

db4o | The Open Source Object Database | Java and .NET

MASSIE LABS Improves Eye Health for Babies with db4o

By Amy Tenderich

Massie Labs' acclaimed Retcam II product provides state-of-the-art Wide-Field Pediatric Retinal Imaging for infant eye screening. The comprehensive database, powered by db4o, keeps track of each imaging session, allowing for later side-by-side comparison or review of the images and image transfer via LAN or Internet. This new capability is ground-breaking in the fight against infant eye disease.

To achieve this functionality, the RetCam system required a highly sophisticated database that would provide interaction through an intuitive user interface. With db4o, imaging session review and side-by-side historical trend visualization can be accomplished in seconds by the clinician, providing a priceless tool to assist doctors with diagnosing and treating babies and children who are at risk of going blind or dying if left untreated.

There are now 300 RetCam systems being used in 30 countries around the world. RetCam II, the company's newest system, is a self-contained, mobile unit that provides state-of-the-art imaging detection of sight-threatening Retinopathy of Prematurity (ROP) in premature babies and young children. Eight of the top ten children's hospitals in the US rely now on this system to easily visualize 130-degrees of the retina, instantly digitize wide-field still images, record clinical examinations in real-time, and allow physicians to closely follow patients' progress.

"What's important in treating infants is to have the best imaging possible. Until now, doctors were viewing patients' retinas through a magnifying glass (ophthalmoscope) and recording observations on paper using colored pencils or crayons. This system is a 500-year leap in technology, from charcoal to digital," said Greg Sprehn, Massie Labs' VP of Engineering. "Wide-field real time imaging, along with the ability to better document and share and compare results, enabled by db4o's database – which matches our requirements exactly – makes this a reality."



Massie Laboratories, Inc. (www.massielabs.com) is a medical device company in Pleasanton, California, that develops, manufactures and markets integrated optical systems and services to enhance the clinician's ability to diagnose, manage, and treat eye disorders. These patented devices combine innovative 21st century optical, laser, electronic and information technologies that change the very nature of the provision of eye healthcare.

The Company's initial product line has improved the standard of eye healthcare for pediatrics and is sold to leading Neonatal Intensive Care Units on a global basis, including:

- Stanford University
- Bascom-Palmer Eye Institute
- UCLA Jules Stein Eye Institute
- Toronto Hospital for Sick Kids
- Cleveland Clinic
- USC Children's Hospital
- Wills Eye Institute



Solving the “Impedance Mismatch”

Important criteria for selecting db4o were its ability to store any object and support distributed environments. During development, Massie Labs’ IT team was struggling with an “impedance mismatch” in which records and columns had to be converted to objects and qualities – an extremely painstaking and time-consuming task.



The team evaluated a number of solutions and quickly concluded that it required a single, reliable engine rather than a variety of technologies patched together. According to Massie Labs’ Lead Software Developer Eric Falsken, a traditional relational database (RDBMS) was ruled out because it falls short for new distributed needs, whereas db4o is specifically targeted at distributed data sets. In addition, the RDBMS model forces developers to track each instantiation individually. Only db4o allows tracking of instances distinctively as part of an application.

“We chose db4o because it’s a library: no server required, no client objects, no connection pooling, etc. It does everything within the application, which is much more efficient from an implementation standpoint,” Falsken says. “db4o helped us smooth out the impedance mismatch directly, with excellent response. There are not a lot of experts out there, so their knowledge was a big factor for us.”

For Massie Labs, the key strengths of db4o technology are:

- the ability to store complex object structures, as they occur in the medical, biotech and healthcare space
- efficient use of reflection (the capability to self-adjust to changing conditions)
- speedy performance
- advanced multi-object tracking capabilities
- sophisticated ability to isolate and define the database, without the limitations of RDBMS technology in terms of being “isolated”

db4o Key Benefits:

- Ability to store complex objects
- Cost savings in supporting installed base
- Pivotal in obtaining FDA approval

db4o is used to store all of the collected data in RetCam II, with ability to accommodate up to 100,000 objects stored in one typical system database. The SODA query language syntax is especially powerful and valuable, because it enables object-oriented retrieval of data from the database. Falsken also notes that db4o avoids a typical drawback of traditional object databases: the code object model usually is the data-persistence format, any changes and refactorings to the code between major releases also affect the database, and existing customer data has to be migrated between object versions. Only db4o allowed for updates and modifications of the object model with automatic adjustment, thus making it perfect for refactoring evolving object models and updating with zero-administration.

