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Dissertation Title: **Improving Reliability in Body Area Sensor Network Communications for eHealth Monitoring**

Abstract:

We are living in an era where advances in sensor technologies, mobile devices and wireless communications are facilitating what some are calling a healthcare revolution. Self-monitoring is already commonplace with inexpensive sensor devices readily accessible to consumers. In addition, there are numerous applications available for our smartphones and tablets that allow us to manage our calorie intake, track how much exercise we have taken and tell us how well we have slept. A phone's camera can even be used to measure how fast someone's heart is beating. Some doctors are beginning to prescribe applications for self-monitoring instead of, or in conjunction with, medication.

eHealth is prevalent in the sports and fitness industry, with some professional teams employing physical performance experts who can monitor each team member's physical activities in real-time through the use of mobile wireless devices such as GPS trackers, heart rate monitors and accelerometers. Injuries and illnesses may be detected early and even prevented in some cases.

Increasing healthcare costs, an aging population and a shortage of medical staff are some drivers for eHealth and telemedicine in remote monitoring scenarios. In the case of assisted living for the elderly, given the choice, many would prefer to remain living in the comfort of their own smart homes instead of being hospitalised. However, in order for remote monitoring to be safe, it is imperative that critical situations are detected promptly and urgent alerts are forwarded to a Remote Monitoring System (RMS) as quickly as possible, so that the appropriate action can be instigated. A lost or significantly delayed alert could potentially mean the difference between life and death. Reliability is therefore of paramount importance and this project focuses on improving the reliability of communications between a Body Area Sensor Network (BASN) and a RMS.

A BASN is a collection of sensors that are worn on, and sometimes implanted within, the human body. These devices can share information by communicating wirelessly with each other and with other computing devices within range. Sewable electronic components, conductive thread and eTextiles all allow nodes in a BASN to be worn as part of someone's clothing. Microcontrollers provide the computing capabilities and lightweight batteries supply the power. The network is mobile, it moves with the wearer, and should have minimal intrusion on the user's activities of daily living.

This dissertation proposes a design for a remotely monitored, reliable and autonomous BASN to support independent living for the elderly. The emphasis of the design is to facilitate the development of a robust and reliable system that remains operational even when communication failures occur. A communications configuration and protocol are proposed to support these objectives. A prototype is designed and implemented that uses a BASN of movement, temperature and heart rate sensors as well as a panic button. Experiments are designed with test suites to evaluate the prototype. The goal of the project is to improve reliability in communications between a BASN and a RMS, with the foremost objective of alerts not being lost when communications errors occur. In order to reduce the risk of an external communications outage, a secondary communications link is required as backup so that alerts generated by a BASN can still reach a RMS if the primary communications link is not working. The proposed communications protocol is designed to work with an event-based architecture and a generic set of sensors. In the event of a total communications outage between the BASN and the RMS, the protocol ensures all outstanding delayed alerts are forwarded to the RMS as soon as connectivity is re-established.