An Overview of Visual Design Techniques For Cyber Forensic
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ABSTRACT
Visual design in general is interested in arranging information items (e.g., text, images, diagrams, pictures, tables) in such a way that it is visually attractive, perceptive and easily understandable. Visual design issues are raised in many domains of human activity such as user interface design, documentation development, presentation design, and graphic layout. Cyber Forensics is a scientific discipline which is concerned with the collection, analysis and interpretation of digital data connected to a computer security. Since any device, data or other resource subject to a forensic examination may be subsequently used as evidence in a court of law, cyber Forensics puts special emphasis on the correct treatment of potential evidence to prevent it from being altered or tampered with. Because of the same reason, any technique or tool used during an investigation has to meet strict standards, and any conclusions drawn must be scientifically reasonable.

Keywords: Graphical Applications, Grid, Interaction Objects, Interactive Objects, Layout, Multimedia Applications, Visual Interface Design and Management, Visual Interaction, Visual Placement, Visual Techniques, Cyber forensics

INTRODUCTION
Visual design in general is interested in arranging information items (e.g., text, images, diagrams, pictures, tables) in such a way that it is visually attractive, perceptive and easily understandable. Visual design issues are raised in many domains of human activity such as user interface design, documentation development, presentation design, and graphic layout. This chapter heavily relies on techniques coming from visual design as used in typography to expand them to user interface design.

When the designer sketches the components of a user interface, the first thing to do is to select appropriate interaction and interactive objects according to the user's task. The second activity is to determine the basic layout of these selected objects ranging from the most important to the least important: the main application window, the title and menu bars, the functional areas of the application window (e.g., a status bar, a toolbar), all child windows, dialog boxes and panels with their contents.

This layout consists of interaction objects and interactive objects. Interaction objects (IO), also called widgets or controls, encompass static objects (e.g. labels, separators, group boxes) and dynamic objects (e.g. edit boxes, radio boxes, option boxes). Interactive objects cover every other kind of object that a multimedia user-
interface could virtually display: static icons, drawings, pictures, images, sketches, video sequences, graphics. Each of these objects allows some special interaction with the user. For instance, an image of the human body may include hot spots for defining different sensitive regions of the body in order to be selected, displayed, explained or zoomed. Some images can be extracted from a video sequence in order to be analysed. Interaction and interactive objects will be further referred to as

![Diagram](a) A layout of a dialog box; (b) The underlying layout grid

Determining the basic layout consists of calculating and drawing any geographical composition of functional areas of the user interface into a comprehensive format depending on the user's task. In particular, solving the layout problem for a dialog box consists of drawing aside the set of related IO, assembling them into a rectangular area, and surrounding them by borders. The layout then looks like a set of rectangles when drawn around each IO (fig. 1a).

A layout grid consists of a set of parallel horizontal and vertical lines that divide the layout into units that have visual and conceptual integrity (de Baar, Foley, & Mullet, 1994; Feiner, 1991; Marcus, 1992; Taylor; 1960). The intersections of these lines delimit these units into rectangles that constraint the IO position (fig. 1b). Equally spaced lines typically establish external margins in the layout and consistent space between the different IO. Layout grids are very practical for form fill-in user interfaces and for text displays since their IO reflect the layout of the source document or the page of a book (Hurlburt, 1978; Müller-Brockman, 1981). Such a layout grid can be applied for both the background and foreground of screens, as in HyperCard (Apple, 1992).

The problem comes from the fact that in modern user-interfaces (especially multimedia interfaces), layout grids are no longer valid since the layout no longer consists of vertical and horizontal lines. Instead of these kinds of lines, the layout may be based on other lines (e.g., oblique lines, discontinuous lines), convex shapes (e.g., lozenge), planes (e.g., a plane with a vanishing point), and volumes (e.g. cylinder). Therefore, we extend the definition of a layout grid to a layout frame. A layout frame consists of dots, lines, shapes and volumes that constraint the localization of IO.

Deciding such a complex layout frame is not an easy task. To help the designer to do this job, several visual techniques are now introduced and exemplified.

