

Wireless Hospital Applications

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1. Introduction

Interacting with computer and technology has become a very important part of one's daily life and routines. Whatever field of study or job one chooses, he will definitely be a frequent user of computers. With the advancement of technology, Information Systems are pressed forward to the society and all jobs keep changing with them.

In hospitals a lot of staff time is spent in supporting tasks that will be redirected to patients care using more efficient processes. The use of wired devices might be difficult in most cases. In many parts of the hospital, the use of cables can be difficult, inconvenient or even more dangerous. In this report, wireless hospital applications that are used to transfer data between portable devices to servers will be tackled.

The concept of wireless hospital is a very interesting field of study. Wireless information technology has the ability to save healthcare providers significant time by accomplishing routine healthcare related and administrative tasks. It includes the concept of mobile computing which involves the use of wireless portable devices such as laptops, tablets and PDA in order to access a wireless local area network (WLAN) or the Internet.

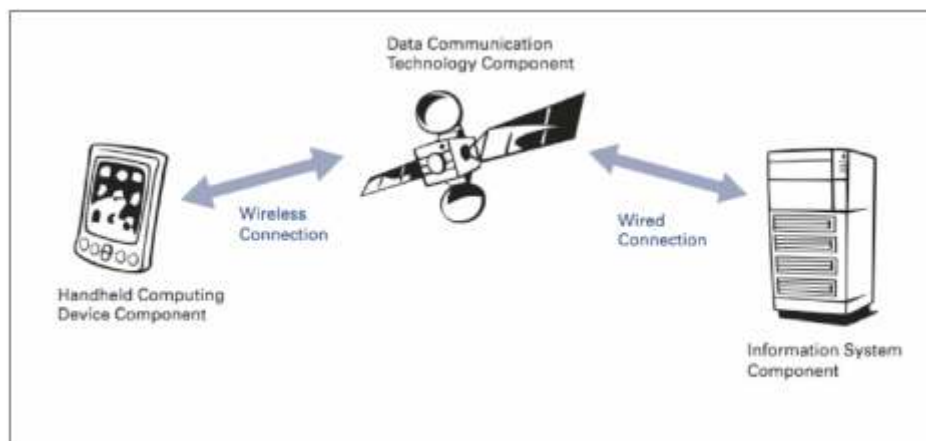


Figure 1 Mobile Computing Concept

2. Overview of Hospital Systems

The Information System that is implemented within a healthcare field is called the hospital system. It is utilizing technology, and people use that technology to plan, support, control, operates, manage, coordinates and make decisions. There are three modern hospital systems.

I.1 Hospital Information System (HIS)

Hospital Information System main goals include gathering, processing and retrieving both patients' healthcare and administrative information. It helps in decision making. The most important tasks of the HIS are storing and monitoring patients' data in the Electronic Medical Record (EMR), managing data workflow and monitoring financial aspects.

I.2 Radiology Information System (RIS)

Radiology Information System is the system that manages radiology data. It is used in processing patient film record, monitoring patients' status and examination, scheduling examinations, creating and formatting diagnostic reports and storing them with digital signature.

I.3 Picture Archiving and Communication System (PACS)

Picture Archiving and Communication System (PACS) is a system designed to store digitally represented medical images such as X-rays, CT, MRI, Ultrasound and NMR. It allows images to be electronically distributed and interpreted in the computer workstation.

3. Accessing Hospital Systems

Providing an instance access to the hospital information anytime anywhere will make the practice more efficient, faster, less error-prone, and it can meet patients' satisfaction. Today Patients' Electronic Medical Record (EMR) is accessible by privileged users from anywhere, in the clinic, at hospital during physicians around or at home using the Internet access to patient portal.

When talking about wireless systems especially in healthcare organization operation, it should be noted that mobile computers access is rationalizing the function and operation of the organization.

Mobile computing has enhanced a host of portable technologies that makes WLAN and Internet access possible. Recently mobile computing has become as indispensable way of life by using standard cell phones, notebook computers and PDAs like Blackberry and iPhone. There are a number of wireless applications that are running in modern hospitals such as: mobile medicine, hospital based RFID and other technologies like Bluetooth and ZigBee that are applied in health and fitness monitoring.

