Inventions on Improving Visibility of GUI Elements

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1. Introduction

The evolution of computing technology has witnessed tremendous growth in the processing power of the computer. The memory and storage capabilities are also increasing year after year. This scenario is encouraging the software developers to build complex graphical user interfaces containing more and more GUI elements to offer various advanced features.

In contrast to the above, the display area of a PC monitor remains the same. Although there are some large display devices, they are expensive, immovable and built for special purpose use. The common user has to use the same small screen in his front. This inhibits the productivity of a computer, as the user does not just have enough view area to interact with the computer.
1.1 The problem analysis

Background problem
An advanced GUI demands more screen space to display its GUI elements. A multitasking environment requires more screen space to facilitate working on multiple applications simultaneously. The user needs more screen space to view large documents and images. Sharing the same limited screen space to meet all these concurrent demands leads to compromise the visibility of certain elements of the graphical user interface. It is necessary to display all the required elements of a GUI without compromising the visibility of the important elements.

Possible solution
One possible approach is to increase the size of the monitor. The previous standard of 14-inch monitors has increased to 15-inch and then 17-inch monitors. There are also 28-inch and even larger monitors available in market.

Contradiction
Although 28 inch and larger monitors are coming to market they are extremely expensive because of non-standard sizes. Besides the human eye will not have a comfortable angle to view beyond a size of around 20-24 inches. We want the monitors to be large to improve visibility but we cannot increase the size of the monitors beyond a limit, as that will have adverse effect on visibility.

Possible solution
Another solution is to reduce the size of the fonts, reduce the size of graphics and other display elements.

Contradiction
But reducing size of display elements has a limit, as the human eye cannot see too tiny objects. We want the fonts and graphical elements to be small to get accommodated within the limited space on the screen, but we want them to be large enough to be viewed comfortably.

Possible solution
A proven solution is to use windows to create multiple virtual screens to display multiple documents and interfaces on the same physical screen space.

Contradiction
In a windows environment the foreground windows disrupt the visibility of background windows and other objects. We want the windows to overlap on each other in order to be accommodated within the small screen space, but we don’t want the foreground windows and objects to block the visibility of background windows or objects.
1.2 The solution analysis

The concept of window has solved the problem of screen space to a great extent by increasing the virtual size of the display. The window based systems attempt to maximize the utilization of screen space by displaying multiple overlapping windows on the same physical location. There are many techniques used by the window based graphical user interfaces to reduce the impediments caused by overlapping windows and improve the visibility of various elements in a GUI.

➤ Several methods are followed to arranging windows, such as, tiled, timed, timed icon, cascaded, minimized, locked etc. (Patent 6512529) in order to reduce the impediments of the overlapping windows.

➤ One may use “transparent” windows and objects (Patent 6118427) to reduce the impediments caused by overlapping windows.

➤ Using “scrollbars” and other scrolling options to view the contents of large documents, images and user interfaces.

➤ There are certain techniques like large virtual workspace metaphor (patent 5704050), multiple virtual workspace metaphor etc. to increase the size of desktop by placing objects outside the boundary of the visible space.

A large virtual space metaphor places objects on a large virtual screen that expands beyond the boundary of the small physical screen. A map of the expanded desktop is placed on the screen. The user clicks on the map to select the corresponding portion of the expanded desktop. This concept provides large visual space to be used by applications through a small visual space for human interaction.

➤ Using icons for windows is a great technique to manage space and visibility. Large objects are reduced to icons when not used and expanded to viewable size when required.

➤ Another approach to increase the display area of a computer is virtual reality. The virtual reality system provides the user with a head-motion parallax: when the user moves his or her head, the view seen through the head mounted display unit changes as it would in real life.

➤ Another approach is “screen zooming” which allows magnification of specific objects or specific parts of the screen for better visibility.

➤ Another approach is “sliding out interface” (Patent 5914716) where specific part of the GUI slides out and displays graphical objects when the user moves the pointer near to it.
Another method is to use “expandable and collapsible” sub-panels (Patent 5986657) where the user can expand and collapse sub-panels to see their contents but the total size of the screen used by sub-panels remain the same.

1.3 Ideal Final Result

Ideally the display screen should accommodate all required data, objects and GUI elements for user interaction. If some data or object is hidden behind or remaining beyond the display area, it should automatically come to the front when needed by the user. If any text or image is reduced in size to save display space, it should automatically be enlarged when the user wants to view it.

2. Inventions on improving visibility of GUI

2.1 Differently magnified interlocked windows with automatic scrolling (US Patent 5625782)

Background problem

Many graphic editing tools use two windows where one window shows the characters/figures in a small size for preview and the other window shows the characters/figures in large size for editing. This method of simultaneous viewing and editing of the characters/figures improves the efficiency of the operator.

