Poster III-25

Application of Digital Video Technology to Telehealth and Medical Monitoring

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In recent years, improved medical technology and constant demands for lower medical costs have resulted in several clear trends: 1) increasing numbers of complex surgical procedures, which were traditionally performed at major medical centers, are performed at non-metropolitan hospitals; 2) health monitoring is more frequently conducted at the residences of patients, rehabilitation facilities, and nursing homes through digital recording devices and network connections; and 3) local treatment of complex medical cases assisted by remote diagnosis and expert consulting in multimedia forms has been utilized as an alternative to transporting patients. Currently, it is not overly complex to send medical data, images, waveforms, and speech signals using broadband Internet connections, such as DSL and digital cable services, to perform telehealth functions; however, sending high-quality video through the Internet is still a significant problem because of the excessive bandwidth requirement, constant variation of transmission speed, and security and privacy concerns. As a result, the functions of Internet-based telehealth systems have been greatly constrained because, without video, the quality of service cannot be satisfied in many important applications.

With support from National Institutes of Health and other federal agencies, we have been conducting research collaboratively at four universities combining different expertise in medicine, electrical engineering, and computer science to solve the video transmission problem for telehealth applications. Our research has focused on three key developments. First, special-purpose, content-based video compression algorithms are being studied for medical applications. In the tele-surgery case, we prioritize video images according to regions of interest and assign different compression quality factors to different regions. In the patient monitoring case, we dynamically vary the frame rate and coding regions taking advantages of the frequent presence of idle segments and local motions in this type of video. Second, encryption, data hiding, and water marking algorithms are being investigated to secure medical video transmission through the Internet. We aim at maintaining both data integrity and compression performance while denying unauthorized access to private information. Third, the quality of service issue is being addressed by using rate control algorithms to regulate video and other multimedia data streams.

Our investigations have produced several prototype Internet-based multimedia telehealth systems for long-term video-EEG diagnostic study of epilepsy patients, for remote health monitoring of the elderly at nursing homes, and for intraoperative neurophysiological monitoring of surgery. These systems have produced high performance over the traditional non-video based systems.

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