User Solution: Laboratory Subject Monitoring and Stimuli Delivery System

A leading Australian Physiology research institution conducts lengthy experiments upon lab rats in their research labs. The subjects under test need constant monitoring and stimulus events at specific timing intervals from a few seconds up to 15 minutes, over approximately an hour of testing. The stimuli events that are executed include audible white noise, clicks, fluid and food dispensing, flashing lights, and mild electric shocks. Previously these stimuli events and the monitoring process were operated manually with a stopwatch and a push button array.

The results from the experiment that need to be recorded to data file are the movement responses or lack of movement (freezing) of the subjects. An automated system was needed in order to control event stimuli and record the results from these stimuli with high level of reliability and objectivity. This would allow laboratory staff to carry out more critical research and offline analysis, whilst leaving an automated computer system to carry out more menial testing tasks.

The Solution

NVSI created a vision software package called "RatCam" that is able to monitor a video feed of multiple subjects over the duration of the test whilst recording levels of movement to a data file. RatCam also simultaneously controls the event stimulus hardware through the new National Instruments PCI M-Series

Data Acquisition (DAQ) cards, with their advanced technology, including 6 DMA channels, meaning fast response times and simultaneous access to all of the card's features.

RatCam has the ability to operate in two different modes: single trial and multiple trial. A single trial can be carried out according to the operator's requirements which are outlined within a previously defined trial file, whereas multiple trials can be conducted by including further trials within the same parameter file. This allows the operator to perform a customized experiment in order to determine the effects of the event stimuli in terms of duration as well as the order in which the events occurred.

After monitoring the movement of the subjects, the data is then able to be viewed in a trial results window. This data can also be viewed offline by reviewing the saved data file. RatCam also has a playback feature in which the video feed that is recorded during the experiment has event sound stamps added to the tape to indicate when certain events have occurred. This

tape can be viewed at a later time to review any unusual results that occurred, and it will display corresponding events that occurred during the experiment.

The video image is acquired from an analogue camera and converted to a 16-Bit digital image using a 10-Bit A/D and a Look-Up Table (LUT) acquired with a National Instruments PCI-1409 high performance monochrome analog image acquisition card. The A/D converter performs the image digitization; the result of which passes to a 1,024 by 10 RAM LUT to obtain the 16-Bit image. The RatCam system detects movement of the test subjects by comparing video images and looking at the changes in the grey levels.

RatCam controls externally operating hardware through digital output lines provided by a National Instruments PCI-6220 250 kS/s, 16-Bit, 16 Analog Input Multifunction Data Acquisition card.
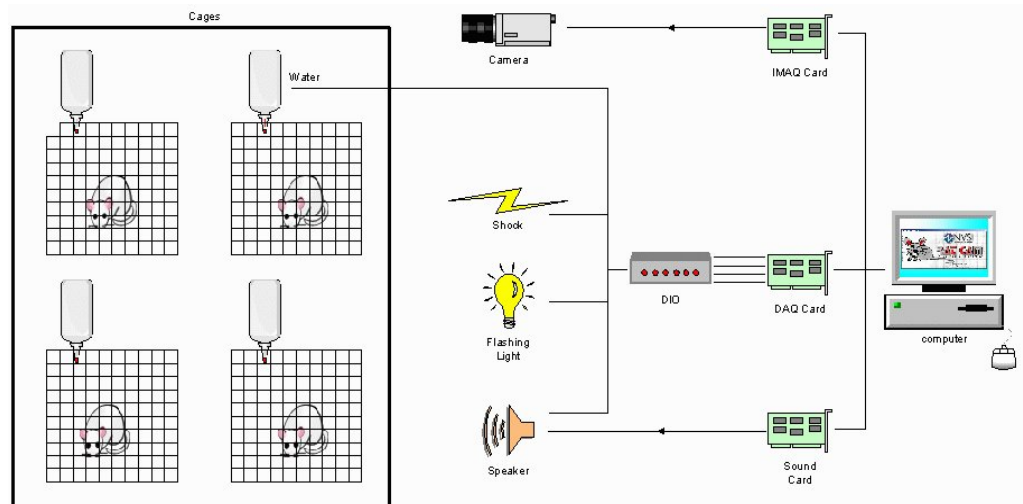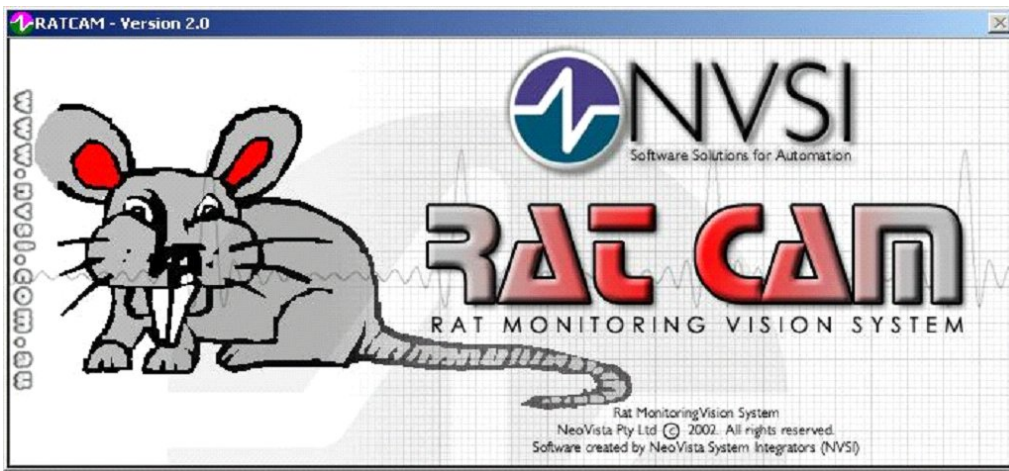
define experimental trials with requiring programming knowledge, and also create series of trials able to run without user interaction over several days. To aid the user's research, trials, series and results are exported to the local hard drive in Microsoft® Excel™-readable ASCII formats. This allows the program to execute any light stimuli, food or fluid stimuli at specific times during the experiment.

The sound stimuli (white noise and clicks) are generated by the software, and output through the computer's sound card to be amplified by external standalone hardware. The movement detection algorithms used by RatCam were developed by NVSI, and use differential measurements between subsequent or groups of subsequent images, highlighting the changes between them. This technique returns a change "value" of movement amplitude – a dimensionless unit representing only the pixellated variations. The user is able to

Conclusion

The client was provided with completely customised software that is flexible and can be easily modified for future developments due to its modular construction. RatCam is a closed-loop research system, which performs automated subject stimuli and response detection in laboratory rats. The software provides researchers with more reliable and objective data that can be easily compared to previous test data. The automation of this test procedure has dramatically improved the amount of research and analysis time available to lab staff.

For more information, please contact: