

Two Screens Are Better Than One

You arrive at your office in the morning, sit down, look at your to do list and wonder how you're going to get it all done. If only you had a tool, a genie in a bottle, anything that would help you get more done in less time. And caffeine is out; you gave that up last week.

Microsoft researchers haven't perfected the genie, but they've found a tool that can increase your productivity by 9 to 50 percent and make your work day easier. And you can begin using it right away.

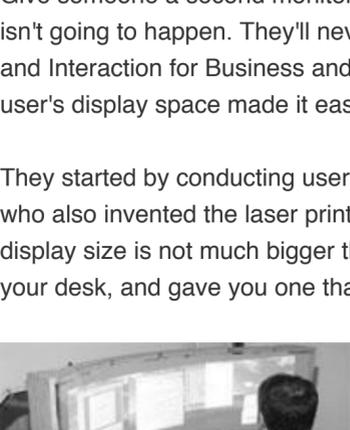
The researchers conducted user studies that proved the effectiveness of adding a second or even third monitor to your workstation, creating a wide-screen effect. In addition, they found out how the operating system needs to change to accommodate a larger screen area.

Their work encompassed changes needed in the next version of Windows, as well as looking forward to when wide screens would no longer mean side-by-side single monitors, but would instead take many different forms. They even developed a prototype wide-aspect monitor to test their ideas.

I'll Never Go Back!

Give someone a second monitor, let them use it for while, and then try to take it away. It just isn't going to happen. They'll never go back to a mono display. Researchers in the Visualization and Interaction for Business and Entertainment group (VIBE), found that increasing a computer user's display space made it easier for them to complete their tasks.

They started by conducting user studies on a monitor designed and built by Gary Starkweather, who also invented the laser printer. Starkweather likes to remind people that the average display size is not much bigger than an 8-by-11 sheet of paper. He asks, "What if I took away your desk, and gave you one that was only 8-by-11? How easy would it be for you to work?"



The monitor that Starkweather built, code named Dsharp, is

42" wide. He used three XGA DLP projectors, each with a 1024 x 768 resolution, and set them into a curved Plexiglas panel, resulting in a 3072 x768 resolution display. The display was curved to avoid distortion at the farthest fields of vision.

"Typically, if you just project something on a curved screen it looks like you're projecting it on the bedroom drapes or something," said Starkweather. "I had to use some special mirrors to distort it back so that I got a fairly smooth image."

The research study required users to complete several different tasks, switch from one task to another, and remember data. None of the study participants had used multiple monitors before.

The first study revealed that the users' productivity increased by 9 percent. Further studies showed even greater increases - at times up to 50 percent for tasks such as cutting and pasting. [Mary Czerwinski](#), the VIBE research manager, is excited about her group's discoveries, asking, "If you're able to squeeze 10 percent more productivity out, do you know how much money that will save?"

One of the user studies that the VIBE group did required users to navigate through a series of doors, and then back their way out. They wanted to test the user's ability to remember a series of actions on a small display versus a large display.

"The interesting thing is that they try to get it right. We found that memory capability is considerably improved on a big display over a small display. There's something about engaging the peripheral vision that improves your spatial memory of what has gone on," said Starkweather.

Women Need Their Space

An unexpected finding during the user studies will greatly benefit women. "We had users go through a maze on the computer to find out which cues in a large display will help users access spatial memory. We stumbled on these gender differences," said Czerwinski. "We thought that smooth optical flow cues were what helped women perform better while navigating through the mazes. And sure enough, when we ran the study comparing how people performed during a smooth animation versus when they faded in and out of the scene, we found that women did a lot better. The men preferred the smooth animation, but the choppy animation didn't bother them or slow them down as much as it did the women."

"It might be that there are other cues, but traditionally women aren't wired the same way as men to navigate long distances and be able to manipulate spaces in their heads as adeptly as men do," explains Czerwinski. "Any one female can be just as good as or better than a man at spatial navigation tasks, but on average females are a little worse. So we need to support females with big displays, with wider fields of views when they're doing intense navigation tasks. They've been at a disadvantage in any 3D system, but just give them a wider field of vision and smooth graphics, and they're good to go."

