A PROPOSED PROTOTYPE OF COOPERATIVE MEDICAL TREATMENT SYSTEM FOR HOSPITALS IN GCC COUNTRIES

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ABSTRACT

Telemedicine, which is a way of providing medical services to patients no matter where the patient or relevant information is located, has become a useful tool for solving the problems of specialists’ shortage in hospitals. Such systems are not in wide use in GCC countries due to the shortage of expert people working in this field and the misunderstanding of the capabilities of this technology in improving treatment with a lower cost.

The objective of this paper is to propose a Cooperative Medical Treatment System to solve the shortage of specialists in the hospitals of GCC countries, and to improve the quality of health care and help the patients in these countries in decreasing cost, time, and efforts of their treatment abroad.

This paper presents the prototype of this system and describes its technology, network, security, and other requirements. The network of this system can be the nucleus for an Arabic Telemedicine system which can implement more applications and include other Arab countries in the future.

Keywords — Telemedicine, Telediagnosis, Teleradiology, Medical Treatment, health-care, cooperative system.
1. INTRODUCTION

Telemedicine, which is the transfer of electronic medical data (i.e., high-resolution images, sounds, videos, and patient records) from one location to another, is quickly becoming an integral component in the delivery of modern healthcare regardless of geographic or socioeconomic status [6].

Generally Telemedicine is defined as the use of telecommunications and computer technologies with medical expertise to facilitate remote healthcare delivery [3].

This delivery required medical multimedia for sending, receiving, editing, and processing data in different formats depending heavily on the types of Telemedicine applications. But it is hardly possible to build a general purpose telemedicine workstation covering all kinds of telemedicine applications [4].

Many developing countries have inadequate health-care and medical services. Developing countries suffer from a shortage of doctors and other health-care professionals and they face various problems in the provision of medical services and health-care [2].

Due to this shortage of specialists and other health-care professionals, thousands of patients yearly are traveling from GCC (Gulf Cooperation Council) countries to other Arab, Asian, European or American countries for medical diagnosis and treatments. Besides, hundreds visits of medical specialists to GCC countries are yearly taking place. These travels cost the country and the patients a lot of money, efforts and time. This research is trying to solve this problem by the telemedicine technology by suggesting a prototype of a Cooperative Medical Treatment System for some main hospitals in GCC countries, in order to substitute this shortage and to improve the quality of health care and to help patients in these countries in decreasing cost, time, and efforts of their treatment abroad as will be explained in the next sections.

2. RESEARCH OBJECTIVES

The objective of this work is to suggest and design a prototype for telemedicine system in order to decrease these numbers of visits or at least decrease the days of staying outside their countries for investigations, diagnosis and consultation, to help the patient find the best specialist in the suitable place, and to be provided with the medicines which are not available in patient country. Through this system, the patients and physicians will satisfy the following aims remotely (online or offline):

1- Eliminating the efforts and costs of travel by conducting medical diagnosing and medicine prescription remotely.

2- Educating and exchanging medical information between the specialists in different majors.

3- Consulting the special and difficult cases between specialists.

4- Providing laboratory and radiological diagnosis for some cases and writing their reports to the specialists.

5- Searching for (explore) a good specialist and hospital for patients who want the treatment abroad. And conduct their medical investigations in their countries before the travel in order to decrease the cost and time.

6- Follow up the treatment of patients (who are treated abroad) in their countries through this system.

7- Improving the medical services for the countries that are participating in this network.

8- Providing treatment, medicine, and information about traditional Chinese and Indian medicine.

9- Providing the medicine (prescribed) which are not available in the patient’s country.

The network of the suggested system will focus on the countries of Gulf Cooperation Council (GCC) which will be the nucleus for a wider network that will include other Arab countries in the future.

3. SYSTEM PROTOTYPE & DESCRIPTION

In this research we try to design a suitable prototype for this system and to specify and explain its important applications, functions, services, database, and requirements, as well as its multimedia and technology.

3.1. SYSTEM ARCHITECTURE AND NETWORK

The different components (members) of the system are located into the following two units (stations) and connected with each other either by Intranet or Internet network, Fig. 1 shows the network structure of the proposed system:

a) Patient station:

Contains the general practitioner’s (GP) workstation, and other medical devices, where the patient’s biological and physiological data acquisition and examination stages take place. This station has to be supplied with restively simple clinical measurement devices necessary to obtain the basic medical data for patient like blood pressure, body temperature, glucose level, pulse rate, weight, etc. In addition, ECG/EEG recorders and simple x-ray and ultrasound machines could be provided in this station.
b) Specialist station:

Contains the specialist’s workstation, and other medical devices that are necessary to import and view the requested patient's data from the central database where they are saved routinely by the patient station staff.

Both or one of these units should be established in the capitals or major cities of the countries that comprise this network. The network of this system would consist of: a specialist, a radiologist, a patient, a practitioner doctor, a pharmacist, medical analyst, and some other medical and computer technicians.

This network connects countries of GCC with each other and with some countries in the region that have qualified specialists (like Jordan, Egypt) and also to a qualified hospitals in Asia, Europe and America. So GCC countries can cooperate among each other through this system as client-server to exchange health-care services, and they can also connect with other countries on the network as clients for diagnosis, consultation, and other health-care services mentioned in the next subsection.

3.2. SYSTEM APPLICATIONS AND SERVICES

The system provides patients who reside in the countries included in this treatment network with the following applications:

- Telediagnosis: Providing diagnosis services to many remote locations which do not have specialists.

