Data Translation Helps Understand How the Brain Works

Our brain is composed of billions of specialized cells called neurons. If we want to find a cure for brain diseases, or invent computers that think like humans, then we must understand how these neurons work. A new technique, called femtosecond laser confocal microscopy, enables researchers to visualize the activity of healthy and diseased neurons with a clarity and speed never achieved before. This revolutionary tool allows scientists to perform experiments that are greatly improving our knowledge of brain cells.

A team from the Department of Neurobiology and Behavior at the University of California, Irvine, is pushing the performance of the femtosecond laser confocal microscope by using hardware and software products from Data Translation. This group, led by Professor Ian Parker, is using a combination of clever mechanical design and innovative software programs to greatly improve the speed of the femtosecond laser confocal microscope, while simplifying its design and lowering its cost.

The microscope previously required two computers, two frame grabbers and an expensive digital video cassette recorder to display and record images from neurons. This arrangement was not only cumbersome, but it was also reducing the speed of the microscope by half, reducing the quality of the images and making data analysis very time-consuming.

A major redesign effort, spearheaded by Dr. Quoc Thang Nguyen, was aimed at developing a computer program to centralize all microscope operations in one computer running Microsoft Windows 98. The software had to provide real-time display and contrast manipulation of incoming images from the microscope. Furthermore, the program had to allow continuous, gap-free data streaming to disk, storing the images as AVI (Audio Video Interleaved) files. The application had to give experimenters the possibility to take snapshots of the screen as bitmap files. Finally, the software would enable users to synchronize the display and storage of images with the activation of experimental devices. All these features had to work without compromising the speed of the microscope (which is able to deliver up to 120 frames per second!).

Because the video output of the microscope is not standard, but consists of interleaved lines of pixels, the UC Irvine team selected the Data Translation DT3152-LS. This PCI frame grabber was chosen mainly for its flexible line scan acquisition mode. In addition, the DT3152-LS, with an acquisition rate of 20MHz/pixel, has the necessary speed to be used with the microscope, and its 4 digital output lines can be used to trigger other devices.

The UC Irvine team quickly realized that, due to the intensive data processing during acquisition, no off-the-shelf software program or ActiveX component would offer the functionalities and the level of performance to rapidly process incoming frames. Instead, the program controlling the display and storage of images had to be written from scratch.

The program, called e-Maging, uses the Microsoft DirectX technology to display the frames at the highest speed possible. E-Maging takes advantage of an advanced feature of Windows called multithreading to make the application very responsive to user commands, even when images are simultaneously displayed and stored on disk. E-Maging was developed with Borland Delphi 5, with time-critical code written in optimized assembly language.

Low-level hardware programming, which is very challenging to undertake under Windows, was completely avoided by using the Data Translation Open Layer library, which allowed easy interfacing of the program with the frame grabber. Furthermore, the architecture of DT Open Layer made the implementation of multithreading much simpler. Finally, thanks to the rich API provided by DT Open Layer, e-Maging required only one man/month to be written and tested.

The combination of the DT3152-LS frame grabber and the e-Maging program is considerably improving the ease-of-use and performance of the femtosecond laser confocal microscope, and

is also used to control another, more conventional system. Due to its unique performance, many researchers at UC Irvine are currently using the improved femtosecond laser confocal microscope to further our understanding of the brain, with help from Data Translation hardware and software.

For more information, click on DT3152-LS, or call (800) 525-8528.

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