# Mixed Signal Interface chip for Wearable Healthcare System

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*Abstract :-* Smart sensors, which are created by combining sensing materials with integrated circuitry are being considered for several biomedical application such as a Glucoselevel, Temperature, ECGetc. Practical usability of the majority of current wearable body sensor systems for multiple parameter physiological signal acquisition is limited by the multiple physical connections between sensors and the data-acquisition modules. In order to improve the user comfort and enable the use of these types of systems on active mobile subjects, a wireless body sensor system that incorporates multiple sensors on a single node is proposed . The system must be suitable for longer-term monitoring of the subjects, such as continuous wear and autonomous operation up to several days without replacement of the power source. Thus power consumption is a major challenge in these applications.
The sensing and read-out of the signals may draw a significant part of the power budget in today's sensor nodes in WBAN, especially when the number of signals or channels is increasing. Thus, reducing the power required for signal extraction is an important challenge. Many system-on-chip (SoC) solutions have been presented for multiparameter sensor systems, but these do not offer application engineers the freedom of tailoring modules in their system to suit their specific application.

Efficient wireless-networked health monitoring requires integrated operation of multiple platforms. In-body medical sensors can network using low-range personal area communication standards, such as Zigbee/802.15.4. The data collection and distribution back-haul requires long-range, high-data rate technologies (WiFi), and finally a mobile Communication interface is essential for anywhere anytime alarming about emergencies. Enabling seamless information dissemination across these heterogeneous wireless platforms is crucial for efficient remote health monitoring.

*Keywords:* Sensors ,WBSN,Health Care , wireless networking

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## I.   INTRODUCTION

Recently, the Wireless Body Sensor Network (WBSN) system has been a popular topic for researchers. Typical WBSN applications include the medical and health applications such as vital signs monitoring, fitness and medical care . Such a network consists of aModerate quantity of low-power, resource-constrained miniature devices (called the sensor nodes) placed in, on or around the body which are usually wirelessly controlled by a portable central control device.
Fig. 1 shows some typical applications in WBSN. In these applications, rather than the peer-to-peer self-organized network topologies, the single-hop
star network topology and the master-slave protocol are commonly adopted to lower the system complexity and power consumption
as well [1], [4]. A typical WBSN is usually composed of a portable device which serves as the master node for central around, or inside the human bodies that act as the slavenodes. Compared to the master node, the slave nodes have more stringent constraints in terms of power consumption and size limitation. And this work mainly focuses on the slave sensor nodes in the WBSNs.control, and a number of miniaturized sensor nodes placed.
Typical WBSN slave sensor nodes can be used for biomedical information acquisition, signal pre- processing, data storage, and wireless transmission. This type of slave sensor node is called the sensing node. In addition, the function of sensor nodes can be expanded to medical treatments, such as drug delivery andnerve stimulating [5],

and this type of slave sensor node is called the stimulating node. One difference between the two types of nodes is that the functions of a sensing node are usually periodicallyperformed, while the functions of a stimulating node can be either periodical or event driven.
The specifically designed passive RF receiver can harvest energy from the RF signals in the space (transmitted by the master node which is not power critical), and hence, the passive standby mode consumes zero power ideally. The active standby mode can be used for the sensing and stimulating nodes. As a contrast, the passive standby mode can find its perfect use for the stimulating nodes, since the event-driven stimulating nodes can be woken up on demand without any response latency, while Consuming zeropower.

In-body medical network may require only moderate data rates and low radio ranges, which can be developed with personal area communication standards such as Zigbee/ 802.15.4. The data collection and distribution back-haul requires long-range and high-data rate technologies (Wi Fi) for wide area connectivity and managing data from several hundred sensors. A mobile communication interface is essential for anywhere anytime alarming about emergencies. These diverse wireless platforms cannot operate autonomously for efficient health tracking. This paper provides a practical implementation of the software and hardware solutions required to enable an integrated health monitoring platform.
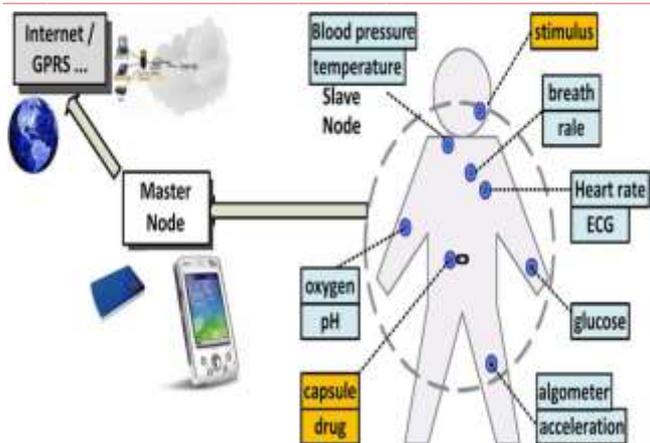
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Fig 1. System diagram of typical WBSN applications

## II. WEARABLE HEALTHCARE

### A. System Applications

There is a wide range of applications for Wearable Healthcare system in supporting medical and healthcare services. By attaching Wearable devices to patients, vital or healthcare data can be automatically collected, which is then forwarded to a nurse centre for patient state monitoring. The Benefit of this scenario is that it can reduce the working load of nurses and result in increased efficiency on patient management.

A reasonable range between these sensors with a receiver carried by the person is set in advance. When the person forgets his belongings and leaves them over the pre-set range, warning signal is generated automatically. Furthermore, in advanced applications, cameras can be attached to a people with visual disability. Pictures taken by cameras are sent to a receiver carried by the people, where they are converted to audio signal to provide guidance to the people. The similar principle can be used for assisting people with speech disability. Here, sensors to catch finger and hand movements are used. The obtained information caught by sensors is converted into speech.

## III. MULTISENSOR INTERFACING

Depending on the application and the operation of the sensor nodes in WBSN, the components of the sensor nodes varies accordingly. There are several sensor nodes, which typically comprises of a wireless transceiver, a processing unit and different types of physiological sensors like electrocardiogram (ECG) sensor, electromyography (EMG) sensor, electroencephalography (EEG) sensor, blood pressure sensor, tilt sensor, breathing sensor, movement sensor, thermometer, etc, deployed on the human being.

In most clinical and research settings, parameters, such as ECG, heart-rate, cardiac vibration, blood oxygen level, blood pressure, respiration, body temperature, body movement, among many others, are commonly obtained through multiple independent bench instruments. When simultaneous and synchronous recording is necessary, a

separate signal-acquisition instrument is often utilized to record the multiple signals. The large size and large number of instruments required for multiparameter physiology analysis often renders mobile and continuous monitoring on active subjects impossible. To address this challenge, for multiparameter body activity and vitals monitoring, a small, lightweight, thin, flexible, one piece, wireless multisensor node is used .

## IV. MULTISENSOR INTERFACING MODULE DESIGN CHALLENGES

### A. Energy Efficiency

The total energy consumption of sensor needs to be drastically reduced to allow energy autonomy. The sensing and read-out of the signals may draw a significant part of the power budget in today's sensor nodes in WBAN, especially when the number of signals or channels is increasing. Thus, reducing the power required for signal extraction is an important challenge here [4].
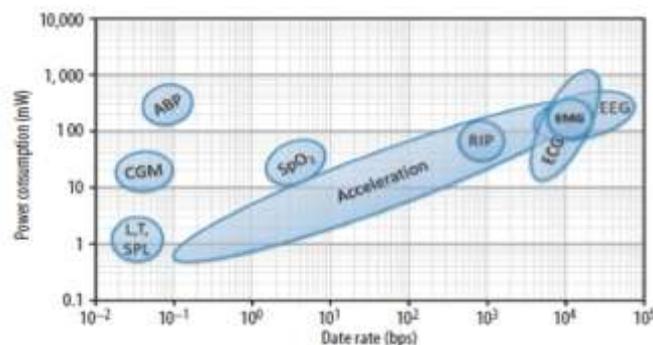


Figure 3 . Average power consumption

### B. Size

To achieve social acceptance, WBSN nodes must be extremely non-invasive, and a WBSN must have fewer and smaller nodes The overall size and weight of sensor nodes should be tailored to the human body.

### C. Reliability

The acquisition of bio-potential signals, namely ECG, EMG and EOG signals, presents an interesting challenge as the signal amplitudes are in the µV range. Various noise sources, such as electrode offset voltage and interference from power-lines, requires high-performance readout circuit design that is capable of rejecting such aggressors while amplifying the weak bio-potential signals.

The signal processing interface between the medical sensor and wireless transceiver is crucial for faithful regeneration of the waveforms at remote end. The voltage measure of physiological condition from medical sensors is typically very small and has to be signal conditioned for wireless transmission. We are developing a medical-signal conditioning interface using Programmable System on Chip

(PSoC) that will allow for rapid changes to Component design through software programming.

### D. Intelligence

The intelligence should be added to sensor signal conditioning and processing so that it is capable of efficiently transferring captured signal data or extracted parameters continuously or on an event-triggered basis. Intelligence could also be introduced by wireless communication.

### E. Sensor Positioning

For distinguishing motions, an accelerometer/gyroscope array with tens of sensors can be deployed. This raises questions for positioning and noise reduction techniques. Proper positioning reduces the number of accelerometers/gyroscopes needed and the resulting data rate.

## V.    NETWORK ARCHITECTURE

The logical architecture of the implemented health monitoring network is shown in figure 4. It comprises three major components:



Figure 4. Integrated Health Monitoring Network

### A. Data Sensing And Transmission

Moduleimplements the user-end, where certain human physiological condition is sensed periodically, processed and is prepared for telecommunication.

### B. Data Colletion/ Storage & Distribution

Module represents the central medical server, which collects and stores all patient information for centralized processing and future retrieval. The server will be interfaced to a back-haul network for wide-area distribution (within and between hospitals).

### C. Mobile

Component implements the alarming interface, which makes the healthcare providers independent of the need to be logged into server all the time for emergency tracking. The following sections explain each component in detail.

## VI.    CENTRAL DATA COLLECTION

The health data from the Zigbee sensor network is collected centrally for storage, collaborative processing and future retrieval. The back-haul network represents the collection and distribution location of all patient information. In our network, the medical sensor information is distributed to the back-haul server network through a base-station sensor that is connected through USB port to a PC or PDA or both. eBox 2300 [11] is used as the PDA/smart-phone emulator, which provides Windows Mobile software development environment.

Recent advancements in MEMS technology allow for penny-sized motes with efficient computing (upto 400MHz) and transmission capabilities (upto 100m), and thus a motebased wireless interface would not drastically increase the size of in-body medical components. Local processing capabilities
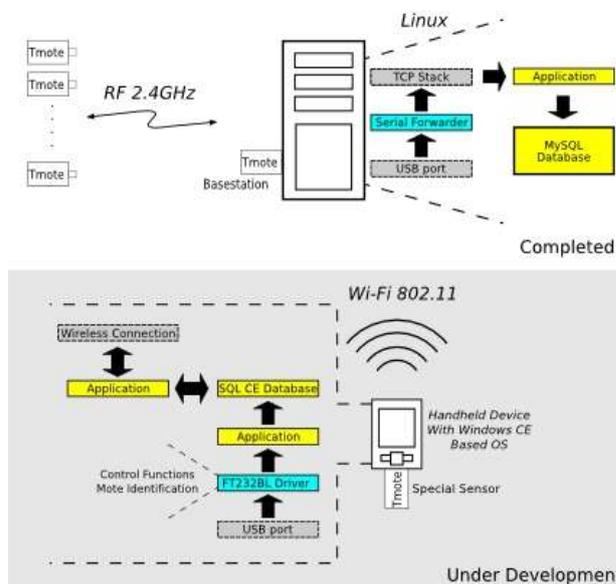will enable local biomedical signal analysis,



Figure 5.Data Extraction from Sensor Mote to PC/mobile-devices

## VII.    CONCLUSION

A prototype WBSN system was built to verify the design. The measurement results show that prototype WBSN with the designed ASIC can operate efficiently as expected. In addition to the work-on-demand capability, the special

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passive standby mode offered by this design shows great advantage in terms of the standby power for the sensor nodes in the WBSN for medical applications.

key issues in WSBN / WSN, and the application specific requirements have been discussed. And then a sensor node architecture with a hybrid of active / passive RF transceivers is proposed. Adopting the passive RF, the "real-time" demand in the medical care purpose can be satisfied with no extra energy induced in the sensor nodes, solving the problems that tradeoff occurs between low-power and "real-time" wakeup in WBSN. It is especially suitable for long-term standby stimulus (or drug delivery) sensor node in the medical application

In this paper, we provided a implementation of an Integrated healthcare network that combined the advantages of 802.15.4, 802.11 and mobile technologies for efficient remote health monitoring and alarming. The crucial gap that needs to be filled is the appropriate software interface Development for wireless platform integration. In this work, we developed drivers that enabled seamless information flow across the 802.15.4, 802.11 and mobile platforms. Also, introducing mobile component is crucial for handling Emergency situations. Mobile health monitoring will allow for patients to be monitored without being confined within hospital environments.

## References

[1] Xiaoyu Zhang, Hanjun Jiang, Lingwei Zhang, Chun Zhang, Zhihua Wang, and Xinkai Chen, "An Energy-Efficient ASIC for Wireless Body Sensor Networks in Medical Applications" IEEE Transactions on Biomedical circuits and systems, vol. 4, no. 1, February 2010

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