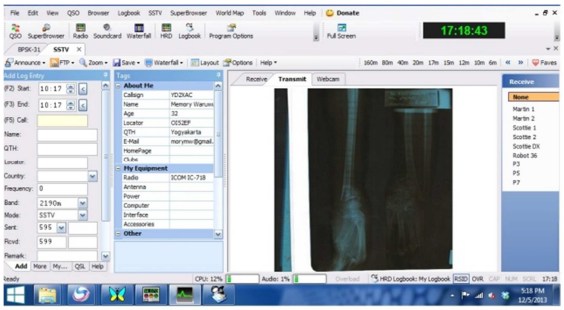

Figure 6 The Image Data Transmission with SSTV Mode

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Table 2 Image Quality Evaluation Data Delivery on A Wide Range of Communication Distance

Test Quality Factor	Image quality score (%)				
	5 km	10 km	20 km	30 km	40 km
horizontal linearity	90.5	80.3	78.1	75.2	57.6
vertical linearity	95.1	80.3	78.0	72.0	58.3
Ratio	99.6	94.0	84.7	80.4	75.0
Contrast ranges	90.2	75.4	60.2	40.5	30.4
Average	93.9	82.5	75.3	67.0	55.3

For the image data transmission received, was found the decreased of the image quality was 93.9% at a distance of 5 km and 55.3 % at a distance of 40 km. Variations of this quality degradation caused by distortion and interference of the frequency. The successful rate of the data transmission was sufficient for the purposes of early diagnosis, except for image data transmission remains to be improved.

5. CONCLUSION

The existence of inpatient public health centers in remote areas needs to be supported with the medical data communications system. They need data communication system for virtual hospital scheme between public health centers at remote areas and regency public hospital based on radio frequency communication.

The system that was needed are the remote station at each public health center consisting of tele-medical sensors such as the blood pressure monitor, the body temperature sensor, the electrocardiograph, the psych meter, and the heart rate monitor. The sensor circuit was connected to the modulator frequency shift keying (FSK) transceiver (Tx/Rx), and an antenna. Then, the data was sent wirelessly to the base station. The base station device which is a computer-based control center was placed in a regency public hospital. The base station consists of an antenna, Tx/Rx, FSK demodulator, a PC (personal computer) with software.

The communication system test results indicate that the accuracy level of the real time data measurement transmission reached an average of 95 % at a distance of 0-40 km. The average of the successful data text transmission reached 97.6%. For the image data transmission, the received image quality decreased to 93.9% at a distance of 5 km and 55.3 % at a distance of 40 km. Variations of this quality degradation caused by distortion and interference of the frequency. The successful rate of the data transmission was sufficient for the purposes of early diagnosis, except for image data transmission remains to be improved.

REFRENCES:

[1] Phunchongharn, Phond, et al. "A cognitive radio system for e-health applications in a hospital environment." Wireless Communications, IEEE 17.1 (2010): 20-28.

[2] Constantinescu, L., Kim, J., Feng, D. D. SparkMed: A Framework for Dynamic Integration of Multimedia Medical Data into Distributed mHealth Systems. IEEE T. Info. Tech. in Bio-Med., 2012, 16(1), 40-52.

[3] Chavez-Santiago, R., and Balasingham, I. Cognitive Radio for Medical Wireless Body Area Networks. IEEE 16th Intl. Wksp. Comp. Aided Modeling and Design (CAMAD), 2011, 148–152, Japan.

[4] ARRL the national association for amateur Radio. The ARRL Handbook for Radio Communications 2011. Newington, CT 06111 USA. 2011.

[5] Sunarno, *Teknologi Instrumentasi Berbasis Penyelesaian Masalah*, naskah pidato pengukuhan sebagai Guru Besar Universitas Gadjah Mada bidang Instrumentasi dan Telekontrol, 2009, UGM, Yogyakarta.

[6] Sunarno, Memory Waruwu, Rony Wijaya, Remote Early Monitoring and Information System for Hazard and Disaster of Mount Merapi in Indonesia, Annual Conference on Civil Engineering and Engineering (ACCEE), 2014, ISBN 978-986-89536-1-1.