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Study of the Platform of a Medical Information System to Promote Telemedicine Services

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Abstract

Promotion of telemedicine services is an important political issue in Japan. The most important factor in determining the quality of telemedicine services is communication infra-structure. With the spread of the IP network, broadband prices have fallen and take-up has increased, but the study of the platform of medical information systems has not yet been fully developed.

This paper first proposes two requirements for the telemedicine information system: 1) to provide the best-quality transmission service with limited communication bandwidth, and 2) to widely share medical information in an integrated and secure manner. Next, it outlines the two themes of our study to achieve these requirements: 1) an on-demand medical information network system, and 2) a highly efficient Region of Interest (ROI) image coding.

The results of the study will contribute to the promotion of telemedicine services on the IP network.

Keywords:

medical information system; telemedicine; region of interest; on-demand network; IP network

Introduction

Asahikawa Medical College Hospital in Hokkaido, to which my group belongs, started a telemedicine service for ophthalmology clinics in 1994, and is now providing approximately 150 diagnostic telemedicine services per year for 22 eye clinics in Hokkaido [1][2]. Currently, this service is also provided to radiology, pathology, surgery and internal medicine departments on a daily basis.

The system of telemedicine services uses transmitters, receivers and communication lines that link between them. The most important factor that decides the quality of the service is communication lines, which are actually less established in the areas that need more remote medical services. Although this constraint is being eased thanks to the recent spread of the broadband network, the establishment of an effective communication infrastructure has not yet been achieved in mountainous areas and remote islands.

Against this backdrop, our group has been involved in various studies and developments relating to a system to improve the quality of telemedicine services. This paper outlines our study according to its main themes.

Purposes

Our study aims to develop a system that meets the two major requirements essential for an effective telemedicine information service. These requirements are: 1) to provide best-quality transmission under limited bandwidth conditions, and 2) to widely share medical information in an integrated and secure manner.

Methods

To achieve the above purposes, especially requirement of 1), the study has been conducted under the following two themes. Meanwhile, regarding of the 2), we have studied and developed the P2P medical information sharing system [3].

(1) Prioritization of medical information transmitted on the IP network

The IP network is generally based on the best-effort service, and communication bandwidth and destination are determined by the contract conditions with communication carriers on the leased line service. However, telemedicine services require a certain level of communication quality in order to operate efficiently, enabling it to prioritize medical information in an emergency. To meet these needs, we have studied and developed an on-demand medical information network system, which controls traffic by prioritizing user requests on the MPLS network.

(2) High-quality transmission of video information according to communication bandwidth

Video information plays a significantly important role in telemedicine services. However, because of its extremely large volume compared with numeric and character information and its need to be transmitted in real time, its quality can be affected by network conditions. Therefore, we have studied and developed highly efficient image coding using Region of Interest (ROI) technology so that efficient transmission can be realized according to network conditions and communication purposes.

Results

Following are the outline and results of our study on each theme.

(1) On-demand Medical Information Network System

To control the network bandwidth, it is necessary to synchronize the data transmission on users' access lines with the transmission on the core network, which links the MPLS routers. The local administrator (LA) manages users' applications and access lines, which exist between users and the core network, as a local resource. The application gateway (APGW) controls the requests from each LA, and forwards the requests to the MPLS router via the router controller (RC) to secure the resource of the core network.

In response to user requests, the LA and APGW decide the application to be prioritized and pass the result to the network control. At that time, they consider a priority policy prepared for each application and the priority level specified by users, using the analytic hierarchy process (AHP) method, to comprehensively decide the order of priority. The user specifies the priority level by stipulating the level of the emergency (urgent or normal) together with the necessity level (5 to 1), based on medical guidelines. The network is controlled so that highly prioritized applications can preferentially secure the bandwidth, and routes are arranged appropriately.

(2) Highly efficient ROI Image Coding

With limited communication bandwidth, we figured out a method of image transmission that, as much as possible, maintains the quality required from the receiver. This method, called ROI image coding, compresses the ROI specified by a rectangle on the image into high-quality data and the outside (non-ROI) into lower-quality data. As giving prominence to characteristics, the quality levels of the ROI and non-ROI are automatically decided depending on the network bandwidth.

Discussion

When the communication bandwidth is broad enough to send and receive data, the receiver has no problem in retrieving information to provide medical support for its patient. However, it is rare to have such a communication environment. In reality, telemedicine services are requested from an area that does not have sufficient communication bandwidth. For such areas, the method of highly efficient ROI image coding is useful to ensure the transmission of the minimum required medical information on the best-effort type IP network.

Telemedicine services are particularly useful in case of emergencies such as disasters and accidents, but the requested information should be preferentially transmitted on the network. This would be similar to how ordinary cars move aside to offer an open road for approaching emergency vehicles. The study of the on-demand medical information network system enables the flexible control of communication quality according to applications and user requests, and secures smooth data transmission even on a congested communication network.

Conclusion

This paper has described our study themes, the on-demand medical information network system, the highly efficient ROI image coding system as the basic study of a telemedicine information system. We believe this study will ensure the quality improvement of telemedicine services on the IP network.

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References

[1] Yoshida A, Kamehata Y. *Telemedicine.* 1st ed. Tokyo: Kogyo Chosakai Publishing, 2000.

[2] Yoshida A. Teleophthalmology in Japan. *Teleophthalmology.* Kanagasingam Yogesan, Sajeesh Kumar, Leonard Goldschmidt, Jorge Cuadros, eds. Berlin Heidelberg: Springer-Verlag, 2006; 179-185.

[3] Mitamura Y, Yamamoto A, Hayashi H, Namioka T, Tsuduki Y, Shimono T, Hirokawa H, Yamakami H, Yoshida A. A peer-to-peer-based medical information sharing system. CCECE / CCGEI, Saskatoon, Proceeding, 364-367, May 2005.

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