Software Innovations To Support Multiple Monitors

There's more to enhancing screen real estate than the hardware. Every facet of the software needs to be examined and tested. One of the items on the list is the cursor. If you are switching from task to task, and sweeping your cursor across dual monitors, or even a seamless wide screen, chances are you might lose track of it.

Researchers [Patrick Baudisch](#) and [George Robertson](#) have designed some new behaviors for the common cursor. "Patrick and I have both been exploring mouse and cursor issues to make it easier to track on a large display. The basic problem is that you have to move the cursor such a far distance from one edge to another that you set your acceleration point really high. But if you move it too fast you can lose track of it," said Robertson. "We wanted to add some mechanism that keeps it visible. The high-density cursor was the best." Their user studies showed a 7 percent increase in performance on a task.

If you are using two monitors you will have the physical edges of the monitors smack dab in the middle of your viewing space. The separate halves of a document opened across the great divide might not line up. Baudisch developed a program that allows users to adjust how the monitor shows windows that are stretched across multiple screens.

In Windows, when you hit the maximize icon, the default for a single monitor is to maximize it to the entire screen. The default behavior built into display cards for multiple monitors usually corrects this so that the window only maximizes to a single monitor size. But what if you do want to use the entire space? As people get used to having the extra space, chances are they'll want to spread out. Robertson is exploring ways to solve this, too.

Looking Ahead

Researchers at Microsoft have two tasks. One is to discover the technologies that fit into our world within the next two to three years, and the second is to think of the breakthrough technologies that we will be using five to ten years from now.

When considering the change to a large display, several challenges come to mind. What will a computer display look like in the future? How do you view incoming data? How do you organize your files - because you'll probably have many more windows open?

Let's start with the monitor itself. The rise of computers has tethered us to our chairs, because that's where the monitor resides. Starkweather has a vision for a monitor that won't tie you to your desk. He is imagining and working toward a way to tile smaller monitors that you can configure on the fly.

"I'd like to think I could have a display that went around my door sill, I'd like to have something that flexible. Whether anyone does it that way is not the point. It's just that I'd have the architectural freedom to do that, whereas today I don't," said Starkweather.

Starkweather's tiled monitor would allow you to have a big display and use the whole space, or only use portions of it depending on your need. Several people could even share one large display.

You could order up a custom display to fit the odd space in your basement where you want your teen to play online games, or put a long narrow display along one wall for your spreadsheets, with a short, fat display on another wall for your novel-in-progress.

Now let's move on to considering incoming data, which might be an email notification, or an appointment reminder. If you're staring at a spot at the computer that's at the far left edge of your display, you might miss an important notification if it pops up at the far right edge.

[HongJiang Zhang](#), the assistant managing director at Microsoft Research Asia (MSRA), has worked on a system to track the gaze of a user so that the computer can place an alert where you'd most likely notice one. He inserted a small video camera into the display. The camera tracks the user's gaze and communicates with the notification software to move alerts to where the user is looking.

How do you organize your data? Don't groan, it must be done. More space might make it easier; however, if you're working on a large screen and switching between spreadsheets, your online research, the company report, your inbox, a collaborative workspace or two, and maybe a game of Solitaire, how do you track it all? The VIBE group wanted to find out if there were some ways to improve the taskbar for a larger display area.

They came up with a few projects, one of which is code-named Scalable Fabric. Scalable Fabric lets you put the windows that you're not working on into the periphery of your screen. Instead of text on a taskbar, you can see a mini version of the whole page.

"We don't minimize in the old sense. The window is not hidden, it's just smaller. When you want to bring it back it comes back into the focus area. When you drag it near the periphery the window gets smaller," explains Robertson.

The VIBE group was formed when researchers who were working in several disciplines across Microsoft Research had a vision to improve the user experience. Now their vision will not only widen yours, it will help you get more done in less time - even without a genie.