Design 08-009

作品名稱

生醫網路上身系統

Bio-medical ntra-body communication SoC networking for biomedical applications

隊伍名稱

生醫網路上身隊 Bio-medical networking on body

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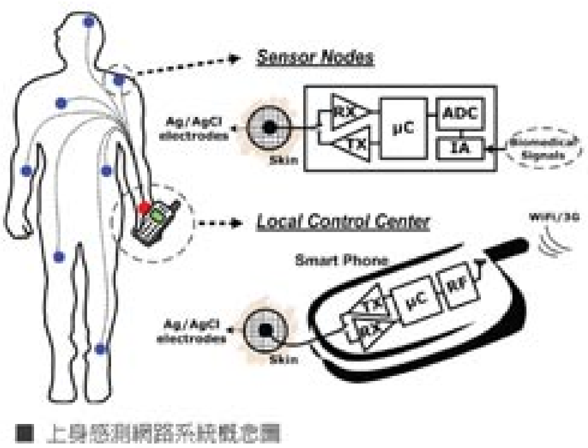
作品摘要

本隊研發出一高度整合之生醫網路單晶片，其具備一專為人體傳輸感測網路(intra-body sensor network)設計之特殊通訊協定，此系統單晶片可應用在位於身體各處之感測點，由近區控制中心(Local Control Center)來控制其行為。不同於一般無線電以空氣作為傳輸媒介，而是以皮膚為媒介，由於人體和空氣相較之下為一較佳之導體，透過人體來通訊，可減低通訊時所消耗之功率，延長感測點的使用時間，且無天線的需求因此感測點的體積可以更小，對於目前越來越多的可攜式應用產品需求，提供了非常好的發展方向和潛力。控制中心可以使用智慧型手機或一手機配合所設計之收發機來實現，最後傳送到遠端的醫院進行資料判讀或處理，醫院或醫生也可以透過電腦來命令感測網路啟動感測點裡的電路並傳送生醫資訊進行監控。可以透過感測點上的電極片收發信號，而控制中心也使用另一電極片控制或收集所有感測點所取得的生醫資訊，最多可同時支援128個感測點。其中感測網路協定採用星狀拓璞結構(star topology)以減少感測點控制電路的複雜度及資訊的延遲時間，也使得控制中心能夠最佳化每一個感測點之電能使用效率。



■ 上身感測網路系統概念圖

Abstract

This work presents a fully integrated SoC associated with a custom-designed hardware-implemented communication network protocol for intra-body sensor network applications. Since human body acting as the transmission medium has lower loss than the air, human body communication (HBC) technique is preferred for the body area network. Moreover, the spectrum capacity in the air is limited and crowded, and the communication channel is interfered easily by adjacent channels. Therefore it can be easily envisioned that the power consumption of the SN in the HBC system is potentially much lower than that in the wireless communication system. Furthermore, the antennas are not needed in the HBC system because of its inherent wired-communication characteristic and hence the HBC system has the benefit of small form factor and thus is more promising for wearable or implantable purposes.

The BBSN is a body sensor network specialized for biomedical signal detection and transmission on the body. The concept of BBSN is depicted in Figure, and the SNs, comprising the proposed SoC, one Ag/AgCl electrode, and few off-chip passive devices, are distributed on the body to gather bio-signals. The SoC in the SN includes an ASIC microcontroller (µC, µController), an amplitude-shift keying (ASK) transceiver, an instrumental amplifier (IA), an 8-bit successive approximation analog to digital converter (SAR ADC), and voltage regulators. A smart phone or a watch can serve as the local control center (LCC) consisting of the transceiver, the µC, and wireless commercial circuits to construct the BBSN by keeping all SNs under its control. Due to its inherent characteristic of short-range transmission, the BBSN uses the "star" topology to reduce the complexity of control circuits and the latency of data transferring. The star topology also lets LCC more easily optimize the power efficiency of each SN. Since most biomedical signals have the characteristics of low variation rate, SNs should go into a low-power Sleep Mode frequently to save power. The BBSN adopts time synchronization procedure and sleep-scheduling techniques to regulate the SN operation cycle. The µC in the SoC has an embedded real-time counter that can be accessed by the command from the LCC. The LCC arranges the transmission and sleep schedule of each SN to avoid conflictions and extend battery lifetime.