Multidisciplinary Approaches To Achieving Efficient And Secure e-Healthcare Monitoring

Mots clés :
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Résumé du projet de recherche (Langue 1)

The recent advances in wireless sensing technology have led to the emergence of a wide range of applications in different domains such as medical treatments, sports, consumer electronics, social networking, and enterprise usage. Among those emerging applications, eHealth is recognized as the most important and promising one, due to its potential for eHealth monitoring of chronic illnesses, lifesaving in emergency situations, and its ability to provide round the clock healthcare to rural and disadvantaged areas. In particular, wireless body area networks (WBANs) are the key enablers of remote and in-hospital health monitoring and are expected to revolutionize the health and real-time body monitoring industry. However, WBANs technology alone is not sufficient to achieve the ultimate goal of eHealthcare stakeholders, and other advanced technologies such as Internet of Things (IoT) and cloud computing are also needed to further improve the eHealth monitoring system efficiency. Thus, we believe the rapid technological convergence between IoT, WBANs and cloud computing would significantly contribute to the emergence improvement of eHealthcare, thereby improving the quality of medical care. In particular, patient-centric eHealth monitoring plays a vital role in eHealthcare service, involving a set of important operations ranging from medical data collection and aggregation, data transmission and segregation, to data analytics. This thesis aims at exploring the tradeoffs between performance goals and security metrics of eHealth monitoring systems. Firstly, we present an architectural framework to describe the entire monitoring life cycle of eHealth monitoring systems and identify the essential service components. Additionally, more detailed discussions are then devoted to data collection at patient side, which is considered as a fundamental basis in achieving robust, efficient and secure eHealth monitoring. As the results of these in-depth analysis, we firstly present a novel CPS-enabled eHealth monitoring system using virtual sensor networks (VSN). Then we propose a lightweight authentication protocol tailored to WBANs. Both of the two designs attempt to achieve the best tradeoff between those identified security and performance metrics, and they are thoroughly validated through both theoretic analysis and simulations. The findings and lessons learned from the two specific designs indicated that developing high quality, cost-efficient and secure eHealth monitoring systems deserves non-trivial research efforts, and they are usually scenario specific. In the final part of this thesis, we discuss some open issues and point out the future research topics. Keywords: eHealthcare, Wireless Body Area Networks, Cyber Physical Systems, Mobile Crowd Sensing, Security, Privacy by design, Trust.