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RESEARCH ARTICLE

Wireless Body Area Sensor System for Monitoring Physical Activities Using GUI

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Abstract

Wireless Sensor Networks (WSNs) technologies are considered as one of the key of the research areas in computer science and healthcare application industries. Sensor supply chain and communication technologies used within the system and power consumption therein, depend largely on the use case and the characteristics of the application. Recent technological advances in sensors, low power integrated circuits, and wireless communications have enabled the design of low-cost, miniature, lightweight, intelligent physiological sensor platforms that can be seamlessly integrated into a body area network for health monitoring. Wireless body area networks (WBANs) promise unobtrusive ambulatory health monitoring for extended periods of time and near real-time updates of patients' medical records through the Internet. We designed the user interface to both address the needs of the research prototype WBAN and support a deployed WBAN system. The user interface must provide seamless control of the WBAN, implementing all the necessary control over the WBAN. Authors conclude that Life-saving applications and thorough studies and tests should be conducted before WBANs can be widely applied to humans, particularly to address the challenges related to robust techniques for detection and classification to increase the accuracy and hence the confidence of applying such techniques without physician intervention.

Keywords: Wireless body area sensor network, physiological sensing, data preprocessing, wireless sensor communications, Activity Monitors, Sensors.

Introduction

We will present, discuss and compare different short-range and long-range wireless communication technologies which could be used in a WBAN system for remote body monitoring. The chapter is divided into two major parts: The first part provides a technical overview of several short-range standard wireless technologies as candidates for intra-BAN communications (i.e., for the communications between the entities within a Body Area Network), and highlights their advantages and disadvantages from a BAN perspective. At the end of the first part, we will provide a side-by-side comparison of the candidate technologies and give motivations for our choice of using ZigBee in the proposed WBAN system. The second part presents different long-range cellular wireless technologies which could be used for extra-BAN communications— that is, for the communications between a BAN and other external Wide Area Networks (WANs) like cellular mobile networks and the Internet. It also gives the pros and cons of each of the technologies in terms of throughput and latency. At the end of this part, we will provide a comprehensible side-by-side comparison of the long-range wireless technologies, and give the reason why we have used GPRS.

Short-Range Wireless Technologies for intra-BAN Communications

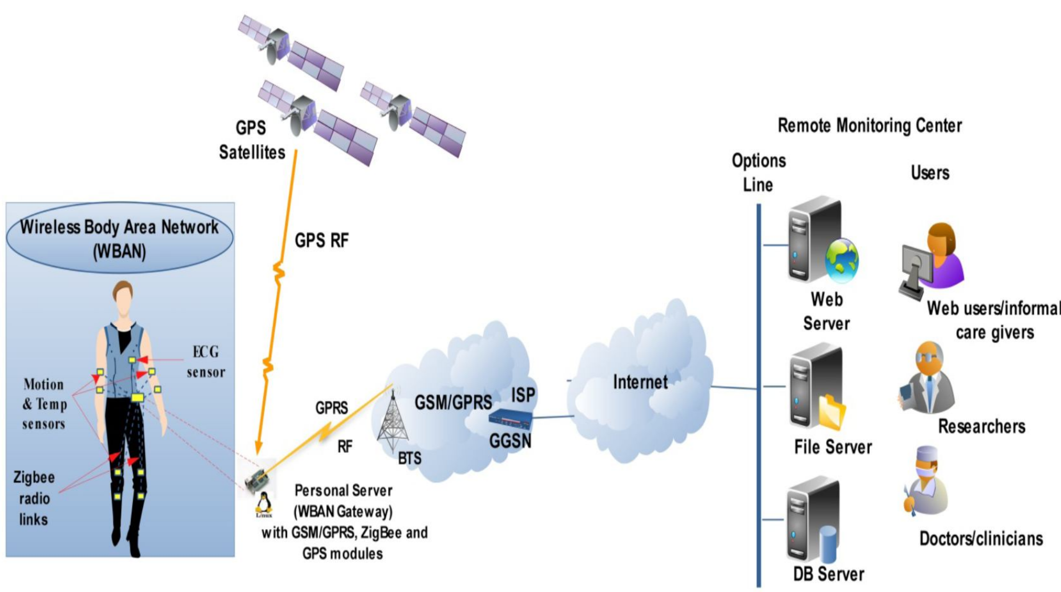
In this part, we will provide a technical overview of four different short-range wireless communication technologies as candidate for intra-BAN communications. We will first present three standard WPAN (Wireless Personal Area Network) technologies: Bluetooth, Ultra Wideband (UWB), and ZigBee. Finally, we will provide an overview of WiFi which is a WLAN (Wireless Local Area Network) technology and address the major drawbacks of this technology from a BAN perspective.