4. Mobile Medicine

Today the latest medical devices, equipment, diagnosis monitoring and treating illnesses have changed and saved millions of patients' lives. Technology has

changed global healthcare. Wireless communication such as mobile medicine has the impact on the way medical environment operates. In the healthcare world, almost every day occurs an invention that improves and streamlines the healthcare delivery and quality.

Previously, the wireless communication tools that save lives were the doctor's pager or the emergency number. Today, it becomes more advanced; critical information from caregivers, patients and family members is reaching the healthcare providers quickly, which improves the prevention and treatment of a number of significant health risks.

A few years ago, the advancement of technology such as third generation (3G) wireless broadband has changed the healthcare delivery services and generated uncounted possibilities of patients care. Today healthcare professionals can utilize instruments and achieve advanced breakthrough by using patients' remote/home-based monitoring system that allows medication ordering and tracking as well as receiving medical information in real time via wireless devices between doctor and patients. This technology can help patient in preventing the scene of hospitalization. This can also help them before admitted to the hospital and even after discharged.

Third generation wireless healthcare technology can now keep patients and healthcare givers connected at all times. A course correcting technique allows physician to view and review patient data remotely and monitor health performance, send input to patient and adjust behavior. Wireless sensors attached to patients can track important vital signs such as oxygen level, blood sugar, blood pressure, etc. This will allow many patients to retain their independence and live at home while they are monitored.

As an example, patients with cardiopulmonary disorders will be able to move in their homes as their heart rates are continuously monitored. In case of emergency, the device will send updates to the medical technicians and to the physicians in the emergency department as well.

The use of a wireless technology will reduce the number of hospital admissions. Many of the hospitalization caused by heart disease or diabetes can be avoided by adopting the proper monitoring system. An example of a wireless monitoring device is the disposable vital sign and heart monitor called Corventis. It is a small device that can be taped to the patient chest. It keeps tabs on heart rate and sends electrocardiogram information to the patient mobile as well as sends vital information to the physician. This will avoid the probability of being admitted to a hospital.

The advancement of wireless healthcare technology has impacted men's day life, especially in communities that are located hundreds of kilometers from health facilities. Patients in remote villages must spend their valuable time traveling to distant healthcare centers to get diagnosis or treatment. Even if this has to be done for the first time, many people cannot travel back for follow up or treatment.

Using mobile healthcare tools is the effective way to address the shortage of medical facilities in rural areas.

