MEDINFO 2007
HISA Ltd Australia
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Evaluation of Wireless Teleradiology System for Emergency Care with Mobile Network

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Abstract and objective

The wireless mobile service with a high bit rate using CDMA-1X EVDO is now widely used in Korea. Mobile devices are also increasingly being used as the conventional communication mechanism. In this study, we have developed JPEG 2000 compression module. We have also developed a web-based mobile system that communicates patient images using CDMA-1X EVDO for emergency care. A wireless mobile emergency patient imaging communication system is developed by using Microsoft Visual Studio.NET, and JPEG 2000 ActiveX control for PDA phone was developed by using the Microsoft Embedded Visual C++. Also, the CDMA-1X EVDO is used for connections between mobile web server and the PDA phone, and between ambulance car and hospital. In particular, images were compressed into a JPEG2000 format and transmitted from the hospital to the radiologist using a PDA phone located outside of the hospital. We successfully demonstrated this system for moving using an RW-6100 PDA phone used in the Yonsei university medical center in Korea.

Keywords :

PDA phone, JPEG2000, CDMA-1x EVDO, emergency care

Methods

A system development environment

The develop environment for mobile imaging communication system was composed a mobile web application system by using a Microsoft Window 2003 server, and internet information service and it is developed by using the Microsoft Visual Studio.NET, and the JPEG 2000 ActiveX control for a PDA phone was developed by using Microsoft Embedded Visual C++. In this study, we used a CDMA-1X EVDO service provided by the KTF communication firm in Korea. The CDMA-1X EVDO transmits data by using a maximum forward bandwidth of 2.46 Mbps and this is used for connection between a mobile web server and a PDA phone.

Composition of the whole system

Considering three spaces of the ambulance car, the hospital to where the emergency patient will be evacuated, and outside, we composed the whole system layout. Emergency patient images which are acquired using the portable imaging acquisition modality are sent in advance to the hospital where the emergency patient will be taken so the emergency doctor in the hospital can quickly receive and confirm transmitted information. CDMA-1X EVDO is also used for mobile communication. Also, it will be possible to refer to received information in the hospital where the emergency patient is taken, using a PDA phone anytime, anywhere.

System evaluation properties

In this study, we evaluated two items using wireless mobile imaging communication system. First, when we refer to JPEG 2000 images using a PDA phone, display time is measured. Second, PSNR values are measured by peak signal-to-noise ratio (PSNR) measurement function in order to compare image quality between the original image and the JPEG 2000 compressed image. In order to evaluate two items, various brain CT images (530KB, 512x512, 16bit) are used. And, PSNR values are measured in proportion to the increase of the JPEG 2000 compression ratio.

Results

The compression of 10:1 is a clinically reasonable maximum compression ratio for emergency care according PSNR measurement in this study. Also, JPEG2000 images of 10:1 compression ratio are transmitted approximately 0.08s from hospital to PDA Phone for moving using CDMA-1X EVDO.

Ratio	File Size	Theoretical Trans. Time (s)	Actual Trans. Time (s)
Original	543kB	1.78s (at 2.4Mbps)	5.43±1.22s
5:1	36.4kB	0.11s (at 2.4Mbps)	1.93±0.22s
10:1	24.1kB	0.08s (at 2.4Mbps)	0.65±0.07s
30:1	12.9kB	0.04s (at 2.4Mbps)	0.44±0.03s
40:1	9.87kB	0.03s (at 2.4Mbps)	0.22±0.02s
50:1	7.59kB	0.02s (at 2.4Mbps)	0.19±0.02s
100:1	4.45kB	0.01s (at 2.4Mbps)	0.14±0.02s

Table 1 - The result of average transmission time of various compression ratios from hospital to portable mobile device – brain CT image (attempt number = 30)

Conclusion

The results of this study are expected to play an interface role between the mobile emergency medical system and ubiquitous healthcare.

Reference

[1] Chan KK, Ricky KT System integration for PACS. Comp Med Imaging Graph 1991; 15: 177-181

[2] Choi BY, Lee HJ, Yoo DJ, Huh W A study on implementation of telemedicine system, Proc KOMBE 1992; 14: 105-108

[3] David DS, John VC Remote diagnosis raises efficiency of radiology, Diagnostic Imaging 1993; 91: 91-179

[4] Fuhrman CR, Slasky BS, Gur D, Lattner S, Herron JM, Dlunkett MB, et al. Intrahospital teleradiology from emergency room, Proc SPIE 1993; 1899: 395-399

[5] Gerneth M, Bartsch SR Tools for cost-effectiveness analysis in teleradiology, Proc SPIE 1993; 1899: 400-407

[6] Peter M., Marco E., Eric M., Introduction to the DICOM standard, Eur Radiol 2002; 12:920-927

[7] Heiss D., Konig A., Endres S., Pfluger T., Pfeifer K.J., Hahn K. A combined PACS and Internet information system in a university medical center. Forschr Rontgenstr 2000;172:542-552

[8] Eichelberg M, Riesmeier J, Demarmels M, Kleber K, Holstein J, Przybyolwicz J, Ossterwijk H, Demonstration of the DICOM softcopy presentation state, Eur Radiol 1999;9:S562

[9] Eichelberg M. Einfuhrung in das Konzept des DICOM Standard. In:Klose KJ., Mildenerger P (eds) 2. DICOM Treffen Mainz. @GIT, Mainz, 1998

[10] Bradley J. Erickson. Irreversible Compression of Medical Images, A White Paper From SCAR 2000; 1-9

[11] Martin Boliek, Charilaos Christopoulos, Eric Majani JPEG2000 Part I Final Draft International Starndard (ISO/IEC FDIS15444-1), ISO/IEC JTC1/SC29/WG1 N1890R 2000

[12] Chilaos Christopoulos, Athanassios Skodras, Touradj Ebrahimi The JPEG2000 still image coding system : An Overview, IEEE Trans. Consumer Electronics 2000; Vol.46: 1103-1127