What sets db4o further apart from other platforms is the fact that it is coupled with programming languages that support reflection (Java and .NET), giving it the ability to analyze executing code during run time. Thus the database has the power to support fully dynamic software systems, “like a biological organism that is evolving,” as one engineer put it.

Storage Makes the Difference

RetCam II enables a quantum leap over traditional ophthalmoscopy in prevention of blindness from childhood diseases. First, the ability to digitally record images is significantly more accurate than manual methods. Secondly, a host of new functions make capturing and evaluating visual data far easier and more comprehensive than ever before:

- instant digital video clip capture (up to 20 seconds of real-time video)
- instant digital image capture
- multi-image data recall and display
- side-by-side image comparison

“In our experience, because the data is being precisely recorded and stored as you do the examination... we’ve been able to find tumors (Retinoblastoma) through the RetCam system that we would have missed with the traditional ‘manila file’ method, or even with more primitive technology,” says Elise Héon, M.D. at The Hospital for Sick Children in Toronto, Canada.



With its powerful storage and querying capabilities, db4o helps provide a clear view of every aspect of a case from initial screening, through diagnosis, treatment and follow-up. Case management becomes easier doctors have immediate access to still images, video clips, patient data, instant retrieval and side-by-side comparison. Images or video clips can also be sent to a colleague for consultation on disk or over the Internet.

“db4o is Admired”

Massie Labs does not run a centralized database. Each of the RetCam II units built is completely autonomous. “db4o is admired because it is not a separate server process that is running on each system. Instead, db4o lives within the application as a resource. This has many advantages,” said Falsken. He outlines these advantages as the following:

- there is no need to maintain smooth operation of separate server processes
- db4o poses no security risk because it’s not “listening to outside network requests”
- db4o can be “spoken to” without reaching out to a network interface because it’s all in-process (i.e. interacting with its own objects)
- if the program is running, and the database objects are accessible, then the database is running

- there is no need to install and configure yet another piece of software, since the systems are embedded

The final point is a very important key to keeping costs down, reducing time spent supporting the systems, and bringing new products to market faster, Sprehn notes.

Results and ROI

The powerful new RetCam II system has solidified Massie Labs' dominance in the integrated optical systems field. Doctors all over the world are now using RetCam II to document instances of juvenile glaucoma, Retinoblastoma tumors and other disorders, and also Shaken Baby Syndrome – for which the clear wide-field images can be printed out on a photoreal dye-sublimation printer for medico legal documentation.

Massie's customers praise the db4o-powered RetCam II for providing better documentation and better visualization – allowing for earlier detection and prevention of blindness. They also value its ease-of-use, which will allow its use to expand beyond ophthalmologists to nurse practitioners and other trained medical personnel. In addition, RetCam II's database utilities make it well suited for use as an educational tool; doctors can use the stored data and images to easily inform and teach parents, neonatologists and other specials, and medical students. This saves hospitals a great deal in costly and stressful “transference.”



In-house, Massie Labs' developers saved a great deal of time using db4o – a native OO database – versus a traditional SQL database, which requires cumbersome object-field mapping code for designing, building and implementing a database schema separate from the object model. The application runs faster by avoiding this “impedance mismatch.” Time spent supporting the application is also reduced because there is simply less software to support: the database is a file on the system and a collection of objects in the code, not a bulky server process.

In short, db4o has enabled this winning product for Massie Labs with minimal in-house expense and effort. Another key outcome was the pivotal role that db4o played in obtaining FDA approval for RetCam II, Sprehn says. The company was required to validate the integrity, repeatability and accuracy of patient data storage and retrieval, and “db4o passed all these tests with flying colors.”

About db4objects

db4objects, Inc. develops, commercially licenses and supports db4o, the world's leading open source object database. With more than 200,000 downloads and many more deployments, db4o offers Java and .NET developers one of the easiest and fastest ways to store objects natively. Development managers at companies such as BMW, Hertz, and Bosch rely on db4o to cut development costs and deliver new products to market faster.