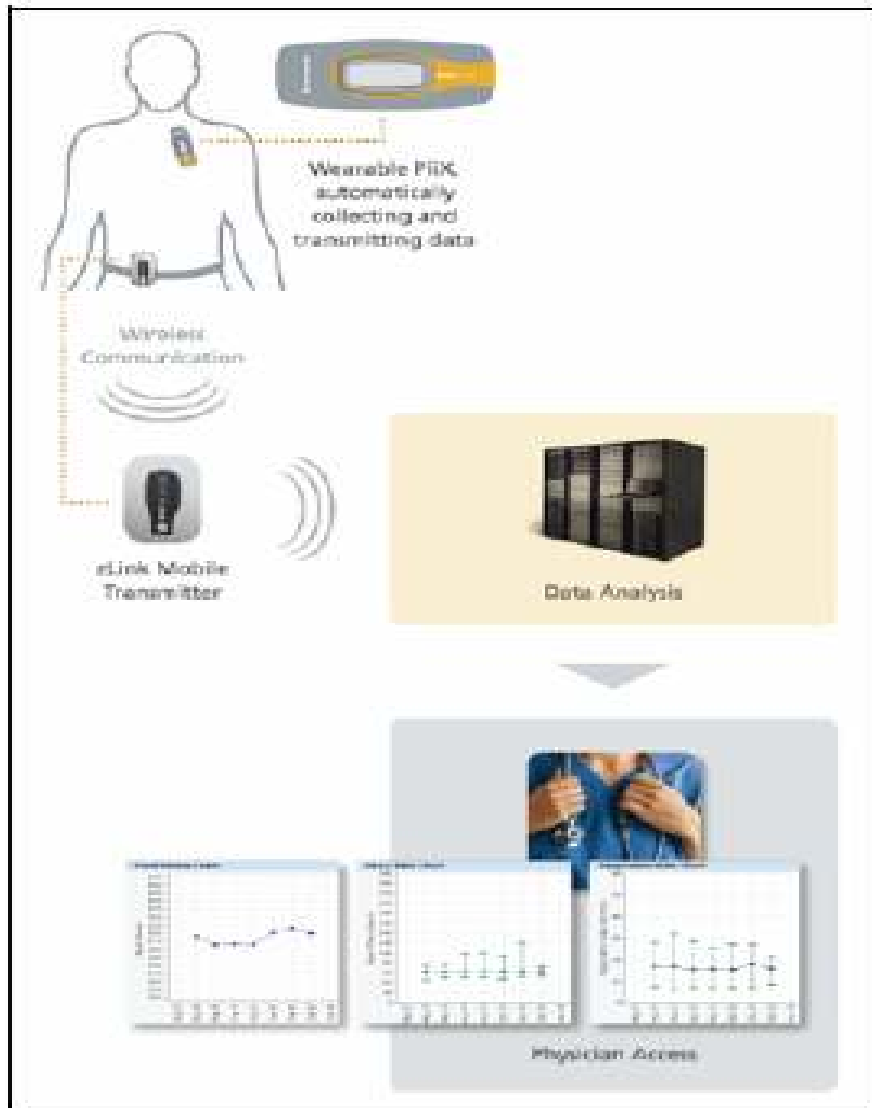


Figure 2 Remote monitoring of heart rates

5. Hospital based RFID

Radio Frequency Identification System (RFID) is a dedicated short-range communication (DSRC) technology. It uses radio waves to identify people and objects automatically. RFID is similar to the bar code identification system in concept but the big difference is that the bar code identification system relies on the line-of-sight reading in order to work while RFID doesn't.

RFID consists of a scanning antenna, a transceiver with a decoder that can interpret data and the RFID tag – transponder –that is programmed with vital information. The scanning antenna puts the signals in short range. The radio frequency (RF) radiation provides the means of communicating with the RFID tag. For passive RFID tags, RF radiation provides the tag with energy to communicate, which means that those tags do not need to contain batteries, and they can be used for a very long time period.

How does RFID work? The scanning antenna can be attached to any surface or either to handhelds. It can take whatever shape one wants. For example, it can be built into a RFID tag has passed through the scanning antenna, it wakes up the RFID chip by detecting the activation signal from the antenna and transfers the information to be picked by the scanning antenna. A large number of tags can be scanned at the same time; the scanning read time is less than 100 milliseconds.



Figure 3 Use RFID technology to track patients

In healthcare field the RFID system can be used to track doctors, patients and equipment in real time. RFID tags can be simply affixed to patients' bracelets which can securely track their movement in the hospital from admission to discharge. It can enhance the overall patients experience in hospital. It also provides an electronic link for wireless communicating patients' information to help them receive the five rights in treatment: right patient take the right medication at the right time with the right dose in the right location. The application can be combined with access control as well to allow authorized persons only to access high-threat area of the hospital.

Using RFID technology in hospitals has a lot of benefits, it continuously track patients, doctors, nurses, expensive instrument and critical equipment locations. It restricts access to critical areas to authorized staff. It also monitors and tracks unauthorized persons accessing high-threat area. Doctors can use this technology to access patients' information using a handheld device by automatically scanning patient RFID tag.

6. Handhelds Devices

Today a number of wireless handhelds devices have been applied in modern hospitals such as Personal Digital Assistants (PDAs), laptops, tablets, etc. In this section, the use of PDAs from physician side will be pointed out.

The use of PDAs for medical and healthcare sector is growing quickly, even if healthcare organization does not utilize that technology physicians and medical students may own one. The expanded memory and new available advanced

software products have grown with the popularity of PDAs. Software applications that are useful to both hospital and physicians include the tracking of patients, laboratory ordering, checking lab test and radiology results, accessing to references and writing prescription.



Figure 4 Personal Digital Assistant (PDA)

Patients tracking application allows the physician to access patient chart from anywhere in the hospital, upload or download notes, and access to medical record, scheduling, billing and contact information. It may be coordinated with other applications such as medication list and laboratory management.

Physicians are using laboratory test-ordering system to order new tests and check their results. The program may include reminders and/or a facility to validate the inconsistent entered orders.

Access to reference materials via PDAs provides access to a large number of medical information, medical specialties, medical journals, reference books and drug information.

The electronic prescription writing alert physicians in case of drug interaction which indicates whether it is on a plan formulary and notify physician against too much ordering of a medicine in a single treatment course.

PDAs have improved the way practicing medicine. Physicians can access and enter patient information electronically anytime anywhere. In paper-based system, physicians have to search their cabinets, their memories or even their pockets for any information regarding patients. By using PDAs, reliable information can be entered and retrieved at the point of care immediately to or from the HIS via the use of a wireless network.

Healthcare organizations that adopt PDA technology need to make sure that these instruments are compliant with the Health Insurance Portability and Accountability Act (HIPAA). Most vendors offer tools that are compliant to HIPAA security and privacy compliance program such as audit controls, encryption and data integrity.

Software protection is important as well; PDAs software must be able to:

- Allow access with authentication controls that ensure that only the privileged users can access their information;
- Provide audit trail to track user activities and data synchronization;
- Allow stored information to be accessed in case of emergency;
- Prevent unauthorized users to access information by timed automatic lockout that needs password reentry;
- Protect patients' files by controlling and tracking users access, delete or change information;
- Use encryption to encode patient information;
- Use remote access via the wireless network to disable lost devices;
- Protect the system from viruses ; and
- Ensure that other devices cannot intercept e-prescription and other wireless data.

7. Telemedicine System

In most cases it is difficult for patients to ensure the possibility of distant consulting for doctors who are far away from the patient location. Sometimes it is essential for a quick consulting and treatment regardless of physicians' current location. For this reason a General Packet Radio Services (GPRS) mobile phone technology is used in order to assist the concept of telemedicine.

As stated by the Institute of Medicine, "telemedicine is the use of electronic information and communications technologies to provide and support health care when distance separates the participants." A complete destruction of producing insulin in the pancreas causes type 1 diabetes. Type 1 diabetes patients should measure their blood glucose (BG) frequently and they have to take at least three times daily insulin injection, a high level of BG may cause many complications in long term due to organ damage.

Type 1 diabetes patients must do their BG measurement and estimate the appropriate insulin injection in order to bring their BG back to normal. They write their measurement in paper and at three-monthly clinics these measurements are discussed with the physician and the regimen may change.

In order to streamline the process and to provide a timely consultation with clinicians, a variety of telemedicine systems have been designed to assist in self-management of diabetes patients. Using a purpose built hardware, a blood glucose meter is interfaced to a GPRS data transmission mobile phone, the patient should connect the cable between two devices, in the phone custom software which downloads the BG reading and asks the patient a series of questions about his/her lifestyle. The data and diary information are transmitted immediately through GPRS to the server. The phone software then will display a graph indicating BG readings and the target range of readings that the clinician specified.

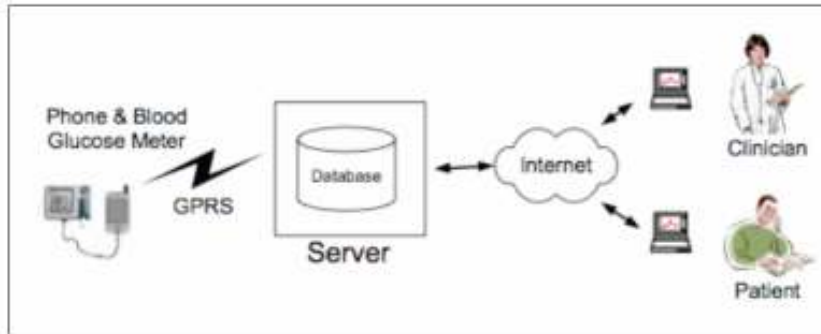


Figure 5 GPRS telemedicine technology

A secure web based access is provided for both clinician and patient. A patient can write comments and provide more information to the clinician. A clinician can contact the patient via SMS messaging system or a voice call.

By using telemedicine system, it is hoped that rapid patients data updating provided to clinicians would allow their feedback immediately, which will improve and encourage patients' self-management.

8. Conclusion

Wireless technology especially in healthcare field provides both patients and caregivers a means of freedom. This allows physicians to have an access to complete, timely, improved information at a low cost. Wireless communication will make individuals healthier, and it can potentially help them live longer. These kinds of application will make their health care experience simpler, more enjoyable and safer.

Few years from now, more new healthcare devices and services will allow automated self-diagnosis and self-healing. More complicated wireless infrastructure in the next generation of m-health devices and services will make all of these possible.

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