Bluetooth – IEEE 802.15.1

Bluetooth is a short-range wireless communication technology originally developed by Ericsson and its partners in the Bluetooth SIG (Special Interest Group), which later has been standardized by the IEEE 802.15 WPAN Task Group 1(TG1) [32], and given a standard name, IEEE 802.15.1. Bluetooth was initially intended as a cable replacement, but later has been extended to be used in different networking scenarios and applications. In each Bluetooth device, there is a radio transceiver microchip. When two Bluetooth enabled devices want to exchange data between them, they will use their radio transceivers to transmit and receive radio signals (carrying the data) according to the Bluetooth protocol. Since Bluetooth uses radio signals for communications which can penetrate solid objects (like walls, doors, etc) and get propagated in all directions, Bluetooth devices do not need to be in line of sight of each other in order to communicate.

WBASN signal processing and communication

Recent improvements in signal processing and very-low-power wireless communications have motivated great interest in the development and application of wireless technology in healthcare and biomedical research, including Wireless Body Area Sensor Networks (WBASNs). Figure 1 shows a Weans Signal Processing and Communications (WSPC) framework. WSPC framework consists of three major components for real-time applications, namely Sensing and Preprocessing (SAP), Application-specific WBASN Communication (AWC) and Data Analysis and Feedback (DAF) to the patient. SAP contains a number of sensors for capturing a raw data related to medical phenomena including blood pressure, respiratory rate, ECG and EEG. AWC utilizes application-specific wireless protocols such as ZigBee (Cao *et al*., 2009) or Bluetooth (Kristina,) to transfer data from body sensors to the gateway, less commonly, in case of high data rates without compression, Wi-Fi protocol may be utilized for intensive data transmission. Analysis of raw data including, possibly, detection and classification of medical anomalies will occur at the DAF component, providing strict and accurate criteria for the physician to make recommendations that maybe sometimes fed back to the patient to provide proactive treatment.



System Structure Diagram

Background work

In this section we present a hypothetical case study to illustrate the usefulness of our proposed system. The patient presented is fictitious, but representative of common issues a recovering heart attack patient would face. We discuss the issues and describe how our system can be used to both address the problem and provide advantages over typical present day solutions. Juan Lopez is recovering from a heart attack. After the release from the hospital he attended supervised physical rehabilitation for several weeks. His physicians prescribed an exercise regime at home. During the physical rehabilitation it was easy to monitor Juan and verify he completed his exercises. Sadly, when left to his own self-discipline, he does not rigorously follow the exercise as prescribed. He exercises, but is not honest to himself (or his physician) as to the intensity and duration of the exercise. As a result, Juan's recovery is slower than expected which raises concerns about his health prognosis, and his physician has no quantitative way to verify Juan's adherence to the program. Our health monitoring system offers a solution for Juan. Equipped with a WBAN, tiny sensors provide constant observation of vital statistics, estimate induced energy expenditure, and assist Juan's exercise. Tiny electronic inertial sensors measure movement while electrodes on the chest can measure Juan's heart activity. The time, duration, and level of intensity of the exercise can be determined by calculating an estimate of energy expenditure from the motion sensors. Through the Internet, his physician can collect and review data, verify Juan is exercising regularly, issue new prescribed exercises, adjust data threshold values, and schedule office visits. Juan's physician need not rely on Juan's testament, but can quantify his level and duration of exercise. In addition, Juan's parameters of heart rate variability provide a direct measure of his physiological response to the exercise serving as an in-home stress test. Substituting these remote stress tests and data collection for in-office tests, Juan's physician reduces the number of office visits. This cuts healthcare costs and makes better use of the physician's time. In urgent cases, however, the personal server can directly contact Emergency Medical Services (EMS) if the user subscribes to this service.

Graphical User Interface

We designed the user interface to both address the needs of the research prototype WBAN and support a deployed WBAN system. The user interface must provide seamless control of the WBAN, implementing all the necessary control over the WBAN. In designing the user interface we identified five design goals that the PS must support:

- Node Identification
- Configuration of sensors
- Calibration of sensors
- Graphical presentation of Events and Alerts
- Visual Real-Time Data Capture (oscilloscope-type function)

Any control or feedback capability provided to the user interface must be implemented using the WBAN communication protocol. The protocol provides the tools enabling control of the WBAN and defines what can and cannot be accomplished. We strived to keep a simple set of WBAN message types and still implement complex user interface functions and application flexibility.