But this method has a drawback. As the window-1 showing the miniature view occupies some screen space, the window-2 gets less screen space, which requires frequent scrolling by the user. To solve the above problem the Japanese patent No 270384 (1992) proposes to display a rectangular body on window-1. By moving the rectangular body on window-1, the contents of window-2 are scrolled. But this method displays window-1 on top of window-2 to enable scrolling operation and thereby obscures some part of window-2.

Solution provided by the invention

Patent 5625782 (invented by Soutome et al., assigned by Hitachi Ltd, issued Apr 1997) discloses a solution to the above problem. The invention displays a first window and a second window in a non-overlapping manner. The first window contains the reduced size and the second window contents the actual or enlarged size. The input or editing can be carried on from either the first window or the second window. Any editing or cursor movement in the first window will reflect the corresponding changes in the second window and vice versa.
When position of the cursor moved in window-1 is not visible in window-2, the display position in window-2 is automatically scrolled to display the position.

**TRIZ based analysis**

The invention uses a pair of interlocked windows, the editing and cursor movements in any one of the windows automatically reflect in the other window (Principle-26: Copy).

The invention reduces manual scrolling by automatically scrolling the other window, reduces cursor movement by automatically moving the cursor to the desired place and improves visibility by automatically scrolling the enlarged window (Principle-25: Copy, Principle-15: Dynamize).

**2.2 Menu selection with menu stem and submenu size enlargement (US Patent 5956035)**

**Background problem**

The pull down menus may contain a large number of items which do not fit into the limited size of the menubox or even within the size of window. One solution is to scroll the menu items within the menubox, but scrolling the submenus off the screen has the difficulty that the user may lose track of his position in the overall scheme. There is a need to avoid scrolling and improve visibility of the menu items.

**Solution provided by the invention**

Sciammarella et al. invented a method (Patent 5956035, Assigned by Sony Corporation, Sep 99) of enlarging the particular item under the cursor. According to the invention the size of the menu item is increased when referred, and decreased when no longer referred. As soon as the user moves to another menu item, this newly referenced item becomes larger than the other menu items, while the previously referenced item is reduced to its original size.
**TRIZ based analysis**

The menu or submenu of a menu scheme should display all the options that is required to be displayed under that menu or submenu. But the size of the menubox or the window is not adequate to contain the number of menu items beyond a limit *(Contradiction)*.

Use a scrollbar within the menu box to scroll the menu option *(Possible solution)*.

Scrolling requires additional burden on navigating the menu tree. Apart from that the user looses his/her track while scrolling through menu items. It is necessary to display all the items in the menubox, but it is not desirable to scroll the menu items in the menubox *(Contradiction)*.

Reduce the size of menu font to accommodate more menu items in the limited display area *(Principle-35: Parameter change)*.

Reducing font size affects visibility. It is necessary to reduce the font size to accommodate more menu items, but it is not desirable to reduce the font size, as that would affect the visibility of the menu items *(Contradiction)*.

The invention displays menu items in small fonts to avoid scrolling, but enlarges the individual items when the cursor is moved onto it for better viewing *(Principle-15: Dynamize)*.

### 2.3 Dynamic control of zoom operation in computer graphics (US Patent 6052110)

**Background problem**

When the user wants to view a large graphical universe within the limited area of display screen, he has to “zoom out” the graphical universe to reduce its size. Conversely, when the user is interested in a detailed view of a particular object, he has to “zoom in” the object-in-interest. Thus zoom in and zoom out are important functions in a graphical user interface.
But this mechanism has some drawbacks. The user cannot zoom in or out with a single operation. Typically, the user has to select one icon (say magnifying glass) to zoom in and select a different icon to zoom out. Besides, the user cannot control the speed of the zoom operation dynamically.

**Solution provided by the invention**


According to the invention, while holding the mouse button depressed the user can move the cursor away from the reference location. As the cursor is moved away from the reference location a direction line appears on the display screen. This direction line indicates the nature of zoom operation. If the line is inside the circle, the object is zoomed-out, and if the line is outside the circle, the object is zoomed in. The length of the line determines speed of the zoom operation.

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**TRIZ based analysis**

The invention provides a zoom operation in computer graphics to improve visibility (*Principle-37: Expansion*).

The invention not only controls the zoom-in and zoom-out operations but also controls the direction and speed of zooming operations dynamically while moving the cursor (*Principle-17: Another dimension, Principle-15: Dynamize*).
2.4 Graphical user interface touch screen with an auto zoom feature (US Patent 6211856)

Background problem
Today’s home entertainment systems provide a large number of functions to the user. Many of them are remote controlled by GUI displays. Although a GUI adds user friendliness to these devices, typically these devices (remote controls, PDAs, photocopier control panel etc.) are relatively small to display the icons in a size that can be accessible by a person’s finger. It is necessary to display maximum number of icons on the display yet the features of the icons should be easily accessible by a user.

