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HEALTHCARE MONITORING SYSTEM USING WIRELESS SENSOR NETWORKS

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Abstract

Health observation of patients could be a common tsk in care areas from nursing homes to hospitals. Medical workers must monitor patients closely and collects their observation body parameters. This proposal can facilitate the medical workers to regulate the general state of monitored patients in autonomous, time period and remotely manner. the appliance of care wireless device networks to those eventualities might perform this job. Through a network it's doable to achieve all of the patients' nodes anytime anyplace as long as a network terminal is accessible. Here the most plan is to propose a reliable continuous observation resolution of hospitalized patients (in a hospital infirmary) supported a care wireless device network (HWSN) with quality support. The patients carry a batch of body sensors (according to their pathology needs) to gather their body parameters. Medical workers evaluates the general state of every patient and analyzes the values gathered by these nodes.

Keywords : Medical applications survey, wireless medical applications, wireless networks, sensing element networks, wireless applications, wireless homecare, Zigbee, Bluetooth, WPAN, Wi-Fi, patient management, CodeBlue, CIMIT, wireless medical solutions, MobileFi, IEEE 802.20

1.INTRODUCTION

Recently, interest in wireless systems for medical applications has been chop-chop increasing. With variety of benefits over wired2 of twelve alternatives, including: simple use, reduced risk of infection, reduced risk of failure, scale back patient discomfort, enhance quality and low value of healthcare delivery, wireless applications bring about exciting potentialities for brand new applications in medical market. Moveable devices like pulse monitors, pulse ox meters, spirometers and blood pressure monitors square measure essential instruments in medical aid. Historically, the sensors for these instruments square measure hooked up to the patient by wires; and also the patient consecutive becomes bed-bound. Additionally, whenever patient has to be moved, all monitor needs to be disconnected so reconnected later. Nowadays, all of those long jobs may be terminated and patients may be liberated from instrumentation and bed by wireless technology. Integrated wireless technology, these wireless devices. Continuous and pervasive medical observance is currently obtainable with the present of wireless aid systems and telemedicine services.

Wireless technology can be the simplest resolution for mass emergency things like natural or human-included disasters and military conflict wherever patients' records like previous medication history,

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identification and alternative important information square measure necessary. With the assistant of hand-held devices during which wireless network integrated, the number of time the doctors have to be compelled to determine the matter, trace back the medication history of the patient and consult fellow doctors will be reduced considerably. Moreover, databases of patients can|that may} be engineered up by continuous medical observation will be accessed and updated simply. As a result, the number of paper works needed and also the duplication of patient record can be born down. With all of those potentials, wireless systems for medical application square measure no longer solely centered by healthcare supplier and therefore the the} government however also by researches and trade. important educational and company resources are being directed towards researching and development of novel wireless aid systems. many innovative applications supported this technology square measure developed or being developed in analysis. during this paper, we are going to discuss many of these comes, lightness their architectures and implementation.

II. BASIC TECHNOLOGIES OF MEDICAL APPLICATIONS

The rising of the technologies extends the potential for exploitation of wireless medical application market. Nowadays, because of the large-scale wireless network and mobile computing solutions, like cellular 3G and on the far side, Wi-Fi mesh and WiMAX, caregivers will access into very important data anyplace and at any time inside the attention networks. the current of pervasive computing, consisting of RFID, Bluetooth, ZigBee and wireless detector network provides innovative medium for information transmission for medical applications

WLAN :

The standards of local area network was3 of twelve 1st introduced in 1997, specifically IEEE 802.11. The capacities of IEEE 802.11 standards evolved from 1- 2Mbps within the initial version to 54Mbps in IEEE 802.11a and IEEE 802.11b. IEEE 802.11a has a range of a hundred feet and 802.11b has coverage of 350feet outdoors and a hundred and fifty feet indoor. once the introducing of 802.11a and 802.11b, Wi-Fi alliance fashioned and began its work certifying wireless primarily based devices. Since that point, 802.11 have been developed a lot of additional. several extensions of 802.11 were discharged, together with 802.11g, additional in 2003 with capacities of 54Mbps transmission engaged on a pair of.4GHz band at vary of 350ft outdoors and a hundred and fifty feet indoors; 802.11n with higher throughput of up to 200Mbps; 802.11i, additional in 2004 with increased security; and 802.11s additional for Mesh Network.

