TECHNOLOGY TRANSFER INSTITUTE
Vanguard

Pliable Display Technology

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Inherent in the finite screen size of a computer display is a joint limitation on the breadth and detail of view of any data set that is portrayed, whether the data represent the cells of a spreadsheet, formatted text, the bitmapped dots of raster graphics, the geometric output of vector graphics, or hybrid data types. When the resolution of an image exceeds that of the display, information is seemingly lost unless data is taken out of context by zooming, panning, or using separate or inset views. Each of these approaches disconnects the area of interest from the underlying information, thus inviting errors in interpretation. David Baar of IDELIX offers a "detail-in-context" alternative called pliable display technology (PDT).

Fleshing out a concept first introduced in Len Kleinrock's lab at UCLA in 1971 and dubbed the fisheye display (which in turn has been recently applied to ad hoc wireless networking—fisheye state routing (FSR)), the PDT variant of the inset view fully retains the broad context of the data set by smoothing the visual transition between the region of detail and the remainder of the image. Thus not only is screen real estate optimized, but continuity is also preserved. "In place, we can show all the detail that is in the information, and keep track of where it is in the context," explains Baar.

Baar's feature-packed product has an intuitive interface that allows the user to readily reshape, resize, and/or reposition the magnification window. An airport safety analyst might pan down a runway, following the position of an airplane of interest while retaining a view of the remaining action on the airfield. Note that not only space but also time is integrated into the application. By storing the results conferred by this additional dimensionality (e.g., by driving the movement of the magnification window with a timer), lens paths can be retraced in future scenarios.

Users are also free to choose the sharpness with which the image transitions between the region of interest and the background. A somewhat extreme application of this tunability—the "folding" feature—allows the user to seemingly pull a segment of the image up and out of the plane of the underlying two-dimensional image. Since PDT's geometry engine maintains the coordinate system of the base image within the lens, point-to-point distance measurements can be calculated within a given lens, between a position in the lens and the background, between points within multiple lenses—another feature of PDT—and between background points. For example, an ecologist might fold two magnified regions of a satellite image to compare the details of stands of trees in different parts of a large study site. But the preservation of relationships among data points within the PDT algorithms does more. If data within a lens is edited—for instance, the image of a suspicious speedboat is circled within a satellite photo of a Persian Gulf harbor—when the magnification window is moved to scan other parts of the image, the editing marks remain associated with the appropriate data points and shrink accordingly. This advanced IDELIX feature is called "undisplace." Boeing, an important IDELIX customer, relies heavily on the undisplace capability for their stereo-imagery-based map-making projects.

Hybrid data is especially well served by Baar's technology. Consider a layered view of a vectorized street map and real-time satellite-gathered raster data of an urban region. "How can we use the location awareness that a lens gives us to do useful things in possibly bringing in the right emergency response team to a location where assistance is needed?" asks Baar. A lens is centered on the operative intersection from the vector graphics map, and the raster image provides immediate information upon which decisions can be made. By dissociating the lens from the specifics of the data and instead gluing it to the on-screen position, diverse data sets can be employed to their best advantage.

Notably, given the current focus on security- and defense-related issues, not all who might view an image warrant access to the finest grains of detail. Pliable display technology preserves gradation along these lines, again through the separation of the view within the lens from the data beneath. The option to impose password-based restrictions to high-resolution imagery, for instance, is an integral feature of PDT.

Although image manipulation might appear to be the most natural realm for PDT, Kleinrock's initial work saw the spreadsheet as the application space of interest. A precursor to PDT, IDELIX's ExcelLens, a product incorporated into Microsoft's Excel, supports comparison of disparate regions of a spreadsheet, and the full product enhances regions of text for easy reading, thus mimicking how people bring a document closer to their eyes to read the fine print. Of particular relevance to the online world is the viewing of newspapers. The traditional paper-based layout transfers poorly to the screen, but with a detail-in-context view, articles can be easily read, threads followed, and photos and charts viewed—all without the reader getting lost.

While the PDT lens appears to confer a third dimension on 2-d data, as most notably apparent in the folding view, the algorithm behind the magnification technology actually works by adding space between the points of data. Three-dimensional data can be treated in precisely the same manner to expose occluded points hidden within a solid object. When a PDT lens is placed with its focal point at the interior region of interest, the occluding data points are displaced along the surface of a cone, thus revealing that which was previously concealed. Undisplace, of course, reverses this operation and restores the data set to its original view. Designers and manufacturers should find that this application significantly eases the task of object assembly as the 3-d magnification lens is manipulated across the many components that compose a whole.

In an effort to enhance adoption by third-party developers and integrators, IDELIX has ported PDT to several platforms: Windows, Unix variants (Solaris, IRIX, and Linux), Mac OS X, and Windows CE, where with the latter case Baar hopes to bring detail-in-context to devices that are severely screen-challenged. Future directions include on-board automobile navigation as well as collaboration with the National Imagery and Mapping Agency (NIMA) to enhance the ability to view their comprehensive library of maps.