Wireless Telemedicine System

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ABSTRACT

As the world is progressing and multiplying manifolds, living has become more stressful than ever. There has been an increase in cases of chronic diseases and the scenario has been aggravated by the difficulty in availability of quality medical care all around the world especially in a socially and economically segregated nations such as India.
Lending a solution to the medical problems of the progressing world is Telemedicine.

This paper is an attempt to illustrate the system's working methodology and scope of application in healthcare with its large spectrum of applications capable of enhancing clinical as well as research prospects.

INTRODUCTION

Telemedicine –The word itself can be broken up as : medicine at a distance.
It is both the delivery of healthcare as well as exchange of healthcare information over long distances by inter-twining medical knowledge with communications and information technology.

Telemedicine applications based on wireless technologies span into various areas. Telemedicine may be as simple as two health professionals discussing a case over the telephone, or as complex as using satellite technology and video-conferencing equipment to conduct a real-time consultation and analysis between medical specialists sitting in two different countries.

It catapults the medical treatment prospects in areas like Emergency healthcare ,telecardiology, telepathology and telepsychiatry . In addition, health telematics applications enable the availability of prompt and expert medical care enables the provision of health care services at understaffed areas like rural health centers, ambulance vehicles, ships, trains, airplanes as well as for home monitoring.

It can also be used as location-tracking technology to filter emergency calls by matching
different reports of the same incident, which would reduce emergency overload and
waste of resources. It can also be used to route emergency vehicles to victims and then to
the closest hospital where needed care and space is available resulting in better quality of
care

WIRELESS TELEPHONY SYSTEM

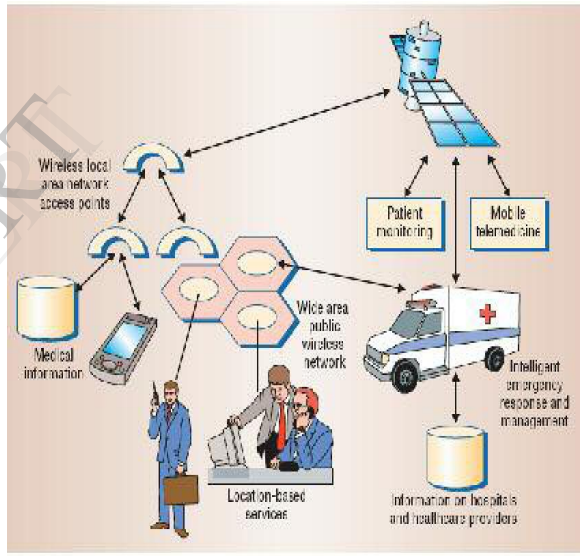

Figure 1. Pervasive healthcare scenario. Wireless network intelligence and advances in pervasive technologies can increase healthcare quality and access.

The Mobile telephony has evolved a lot and offers new devices with some useful resources, such as serial ports and Internet connections at high data transfer rates. Phones can interact with electromedic devices (EMDs) – like patient monitors, and transmit vital signals through Internet protocols, such as TCP/IP and UDP. The vital signals are acquired from the EMD using the RS232 interface and transmitted through Internet.

Using radio frequency (RF) technology, WLANs transmit and receive data over the air, minimizing the need for wired connections. Thus, WLANs combine data connectivity with user mobility

Satellite systems are able to provide a variety data transfer rates and provide an add-on of operating all over the world

Advance security methods over W-Lan for resource optimization and proper noise cancellation as well as accurate reconstruction which is done by employing Wireless covert channel signaling and wireless self protection systems

TRANSMISSION OF DIGITAL IMAGES AND VIDEO

There are essentially no theoretical bandwidth requirements for transmitting medical images. Lack of bandwidth can be compensated by longer transmission times. Yet, high quality medical images such as a single chest radiograph may require from 40 to 50 Megabytes. In practice, it is desirable to at least be able to transmit medical images during a single patient visit, so as to at least avoid a follow-up visit or sometimes for a mobile system it becomes a pre-requisite.

