

Recording and Transmission of digital wound images with the help of mobile devices

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Abstract: The goal of this project is to develop a mobile device for transmitting images for the aftercare of surgical patients within the framework of the competence center TELTRA. After designing and evaluating different platforms and cameras, it was decided to develop for a compact flash camera card and an HSCSD modem which is based on and can be plugged into a pocket PC. The recorded images are sent with the help of a Java program from the pocket PC over an IrDA or Bluetooth interface to the HSCSD mobile telephone, and then to the web server, where it is saved in a digital patient record.

1. Introduction

Up till now, the billing system for hospitals was extensively based on the so-called care rate. For every day a patient is lying in a hospital, a certain lump-sum rate per day must be paid by the insurer.

As can be seen in Fig. 1, after the point where the cost curve and the billing curve intersect, i.e. when the patient lies in the hospital for a long time, the hospital profits.

Since after January 1, 2004 billing will be based on the system in Australian DRG's (Diagnosis-Related Groups), the diagnosis will be the basis of the lump-sum bill, which is independent of the in-patient duration 0.

This should motivate hospitals to work efficiently with the available resources and to tend toward shorter in-patient lengths of stay and cost-lowering technology. This, however, leads to a medical problem. How early can a patient be discharged without risking that possible consequences of the early discharge send the costs skyrocketing again?



Figure 2: Image of a Wound

2. System Concept

After the design and evaluation of different platforms and cameras, we decided to develop a compact flash camera card based on a pocket PC (HP Jornada 568), which has a resolution of 640x480 pixels and a HSCSD modem (Nokia 6210). This is especially because the development of mobile devices for consumer applications goes in the same direction as needed for the wound camera. Mobile phones and PDA's are growing together to form a "Smart phone" (with a large display), into which a camera can be plugged, which can be used as a mobile terminal device in the future.

The patient can make photo images of his wound and transmit it using a Java program over an IrDA or Bluetooth interface to the HSCSD mobile telephone, which has a possible upload data transfer rate of 28 kbit/s. It is then sent to a web server (the TELTRA image server 0), where it is added to his patient record. For this application, fast data transmission is important, especially "upstream" (from sender – the application – to the receiver – the web server), since images must be uploaded. HSCSD has an upload rate of 28 kbit/s. Right now, this is the fastest technology (GPRS offers only one channel in the direction of transmission with a maximum of 13.4 kbit/s. GSM modems can only achieve 9.6 kbit/s). A doctor can check these images regularly to monitor the healing process, and if necessary, call the patient back in. The detailed procedure is as follows: The camera program stores the images in a certain file. The client program reads these images from the file and sends data wrapped in SOAP (Simple Object Access Protocol) 0 over HTTP (application layer). These are transmitted to the mobile phone over the IrDA interface and make it to the patient record server (transport layer) over the provider using HSCSD or GSM (see Fig. 3). A SOAP interface, over which the patient records can be changed, can be found on the TELTRA image server. The user program is easy. All you have to do is click on a symbol to transmit the images.

Data on the pocket PC can be secured by password protecting it when the device is turned on. In this case, both user name and password are stored in a special file on the pocket PC. This

makes it easier to use the program, since the password doesn't have to be constantly re-entered. As a matter of security, however, the images on the PC should be deleted after every transmission. The transmission can be secured by encryption and the application layer using: the Java Secure Socket Extension (JSSE) 0.

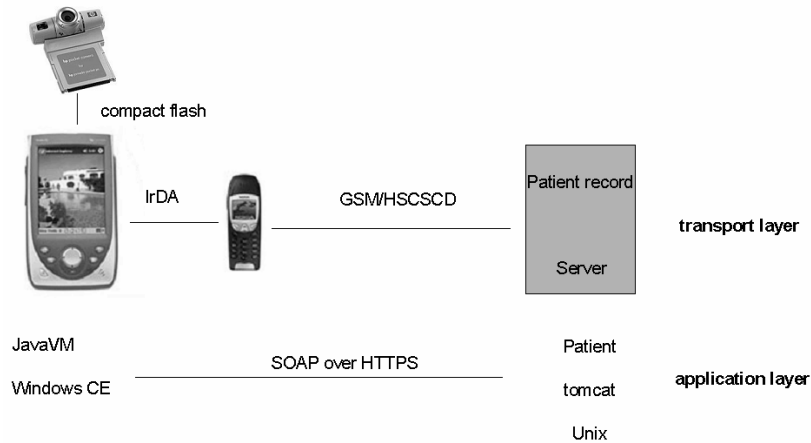


Figure 3: Overview of the transport and application layer

3. Results

The goal of this project was to develop a handy mobile tele-medicine device for patients, and to thereby lower health costs. We have shown that such a device can be implemented on presently available pocket PCs and mobile telephones. In the meantime, there are smart phones, which unify a PDA and mobile phone in one device (e.g. Siemens SX45 with a compact flash camera card). The device is easy to use. There is one button for taking the picture and one for transmitting the image to the patient record. See Fig. 4. In a clinical study, we would like to show that the developed device is accepted by the patient and helps to lower costs in the health system [5].



Figure 4: Operation

Among the available smart phones on the market today, the SX45i by Siemens is one of the best. A compact flash camera (similar to the one for the Jornada 568) is available as an accessory (Casio JK 710DC). In the near future, an HP smart phone (Jornada 928) will be available, based on the 560 series with the same equipment regarding the processor, operating system and transmission protocol. The program developed for the HP Jornada 568 won't change significantly when it is made into a smart phone. This is one of the advantages when using Java as the programming language. The developed software should be portable to this hardware without a problem.

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