Sensor Node Identification, Association and Calibration

Sensor node identification requires a method for uniquely identifying a single sensor node to associate the node with a specific function during a health monitoring session. For example, a motion sensor placed on the arm performs an entirely different function than a motion sensor placed on the leg. Because two motion sensors are otherwise indistinguishable, it is necessary to identify which sensor should function as an arm motion sensor and which sensor should function as a leg motion sensor. In order to make node identification user friendly and intuitive, we developed a scheme taking advantage of the inherit motion sensing capabilities of each sensor. We let the user arbitrarily place a motion sensor on his arm or leg, and then we are able to identify and associate the sensor with

the proper function through a series of easy to follow instructions. Our form instructs the user to "move the arm sensor" or in a denser WBAN, "move the left arm sensor". This interface is more intuitive from a user's perspective, but was implemented using only WBAN protocol event messages already implemented for event processing. While the user is moving the sensor, the PS broadcasts an *ACTIS_EVENT_MASKMSG* requesting all sensors to report activity level estimations. Based on the largest activity estimate returned, the PS can identify which sensor the user is moving and associate it with the appropriate function. The same message can also used be for configuration. Although the user interface presents these as two distinct functions, they are implemented using the same message. Event mask messages are also used to determine the degree of signal processing and the specific events of interest during a given health monitoring session. This approach allowed us to minimize the complexity of the communication protocol and still provide rich feature set to the application designer and user. The Personal Server and ActiS nodes support two types of calibration. The first type is a sensor calibration; its purpose is to accommodate sensor-to-sensor variations and the exact nature of the calibration is sensor dependent. This is typically a one-time calibration and not expected to be a long term function of the user interface, but certainly necessary for sensor preparation. The second type of calibration is a *session calibration*, required immediately prior starting a new monitoring session to calibrate the sensor in the context of its current environment. For example, Activity sensors on the leg might need an initial calibration of default orientation on the body.

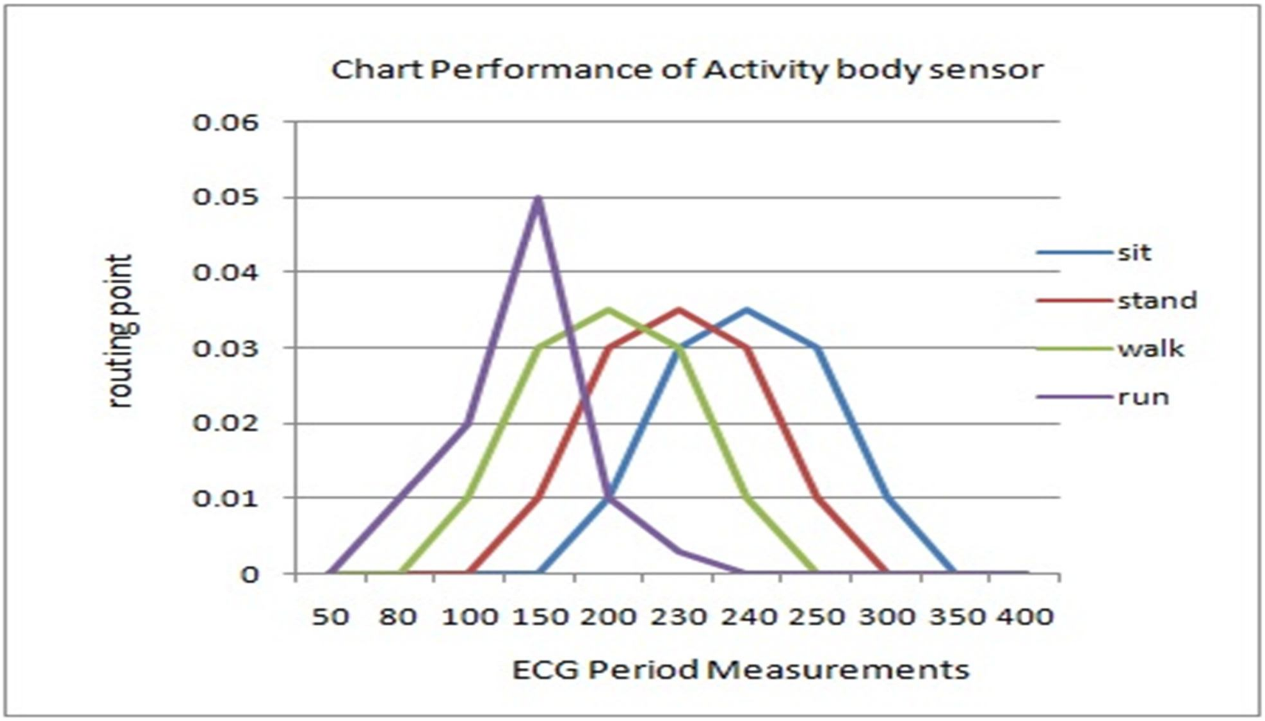
Event Processing

The Personal Sever is solely responsible for collecting data and events from the WBAN. Each sensor node in the network is sampling, collecting, and processing data. Depending on the type of sensor and the degree of processing specified at configuration, a variety of events will be reported to the Personal Server. An event log is created by aggregating event messages from all the sensors in the WBAN; the log must then be inserted into a session archive file. The Personal Server must recognize events as they are received and make decisions based on the severity of the event. Normally R-peak or heartbeat events do not create alerts, and are only logged in the event log. However, the Personal server will recognize when the corresponding heart rate exceeds predetermined threshold values. The Personal Server can alert the user that his heart rate has exceeded the target range.

Real-time Data Capture

Although all sensors in our system perform on-sensor processing and event detection, there are events where processed and summary events are not sufficient and real-time raw signal capture is necessary. During development, it was invaluable to be able to monitor sensor data in real-time. For heart rate sensors we implemented a single graphical ECG trace; for motion sensors we implemented three traces representing x, y, and z acceleration components on the same graph, as represented in This captured data is also stored to a file and can be analyzed off-line to improve step detection algorithms. In most cases, the algorithms were first developed on sample data sets previously recorded. When the algorithms worked well on the sample data sets, they were then implemented on the embedded sensors to run in real-time.

Result Analysis



Even in a deployed system where intelligent sensors analyze raw data, process, and transmit application event messages, there may be cases where it is necessary to transmit raw physiological data samples. Such cases become apparent when considering a deployed ECG monitor. When embedded signal processing routines detect an arrhythmic event, the node should send an event message to the PS which will then be relayed to the appropriate medical server. GUI WBAN systems that monitor vital signs promise ubiquitous, yet affordable health monitoring. We believe that WBAN systems will allow a dramatic shift in the way people think about and manage their health – in the same fashion the Internet has changed the way people communicate to each other and search for information.

Conclusion

GUI WBAN systems that monitor vital signs promise ubiquitous, yet affordable health monitoring. We believe that WBAN systems will allow a dramatic shift in the way people think about and manage their health – in the same fashion the Internet has changed the way people communicate to each other and search for information. This shift toward more proactive preventive healthcare will not only improve the quality of life, but will also reduce healthcare costs. The initial test results for this WBAN prototype, as well as expected technological advances, indicate the tremendous potential of WBAN technology for ambulatory monitoring. Several emerging technologies, such as extremely low power wireless MEMS transceivers promise further performance improvements of 2-3 orders of magnitude. However, a number of challenging tasks should be further addressed in an effort to make this technology affordable, robust, secure, and easy to wear.

References

[1] R.S.H. Istepanian, E. Jovanov, Y.T. Zhang, "Guest Editorial Introduction to the Special Section on M-Health: Beyond Seamless Mobility and Global Wireless Health-Care Connectivity," *IEEE Transactions on Information Technology in Biomedicine*, Dec. 2004, 8(4): 405 - 414.

[2] D. Raskovic, T. Martin, E. Jovanov, "Medical Monitoring Applications for Wearable Computing," *The Computer Journal*, July 2004, 47(4): 495-504.

[3] B.G. Steele, B. Belza, K. Cain, C. Warms, J. Coppersmith, J. Howard, "Bodies in motion: Monitoring daily activity and exercise with motion sensors in people with chronic pulmonary disease," *Journal of Rehabilitation Research & Development*, Sep/Oct 2003, Supplement 2, 40(5): 45 – 58.

[4] S.W. Lee, K. Mase, "Activity and Location Recognition Using Wearable Sensors," *Pervasive Computing*, July-Sep. 2002, 1(3): 24 -32.

[5] I.P.I. Pappas, T. Keller, S. Mangold, M.R. Popovic, V. Dietz, M. Morari, "A Reliable Gyroscope-Based Gait-Phase Detection Sensor Embedded in a Shoe Insole," *IEEE Sensors Journal*, Apr 2004, 4(2): 268-274.

[6] Ahmad, N.F., D.B. Hoang and M.H. Phung, 2009. Robust preprocessing for health care monitoring framework. Proceeding of the 11th IEEE International Conference on e-Health Networking, Applications and Services, Dec. 16-18, IEEE Xploor, Sydney, pp: 169-174.

[7] Bourbakis, N.G. and A. Pantelopoulos, 2010. A survey on wearable sensor-based systems for health monitoring and prognosis. IEEE Trans. Syst., Man Cybernetics-Part C: Appli. Rev.40: 1-12.

[8] Bsoul, M., H. Minn and L. Tamil, 2010. Apnea medassist: Real-time sleep apnea monitor using single-lead ECG. IEEE Trans. Inform. Technol. Biomed., 15: 416-427.

[9] Cao, H., V. Leung, C. Chow and H. Chan, 2009. Enabling technologies for wireless body area networks: A survey and outlook. IEEE Commun. Mage., 47: 84-93.
[10] Cao, H., X. Liang, I. Balasingham and V.C.M. Leung, 2009. Performance analysis of ZigBee technology for wireless body area sensor networks. Lec. Notes Institute Comput. Sci. Soc. Inform. Telecommun. Eng., 28: 747-761.

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