RESEARCH ARTICLE OPEN ACCESS

Survey on Mobile Based Telemedicine System for Patient Monitoring and Diagnosis for remote Places in Sikkim

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ABSTRACT
Recently remote health care has been a key issue to look after. As Sikkim is a hilly area suffering from transportation and inadequate medical facilities. Therefore, this survey on telemedicine system provides sufficient ideas for remote health diagnosis and monitoring in remote of Sikkim. As per the health personalities the various chronic diseases are diagnosed and treated with the human parameters such as ECG, SpO2, temperature, and blood pressure. These psychological signs are diagnosed in remote hospitals and PHCs and all physiological signs will be immediately transmitted to remote medical server through both cellular networks and internet. Also data can be transmitted to a family member's mobile phone or doctor's phone 3G and 4G networks. As Sikkim has 7 major hospitals and 24 PHCs, so one major hospital such as CRH Manipal or STNM can be chosen as a remote server unit and all the information through advance wireless communication module is received in this unit and patient health status can be diagnosed. As this hilly place lacks in medical facilities in remote places due to in educate knowledge of telemedicine system. This paper discuss about the recent trends in telemedicine for a small state. This paper is discussed in order to give 24*7 medical facilities in every corner of Sikkim. This paper also discusses the telemedicine system for normal and emergency condition. As this telemedicine is not a new technology, it's an existing technology this paper discuss the advancement in such technology to provide better medical service for remote places.

I. INTRODUCTION

A healthcare system in the last decade was made possible due to the recent advances in wireless and network technologies. The term telemedicine refers to the utilization of telecommunication and networks technology for medical diagnosis, treatment, and patient care for remote places. The aim of telemedicine is to provide expert-based healthcare to understaffed remote sites of Sikkim through modern telecommunication (wireless communications) and information technologies. Many physiological signals can be measured from individual's remote hospitals and PHCs and the patient care unit can be considered to acquire all the status of patient vital signs and stored and processed through type of sensors, type of data communication, monitoring device, and signal processing/medical algorithms. The main telemedicine system components in recent years include bio signal sensors, processing units, data communication networks, and medical service center. The patient vital signal is acquired and then it is filtered using various digital filters and amplified using various power amplifiers. Initially the signal is analog and then it is converted into digital using ADC which uses sigma delta techniques. As today all electronics and communication uses digital signals which can be easy to process and control. The signal can be controlled using PIC microcontroller which can be suit the recent controlling technique. The power supply for patient care unit can be used low power supply of 5v dc. Further the supply is needed for processing and control which can be used as low power supply of 15v dc. Since the digital electronics needs low power supply so these power supplies suits perfect for this technologies. Once the signal is processed and control then it has to be transmitted to the remote server where the patient is to be monitored and diagnosed. The signals can be transmitted in two modes REAL TIME and STORE AND FORWARD. The vital signs of patient can be transmitted through cellular network through WCDMA (3G) or LTE (4G). As the cellular technologies are growing at a faster rate so LTE can be preferred over WCDMA because LTE has high data rate up to 40 to50 mbps. The same transmission can be adopted for 5G which has high data rate up to 1gbps. In store and forward mode the signal is transmitted via internet. Wife or WAN can be used in this case. The signal is then received in remote server and monitored and diagnosed and monitored by specialized doctors and then he decides as per the requirement. As remote places of Sikkim lack in medical facilities and even patient may die in such scenario and also the area does not proper transportation and even patient may lost his life. So this paper discusses the overall telemedicine system for normal and emergency condition.

II. SYSTEM ARCHITECTURE

The main aim of this paper is to provide an expert based health care services in remote places of Sikkim. The proposed system comprises of remote hospitals and PHCs where patient care unit is bound to the patient body, communication and its module and Remote server unit (any specialized hospital). The overall system architecture is shown in fig1 and discussed further.