WIMAX:

Based on the IEEE 802.16 standards, alleged Wireless MAN standards, WiMAX is made by the WiMAX Forum, which has strong-security wireless information transmission over long distance, up to 50km, with high rate, up to seventy Mbps, and high mobile

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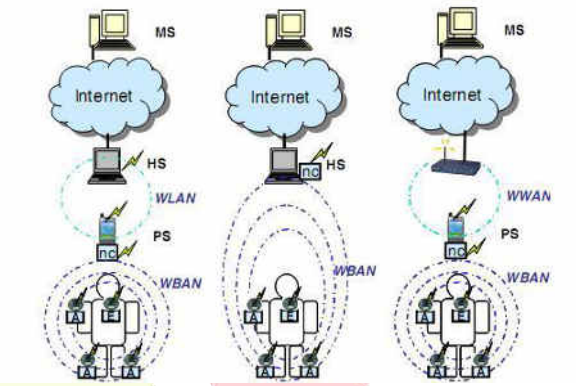
capability, up to 150km/hour. the quality is that the incorporation of many advanced radio transmission technologies like adaptative modulation and secret writing (AMC), adaptative forward error correction (FEC), well outlined quality of service (QoS) framework and orthogonal frequency division multiplexing (ODFM).

WPAN:

WPANs exploitation ZigBee or Bluetooth standards square measure gaining in quality, with wireless motes on the market from business. A number of physiological watching systems supported the motes are projected and deployed in real clinical settings. In addition to patient watching these systems will be used for patient pursuit in things wherever location data is essential, like mass casualty incidents. Another technology exploitation in WPANs is ZigBee, a supposed IEEE 802.15.4. The standard is AN ultra-low power, low-data rate that is employed for watching and dominant applications. Devices using ZigBee has but a hundred and twenty fifth life time in active standing. In most of the life, the devices square measure in sleep mode to save lots of device's power.

WBAN:

Recent technological developments in low-power integrated circuits, wireless communications and physiological sensors promote the event of small, light-weight, ultra-low-power watching devices. A body-integratable network, socalled WBAN, will be fashioned by desegregation these devices. WBAN with sensors overwhelming extraordinarily low power is employed to monitor patients in important conditions within hospital. Outside the hospital, the network will transmit patients' very important signs to their physicians over net in period of time. WBAN sometimes uses ZigBee, or UWB normal.



WWBAN deployment scenarios

E. Other technologies

Many alternative standards, technologies ar applied to medical applications, as well as RFID, sensing element network, 3G, 4G, and soon. during this section of the paper, we are going to establish in short these technologies. the primary RFID chips were approved by Food and Drug Administration in Oct 2004[RFID], that opens the door for applying RFID in4 of twelve medical applications. Since that point, variety of U.S. hospitals have begun implanting RFID tags into their patients to spot them. RFID isn't solely the economical technique to stay track medical equipments however even have potential in positioning patients and hospital staffs. sensing element networks are applying in varied aspects of treatment. By

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militarisation patients with tiny, wearable sign sensors, physiological standing of patients is obtained simply.

III. SYSTEM ARCHITECTURE

A. Overview of system architecture

The whole system design is shown in figure. it's composed of medical sensing element nodes, a hand-held personal server, a hospital server and connected services. during this system, medical sensing element nodes square measure wont to collect physiological signals including bio-signals, medical pictures, and voice signals. These obtained signals square measure fed into the non-public server through wireless personal area network (WPAN). The wireless communication between the sensing element nodes and the hand-held personal server uses IEEE 820.15.4/Zigbee commonplace. once inbound at the hospital server, the information square measure either keep within the clinical information base, or obtainable to a practician through a hospital's native space network (LAN). Then clinicians will analyze the physiological information and provides identification advices consequently

