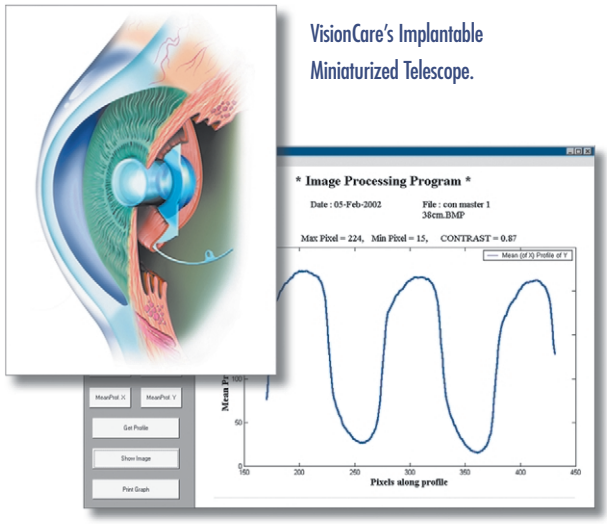
USER STORY

Test Station for Implantable Intraocular Telescope Developed with MATLAB®



VisionCare's Implantable Miniaturized Telescope.

The test station interface.

An estimated 35 million people worldwide suffer from macular degeneration, an age-related disorder that destroys the central vision and leaves the patient unable to identify details, such as written text and faces.

A micro optical device developed by the Israeli company VisionCare Ltd. compensates for the effects of macular degeneration. The Implantable Miniaturized Telescope (IMT) can be implanted in place of the eye's natural lens. The IMT projects magnified images on the retina that allow the macular degeneration patient to watch television, read, identify faces, and scan an area without having to wear special glasses.

VisionCare used MATLAB® and the Image Processing Toolbox to develop the test environment for the IMT. "MATLAB not only saved us valuable time in developing the test system but also ensured that the test procedure was reliable and of optimum quality," says VisionCare R&D manager, Gideon Dotan.

THE CHALLENGE

VisionCare engineers needed to perform complex and rigorous tests on the IMT without jeopardizing their tight production schedule.

Quality control testing of a final product usually involves testing samples according to standard criteria and regulations. Since VisionCare's IMT is implanted in the eye, every single lens needed to be tested individually. Each lens had to undergo quality assurance tests designed to verify that it met the original specifications, as well as complex production-line tests that evaluated the MTF (modulation transfer function), the focal lens, and the contrast of an image produced by the lens.

The test system had to be sophisticated enough to manage this complex testing yet easy to operate.

THE SOLUTION

VisionCare used MATLAB and the Image Processing Toolbox to develop a quality control program to satisfy the strictest criteria. "MATLAB was a natural choice for us because it has already been debugged," says Dotan. "If you're writing in C, you have to verify all the code that you're writing, but if you use a higher-level program like MATLAB, that work has already been done."

MATLAB shortened development time for the test equipment software significantly. VisionCare combined test code algorithms with their existing interface programs from a previous project to produce test results.

THE CHALLENGE

To develop a testing procedure that would ensure the safety and effectiveness of an implantable ophthalmic device

THE SOLUTION

Use MATLAB and the Image Processing Toolbox to develop test procedure algorithms and display and calculate test results quickly and accurately

THE RESULTS

- Shortened development time
- Significant cost savings
- An effective system for testing complicated variables

> *MATLAB was and will remain my natural choice for fast, effective, and qualitative development.*
>
> Gideon Dotan, VisionCare

"Instead of investing months writing and debugging new code, with MATLAB we could integrate existing programs that were written for different purposes, debugged, and found suitable for the operator interfaces of our test procedure algorithms," Dotan explains.

The test procedure included importing bitmap images produced by the IMT lens using a frame grabber. They used the fast Fourier transform algorithm to compute the discrete Fourier transforms of a sequence. The fast Fourier function in MATLAB performed a Fourier analysis of the input signal over a running window of one cycle of the fundamental frequency of the signal. "With MATLAB it's very simple to take an image and to make the calculation. Interfacing between the Image Processing Toolbox and MATLAB is virtually transparent," Dotan says.

The test system consisted of an optical bench with a CCD camera. Using MATLAB, the programmers designed a GUI that captures an image produced by the IMT, enabling the quality control team to measure different lens parameters and then determine whether to approve or reject the lens for implantation.

The MATLAB GUI is easy to operate, but behind this user-friendly interface are complicated signal and image processing algorithms that supply the parameters required for assessing lens performance (such as modulation transfer, light scattering, and contrast testing).

The developers also used MATLAB to display and calculate test results using methods such as statistical analysis and curve fitting. The curve fitting function enabled the developers to reduce the effects of noise in their samplings signal.

After successful clinical trials, the IMT was approved for use in the European Union. VisionCare is now completing the FDA approval process to enable the device to be used in the United States.

THE RESULTS

- **Development time reduced by almost 400%.** "Developing the test system using MATLAB took less than 300 hours. Had we used C++ instead of MATLAB, it would have taken at least three to four times longer to develop our test system," Dotan says.
- **Significant cost savings.** According to Dotan, "We estimate that using MATLAB potentially saved us $25,000 by reducing the engineering time needed to complete the design."
- **An effective system for testing complicated lens performance variables.** The easy-to-use MATLAB GUI enables VisionCare to perform sophisticated quality assurance and production-line tests to validate the effectiveness and safety of each lens.

To learn more about VisionCare visit **www.visioncare.co.il**.

APPLICATION AREAS

- Algorithm development
- Image processing
- Software development

PRODUCTS USED

- MATLAB®
- Image Processing Toolbox

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