



As the population ages and the risk of chronic disease increases, the cost of healthcare will rise. Technology for mobile telemetry could reduce cost and improve the efficiency of treatment. In order to achieve these goals, we first need to overcome several technical challenges. We built a Mobile Biotelemetric System (MBS) that addresses these remote medical monitoring challenges. MBS comprises a custom low-power sensor node that accurately collects and analyzes electrocardiogram (ECG) data, a client service with a multifaceted policy engine that evaluates the data, and a web portal interface for visualizing the ECG data streams. MBS differs from other remote monitoring systems primarily in the policy engine's ability to provide flexible, robust, and precise system communication end-to-end and to enable tradeoffs in metrics such as power and transmission frequency. We showed that, given a representative set of ECG signals, policies can be set to make the operation of the hardware and software resilient against transient ECG conditions for both security and monitoring purposes. We demonstrated that our system adaptively trades off system-level metrics based on a combination of operating conditions and user input, and that our heartbeat detection algorithm performs well for challenging ECG input.

Biotelemetrics

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An Empirical Performance Evaluation of Relational Keyword Search Techniques

Extending the keyword search paradigm to relational data has been an active area of research within the database and information retrieval (IR) community during the past decade. Many approaches have been proposed, but despite numerous publications, there remains a severe lack of standardization for the evaluation of proposed search techniques. This lack of standardization has resulted in contradictory results from different evaluations, and the numerous discrepancies muddle what advantages are proffered by different approaches. In this project we have created the most extensive empirical performance evaluation of relational keyword search techniques to appear to date in the literature. Our results indicate that many existing search techniques do not provide acceptable performance for realistic retrieval tasks. In particular, memory consumption precludes many search techniques from scaling beyond small data sets with tens of thousands of vertices. We also explore the relationship between execution time and factors varied in previous evaluations; most of these factors have relatively little impact on performance. Our work confirms previous claims regarding the unacceptable performance of these search techniques and underscores the need for standardization in evaluations as exemplified by the IR community.

Crowdsourcing the Crisis

The premise of this work is that the public would be better served if it had access to reliable, near real-time information concerning the “ground truth” of unfolding events. One way to collect those reports is through crowdsourcing. By taking advantage of the army of people connected to the internet via both wired and wireless technologies, we can easily gather information that would help a citizen make an informed decision regarding his or her health and welfare. The widespread use of smartphones allows people to post geolocated reports and pictures with ease. Disaster management teams would likewise benefit from the input of more observers. On the other hand, the trustworthiness of these reports may be uncertain. We have built a crowdsourced system that could be used to enhance disaster management, and we developed three methods to enhance the trust that the citizen places in such a system.

Weaver and colleagues developed the Xpress Transport Protocol (supporting multicast and knowledge of the multicast group members) for the US Navy, and then turned XTP into a commercial product. He was a founder of Virginia’s Internet Technology Innovation Center, which provided technical and business strategy for e-business, and developed e-commerce software for corporate and government clients. Previous projects included improving security for mobile devices and writing software that could perform a scientometric analysis of scientific literature. Current research focuses on determining whether the use of crowdsourcing would be an effective adjunct for disaster management.

RECENT RESEARCH DEVELOPMENTS

- Liliya I. Besaleva and Alfred C. Weaver, "Applications of Social Networks and Crowdsourcing for Disaster Management Improvement," IEEE Computer, May 2016.
- Liliya I. Besaleva and Alfred C. Weaver, “Imbalanced Data in e-Commerce Networks,” Advances in Social Networks Analysis and Mining, San Francisco, CA, August 18-21, 2016.
- Joel Coffman and Alfred C. Weaver, “An Empirical Performance Evaluation of Relational Keyword Search Techniques,” IEEE Transactions on Knowledge and Data Engineering, vol. 26, issue 1, January 2014, pp. 30-42.
- Deborah Johnson, Priscilla Regan, Katherine Wesson, Siva Vaidhyathan, Kent Wayland, Roberto Armongol, and Alfred C. Weaver, House of Mirrors: Surveillance and Transparency, Routledge Studies in Science, Technology and Society, 2014.
- Liliya I. Besaleva and Alfred C. Weaver, “Imbalanced Data in e-Commerce Networks,” Intelligent Systems Conference (IntelliSys 2017), London, United Kingdom, September 2017 (accepted).

RECENT GRANTS

- Battelle Memorial Institute – Scientometric Analysis of Eastern European Literature
- DOD/Defense Energy Office – Crowdsourcing the Crisis
- NSF – Secure Mobile Computing

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