- Telepharmacy: Providing medicines prescribed by doctors to patients.

- Teleradiology: Transmission of x-ray images to the radiologist for writing the report to the specialists.

- Telesurgery: One of the surgeons performs the operation while the other remotely gives advices via a television screen.

- Teleconsultation: Consulting special cases among physicians and other health care providers in various locations.

- Tele-education: Access to remote information and community health education to improve the chances of early detection of diseases and reduces the subsequent treatment requirement.

Any other application can be added later if it is necessary. These applications should provide the following services: diagnosis, consultation, medical information resources, medicine, and abroad reservation services.

This system can also provide the patients with services about other type of treatments such as Chinese and Indian traditional medicine by connecting this system to some hospitals that has such medicine.

3.3. SYSTEM FUNCTIONALITY AND DATABASE

The system should be connected to a central database which consists of patients’ information and other medical information. This database could be realized using MySQL, which is a relational database management system that is particularly suited for web-based applications. Besides that MySQL has several advantages: low cost, faster than other databases, its distribution is relatively small package, understands structured query language, working with several other tools such as Apache, PHP for several platforms including Linux, UNIX, and Windows.

The main functionality of the system is based on two services: a patient data storage service that provides the basic medical information of patients and a data monitoring service that provides transmission of physiological data for remote monitoring.

In order to provide these services with the required functionality, several components work in parallel in the background: a data capture component for the source of data, a storage component for storing and retrieving data objects into disk, a data-object cataloguing component for generating derived data and presents the information via WWW user interface, and a network component for linking all the distributed components into a single system.

Both patient data storage service and data monitoring service can be implemented as dynamic web pages based on PHP, which is an open-source server-sided scripting language for creating web pages [7].

3.4. SYSTEM SECURITY FEATURES

Security of data has three aspects: confidentiality, integrity (i.e. completeness, correctness, and prevention of unauthorized modification), and availability (i.e. accessibility and readiness for immediate use) [2].

A potential problem with a system whose operation is based on data transmission over the Internet is that anybody with an Internet access can reach and modify the data stored in the database. To ensure the confidentiality of the records stored in the database, security features are included in the system only the users with required permission could access it. The system administrator provides these permissions by using a username and password.

However, in order to increase the security of the system, additional information can also be written such as IP number, login time, and browser information.
Besides these security features different access rights should be existed in reading/writing/updating the database. Also for remote access to the system, firewalls are often used to filter out unauthorized communications. And data confidentiality and integrity can be addressed through secure networks such as VPNs [1].

3.5. SYSTEM TECHNOLOGY AND MULTIMEDIA

Telemedicine applications can be categorized as requiring low, medium or high bandwidth transmission. The range of network choices includes basic telephony, digital land line, cellular/wireless, satellite and broadband networks such as ATM. When considering telemedicine technology, it is important to evaluate not only capabilities and the cost/performance, but also general technical development. Cellular, wireless and satellite technologies are options which should be considered in providing health-care to remote locations [2].

The provision of health care should be done through a combination of telecommunications and multimedia technologies with medical expertise.

Telemedicine has become increasingly possible due to a confluence of ongoing technical advances in multimedia, computers, telecommunications, and information systems [7].

Different multimedia systems can be integrated in one workstation which is very necessary and helpful for telemedicine use. It allows numerous collaborators at separate geographic sites to interact as if they were in the same room viewing the same medical images [5].

A multifunction workstation for telemedicine purposes must be prepared for all media included in different telemedicine applications available in our suggested system; so these workstations, which are available in both patient and specialist stations, should achieve the following main processes:
- Audio and video conferencing.
- Remote control and monitoring.
- Still images and video transmission and processing.

4. DISCUSSION

In the GCC countries, telemedicine system is not in wide use mainly because of the high costs and the technical complexity. Lack of such systems has serious implications such as the costly travel expenses and, more importantly, the delay that occurs during transportation that could lead to disease progression.

This paper presents the design of a simple Telemedicine system that could be effectively used in these countries to solve the shortage of health-care professional problem. This system has two main aspects, first is the system economically affordable and easy-to-implement as a result of using free software such as Linux, Windows, PHP, MySQL, and web browsers. Second aspect is that it provides the users with access to the patient records as well as the capability of managing physiological signals and biological data.

5. CONCLUSION

The paper presents the design of prototype of Cooperative Medical Treatment System that could be effectively used to connect all GCC countries each to other and to high professional hospitals in other countries to get diagnosis, consultation, and other medical services through some telemedicine applications.

The key features of the suggested system are its simple implementation with low-cost components, ease of use, and powerful security features. But a potential problem with the system is to ensure the confidentiality of the patient's records which stored in the database because it uses the Internet which is a public technology. In addition to that some multimedia data is difficult to transmit it in a good quality.

This system will solve the shortage of specialists and other modern health care in GCC countries; its network is easy to extend to be the nucleus for an Arabic Telemedicine system which will implement more applications and include other Arab countries in the future.

REFERENCES

[6] Mehmet Kuntalp, and Orkum Akar, “A simple and low-cost Internet-based Teleconsultation system that could effectively solve the health care access problems in underserved areas of developing
patients’ data acquisition and processing

Medical devices for examinations and patient’s data acquisition and processing

Hardware and Software for retrieving and viewing requested data

Fig. 1 (The proposed network of the GCC's medical Treatment System)