Home Monitoring of Patients with Late Stage Parkinson's Disease

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Introduction

THE goal of this project is to develop a web-based remote monitoring application for monitoring motor fluctuations in patients with Parkinson's Disease (PD). Home monitoring of patients with PD can provide valuable feedback to clinicians and guide medication titration. Recent advances in wearable sensing technology [1] enable development of miniature wireless sensors that can record data pertaining to a patient's motor state and can be worn comfortably by patients in their home environment for a long period of time. Results from earlier studies and ongoing research [2] point to the fact that it is possible to derive clinical information from data recorded using miniature wearable sensors such as accelerometers.

Materials and Methods

The sensor platform chosen for the study is the Sensing Health with Intelligence, Modularity, Mobility, and Experimental Reusability (SHIMMER). SHIMMER consists of a TI MSP430 microprocessor; a Chipcon CC2420 IEEE 802.15.4 2.4GHz radio; a MicroSD card slot (up to 2GB); a triaxial MEMS accelerometer; and a rechargeable battery. The device measures 1.75" x 0.8" x 0.5" and weighs just 10 g. The platform uses a wireless body sensor network architecture call Mercury. Mercury has been designed specifically for long-term home monitoring applications. It makes intelligent use of available network resources to maximize battery life while maintaining high data fidelity.

Ten SHIMMER sensors are placed at locations shown in *Figure 1*. The patient performs a set of tasks taken from the United Parkinson's Disease Rating Scale (UPDRS) and activities of daily living such has reading while seated, walking, using the phone and typing on a computer. Data collection is performed on 3 separate sessions 3 months apart. The first 2 sessions occur in the laboratory and the final data collection is performed remotely via a secure flash-based web application that allows one to remotely interact with patients and access sensor data.

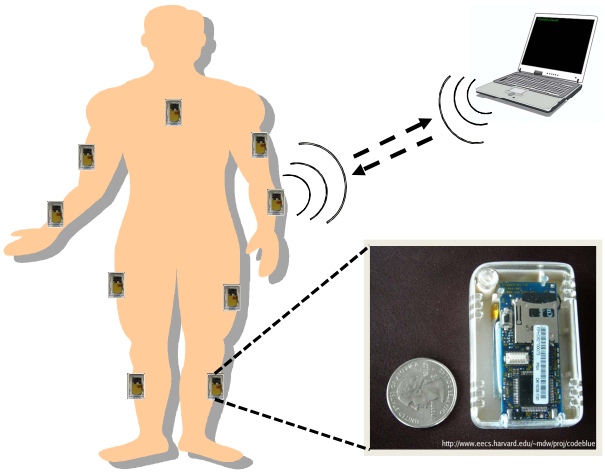

Fig. 1. Sensor setup for the study.

Data gathered with the SHIMMER sensors is processed and analyzed to achieve estimates of UPDRS scores and assess severity of Parkinsonian symptoms.

Results

Testing of the sensor platform and the web-based application show that whole system is suitable for remote monitoring of patients with PD. Results of the data analysis show that it is possible to derive reliable estimates of the severity of tremor, bradykinesia and dyskinesia. We are currently analyzing longitudinal data to assess if the proposed approach can be used to track changes in the severity of symptoms that occur over time as the disease progresses.

References

[1] P. Bonato, "Advances in wearable technology and applications in physical medicine and rehabilitation," *J Neuroengineering Rehabil*, vol. 2, pp. 2, 2005.

[2] S. Patel, K. Lorincz, R. Hughes, N. Huggins, J. Growdon, D. Standaert, M. Akay, J. Dy, M. Welsh, and P. Bonato, "Monitoring motor fluctuations in patients with Parkinson's Disease using wearable sensors," IEEE Trans Inf Tech Biomed., vol. 13, no. 6, pp. 864–873, 2009.

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