1 Visual Techniques

A visual technique relies on a commonly accepted visual principle to suggest the arrangement of the layout frame components. The visual techniques listed in this section are sorted by similarity and not by rank of importance because we are convinced that all visual principles cannot be
applied with the same representativeness. Some principles are very thorough to apply, some other are more difficult to compel with, and some other become very hard to translate. Moreover, applying this or that principle mostly depends of the involved IO and the visual aims that the designer has in mind. Some principles cannot be excluded nor can all principles be included.

**Visual techniques can be grouped into five categories:**

- **Physical techniques:** balance, symmetry, regularity, alignment, proportion, and horizontality.
- **Composition techniques:** simplicity, economy, understatement, neutrality, singularity, positivity, and transparency.
- **Association and dissociation techniques:** unity, repartition, grouping, and sparing.
- **Ordering techniques:** consistency, predictability, sequentiality, and continuity.
- **Photographic techniques:** sharpness, roundness, stability, levelling, activeness, subtlety, representation, realism, and flatness.

**Physical Techniques**

Balance is a highly recommended technique evoked by many authors (Dondis, 1973; Dumas, 1988; Galitz, 1989; Horton, 1990; Kim & Foley, 1993). Balance is a search for equilibrium along a vertical or horizontal axis in the layout. If a weight is attached to every IO, balance requires that the sum of IO weights on each hand of the axis remains similar. Balance is justified by the human perception and intense need for it in visual layouts.

Balance is a technique in which there exists a gravity centre located on an axis (vertical or horizontal).

Instability is the opposite of balance where IO are not distributed equally on each hand of the axis. “They seem ready to topple over. “ (Galitz, 1989). Balanced layouts are not only easy to understand, but, also, easy to design by a game of counterpoise. If an IO is placed to the left of the vertical axis, instability is provoked and immediately countered by adding an IO if the same weight to the right of the vertical axis.

Symmetry consists of duplicating the visual image of IO along a horizontal and/or vertical axis (e.g., left on the right, top to bottom, or vice versa). Achieving symmetry automatically preserves balance, but the balance can be performed without symmetry. Symmetry is very simple to verify and logical to imagine, but can lead to static layouts without originality (Dondis, 1973).

The opposite of symmetry is asymmetry where at least one IO do not possess a replication on the other side of the axis.

Regularity is a visual technique establishing uniformity of IO placed according to some principle, method, convention that do not change from one layout to another. Regularity is very concerned with the horizontal and vertical uniformizations and equilibrations. For instance, a layout where IO are uniformly spaced in columns and rows is qualified of regular.

Irregularity arrives when no such principles, method or convention exists, when no logical order of IO is apparent. Irregularity emphasizes
unexpected, unusual and uncomforting layout grids (Dondis, 1973).

Alignment is probably the most accessible and practical visual technique. Alignment is guaranteed if the number of vertical alignment points in a row and the number of horizontal alignment points in a column is reduced, minimized.

Misalignment - the opposite of the alignment - occurs when the number of alignment points is greater than one. Misalignment is accentuated when all IO containing task's data are placed just after their identification labels. Fonts with descenders and ascenders may affect alignment of similar IO if badly used.

Proportion strives for an aesthetically appealing ratio between the dimensions of IO (often composite IO). Because dimensions exist in the real world, we can feel them, we can see them, we can compare them. Mirroring dimensions in layouts consists of retracing this feeling, this illusion in the user interface. The ratio is calculated by dividing the height of an IO by its length. Several proportions have been either proved aesthetic (e.g. the Golden Ratio 1:1 5/2 + used by the Greeks) or widely and conventionally preferred (e.g. 1:√2, 1:2, 1:1.29, 1:1.5, 1:4/3, 1:1.6 as recommended by Marcus (1992) and Tufte (1983)).

Disproportion - the opposite of proportion - is implied at the time no special ratio is used or a large difference appears between the two dimensions.

Horizontality is a corollary of the previous technique: it shows that layouts with greater length than height (i.e., a horizontal ratio) are predominant.

Verticality - the opposite of horizontality - arrives if unwanted layouts have greater height than length (i.e. a vertical ratio). Horizontality is highly preferred than verticality: having long, narrow vertical dialog box is disgusting.

