Muscular Dystrophy Grip Strength Testing

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Category: Biotechnology/Life Sciences

Products Used:
National Instruments LabVIEW 6.1
Dell Laptops
National Instruments PCMCIA 6012E Daq Card 20kS/s, 16 Ch/16Bit
National Instruments CA -1000 B7D704
Grip Dynometer using Omega Strain Transducer Using RS232 Interface
PDS Instrumentation KoKo Spirometer K299A26
Treadlite II remote switch T-91-S using BNC Connection
Interface 50lb. Force Transducer (load cell) SM-50-12 Using RS232 Interface
National Instruments SC-2043 SG.8 Channel Strain Gauge Signal Board

The Challenge
A prominent medical association has obligations to test various clinical treatments on children with Muscular Dystrophy through the US and the World. Grip and Muscle Group testing are two ways that quantitative measurements are taken. The original prototype of this system was developed in the DOS platform, and could not be maintained or enhanced. New
updates are required to this software to include the newest innovations in clinical trials and for operational enhancements to simplify field use for deployment to hospitals and research organizations.

The Solution
Data Science Automation has designed a next generation quantitative muscle measurement system to improve the ease of use and create engaging displays to encourage the desired patient response for accurate testing results. This system utilizes National Instruments LabVIEW 6.1 and NI-DAQ components for data acquisition.

Abstract
The purpose of this new system is to improve the reliability of testing processes and results, and will enable researchers to focus on clinical analysis rather than the technology. Researchers can make quick progress with their grant funding and acquire and report on results with unprecedented consistency.

Modules of Quantitative Testing System (QTS)
For each clinical trial, the quantitative testing system is used during a series of patient visits throughout the patient’s treatment schedule. Every clinical trial starts with two screening visits to determine if the child is physically able to enter the clinical trial. Analysis of total muscle score and other factors determine suitability for trial. After a child enters the clinical trial, tests occur on a scheduled basis. When the scheduled visits/tests are complete, the test results assist researchers in prescribing follow up or post treatments options. The child’s progress is tracked after treatment to decide what new treatment regimens should be implemented.

The QTS has a series of quantitative muscle testing modules that are designed to test all abilities of a subject that may be affected by treatment. These areas include different muscle groups like legs, hips, arms, and shoulders, and respiratory strength. Patient strength, endurance and movement are measured. Movements include flexion, extension, abduction, aversion, inversion, and rotation. In Figure 1 the main screen is shown. Figure 2 is the screen for Manual Muscle Testing.

Figure 1 – Main
Figure 2 – Manual Muscle Testing

The Manual Muscle Test will test both the right and left sides of a child and the evaluator will assign a score to the ability of the child. The evaluator can also assign (DIX) values which designate injury or disease progression which may prohibit the child from performing the muscle movement.

Then next module is the (QMT) Quatitative Muscle Test for Grip Strength. This test is designed to engage the patient into the test by using colors, vehicle, and responses according to effort. At each visit, before QMT testing begins, the patient may select a vehicle and color combination that will be used during testing. This is shown in Figures 3 and 4.

Figure 3 – Vehicle Select for QMT Testing
Once a vehicle and a color have been selected the patient will perform three versions of the QMT test. The first version uses a grip-o-meter to test the grip strength of the patient. This grip-o-meter is manufactured by Data Science Automation and incorporates Omega Strain Transducers to output a voltage to the stain gauge module inside the CA-1000 data acquisition unit. The patient response is measured with NI LabVIEW and NI DAQ. Scaling is performed to convert this patient response into pounds units, and displayed in a visually engaging manner for real-time feedback. Configuration files permit storage of a variable number of tests per left/right sides. The QMT grip screen is shown in Figure 5.

Figure 5 – QMT Grip Testing Screen
There are two more QMT tests that focus on the upper torso and the lower torso of the patient. These tests use an 50 lb. load cell to test the strength in a patient’s arms, legs, etc.

The third test class includes functional and timed testing, to evaluate abilities include walking, climbing stairs, etc. These test modules are shown in Figure 6 and Figure 7.

Figure 6 – Functional Tests
The last test module evaluates respiratory performance using a companion software package named Koko PFT Testing System. LabVIEW makes dynamic calls to the KOKO software to test the pulmonary force of a patient.
Support Files

The backbone of the QMT system is its configuration file and database features. These files store all information for each patient registered. The configuration file shown in Figure 8 sets all parameters of the clinical trials and manages the database information by storing record numbers and paths.

![Figure 8 – Configuration File](image)

The Quantitative Measurement System contains a patient file and a test file. Both files are tab delimited and used as storage for testing results and patient data. The patient file is shown below in a text format in Figure 9 and the test file that contains results from each visit is shown in Figure 10.

![Figure 9 – Text Based Patient File](image)

![Figure 10 – Text Based Test File](image)
Conclusion

Using the technology of NI DAQ and LabVIEW products the QMS is the leading product used worldwide to test children with Muscular Dystrophy. The flexibility, engaging screens, and the ease of use will continue to benefit researchers striving to cure the debilitating diseases of their patients.