Solution provided by the invention
Patent 6211856 (invented by Choi et al., issued in Apr 2001) used a zooming feature to solve this problem. According to the invention an entire collection of icons are displayed at a scale in which the individual function of each icon is large enough to be recognizable but too small to be easily accessed by a finger touch. When the user touches the icon on the screen, that icon is zoomed to the full screen so that the user can select the desired feature.

For example the initial screen may display the icons of a TV, VCR, DVD, Keyboard etc. When the user touch-selects the TV icon then the TV icon is zoomed to display the functions available inside the TV option, such as channels, volume etc.

TRIZ based analysis
The icons in these tiny touch sensitive devices should be large enough to be selected by a finger or a stylus. But making the icons large reduces the number of available functionalities on the screen. It is necessary to display large icons to be operated through a finger or stylus, but it should also display a number of functionalities to the user (Contradiction).
The invention initially displays the icons in a size that is convenient to recognize but difficult to select through a finger or stylus (Principle-16: Partial or excessive action).

Upon touching the screen area the screen provides a zoomed version of that area so that the user can touch select the underlying features (Principle-15: Dynamize, Principle-37: Expansion).

2.5 Graphical user interface (US Patent 6353436)

Background problem
When the user is working with various applications simultaneously or working with large documents or images it is necessary to have a large display screen to view them properly.

Although windows and virtual workspaces have solved this problem to some extent they need a lot of scrolling and excessive use of mouse movements to select the desired objects on the screen.

Solution provided by the invention
Patent 6353436 (invented by Reichlen, assigned by Sun Microsystems Inc., issued in Mar 2002) discloses a method of rapidly navigating through windows and performing GUI operations without requiring the use of a keyboard or mouse.

The invention uses a video display system which includes a swiveling chair, a computer mounted at the base of the chair, a platform for supporting keyboard and mouse, a head mounted display and a position sensor, including a transmitter mechanically coupled to the head mounted display and a receiver mechanically connected to a stationary reference point. The reference point can be located above the user’s head, at the base of the chair or any other place nearby.

The virtual view space is the total image area in the video display system. The virtual view space is 360 degree and has a height of 135 degree. The virtual view
is shaped like a “cylinder” which surrounds the user. The view space includes 96 million discrete points, 16 thousand in horizontal and 6 thousand in vertical, each identified by a yaw and pitch location. During operation the user may navigate the virtual view space moving and rotating his head.

**TRIZ based analysis**
The invention maximizes the display area by using virtual view space (Principle-37: Expansion, Principle-26: Copying).
The virtual view space is shaped like a cylinder that surrounds the user (Principle-14: Curve).

### 2.6 Enlarged virtual display (US patent 6445364)

**Background problem**
When the user has a very low vision he can see only the large objects. The conventional GUI does not help him. There are certain mechanisms to enlarge the display on a conventional screen. But these mechanisms enlarge only part of the page or object or worksheet and the rest of it extends beyond the screen. The other option may be to go for large monitors or projectors but those are expensive, space consuming and not suitable for individual use.

**Solution provided by the invention**
Arthur Zwern invented a virtual monitor for enlarged display (US Patent 6445364, Assigned by Vega Vista Inc., Sep 2002) which addresses this problem. The invention is a head mounted display which allows enlarged virtual display of the computer output. The user can move his head to view the desired direction. This enlarged computer output is found to be beneficial for the visually impaired users.

![Head Mounted Display Diagram]

**TRIZ based analysis**
The invention provides an enlarged display for better visibility (Principle-37: Expansion).
3. Summary

It is desirable to view a large number of objects and GUI elements within the limited size of a computer screen. Displaying large number of items often necessitates reducing the size of the items. But reducing the size of the items affects their visibility. It is necessary to display the required number of visual items but without compromising their visibility.

There are many inventions dealing with improving visibility under such circumstances. This article analyzed six patents from US Patent database, which try to solve the problem in the following ways:

⇛ By displaying an enlarged view of the first window in the second of the two interlocked windows.
⇛ By enlarging the menu item under the cursor dynamically along with cursor movement.
⇛ Dynamically controlling zoom-in and zoom-out operations while moving (or dragging) the cursor.
⇛ Zooming the icons on the touch screen upon touching the screen area.
⇛ Using a head mount to create a large virtual display.

The article analyzes the background of each problem, their objectives or desired results, contradictions faced in achieving the desired results and how these inventions have solved the contradictions. Visibility is still a challenging issue and demands more inventions to solve many more problems.

Reference to patents:


Other references:


