Stanford ME 310 Project

Customer Success Story

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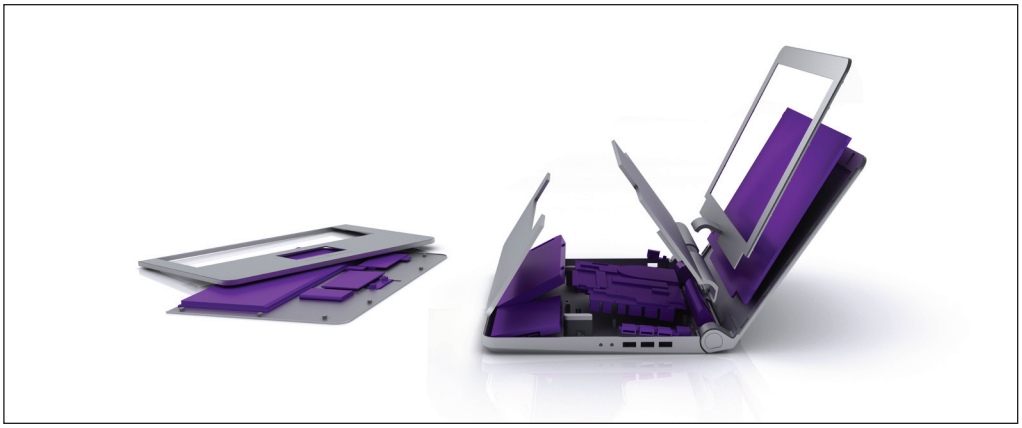
Within five minutes of installing Autodesk Inventor Publisher, one of my teammates had created a 10-second animation showing two parts of the laptop coming together. The next day, he had an animation of the whole laptop being disassembled.

—Aaron Engel-Hall
Stanford Student

Putting the Bloom on sustainable design.

Students from Aalto University and Stanford University use Autodesk® Inventor® and Autodesk® Inventor® Publisher software to design and document a sustainable laptop.



Project Summary

According to the U.S. Environmental Protection Agency, 1.9 to 2.2 million tons of electronics became obsolete in 2005. Of those, only 345,000 to 379,000 tons were recycled. The other 1.5 to 1.8 million tons ended their lives in landfills. As the demand for electronics grows, so does the issue of how to dispose of them responsibly. For the most part, consumers don't know where or how to recycle these items, and electronics manufacturers haven't designed their products to be recycled easily.

So how do we overcome these barriers to e-cycling? Ask the Autodesk-sponsored team of students in the Mechanical Engineering 310 (ME 310) class offered through Finland's Aalto University and Stanford University in the United States. The team spent nine months researching, prototyping, and conducting user tests with the sole purpose of redefining the relationship between consumers and their electronics. The goal: develop an electronic product that makes e-cycling a more effective, engaging, and complete process for consumers and thus decreases the electronic waste added to landfills every year.

With help from Autodesk® Inventor® software and Autodesk® Inventor® Publisher software, the ME 310 team developed and presented the Bloom laptop, which can be disassembled for recycling:

- In 10 easy steps
- With no tools
- Within two minutes

The Challenge

A graduate course for mechanical engineering, ME 310 challenges students to address a real-world problem. "The project was very open-ended for us," says Kirstin Gail, a member of the ME 310 team. "It wasn't just about manufacturing. We spent a long time trying to find out what motivates people and conceptualizing designs."

The multidisciplinary, global team included mechanical engineering students, a business student, and two industrial design students from Aalto and Stanford universities. For the first few months of the project, the team worked to identify barriers and motivators for recycling electronics as well as key design requirements. It wasn't until four months later that the team decided on the electronic consumer product it would make—a laptop. By that time, the members had learned something unexpected. "We realized the selling point for the product couldn't be that it was green," explains Linda Liukas, a business student and team member from Aalto University. "The laptop had to deliver other benefits as well."

The team also established basic requirements that would make it more likely for consumers to recycle the laptop, such as quick and easy disassembly without tools. "The minute consumers have to use tools, they become frustrated," says Liukas. "We knew we had to make the disassembly quick, simple, and intuitive."

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Students help remove barriers to e-cycling with help from Autodesk.

The Solution

The design process for the laptop started with deciding which hardware to use. Then the team began designing a case to enclose the hardware, which would be simple and easy to disassemble. For this, it turned to 3D modeling software with Autodesk Inventor. "We created 3D shapes to represent the hardware we had to design around," explains Aaron Engel-Hall, a Stanford student and team member. "We used Inventor software often during the ideation phase to experiment with the design."

For example, the team played around with various thicknesses for different portions of the case. "I was responsible for the screen, which I tried to make as thin as possible while maintaining structural integrity," says Engel-Hall. "With the Inventor model, I could move different planes around to vary thickness of components. Inventor's parametric design let me put in different parameters so all the model dimensions would update immediately."

Throughout the process, the team sent Inventor files directly to 3D printers to create stereolithography (SLA) prototypes for evaluation. "We created 3D prints of the laptop case from our Inventor models," says Gail. "Then we were able to rewire internal circuitry from an existing computer and put it in the SLA prototype casing to see if it all worked."

The end result of the team's efforts was the Bloom laptop, which can be disassembled in 10 steps, without tools, and easily separated into material types, such as plastics, metals, and circuitry. As a comparison, a commercial laptop popular with students took a team of three engineers 45 minutes, three tools, and 121 steps to disassemble.

Beyond recyclability, Bloom delivers other benefits for consumers. "When we watched people interact with their laptops, we realized they used them in an awkward manner," explains Liukas. "We used the easy-to-disassemble modularity of Bloom to develop a keyboard and track pad that detach, allowing for more ergonomics." The ease of disassembly also makes it easier to repair and upgrade components over the lifetime of the product, so that buying a computer is no longer a singular investment, but a longer-term relationship between the consumer and the service provider.

Impressive Animations

The team's work didn't end with building Bloom. It had to present the project at the Stanford University EXPE conference. To prepare for this, the members turned to Inventor Publisher software, which allowed them to create animations directly from the digital prototypes created in Autodesk Inventor. "Within five minutes of installing Autodesk Inventor Publisher, one of my teammates had created a 10-second animation showing two parts of the laptop coming together. The next day, he had an animation of the whole laptop being disassembled," says Engel-Hall. "The video was easy to create and we received a great deal of very positive feedback on it. Everyone was impressed."

The Result

The Autodesk-sponsored ME 310 team—which also included Rohan Bhobe, Juho Huotari, Markku Koskela, and Chongbei Song—succeeded in meeting its vision for the Bloom laptop. First, users can disassemble it easily and intuitively without tools. Second, the Bloom achieves its "greenness" as a by-product of a modular design that offers other benefits to the consumer. Finally, the laptop provides an engaging end-of-life experience that reinforces consumers' internal "feel good" motivations for recycling.

Perhaps more importantly, the experience had a major impact on the team members. Engel-Hall abandoned his plan to pursue energy systems in

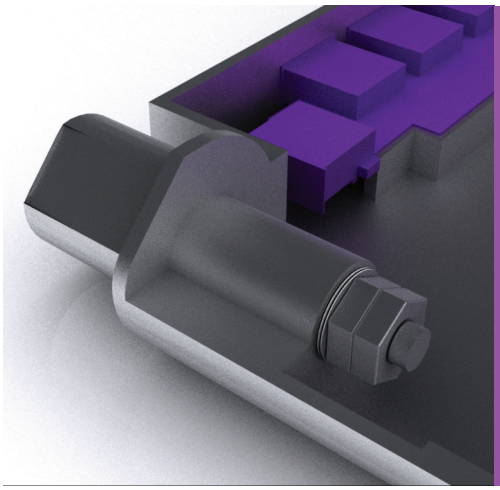
favor of product design. "I stumbled on the class and absolutely loved it," he says. "I know now that I want to do product-based design. I really like working with users firsthand and seeing how they experience objects."

Likewise, Liukas and Gail shifted their career focus. "I definitely feel more inclined to do product development now," says Liukas. Gail went in the opposite direction. She says, "My initial ambition was to go into product engineering, but now I'm more involved in need-finding for products. It's much more about collaboration and communication."

While the team members each got something different from the experience, they all agree that Autodesk was a great sponsor. "The Autodesk people were incredibly supportive and interested in what we were doing, but they were never heavy-handed," says Engel-Hall. "They gave us freedom and supported our decisions. We couldn't have asked for more."

For More Information

To find out how Autodesk Inventor software and Digital Prototyping can help you realize the potential of sustainable design, visit **www.autodesk.com/company/sustainabledesign**.



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