A controlled environment (compared to actual streaming) is often sought, where parameters involved in video streaming (such as loss rate, delay, jitter, available bit rate , mobility, end-user devices, etc.) can be easily modified in order to measure different possible aspects that can affect the design of a developed application. This kind of environment can be found in network simulators like OPNET.

To import video traffic in network simulators, video traces are employed which aim to map the encoded video bit stream. Acquisition of the medical video is done via a portable ultrasound device and/or a high quality camera. Source encoding can be performed using the JM H.264/AVC reference software an open source Codec for H.264/AVC.

The advantage of this approach is that it can significantly reduce the required bandwidth while maintaining high-quality video images of the regions of diagnostic interest.

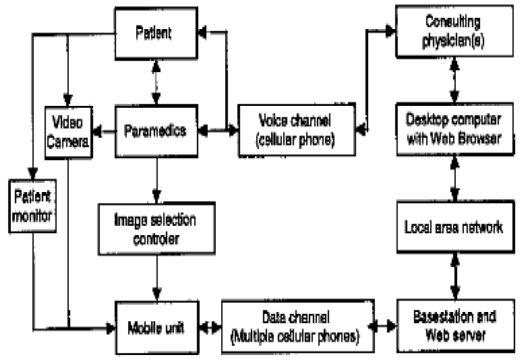

Fig. 1. Information flow of the mobile telemedicine system.

TELEMEDICINE METHODOLOGIES

Real Time Telemedicine and **Store and Forward methodologies** are implemented where two way interactive television is used by providers/patients at distant locations interact with each other using communication technology in the form of audiovisual and wireless or microwave signals.

Apart from video-conferencing, peripheral sensing devices can also be attached to the patient or the equipment to aid in interactive examination. For example, tele-stethoscope to monitor patients heartbeat or tele-otoscope to examine patients ear.

Store and Forward (asynchronous) technology involves acquiring medical data (images, bio-signals) and transmitting this data to a medical specialist for consultation, evaluation or other purposes. It does not require simultaneous communication between both parties in real time. Radiology, pathology and dermatology are most conducive for utilizing this mechanism

TELEMEDICINE SYSTEM ARCHITECTURE

Telemedicine homecare services are based in client-server architecture.
There is a server application (normally, sited in a hospital) which stores and makes available the incoming vital signals came from the clients. The client, in its turn, is responsible for acquiring data from patient monitors and transmitting them through Internet.

At his home, the patient is connected to the patient monitor. So, the EMD acquires the usual vital signals, such as ECG, heart rate, blood pressure, SPO2, respiration rate and temperature.
Next, the mobile phone connected to the monitor receives the information through the RS232 interface.

The signals are converted in packets and transmitted to the server using TCP/IP and/or UDP protocols. The server settled in hospital stores data in a relational database. Then, health care providers (HCPs) monitor their patients using the server application. Also, signals are stored as XML files and exported to other systems or printed with ease due to interoperability of XML files.

A. Client Side

Most of the existing patient monitors present traditional and reliable signals acquisition capabilities. Most of these monitors and alarms are historically serial-port (RS232 standard) based.

The client application, including the communication protocol, runs over the mobile phone. It is implemented using the Java MIDP. MIDP stands for Mobile Information Device Profile. It provides the core application functionality required by mobile applications - including the user interface, network connectivity, local data storage, and application lifecycle management - packaged as a standardized Java runtime environment and set of Java technology APIs.

Once the client application is supposed to be utilized by patients, its interface should be simple. Therefore, the MIDP program was specified to have few commands and simple options, making easier to the user. Since the platform is a mobile phone, all the software was designed to not be different from the usual programs in this kind of device.

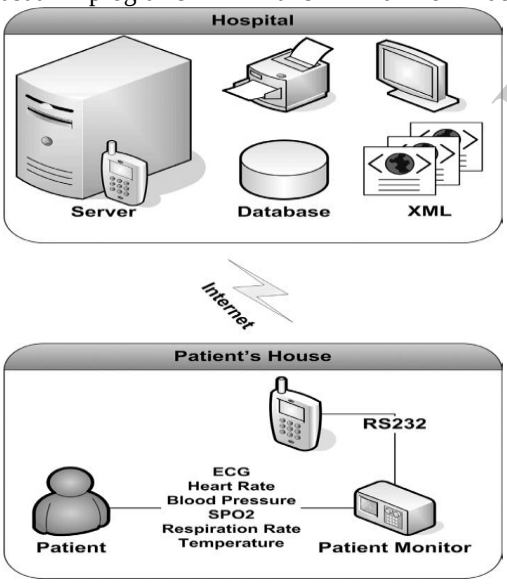

Fig: (2) Architecture of Telemedicine System

Actually, the client side was projected with just four screens: main, setup, equipment and connect. The screens allow the choice of patient monitor, the patient's ID and the connection with the server.

B. Server Side

In the application of telemedicine, the medical information usually needs to be distributed among medical doctors and display, archival, and analysis devices .
Therefore, the server side was developed with the purpose of receiving, storing and distributing the vital sign data from patients.
Basically, the server is composed of a Java application and a relational database. The application offers the follow features:
a) list of patients;
b) personal information about patients;
c) visualization of vital signals;
d) data export.
The doctor controlling the server has several tools to work with ECGs. It is possible to list, visualize (with a zoom option) and export to PNG format. The ECG can be also printed. As XML is utilized as an export format.

Real Time Application of Wireless Telemedicine Systems

Wireless Telemedicine System will enhance the provision of emergency care services not only in emergency department but also in pre-hospital emergency care conditions by facilitating remote consultation and monitoring for the patient which is not only essential for patients recovery but also survival in many instances.

Especially in cases of serious injuries of the head, the spinal cord and internal
organs, the way of transporting and generally the way of providing care are crucial for the
future of the patient. Furthermore during cardiac disease cases, much can be done today
to stop a heart attack or resuscitate a victim from trauma.

The system enables the transmission of critical bio signals (ECG, BP, HR, SpO2, temperature) and still images of the patient, from the emergency site to an emergency call center; thus enabling physicians to direct pre-hospital care in a more efficient way, improving patients outcome and reducing mortality. The system was designed in order to operate over several communication links such as Satellite, GSM, POTS and ISDN.

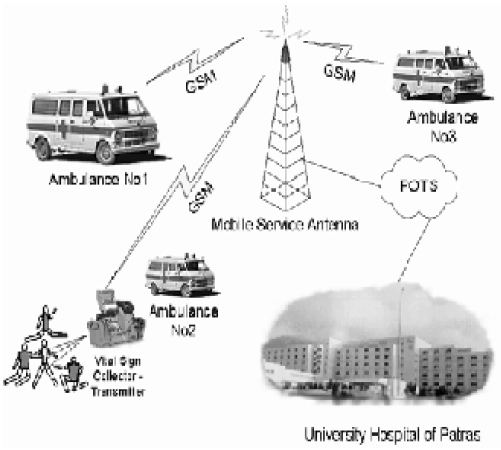

Fig. 1. Transmission of the acquired viral signs both of on the field or on route to the hospital

Imagine a system which will be able to treat a person who has suffered from brain damage in an accident moments ago, a mobile van that houses a whole body spiral computed-tomography (CT) scanner and a second van that houses the satellite communications equipment comes around for CT scanning, and an on-line two way transfer of image data and teleconferencing to a consultation center with various specialists takes place and hence we can bail the patient out of a cataclysmic situation.

Its basically a *TeleRadiology System Using a Mobile CT van and High Speed Satellite Communication* ;an example of a Mobile Wireless Telemedicine System

It is also used for specialty care in psychiatry, internal medicine, rehabilitation, cardiology, pediatrics , neurology ,obstetrics and gynecology.

CONCLUSION

We can put away concerns regarding
severe cost constraints,
mal-distribution of physicians in different geographic regions and scarcity of the same,
regular treatment of chronically ill patients as well as long term care patients, as now we have Wireless Telemedicine System around.

Wireless telemedicine gives you better access on the run and even at your doorstep at cheaper prices and to top it, it magnanimously improves the chances of a casualty survivor, is there any better a saving than that?

Application of Wireless Telemedicine systems in hospital operations and rural health centre services as well as training of the physicians, the paramedics and administrative staff on this amalgam of wireless information technology and medicine is surely the way ahead..

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