Chapter 3.27
Multimedia Computing Environment for Telemedical Applications

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ABSTRACT

This chapter describes the system design for a multimedia telediagnostic computing environment (MMTE) for telemedical applications. Such an environment requires the design of: (i) a wired-in or wireless computing facility based on currently available technology with a high bandwidth for fast, reliable, and efficient communication of data, voice, and image; (ii) a database query system to access data, voice, and medical images from a fixed server to the mobile or fixed hosts; and (iii) suitable audiovisual software communication tools among the cooperating fixed and mobile hosts to help visualize pointer movements remotely (telepointers) and for teleconferencing. Appropriate software and hardware tools for the design of the cooperative environment are described. We also provide an up-to-date bibliography.

INTRODUCTION

Telemedicine (in short, e-medicine) is a means of delivering medical services to any place, no matter how remote, thereby removing the limitations of space and time that exist in today's health-care settings. Computers are indispensable in telemedicine since they provide for efficient, relevant data gathering for large-scale applications. Besides providing immediate feedback of results to patients and doctors, they also can compare past patient records and evaluate relative improvement or deterioration. Further, they are readily available at any time, are fatigue-free, and can be more objective.

Also computers provide for multimedia imaging—ultrasound, digital X-rays, 3D spiral CAT scanning, magnetic resonance imaging, PET scanning, etc.—and can fuse them into a single multipurpose image using fusion software. Add-

ing mobility to computers enhances their role in telemedical applications considerably, especially at times of emergency, since the patients, doctors, and data collecting and retrieval machines, as well as their communication links, can always be on the move.

For instance, very simple, inexpensive mobile communication and computing devices can be of great help in telemedicine, as illustrated below:

- **Low-cost radio:** Even the simplest of mobile devices—such as a low-power radio that can transmit messages to a home computer, from which medical data can be sent through the telephone line and the Internet—can be of great value in saving lives (Wilson et al., 2000).
- **PDA (personal digital assistant):** The simplest of the computers, such as palm-tops and PDAs, can assist the doctors for instant nomadic information sharing and looking for diagnoses of different diseases and treatments. PDAs can help the doctors to figure out drug interactions, storing summaries of sick patients and their drug lists. Further, PDAs can provide for downloading suitable programs from the Web and can be programmed for alert, sending and receiving e-mail, jotting down pertinent points, and storing immediately needed clinical results to carry out ward rounds.
- **Internet:** The Internet is an important tool for medical professionals and will completely change the manner in which medical consultations are provided (Coiera, 1997). For minor ailments, Internet-based consultations to doctors can provide prescriptions for medical/pathological examinations by laboratories. The results are then posted on the Internet for subsequent reading of the results by the concerned doctors, who can prescribe medicines that can be posted on the Internet. This prescription can then be handled by a pharmacy to dispense the medicines to the concerned individual. Kim and Hwang (2001) have proposed a password-controlled Internet-based medical system that brings in a variety of services to doctors, patients, pharmacists, and health-care professionals. It allows people to receive medical examinations and medical advice on the Internet enables examinations that are not possible in the Internet to be treated to have a direct contact with the doctor.

TELEMEDICAL INFORMATICS

The first step in telemedicine is the telemedical diagnosis (or telediagnosis) based on information obtainable from medical images, blood, urine, and other pathological test reports. Usually, for diagnostic purposes, the doctor sends a patient for such examinations. The laboratory assistant takes the required X-ray or ultrasound images or carries out pathological tests and passes these images (or readings) on to a radiologist/pathologist, who then makes an analysis and sends a report to a doctor. These manual actions are totally sequential and slow. This whole procedure can be made cooperative and faster if the images and data are stored in a database and these can be simultaneously retrieved by doctors, radiologists, and specialists in their offices or homes, using personal computers to make a cooperative diagnosis. This is the basis for **telemedical (e-medical) informatics** (Alfano, 1997; Coiera, 1997; Ganapathy, 2001; Gomez et al., 1997; Jameson et al., 1996; Kleinholz et al., 1994; Lauterbach et al., 1997; Mathew et al., 1999; Pham & Yearwood, 2000; Yearwood & Pham, 2000).

Principal Aims

The principal aims of e-medical informatics are to: