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Healthcare Wireless Sensor Networks

Duong Quoc Dung*
Division of Biomedical Engineering, University of Technology, Hochiminh City, Vietnam

Editorial

We have seen the growth of Wireless Sensor Networks (WSNs) in healthcare in recent years, driven by technological breakthroughs in low-power networked systems and medical sensors. These WSNs have the potential to significantly improve and expand the quality of care in a number of settings and for various sectors of the population. These difficulties go beyond the resource constraints that all WSNs face, such as restricted network capacity, processing and memory constraints, and limited energy reserves.

Healthcare applications, in particular, place rigorous requirements on system stability, quality of service, and, in particular, privacy and security, in contrast to applications in other areas. Wireless sensor networks for healthcare have emerged in recent years because of the convergence of the need to collect data about people's physical, physiological, psychological, cognitive, and behavioral processes in spaces ranging from personal to urban, and the recent availability of the technologies that enable this data collection.

We offer some sample healthcare applications in this review and discuss the issues they pose to wireless sensor networks due to the required level of trustworthiness and the necessity to protect the privacy and security of medical data. These include: 1) network systems for vital sign monitoring that demonstrate that highly reliable data delivery can be achieved over multihop wireless networks deployed in clinical environments; 2) systems that overcome energy and bandwidth limitations by intelligent pre-processing of measurements collected by high data rate medical applications such as motion analysis for Parkinson's disease; and 3) an analysis of privacy and security challenges and potential solutions [1-4].

Medical sensing

Medical sensors use transducers to detect electrical, thermal, optical, chemical, genetic, and other physiological signals, as well as signal processing algorithms, to estimate aspects that indicate a person's health state. Sensors other than those that directly monitor health status have also been used in medical practise. Location and proximity sensing technologies, for example, are being used to improve patient care and workflow efficiency in hospitals, track the spread of diseases by public health agencies, and monitor people's health-related behaviours (e.g., activity levels) and exposure to negative environmental factors like pollution [5].

Platforms for wireless sensors

Existing motes typically use 8- or 16-bit microcontrollers with tens of kilobytes of RAM, hundreds of kilobytes of ROM for programme storage, and external Flash memory storage. These gadgets have a few milliwatts of power and run at around 10 MHz. Because the majority of the circuits can be turned off, the standby power can be as low as 1 W. The average power consumption of such a device is only a few microwatts when it is active for 1% of the time, allowing for long-term operation with two AA batteries. Low-power radios, such as those complying with the IEEE 802.15.4 standard for wireless sensor networks, are commonly used in motes. Smartphones, in contrast to resource-constrained motes, offer microprocessors that are more powerful, bigger data storage, and increased network bandwidth via cellular and IEEE 802.11 wireless interfaces at the cost of increased battery consumption [3,4].

Applications for healthcare

Wirelessly networked sensors provide intensive spatiotemporal sampling of physical, physiological, psychological, cognitive, and behavioural processes in environments ranging from personal to buildings to even larger scale ones. Sensory information-based healthcare applications, unlike those described in Section II-A, fuse and aggregate information acquired from many distributed sensors as a result of such dense sampling across spaces of various scales.

Monitoring in mass-casualty disasters: During mass-casualty crises, it is necessary to improve the assessment of first responders' health. Wireless sensing systems' greater portability, scalability, and quick deployment capabilities can be used to more effectively report the triage levels of multiple victims and track the health status of first responders at the crisis scene.

Monitoring in hospitals: Wireless sensing technology that is less visible and has persistent network connectivity to backend medical record systems helps to reduce tangles of cables and patient anxiety, as well as the occurrence of errors.

At-home: Wirelessly networked sensors installed in people's living surroundings or worn by them can capture real-time data on their physical, physiological, and behavioural states and patterns.

Support for motor and sensory decline: We are seeing the introduction of new forms of intelligent assistive technologies that employ data from sensors integrated into the device, worn or even implanted on the user's person, and embedded in the environment to provide information about the patient's physiological and physical status. These intelligent assistive gadgets not only adjust their responses to particular users and their current circumstances, but they can also provide critical feedback to the user and their caretakers for long-term training.

Technical difficulties

Trustworthiness: A variety of problems makes it difficult for the systems to achieve the level of confidence that applications need. For starters, medical facilities, where some of these devices will be installed, can be extremely hostile to radiofrequency (RF) connections. This harshness is the result of structural features such as metal doors and partitions, as well as deliberate efforts to offer radiation shielding, such as in operating rooms where fluoroscopy is used for orthopaedic surgeries [1,6].

Privacy and Security: The first privacy difficulty is the lack of a clear definition of privacy. One issue is that HIPPA and other privacy legislation use human language (e.g., English) to define privacy, resulting in a semantic

***Address for Correspondence:** *Duong Quoc Dung, Division of Biomedical Engineering, Hochiminh City University of Technology, Vietnam; E-mail: dqdruo@hcmut.edu.vn*

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nightmare. Nonetheless, privacy specification languages have been developed to formalise the specification of a system's privacy policies.

Resource Scarcity: Because both computational horsepower and radio bandwidth are limited, sensor nodes must trade off computation and communication overheads, such as by doing some on-board processing to reduce data transfer requirements.

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Conflict of Interest

The author reported no potential conflict of interest.

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