Composition Techniques
Simplicity is directness and singleness of layout, free from secondary complications or sophistications. Simplicity improves largely the ease of understanding the layout grid. Simplicity is guaranteed by placing IO according to a logical and natural arrangement (e.g. by frequency, by physical property) driven by the task's semantics.

Complexity – the opposite of simplicity - increases visual intricacy with too much units, forces and results and hinders any organization of the layout grid. Tiled IO are considered as a simple layout; varying overlapping IO are considered as a complex layout.

Economy is the frugal and judicious use of IO in the layout to present information as simply as possible. Economy can be pursued when necessary and sufficient IO are placed in the layout and nothing else: no IO that are extraneous to the user's task. The aim of economy is the fundamental visual layout, emphasizing the conservative and understatement of the poor and the pure. Economy is intended to define the boundaries of necessity within which it can work successfully (Bowman, 1968).
**Intricacy** - the opposite of economy - is manifested when unfrequent, unwanted IO encumber the layout unnecessarily visually or not. Intricacy endlessly details the layout with ornamentation or overcrowding IO. This situation particularly occurs when highly detailed or digitized images with a lot of decoration are placed rather than simple IO that are reduced to the essentials and whose important features are the only salient features.

Understatement its opposite, the exaggeration, are equivalent to the couple economy-intricacy, but in the domain of intellectual, mental representation rather than physical, spatial representation. Understatement supposes that the viewer of the layout is able to deduce a maximum of information from a minimum of IO to be presented. The verbal counterparts of understatement is euphemism and ellipsis, i.e. the art of saying much things with little words.

Exaggeration shows in the layout a minimum of information with maximized IO. The verbal counterparts of exaggeration is hyperbole. Exaggeration is achieved through extra vagrancy, amplified expressions that are enlarged far beyond possible.

Neutrality cuts every resistance, repulsion, or even belligerency of the layout viewer. A neutral atmosphere in the layout is obtained by placing all IO at the same level, with the same presentation attributes (or, at least, with little variations) as much as possible and, preferably, with no highlighting method (e.g. no blinking, no underlining, no bolding, no boxing).

**Accent** - the opposite of neutrality – is equivalent to the rendering of any highlighting method on a particular IO against a sameness of background. Most graphical highlighting methods are useful: reverse video, color, brightness, boldness, boxes, borders, different sizes, overprinting and magnifying.

Singularity is the focus of a layout on one separate and solitary IO, unsupported by any other IO or composition of IO. Specific emphasis is conveyed on a simple IO, despite the presence of other IO.

**Juxtaposition** - the opposite of singularity - expresses an interaction between IO placed side by side or to be compared with an activated relationship or to be related by any visual technique.

Negativity displays IO in dark colors on a light background. Black IO (text, separators, labels, fields) and coloured IO (bitmaps, images) are generally displayed on a white or grey layout.

**Positivity** - the opposite of negativity - displays IO in a bright color on a dark background. If negativity has been experimentally tested to reduce errors and reading time, to increase subjective satisfaction and legibility, positivity may still be used to convey special atmospheres, often with light IO (e.g. grey pictures).

Transparency means a visual layout where IO, superseded by other IO, can still stay visible behind or through them. Transparency is typically mandatory when displaying text on a colourful picture. A light transparent surface (e.g. grey or blue) is added between the text and the picture to improve the legibility of the text and to allow in
Opacity – the opposite of transparency - means the complete blocking out, concealing of IO that become visually occulted. Having partially occulted IO force the user to guess what IO (part or complete) are hidden. Opacity can also be used to give the impression of a relative distance or depth (see depth below) legislated by overlapping.