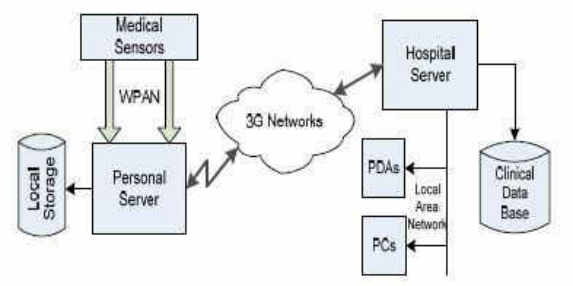

Fig: System Architecture

B. Medical sensors & wireless personal area network

The main tasks of the medical sensors area unit to gather physiological signals and send them to the private server. Typical medical sensors and characteristics of the signals area unit shown in table one. during this system, the sort and variety of medical sensors area unit climbable betting on applications. many ordinarily used medical sensors area unit shortly introduced as follows:

Table.1 Characteristics of biomedical signals

Signal	Frequency Range	Signal Range
Electrocardiograph (ECG)	0.05~100 Hz	0.01~5 mV
Electroencephalograph (EEG)	0.5~60 Hz	15~100 mV
Electrooculogram (EOG)	0.5~50 Hz	N/A
Electromyogram (EMG)	0.5~60 Hz	N/A
Heart Rate	45~200 beats/min	N/A
Breathing Rate	12~40 breaths/min	N/A
Blood pressure	dc-60 Hz	40~300mmHg

C. The personal server

Previous descriptions show that the private server plays a vital role in overall telemedicine system. it's designed as a hand-held unit which might be wont to communicate parallels with a series of ascendable medical device nodes in addition as a remote hospital server. It maintains a

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communication bridge between patients and therefore the hospital and information could also be sent to the remote hospital server for more process if necessary. In general, the private server performs the subsequent tasks:

1) formatting and configuration of medical device nodes.
2) aggregation information from medical sensors.
3) process physiological information and displaying results.
4) Keeping reliable communication with remote hospital server.
5) Providing a graphic programme.

IV. SENSOR NODES AND CCU HARDWARE DESIGNS

Sensor nodes area unit designed to gather raw signals from a person's body. The signal from a person's body is typically weak and coupled with noise. First, the signal ought to undergo amplification and filtering method to extend the signal strength, and to get rid of unwanted signals and noise. when that, it'll undergo associate degree Analog to Digital conversion (ADC) stage to be born-again into digital for digital process. The digitized signal is then processed and keep within the silicon chip.The silicon chip can then pack those information and transmit over the air via a transmitter.

V. POTENTIALS AND CHALLENGES OF WIRELESS MEDICAL APPLICATIONS

With the advancement of wireless technology, wireless devices are often accustomed cut back medical errors, increase medical care quality, improve the potency of caregivers, reduce the caregiver-lacking state of affairs, and improve the comfort of patients. though the technology has found ways in which into varied fields, medical domain has terribly strict quality and assurance necessities, that causes several challenges that ar long-faced once implementing and in operation the systems. The following a part of the paper are reserved to spot potentials and challenges of tending system mistreatment wireless technology.

A. Potentials of wireless technology in medical application

Wireless inside-body observation could be a hot application of wireless network in patients' observation. Using WBAN technologies to transmit information from observation devices, like Capsule medical instrument, to outside body, these applications used to monitor the biological process organs like the little viscus by video or ordered image information. The system uses IEEE 802.15.6 and wearable WBAN to ensure the standard of system. Details regarding Capsule medical instrument are going to be given within the later section of paper. Operation helping is extremely new application of wireless network [CIMIT]. In Associate in Nursing operation, doctors have to monitor the patient's very important signs

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to own timely actions. These signs are often obtained by applying to the patient adhesive electrodes in order that the signs square measure transmitted over wires to show monitors. the big range of wires used around the operation table prevents the medical team's access to the patient. A device displays patient's signals while not adhesives or wires. though time period patient observance field isn't a brand new topic in wireless medical applications, researchers and industries area unit finance lots of effort and cash thereto. These applications essentially use medical specialty sensors monitor the physiological signals of patients such as electro-cardiogram (ECG), blood element level, blood pressures, blood sugar, activity, weight, heart rate, EMG, ECG, oxygen saturation, etc. 5 of 12 Home monitoring systems for chronic and elderly patients is rapidly growing up in quantity and quality . Using the system can reduce the hospital stay of patient and increase patient safety and mobility.

