

Chapter 6

Telemonitoring System of Neurological Signs in a Health Telematique Network

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ABSTRACT

The paper presents a new, experimental, wireless tremor telemonitoring system composed of an optional variable number of portable devices integrating three-axis acceleration mini-sensors which are connected to very small dimensions acquisition systems with Wi-Fi transmission capabilities. The main advantages of the design system consist of the possibilities to monitor simultaneously many body parts of one or multiple subjects on local or more extended areas both for scheduled assessments and in an everyday life environment. Possible applications of the presented experimental system, considered as a part of a health telematic network, consist of delivering supplementary, consistent sets of data to clinicians in order to reliably assess patients' state in home and community settings, over longer periods of time. This system consists of delivering new data necessary for differential diagnosis of different types of tremors, or to precise different stages of illness in a health telematic network. The multiple simultaneous measuring capabilities and the extended observation time period could cover eventually neglected aspects related to occasional, temporary, or an intermittent tremor. The Wi-Fi DAQ proposed system's novelty, in contrast with existing Wi-Fi solutions, is its ultra low power Wi-Fi capability, which makes it suitable for sensing applications where battery power management is critical.

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INTRODUCTION

Tremor is defined as an approximately rhythmic, unintentional movement of a body part, determined by involuntary, uncontrolled muscle contractions. In many cases, it is associated with neurological, muscular, and neuromuscular diseases - pathological tremor, but, in specified limits and conditions, can be considered a normal manifestation - physiological tremor. The challenges of this complex domain generated a constant research interest, materialised in older and recent studies which investigate either pathological (Kraus et al., 2006; Jankovic, 2000; Louis et al., 1995; Dogu et al., 2003; Choiunard et al., 1997; Deuschl et al., 2001; Abuarqub et al., 2006; Alusi et al., 2001) or physiological characteristics (Takanokura et al., 2002; Ebenbichler, 2002; Hwang et al., 2009; Maton & Gamet, 1989) of tremor. The assessment of tremor, as a continuous target of many experiments, was accomplished taking into account its various types, defined as rest tremor, postural tremor, isometric tremor, kinetic tremor, intention tremor or action tremor.

Although the use of generally accepted, large scale applied clinical diagnosis tests, demonstrated their relevance and the existence of necessary capabilities to identify a multitude of specific pathological or physiological features, some possible exploration zones remain open.

Essential tremor (Jankovic, 2000; Louis et al., 1995; Dogu et al., 2003; Choiunard et al., 1997) is an illustrative example of permanently studied movement disorder which can benefit from specific parameter measurements and registrations during everyday life activities. The disease progress, close connected with the severity of tremor, can be revealed registering the patients' difficulties in performing tasks requiring motor manipulation skills.

Suddenly, the undesired action of some substances, medication, considerable physical effort, environmental or other external conditions (times

of stress or strong emotion), having as secondary effect an increase of normal physiological tremor, must be investigated. Physiological tremor can simultaneously affect, with different intensities, many body parts. Bilodeau et al. (2009) use mechanical loading of the hand and frequency analysis in an attempt to identify the mechanisms involving differences of physiological tremor amplitudes of the same subject's hands.

Considered as an individual variable in effort limits, the intensity of tremor can be measured during sportive or medical training activities. When the individual is physically exhausted, during certain postures or movements, some tremors become exaggerated. A more detailed investigation of such cases, performed in conditions of subjects' mobility, can be particularly useful for sportive training monitoring.

An obvious conclusion after the above brief presentation on the complexity of factors which must be taken into account in the tremor monitoring, is the necessity to perform specific parameters measurements during daily activities of subjects, in different circumstances and, sometimes on more extended areas. In order to complete the available knowledge about tremor characteristics, new measuring devices and processing methods, designed to cover difficult investigation conditions, are necessary.

From a few years, a promising approach bringing incontestable benefits to many medical domains is that based on wearable sensors. First oriented to applications aiming to monitorize old and cardiac patients (Rajkasekaran et al., 2009) and transmit vital parameters (heart and respiratory rates, respiratory, blood pressure), this approach was extended, in some cases, including motion sensors (Jovanov et al., 2005).

Following this orientation, the paper presents a new, end-to-end, experimental wireless tremor telemonitoring system, based on Wi-Fi technology and SIP protocol. It is composed of an optional variable number of portable devices integrating

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