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Saving the Cost and Energy by an Interactive Multimedia System with ISDN 128 Kbps for Telemedicine

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The telemedicine systems offer many potential advantages for health care delivery. In 1997, we implemented Phoenix, the interactive multimedia system of the Nippon Telegraph and Telephone Corporation (NTT) for clinical application involving teleconsultations over a wide area for delivery of special care in emergency medicine at Tokai University linking with eight hospitals via the Integrated Service Digital Network (ISDN) 128 Kbps. This study was designed to determine the potential saving of the cost and energy through the interactive multimedia network. By using the interactive multimedia system with some modifications, we achieved a satisfactory real-time contact regarding clinical matters. We believe that this network has allowed appropriate transfer of information between medical centers. This system has also significantly reduced the estimated cost for clinical meetings.

Key words : Telemedicine, ISDN, Whiteboard, Store-and-forward data transfer

1. INTRODUCTION

The Integrated Service Digital Network (ISDN) has already been widely available in developed countries around the world. An interactive-type multimedia system using an ISDN 128 Kbps link is on the market and is in use in many sectors. Nippon Telegraph and Telephone Corporation (NTT) offers a video-conferencing system known as Phoenix, which can readily provide video-telephone functions through the addition of boards designed for video-conferencing to the personal computers. We have been using this system to transfer medical information and hold video-conference with eight allied hospitals, as well as for other purposes. However, this equipment was originally developed for general consumer applications and, therefore, still leaves a room for improvement of the picture quality when it is utilized to transfer medical images.

In the following sections, we will discuss the modifications we have made to Phoenix for the purpose of using Phoenix to transfer high-definition dynamic and static images. We will also evaluate its actual operation and consider related issues.

2. SYSTEM

Several additions were made to personal computers in order to apply the commercial interactive multimedia system, Phoenix, to clinical medicine. Phoenix has the advantage of an interactive multimedia system with ISDN 128 Kbps.

1) Basic Tools:
*Personal computer:
Disk Operating System/Version (DOS/V) machine with Windows95 capability. NEC 9800 series is also acceptable.
*Multimedia system board: Phoenix Kits
Specifications of Phoenix Kits
Communication H.320
Data Speed 2B (64+64 Kbps)
Video: 64 Kbps, Voice: 32 Kbps, Data: 32 Kbps
Motion Picture Compression H.261
Full Common Intermediate Format (FCIF): 352 288 pixcels/15 frames
Quarter Common Intermediate Format (QCIF): 176 144 pixcels/30 frames
Structure of Frame: H.221

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Voice Compression: G.711, G.722, G.728, PT.724

*Supplementary Devices and Equipments:
National Television System Committee (NTSC) motion picture input: Moving Picture Coding Experts Group (MPEG-1) video capture board (Melco MEG-VC1)
NTSC frozen picture input: NTSC video digitizer (V-PORT/Max.1500 1152 pixcels)

*Analog X-ray input:
Digital camera
(Olympus, 1,400,000 pixcels)

*Internet I/O:
Surfing Board 128 Kbps (for store-and-forward transfer) or Transmission Control Protocol/Internet Protocol (TCP/IP) board is connected for Local Area Network (LAN).

3. METHOD OF OPERATION

Medical motion pictures obtained using an NTSC camera and compressed with an MPEG-1 board (video endoscopic images and echocardiographic images), X-ray images of the chest and abdomen recorded by 1,400,000 pixcel digital camera, ultrasonic images of the abdomen, and images of a patient's affected area obtained using an NTSC camera were compressed by JPEG at a compression ratio approximately 1:8 to 1:10 and then transmitted in the store-and-forward transfer mode, with associated medical analysis data. Phoenix makes it possible to hold two-way conferences on medical topics while simultaneously opening static image files and displaying medical data in real time on Whiteboard, thereby allowing all individuals attending the conference to share the same data. For example, the conference attendants can draw annotations directly on the same X-ray images displayed on the Whiteboard. MPEG-1 motion picture are mutually regenerated on both sides during the conference. However, since motion pictures cannot be opened on the Whiteboard, each terminal must open the file in an asynchronous fashion. During the regeneration of both frozen and MPEG-1 motion pictures, the sound and H.261 dynamic images can be accessed bidirectionally.

4. EVALUATION AND CONSIDERATIONS

4-1 Evaluation of the Whiteboard

The Whiteboard function enable the same data to be shared among the conference attendants in real time, as if everyone were in the same room. It allows multiple participants to share complex graphic information and on-line medical resources, such as X-ray, CTscan, MRI, and microscopic images. We operated more than 120 emergency cases during 1997 using the Whiteboard.

