Microsoft Web Platform
Customer Solution Case Study

Firm Creates an Advanced Platform for Spatiotemporal Control of Gene Expression

Overview

Country or Region: United States
Industry: Life sciences

Customer Profile
Syntrix Biosystems is a Seattle, Washington–area company that develops and commercializes life sciences platforms and consumables, primarily for developmental biologists who conduct cancer research.

Business Situation
Syntrix Biosystems wanted to address the need among researchers for up-front validation, flexibility, and a friendlier user interface in their instrumentation.

Solution
Working with partner Jetstream Software and using the Microsoft .NET Framework and Windows Presentation Foundation, Syntrix Biosystems built the SNLS 2200 Light Activation System, a fully integrated platform for advanced spatiotemporal control of gene expression.

Benefits
- An industry "first"
- Business growth
- Rapid development, reduced costs
- Recognition in the industry

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John Zebala, M.D., Ph.D., President, Syntrix Biosystems

With sophisticated offerings in instrumentation solutions, consumables, and drug candidates, Syntrix Biosystems is a leader in giving developmental biologists the tools they need to conduct cutting-edge research in cancer and inflammatory disorders. Working with developers from Jetstream Software, Syntrix Biosystems recently introduced the SNLS 2200 Light Activation System, the first commercially available product to offer a fully integrated platform for conducting experiments involving advanced spatiotemporal control of gene expression. Using Windows Presentation Foundation to develop the control application and user interface, the company implemented up-front validation, the flexibility to design an array of experiments, and an elegant user interface viewable both through the microscope ocular and on a PC screen, while reducing development time and costs by more than half.

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Paul McKee, Senior Software Engineer, Jetstream Software

Situation

Headquartered in the Seattle, Washington, area and with a workforce of 12 people, Syntrix Biosystems develops and commercializes advanced research platforms and consumables for developmental biologists who work in pharmaceutical, biotechnology, and academic research environments. The company also works to discover, develop, and commercialize small-molecule drug candidates for treating cancer and inflammatory disorders and for stimulating the immune system. Since its founding in 1998, Syntrix Biosystems has been awarded more than U.S.$15 million from the National Institutes of Health in support of its development efforts.

In developing its products, Syntrix Biosystems works continuously to address some of the toughest challenges faced by providers of instruments and solutions for researchers in the laboratory environment, particularly those researchers who are using spatiotemporal control of gene expression in their work.

One of those challenges is implementing up-front validation in an instrument so that it can inform a researcher in advance whether the hardware is capable of running a proposed experiment. Another challenge is providing researchers with the flexibility they need to design and program a wide variety of experiments. Yet another challenge is giving researchers a user interface that enables them to access all the functionality available in the instrument without being diverted from the task at hand.

Solution

Starting back in 2003 and with grant support from the National Institutes of Health, developers at Syntrix Biosystems tackled each of those challenges when they set out to build a powerful light-activation instrument of the kind that was unavailable outside select academic settings. As the developers envisioned it, the new product would integrate an off-the-shelf laboratory microscope with high-precision optics, programmatically controllable light sources, a digital micromirror device, a data acquisition system, a digital camera, a motion-control system, and a highly intuitive user interface that could be accessed both through the ocular and on a PC display.

After hardware development was well under way, Syntrix Biosystems enlisted the help of Jetstream Software, a nearby solution provider and Microsoft Gold Certified Partner, to create the software solution for the instrument—specifically, the user interface and the application for controlling the data acquisition system and various hardware components. In his role as team leader, Paul McKee, Senior Software Engineer and Project Team Lead at Jetstream Software, decided to base the solution on the Microsoft .NET Framework 3.5.

"We knew the solution would need to access and control a data acquisition system and scientific camera, both of which were supported by Microsoft .NET libraries and would need to fully interoperate with the native Windows environment," McKee says. "These considerations, together with our experience developing in .NET technologies as well as Microsoft Visual C#, led us to a solution based entirely on .NET."

For application design, coding, and testing, the team used the Microsoft Visual Studio 2008 development system, and for developing the solution's graphical application programming interface, they used Windows Presentation Foundation.

With a biology that is remarkably similar to that of humans, the zebrafish is a model organism for studying the genetics of many human diseases. Here, a zebrafish embryo is shown under 100x magnification with the SNLS 2200 Light Activation System.

As McKee explains, he and his colleagues initially considered using Windows Forms, which is also part of the Microsoft .NET Framework, before deciding on Windows Presentation Foundation.

"We wanted the solution not only to control the data acquisition system and other instrument components, but also to provide researchers with a highly customized, 'designer' user interface," McKee says. "We understood that to implement the control application and user interface that Syntrix Biosystems wanted, we would need the power and flexibility offered by Windows Presentation Foundation." The team also used the Microsoft Expression Blend 2 design software to develop the user interface.

To create both the control application and the user interface, McKee and other software developers and designers at Jetstream Software worked for about six months while hardware developers took the product through its final stages of fabrication and validation. The result of their combined efforts is the SNLS 2200 Light Activation System, sold under the brand of Supernova Life Sciences, a wholly owned subsidiary of Syntrix Biosystems.

The SNLS 2200 Light Activation System uses advanced optics—of the kind previously available only in semiconductor-manufacturing equipment—to direct and control UV light patterns with cell-scale spatial precision on caged reagents that release active chemical modulators of biologic molecules under illumination. Researchers using the instrument can generate customized illumination patterns and, with a digital micromirror device that moves up to 1 million micron-scale mirrors independently, project those patterns with far greater precision than they could using laser-based systems.

Benefits

With the SNLS 2200 Light Activation System, Syntrix Biosystems is offering developmental biologists the kind of functionality previously available only in a limited number of academic settings, along with the kind of usability more commonly available in consumer applications for the PC. As a result, the company is helping researchers use their time and talents more efficiently, solidifying its market position, and expanding its consumables business.

Moreover, because developers were able to bring the SNLS 2200 Light Activation System to market rapidly, the product was available for demonstration at an important industry conference. This demonstration provided valuable exposure not only for the product and Syntrix Biosystems, but also

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for Jetstream Software, as an example of that company's development expertise.

Introducing an Industry "First"

As explained by John Zebala, M.D., Ph.D., President of Syntrix Biosystems, the SNLS 2200 Light Activation System is the first commercially available product to provide developmental biologists and other researchers a fully integrated platform for automating and conducting experiments that involve advanced spatiotemporal control of gene expression.

"With this product, researchers can access icons representing familiar tasks and custom-design illumination cycles, patterns, and sequences—at the touch of a button, without having to think about the instrumentation," Zebala says. "They can interact with an uncluttered user interface not only through the ocular of their microscope, but also on a large-screen PC display, a capability that is unique in the industry."

Another differentiator for the SNLS 2200 Light Activation System is its support for up-front validation. As Zebala explains, with the SNLS 2200 Light Activation System, researchers have the flexibility to program any arbitrary number of automated light-activation and image-capture steps across dozens of wells on a plate. Despite all this, however, the instrument is limited by fundamental laws of physics—and that is where up-front validation becomes so important.

"To take just one example, an instrument cannot illuminate one well while simultaneously photographing an adjacent well on the same plate," Zebala says. "But with the up-front validation built into the SNLS 2200 Light Activation System, it can warn researchers ahead of time that such a task cannot be implemented. This can help researchers use their valuable time and skills a lot more efficiently and avoid the unnecessary destruction of irreplaceable samples."

Solidifying Market Strength

Another factor that makes the SNLS 2200 Light Activation System stand apart is its price. As Zebala points out, since the 1980s, research groups within universities have had varying success in addressing the challenges of up-front validation and control of UV illumination with cell-scale spatial precision. With the SNLS 2200 Light Activation System, Syntrix Biosystems offers a commercially available product that tackles the same challenges, and does so in a price range that is accessible to most major research organizations.

"The SNLS 2200 Light Activation System is an elaborate and highly precise optical system, and the software simplifies not only the projection of patterned light onto specimens, but also the operation of the instrument," Zebala says. "It's one thing for a major research university to put together such capabilities, but quite another for them to be offered in a consumer plug-and-play package."

In fact, the closest competitive product to the SNLS 2200 Light Activation System is a laser-rasterizing imaging system, which is significantly more costly. "Consequently, that product is not widely used for spatiotemporal control of gene expression," Zebala says. "With the SNLS 2200 Light Activation System, we are pretty much unique in our market niche."

In addition, the SNLS 2200 Light Activation System has better positioned the company for growth for its consumables business, particularly its PhotoMorph 2.0 light-activatable gene-silencing reagent. "There is a keen interest in the capabilities of the

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Jon-Jacques Umphrey, Vice President of Operations, Jetstream Software

SNLS 2200 Light Activation System among academic and commercial laboratories that are purchasing reagents," Zebala reports. "We anticipate that by offering this product, we will generate greater interest in our consumables, adding up to 50 percent in growth for that side of our business."

Reducing Development Time and Costs

Yet another plus for Syntrix Biosystems is that the development of the SNLS 2200 Light Activation System turned out to be significantly less costly than it might have been. For this, Zebala credits the decision to use the Microsoft .NET Framework and Windows Presentation Foundation to develop the control software and user interface.

"Developers built the solution very cost effectively by working from a 'whole-user-interface' prototype, which they were able to do because Windows Presentation Foundation supports the independent development of the user interface and application," Zebala explains. "That prototype served as a shell into which developers simply plugged the application-specific functionality. This enabled them to evolve the user interface and application simultaneously, without having to worry about conflicts."

A related advantage is that by following the whole-user-interface approach, developers avoided the common practice of building the prototype user interface in a separate graphics program—a user interface that would later have to be coded for the application. "The whole-user-interface approach supported by Windows Presentation Foundation minimized the volume of 'throwaway' work, reducing our time and effort on user-interface development by nearly two-thirds," says Jon-Jacques Umphrey, Vice President of Operations at Jetstream Software.

Developers also had little need for hardware prototypes, which reduced costs and time-to-market alike. "Considering that the total engineering and development costs for the first hardware prototypes for this product came to almost $2 million, we had only two of them, and they resided not where we were doing the software development, but at the hardware partner's site," McKee says. "Because we were using Windows Presentation Foundation, however, that was not a problem, as we were able to build a prototype user interface and then run multiple iterations of it on an ordinary desktop PC."

McKee elaborates, pointing out the importance of flexibility. "On every project we tackle with Windows Presentation Foundation, we are further impressed by the flexibility it offers for building user interfaces," he says. "In Windows Presentation Foundation, if you can imagine the user interface, you can implement it."

Earning Industry Accolades

Taking advantage of these efficiencies, the team completed the development of the user interface and other software for the SNLS 2200 Light Activation System considerably faster than they had expected.

"Other companies that develop sophisticated life sciences instrumentation often use a big engineering team, but we did this with just a few people and on a relatively limited budget, thanks to a development platform that gave us a clean and easy way to design a complex user interface and integrate sophisticated control functionality," Zebala says. "Developers working on software for the SNLS 2200 Light Activation System spent less than half the time they would have spent working without the capabilities of Windows Presentation Foundation."

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By working so rapidly, the team not only saved money for Syntrix Biosystems, but also was able to finish a near-production version of the product in time to showcase it at the Eighth International Meeting on Zebrafish Development and Genetics. This earned accolades for Syntrix Biosystems and Jetstream Software alike. "With this project, we delivered a successful product and met a difficult deadline for an important trade show," Umphrey says. "Considering we generate nearly 100 percent of our business through word of mouth, the conference demonstration and the reference from Syntrix Biosystems for this project have been enormously valuable."

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