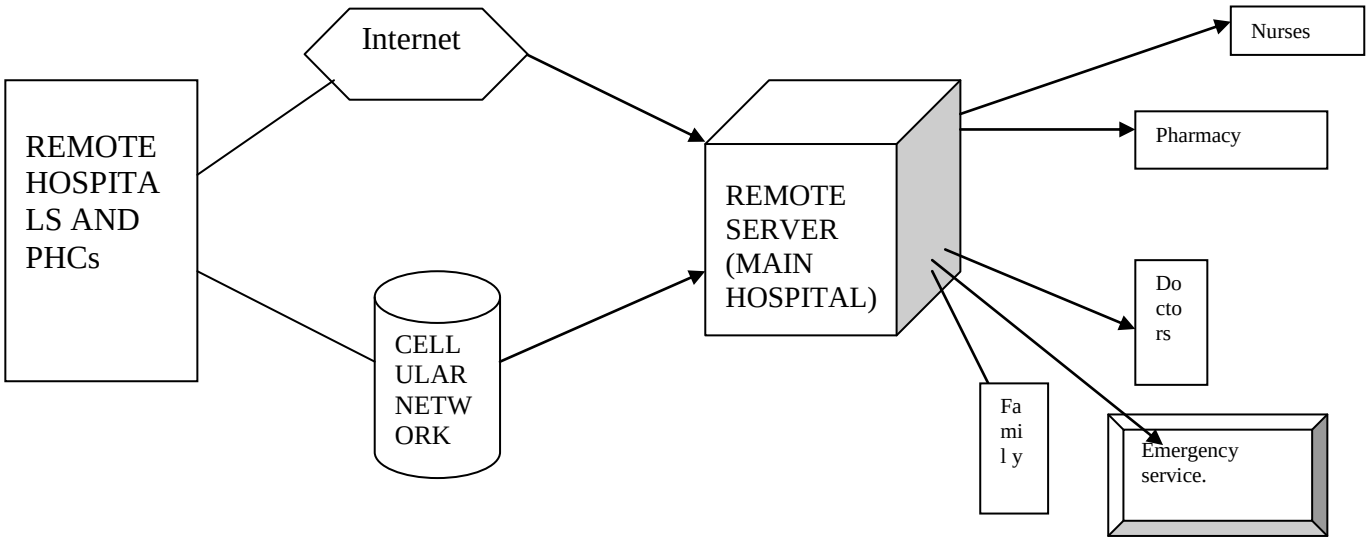

Fig1. System architecture

2.1. REMOTE HOSPITALS AND PHCs

As there are 7 major hospitals and 24 PHCs and the patient care unit is bound to a patient body without affecting the patient normal status. And the acquired signal is further processed using various digital methodologies like filtering, amplifying, ADC and control. These data is then transmitted to the remote server by wireless communication. The cellular communication can be used in real time or emergency mode and uses internet in normal and store and forward mode.

2.2 REMOTE SERVER UNIT (MAIN HOSPITAL)

These units is can be place in any specialized hospitals (CRH Manipal or STNM) and it stores the received vital signs in a human physiology database and displays the physiology signals to the medical personnel. The signal can be received in PCs, Laptops and cell phone. After final examining of the received vital sign of the patient the doctor decides to send the feedback to the remote hospital for resend of the data or if the doctor needs the help of medical staff he may use cell phone. Even the doctor can provide information to the family member of patient through wireless communication.

2.3 COMPONENTS OF TELEMEDICINE SYSTEM

This section details the system components of the mobile telemedicine system for patient monitoring and diagnosis**.**

2.3.1 PAPIENT CARE UNIT IN REMOTE HOSPITALS

In such type of telemedicine we built a patient care unit which is small in size and bulky which can be moved from one patient to other without any harm to the patients. The unit comprises the vital sign which is used to diagnose the patient health status. The vital sign is extracted in the acquisition module. The received sign is then filtered using various digital filters HPF, LPF and Notch filter. The signal is then amplified using the amplifier. The receiver sign is then further processed. Initially the signal is in analog mode, and then the signal is converted into digital using ADC with sigma delta conversion technique. Then the signal is to be controlled. The signal can be controlled using PIC microcontroller because it has inbuilt RAM, ROM, EPROM and it has advantages over other microcontroller. Lastly the signal is ready for transmission and is transmitted as per our requirement using internet module or cellular module. The alarm switch can also be used for the patients whenever he/ she needs the help of the nurses and doctos. The block diagram for the patient care unit is shown in fig 2.

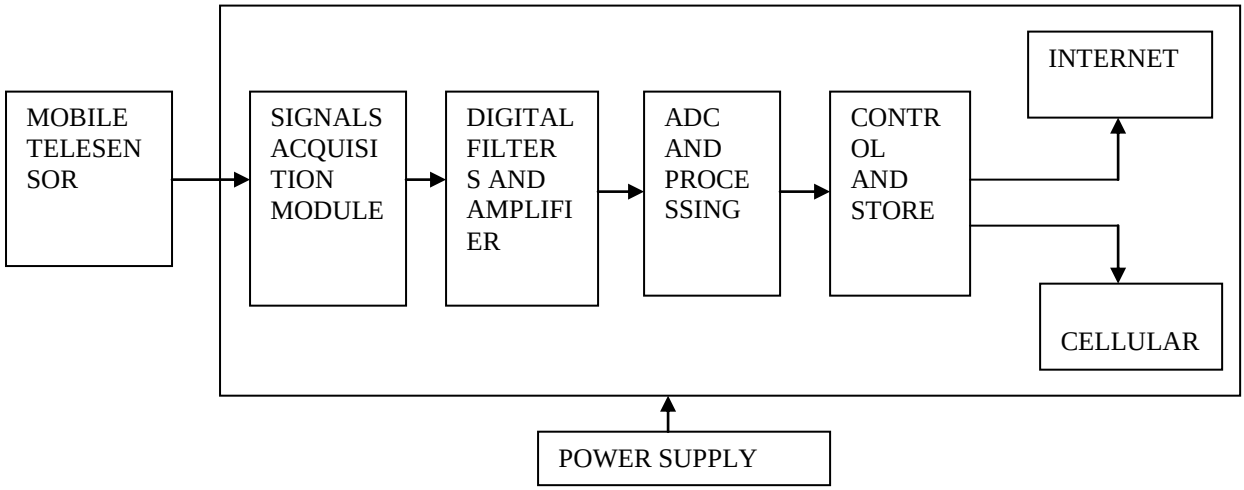

Fig2: block diagram of patient care unit.

