

Application of PDA-Based LabVIEW to Emergency Medical Practice

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Category:

Biotechnology/Life Sciences

Products Used:

LabVIEW™ 7.0
LabVIEW PDA Module™ (Pocket PC)
DAQ for Pocket PC 2002™
DAQCard-6062E™

The Challenge:

Deliver a portable, non-invasive, instrument for first responders to assess a patient's brain's neurological condition and provide early detection of traumatic brain injury (TBI) as well as diagnosis and differentiation of stroke.

The Solution:

Using a Pocket PC, LabVIEW PDA Module, and DAQ for Pocket PC, we were able to use COTS National Instruments hardware for signal measurements and processing. Our solution allowed for rapid product development resulting in quicker deployment to first responders and increased accuracy in patient brain assessment diagnoses.

Abstract

Leveraging Active Signal Technologies' sensor technology and Mink Hollow Systems' integration expertise, a PDA-based LabVIEW application was developed to enable direct monitoring of physiological variables associated with stroke and trauma and data processing for pre-hospital brain assessment of patients. The handheld device is small enough for deployment to ambulances and medevac helicopters and powerful enough to provide non-invasive feedback to the first responder for improved diagnosis. As development of the system continues, an untapped EMS market of over 45,000 platforms could benefit from the system's use, not to mention a potentially large yet unidentified military market.

Introduction

Rapid, pre-hospital head injury and/or stroke diagnosis fulfills a vital need because treatment for either is time critical e.g. the "Golden Hour" of head trauma and the "3 Hour Window" of ischemic stroke for administration of clot busters. Calls have been made to have some type of small computerized tomography (CT) scan in ambulances to enable such pre-hospital diagnostics, but current size and weight considerations of CTs make this impossible.

A desirable alternative concept has been to implement PDA based diagnostic tools noting that hand held PDA devices have been widely used in the medical community, albeit mostly for record keeping or other database applications. With the advent of the LabVIEW PDA Module, the possibility of transforming these ordinary PDAs into powerful diagnostic tools has become reality.

The LabVIEW based Pocket PC stroke monitor has now been added to the arsenal of the pre-hospital care providers. This tool combines data acquisition and analysis capability with a compact PDA package and is compatible with the ambulance and medevac environments. Currently systems developed jointly by Mink Hollow Systems and Active Signal Technologies' are being tested by the Maryland Emergency Medical Services Systems, specifically in medevacs for trauma and ambulances for early differentiation of strokes. One can extrapolate that the same need exists in the U.S. military where direct field diagnostic capability of head injury is impossible yet critically needed as daily events in Iraq would testify.

System Development

In earlier stages of product development, Mink Hollow Systems and Active Signal Technologies joined forces to create a laptop-based brain assessment monitor for use in hospital emergency rooms. The product has been shown to be highly successful in quickly diagnosing brain trauma in patients and has shown positive indication of early stroke subtype differentiation. The constraints of medevac and ambulance environments rule out the use of this initial system because laptops are too bulky for transit and use in pre-hospital treatment where space and usability are at a premium. Accordingly, a second development phase was implemented to reduce the instrument size. This smaller device could then be used for testing by first responders in both ambulances and medevacs.

The portable, non-invasive brain assessment system tested by first responders is shown in Figure 1 below. The system weighs less than one pound and measures 14 cm x 9 cm x 6 cm including the signal conditioning cradle.



Figure 1. PDA Displaying GUI, Carrying Case

In a parallel development effort, Active Signal Technologies developed the next generation of their sensors that would be suitable for non-invasive measurements in unstable and noisy environments as would be encountered in medevacs and ambulances. Mink Hollow Systems reduced the software footprint and modified GUI and file I/O but at the same time was able to keep the vital signal processing technology used in the laptop system and integrate it on

the Pocket PC. The availability of LabVIEW on the Pocket PC saved countless hours of development time that would have been needed to rewrite code in another language and select, write drivers for, and test a data acquisition PCMCIA card.

Future Development

Successful system testing in ambulances and medevac helicopters with the Maryland Emergency Medical Services Systems has been completed. Future development is expected to include wireless sensors for easier connection to the patient and improved GUI and data processing. Additional sensor capability will be added and software versatility will be enhanced with the implementation of windowing capabilities. Also, leveraging the PDA's wireless networking capabilities and LabVIEW's ease of integration, the software may soon connect to remote hospital networks as the first responder vehicle arrives allowing for near instantaneous relay of patient data efficiently and accurately.

As the system becomes smaller, more robust, easier to use, and a better diagnostic tool, the potential market for the device will certainly increase. In addition to the large U.S. EMS community that could benefit from the system, the military market is being investigated as well as the world market, especially Europe, where there is a critical need but no available tool. Recent calls for such diagnostic capability have been received by Active Signal to aid in early diagnosis of head trauma in both Iraq and Afghanistan.

Conclusions

Accurate patient brain assessment is critical in trauma situations, and the faster the diagnosis is made, the better the chance of complete recovery by the patient. With limited tools available to first responders, these diagnoses can be difficult to make resulting in a longer time before treatment. Using Active Signal Technologies' sensors and the LabVIEW PDA Module, we took a powerful laptop-based hospital diagnosis tool and modified the code for deployment on a PDA. The handheld device allows for non-invasive brain assessment for quick diagnoses and accordingly increases the chances of full patient recovery.

Successful tests in medevac helicopters and ambulances are leading to excitement in the medical community about the system's potential. Future products are anticipated to be used by the existing 45,000 EMS platforms, as well as U.S. military and worldwide critical caretakers to help speed diagnoses and save lives.

Shown in Figure 2 is a Maryland State Police Medevac First Responder using the brain assessment system to diagnose a patient.



Figure 2. Medevac First Responder Using the Brain Assessment System