KineTrax Multi Purpose Networked Data Logger

Sponsor Information:

WEARABLE INFORMATICS LABORATORY

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Project Description:

I has been estimated that in excess of 500,000 people in the US alone have Parkinson's disease, over 20,000 have Amyotrophic Lateral Sclerosis, over 400,000 have Multiple Sclerosis, one in every 360 children have been diagnosed with Tourette Syndrome, and approximately 10 million Americans have essential tremor. These are just some examples of neurological diseases that have associated movement disorders affecting the central and peripheral nervous systems.

For many neurologic diseases, such as Parkinson's disease, medication is dosed according to clinical assessment and patient feedback; these clinical assessments are generally done "live" once or twice a year at most, to update the patients records and adjust medications. For example, the standard for clinical gait assessment requires either visual observation while a person is asked to walk back and forth in a clinical hallway, or use of a motion analysis system attached to the patient. Clearly a motion analysis system is of greater precision and less susceptible to observer bias, yet the number of steps observed in such a system is typically less than 50 over the course of an hour long session.

The overall aim of the KineTrax project is to break through this limitation by developing the hardware, software, and analysis methods to collect neurological assessment data freely and continuously outside the clinic, as the patient goes about daily life. Rather than assessing gait impairments based on just 50 observed steps in the clinic, the Kinetrax will allow assessment based on analysis of the 6,000 to 30,000 steps a healthy person takes in a normal day.

The KineTrax has applications outside of neurological disorders such as those listed above. Consider that one in three people who have a transient ischemic attack (TIA) later experience a stroke. Because a TIA is by nature transient, all symptoms have typically passed by the time someone is able to get to see a doctor. For context, approximately 795,000 people suffer a stroke every year in the
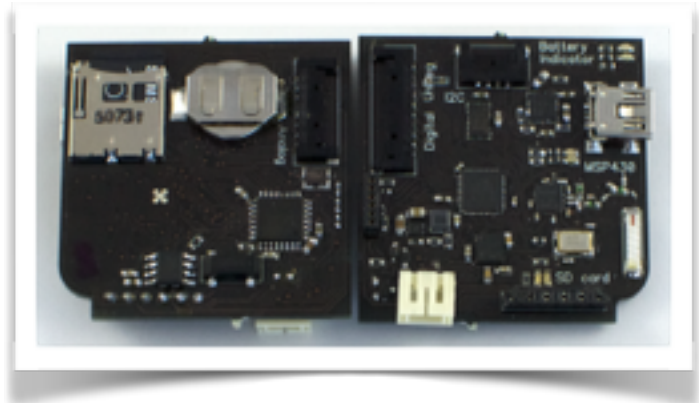
US. About 600,000 of these are first attacks, and 185,000 are recurrent attacks; more than 140,000 people die each year from a stroke. With detailed continuous observation, it may be possible to identify when a TIA has occurred, and intervene before a stroke occurs.

The goal of this project will be to design and develop the embedded software to run on the MSP430 based KineTrax device. This software must be able to be network with other devices, both for exchange of information and to measure proximity to the other devices.

The KineTrax device, shown in the picture above, is a dual processor system that utilizes a Texas Instruments MSP430 and an Atmel 368 processor for data collection and logging to an onboard microSD card. Key features of a successful project will be:

- automatic establishment of a wireless network between devices
- automatic synchronization of clock time between devices
- user adjustable data recording rates
- user adjustable data measures (ie I2C, analog channels, accelerometer, etc)
- assessment of distance and signal strength to the other nodes on the network
- automated data exchange, complete and reduced
- a user GUI, implemented in the Processing language, to create an easy cross-platform application for setting of parameters and offloading of complete data sets

This project is expected to be deployed for use in several studies in the Flagstaff and Northern Arizona areas, and will be used to monitor and create classification systems for monitoring gait and other physical movements of those with any of the above listed neurological or cardiovascular diseases.

Exemplary students may have the opportunity to consider participating in research projects of the Wearable Informatics Lab following completion of this project.

Knowledge, Skills, and Expertise Needed:
- Software design.
- MSP430 Programming.
- User Interface Design.
- Processing.
- Soldering - those versed in surface mount soldering will have the opportunity to help construct several boards.

Equipment Requirements:
- The KineTrax Device (supplied).
- If needed, my lab can provide space to work, as well as Mac, Linux, and Windows boxes for testing and development.

Software Deliverables:

- Weekly meetings with demonstrations of project status, as well as written progress summaries. Regular meetings will be held in my lab (USB First Floor).

- Documentation for end users and developers.

- Professionally documented codebase, delivered both on USB stick and via access to an online repository. A locally managed Wiki is one documentation option.

- The Subversion maintained history of development and all related files (I will supply the repository).

- A strong as-built document that details the design and implementation of the site. This must be robust enough to allow a future development team to easily pick up where you left off.