Chapter 68

A Survey of Recent Trends in Wireless Communication Standards, Routing Protocols, and Energy Harvesting Techniques in E–Health Applications

Fahimeh Rezaei
University of Nebraska, USA

Michael Hempel
University of Nebraska, USA

Hamid Sharif
University of Nebraska, USA

ABSTRACT

One of the most rapidly growing technology areas is the advances in sensing, networking, and miniaturization in medical domain, which enables innovative new applications. This is especially apparent in e-Health and telemedicine. There is an enormous demand for innovation in wireless sensor networking, body area networks, network security and routing, and many other areas, attracting the attention of numerous researchers. With all the advances it can be challenging to identify trends and areas with opportunities for research engagement. In this paper, the authors therefore review the state-of-the-art in wireless communication used in telemedicine and e-Health applications – ranging from the Wide Area Networks to Body Area Networks – and discuss the studies and literature that employ these technologies for e-Health applications. Moreover, recent routing protocols and techniques that are used for Body Area Networks are investigated. One key challenge for e-Health applications, particularly for mobile or patient-worn devices, is energy consumption and supply. One possible solution is found in energy harvesting, and our survey encompasses current challenges and accomplishments in its application to e-Health and discuss various promising techniques.
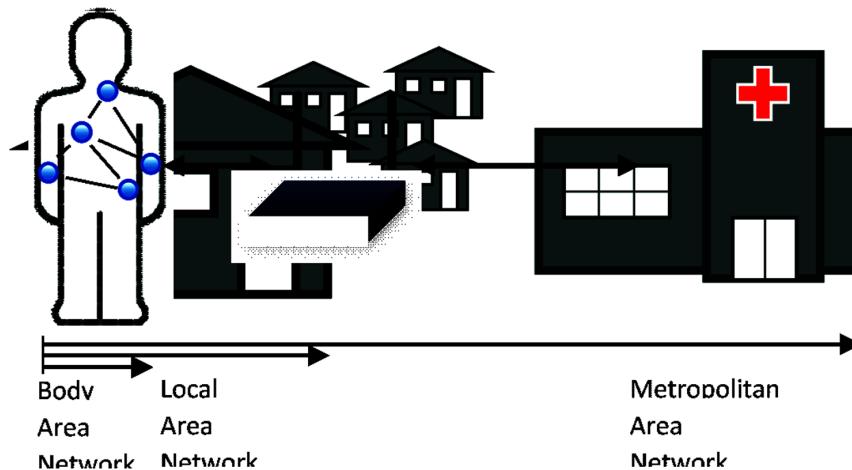
1. INTRODUCTION

Wireless communication technologies and standards have seen a steadily accelerating growth, especially over the last decade. This allows them to be applied to various domains that were previously not feasible. E-Health and telemedicine are two areas at the forefront of this development that take full advantage of current wireless communication technologies to provide emergency and on-demand medical services, enable outpatient monitoring and treatment, aid in patient recovery, directly connect doctors and nursing staff with patients, and much more.

Employing diverse wireless communication standards in healthcare contributes to patient monitoring and diagnosis of the health concerns remotely, and in real-time. This provides the means to revolutionize the speed and accuracy of offering healthcare services in all aspects of our lives, especially when medical personnel are not locally available. The overall view of the end-to-end e-Health wireless technologies are presented in Figure 1.

The contribution of the wireless communication standards in e-Health currently culminates with Body Area Networks, enabled through advances in device miniaturization, drastic improvements in energy efficiency in hardware and optimization in software, as well as novel communication technologies. Body Area Networks (BAN) leverage support for ultra-low power short-range communication of sensor nodes placed in different locations of a patient's body. These sensors collect biosignals, defined as the collection of all measurable data from a biological being. These biosignals are delivered to medium-range gateways via Local Area Network technologies that interface with the Body Area Network to collect the information from the sensor nodes and transfer it to local monitoring centers. This information can then further be relayed to medical centers or hospitals via Wide Area Networks.

With the rapid advances in healthcare technology we can observe a corresponding exponential growth in data volume produced by a plethora of medical sensors such as high-resolution Magnetic Resonance Imaging (MRI) or Computed Tomography (CT) scans, live multi-lead Electrocardiogram (ECG) data, and more. Therefore, the wireless communication standards that are involved in e-Health and telemedicine

Figure 1. End-to-end view of a typical e-health topology

Related Content

Customized Visual Computing: The Aesthetic Computing Method
Paul A. Fishwick (2008). *Visual Languages for Interactive Computing: Definitions and Formalizations (pp. 425-435).*
www.irma-international.org/chapter/customized-visual-computing/31050

Romantic Jealousy on Facebook: Causes and Outcomes
Christopher J. Carpenter (2016). *International Journal of Interactive Communication Systems and Technologies (pp. 1-16).*
www.irma-international.org/article/romantic-jealousy-on-facebook/191319

The Wisdom of the Crowds: Creating Value with Blogs and eWoM
Zhang Weiand Yang Ke (2012). *Understanding the Interactive Digital Media Marketplace: Frameworks, Platforms, Communities and Issues (pp. 330-337).*
www.irma-international.org/chapter/wisdom-crowds-creating-value-blogs/60480

The Management Of Ambiguities
Maria Chiara Caschera (2008). *Visual Languages for Interactive Computing: Definitions and Formalizations (pp. 129-140).*
www.irma-international.org/chapter/management-ambiguities/31037

Traditional and New Media: A Comparative Analysis of News Outlets' News Feeds on Snapchat
Eun Jeong Lee (2019). *International Journal of Interactive Communication Systems and Technologies (pp. 32-47).*
www.irma-international.org/article/traditional-and-new-media/220465