4-2 Evaluation of the Quality of the Images Taken with Supplemental Devices

1) NTSC input: In multiple frames, static images up to 1500×1152 pixcels can be recorded, althought 640×400 pixcels are easier to handle in practice. The image quality stored by 640×400 pixcels, such as ultrasonic images and video endoscopic images, is sufficient for practical use. [1, 2, 3]

2) Digital camera (1,400,000 pixcels): The images of the chest X-ray are provided as a reference material but can be fully used during the conference since the attendants can illustrate points on the images by drawing on the Whiteboard. We are planning to use a Laser scanner in the near future for the improvement of the image quality.

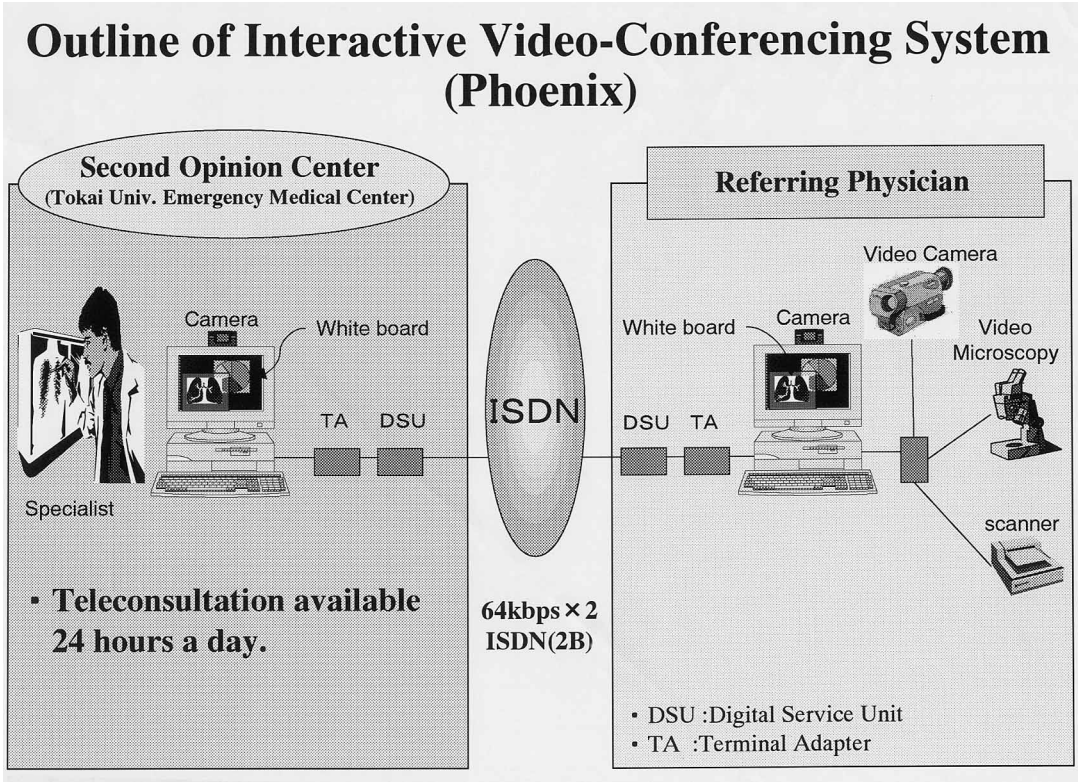
3) Motion pictures: During the video conference, the MPEG-1 file can be opened. As to picture quality, the system enables images of CIF (Y360, Cr180 or Cb180) and 29.7 frames/sec. to be regenerated in excellent conditions. Therefore, video endoscopic images can be saved as a reference material for clinical application. [4, 5]

4-3 Economic Considerations

Phoenix was originally developed as a general consumer product, and is available at $1600. The communication costs (20 ¢/5min., local call areas, $28/1hr. at 1000 Km distance) are reasonable, as the analog telephone line can be utilized. For these reasons, this multimedia system should come to a widespread use in many medical institutions in the future. [6, 7]

4-4 Energy Consumption

In case of one hour consultation performed by Phoenix between Fukuoka city and our institution at a distance of 1000 km, energy consumption was measured only at 0.3 kWh. If a medical doctor weighting 80 kg makes a two-way trip to Fukuoka city for consultation, the energy consumed would measure 420 kWh. This value equals 0.03 %



of the annual energy consumption of one average Japanese person.

Through analysis of these data, this multimedia network can be considered to be very useful for delivery of information to patients at appropriate medical institutions and could significantly decrease medical expenses and energy consumption.

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