2.3.2 Mobile Telesensor:

Mobile telesensor is an electronic chip that can be put into patient's finger which is used to extract the patient's vital signs such as ECG, Temperature, BP, heart beat and SpO2 in a single chip and it is further transferred to acquisition module.

2.3.2 Signals Acquisition module:

Signals acquisition module is responsible for collecting all the patients' vital sign which is required for diagnosis. The vital sign includes ECG, temperature, blood oxygenation, heart beat rate and blood pressure.

(a) ECG

An ECG is a bioelectric signal which records the heart's electrical activity versus time. The electrocardiogram is obtained by measuring electrical potential between two points of the body using specific conditioning circuit.

(b) Temperature Sensor.

Temperature is the other parameter which is used to diagnosis the patient. Usually the temperature of a normal human being is 37 degree centigrade. Temperature can be sensed by using temperature sensor and further put into processing

(c) (SpO2) and Heart Rate.

SpO2 or blood oxygenation is the measure of oxygen saturation in the blood, which is related to the heart pulse when the blood is pumped from the heart to other parts of the human body. When the heart pumps and relaxes, there will be a differential in absorption of light at a thin point of a human body.

2.3.3. Digital filter and amplifier:

The patient's vital signs are extracted and it is filtered by using the high pass filter, low pass filter and notch filter and further they are amplified using the amplifier.

2.3.4 ADC and processing:

Initially the patient's vital sign is analog in nature and the generated signal has to be converted into digital. The analog signal is converted to digital signal using ADC through advance digital signal processing such as sigma delta technique and other multirate signal processing.

The main functions of patient care unit can be summarized as:

First it acquires the patients signal and then it is filtered using various digital filters and the analog signal is converted into digital using ADC and processed through various advance digital signal processing technique. The digital signal is then controlled using PIC microcontroller and then stored and finally it is transmitted to the remote server using various communication technologies.

2.4 Communication Module:

The communication module is used to transfer the patient's health status and various vital signs from the remote hospitals to the main hospital where the remote server is located. The transmitted data is then received by the doctor in the remote care unit and then it is monitored and diagnosis. The communication made acts in two modes real time mode and store and forward mode. The real time mode is usually used in emergency condition through cellular communication and internet can be used in normal condition using TCP/IP or UDP protocol.

2.5 REMOTE SERVER UNIT:

In the applications of telemedicine remote server is considered the backbone for the patient monitoring and diagnosis. All the information's including the patents vital sign are received in this unit via communication module. This information is used to

connect with the specialized doctors and this unit can be developed either by using program or java and responsible for the following operations.

1. List of patients.
2. Name, age, sex of the patient.
3. Store and retrieve the patient's vital sign that is transmitted from the remote hospitals.
4. Store retrieve, and update the ECG data, record time, location of the R wave, and estimated ECG beat type.
5. Store, retrieve, and update registered doctors, physicians, and nurses.
6. The web page can be developed using Microsoft visual studio 2010. . Remote web user will have real time and continuous access to patients' vital signs through the internet. The web user interfaces with the web components using HTTP protocol over TCP/IP connection.

III. CONCLUSION

Telemedicine system, in which all physiological vital signs are transmitted to remote server unit using both cellular networks in emergency case and internet in normal cases. This paper provides the detail concept how the telemedicine system in remote places can be designed and implemented. The System integrates sensor unit, processing unit, and communication unit in one chip bound to patient's body called patient care unit, so patient could do his/her daily activities during monitoring. In other words, this will improve the mobility of patient. In the future, a lot of work could be done in the three main aspects of telemedicine systems to enhance the health care services. In the sensor layer wireless sensor network of wearable on invasive sensor units can be designed. Also we can increase the number of transmitted vital signs to have a complete picture of patient's case. For more improvement in telemedicine systems, many medical algorithms can be developed to help in patient diagnosis and early detection of cardiovascular diseases and real-time analysis of vital signs can be performed in the place where the vital signs are acquired. The latest achievement on a smart phone market provided an opportunity to integrate smart phones in telemedicine systems. Recently the smartphone with higher wireless connectivity having faster rate has came into picture and also the smart phone is enabled with higher sensors applications. For example, android based mobile phones patient monitoring application could be developed which allows doctors to monitor the health. In future such type of mobile based telemedicine system will be realistic and provide best medical facilities in remote places since 4G and 5G technologies plays a key role in this type of system.

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