B. Challenges of wireless technology in medical application

The use of wireless technologies in medical environments is transferral major blessings to the prevailing attention services. However, these have many key analysis challenges like varied forms of network communication infrastructure, fault-tolerance, information integrity, low-power consumption, transmission delay, node failure, etc. dependableness is one of the foremost vital factors in an exceedingly productive attention system. to confirm this issue, system designers need to care about adaptation of nodes once its location, affiliation and link quality is modified. completely different network communications infrastructure ought to be employed in acceptable state of affairs. for instance, with risky patients, the services with higher QoS should be used. The mentioned challenges square measure related to technical implementation. However, there square measure several alternativechallenges related to readying of a brand new technology. Specifically, the new system ought to be low value and not interfere with existing infrastructure. thus managing interference between the recent system and also the new one and exploitation spectrum properly square measure challenges of wireless technology applied to medical applications. From patient's facet, one of the most important problems is however snug they feel once exploitation these new applications. Therefore, the applications must be not only helpful but also unobtrusive, specifically little, light-weight, etc. Last however not least, patients' information must be private and secure, but remain accessible to authorized persons.

VI. STANDARDS USED IN WIRELESS MEDICAL APPLICATIONS

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Coming along with a rapid increase of wireless systems for medical applications, significant academic and corporate resources are being directed towards development of standards. Significant progress in issuing industrial standards has been made by organizations, such as IEEE, Bluetooth SIG, ISO, ASTM, etc.

A. IEEE standards

A set of standards, so-called ISO/IEEE 11073 or X73, identifies nomenclature, abstract data models, service models, and transport specifications for interoperable bedside devices. The standards' primary goals are "providing interoperability for patient-connected medical devices and facilitating the efficient exchange of vital signs and medical device data in all health care environments".

B. ISO Standard

Many standards issued by ISO to provide guidance for implementation, use and management of wireless communication and computing equipment in healthcare facilities "The recommendations given recognize the different resources, needs, concerns and environments of healthcare organizations around the world, and provide detailed management guidelines for healthcare organizations that desire full deployment of mobile wireless communication and computing technology throughout their facilities".

C. Bluetooth SIG standards

The Bluetooth Special Interest Group (SIG) issued the Medical Device Profile for Bluetooth wireless technology at Medical, the 39th World Forum for Medicine in Düsseldorf (14-17 November 2007) [Bluetooth]. A Bluetooth profile provides guideline of how different applications use Bluetooth wireless technology to set up a connection and exchange data. The profile is developed by the Medical Devices Working Group to ensure that devices used in medical, health and fitness applications can transfer data between devices in a secure and well defined way via Bluetooth wireless technology.

D. ASTM standards

ASTM issued ASTM F1220-95(2006), a standard guide for emergency medical services system (EMSS) [ASTM F1220].

The standard and its sub-standards provide guide for telecommunication practices, required performance standards to support all of the functions of community EMSS. In addition, the standards identify state planning goals and objectives for EMSS communications.

CONCLUSIONS

This paper demonstrates the employment of WSNs as a key infrastructure enabling unassertive, continual, ambulatory health monitoring. This new technology has potential to supply a large range of advantages to patients, medical personnel, and society through continuous monitoring in the ambulatory setting, early detection of abnormal conditions, supervised rehabilitation, and potential information discovery through knowledge mining of all gathered data. We have delineate a general WWBAN design, vital implementation problems, and our paradigm WWBAN based on ready-made wireless device platforms and custom-designed electrocardiogram and motion sensors. we've addressed several key technical issues like sensor node hardware architecture, package design, network time

synchronization, and energy conservation. additional efforts area unit necessary to enhance QoS of wireless communication, responsibility of device nodes, security, and standardization of interfaces and ability. additionally, additional studies of different medical conditions in clinical and mobile settings area unit necessary to see specific limitations and possible new applications of this technology.

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