Association And Dissociaion Techniques
Unity is the placement of individual IO into one totality (e.g. a window) that is visually all of a piece. With unity, all IO seem to belong to each together and to be bound so that they can be seen as a whole and taken as one sealed unsectile thing: seeing one element is seeing the whole. Unity can be revealed with similar sizes, colors, surrounding blank spaces, logical organization exhibiting interrelation of IO in terms of the whole. fragmentation, all IO seem to be isolated, to retain their own character themselves. Fragmentation is one of the most unbelievable danger of multimedia layouts where IO, as they appear non convex, are not aggregated nor related. Repartition proposes to share IO among the four quadrants of the layout as systematically as possible. Experimental results argued it is not often the case while first, second, thrid, and fourth quadrants consume 40%, 20%, 15%, and 25% of the IO, respectively (Quadrant preference - the opposite of repartition – occurs when IO are preferably placed in one or many specific quadrants. Of course, we have taken into account the fact that human eyes favor the left-hand and lower area of any layout (this phenomenon is called Preference for lower left). But there are numerous examples of poorly distributed user interfaces. Most of these examples show displays in which IO are pushed over to the left-hand portion of the layout. Is it because Western users read from left to right or because programmers find very easy this way of placing IO? In all cases, the repartition should be compatible with the task structure, rather than with the file or database structure.

Grouping is a visual technique that creates a circumstance of give and take of relative interaction. Grouping is mainly based on the law of attraction: two grouped IO fight for attention in their interaction by establishing individual statements depending on the distance between the IO. The close the IO are, the stronger the attraction is. Grouping is also affected by the law of similarity: opposite, dissimilar IO repel each other, but equal, similar IO attract each other. When dissimilar IO are grouped, the human eye increases the relation between them. When similar and dissimilar IO are grouped, hidden connections are identified as fast. Grouping is one of the best techniques for structuring a layout namely by providing an aesthetic appearance, by helping remembering and by accelerating a layout search. One of the most important usability guidelines is the fact that objects that are semantically linked should be grouped in some way. Contrarily, objects that do not share any semantic relationship should be split.
Splitting - the opposite of grouping - means that no such structure is appearing: IO are disseminated without the ability to visually perceive an attraction or a repulsion between IO. Typically, the layout consists of a certain amount of IO that are placed in Indian file or where there is some free space all over the layout.

Sparing looks for avoiding cluttered or overcrowded layouts: it suggest to keep the visual loading of a layout within reasonable boundaries.

**Density** - the opposite of sparing - takes no care about stacking and packing IO too tightly in the layout. Generally, much layouts contain too much IO to the point that easy scanning is no longer possible. The trend is to fill each layout space with as much IO as possible (e.g. text, fields, pushbuttons, images). The *visual loading*, sometimes called density, is, by definition, the proportion of busy positions on the layout. For alphanumeric displays, it can be expressed as the ratio of displayed characters by the total amount of characters in the layout (Tullis, 1983). In graphical user interfaces, the density is calculated by dividing the number of lighted pixels by the total number of available pixels. Also measure the field density which is the total amount of fields (static of dynamic) in the layout, and the box density, which is the total amount of visual groups whether surrounded or not.

**Ordering Techniques**

Consistency is a visual technique for expressing visual compatibility with the subject, for developing a layout whose IO are dominated by one sound, uniform, constant thematic. Consistency takes place not only in the dimensions or the ordering of IO, but, also in their (little) differences.

**Variation** - the opposite of consistency - has no burdens for the domination of one or many themes. Variation is the strategy for identifying changes, elaborations as variations in musical themes. Variation do not have necessarily to take the form of unconsistency, where same IO are laid out at different places from one layout to another. Moreover, variation can be assumed by a serie, a continuum of IO whose contents, shapes, colors, themes vary significantly.

Predictability is a visual technique where IO are placed according to some order or plan that is highly conventional and recognizable. Knowing the information structure of the task, viewing one layout or remembering it should enable the user to predict how another layout will be arranged. Predictability also suggests the user is able to foretell in advance what the entire layout will be just by seeing a minimum part or some significant part of it. Predictability is enhanced through layout consistency.

**Spontaneity** - the opposite of predictability - do not suggest such a highly conventional plan. The user will therefore be unable to infer successive layouts from already viewed layout or to generalize the entire layout from its parts. Spontaneity is synonym to impulsion, freedom, unconstraint, and unselfconsciousness.

Sequentiality is a plan of layout that is arranged in a logical, rythmic, expected order. Many orders can be followed to sequentially place IO: numerical order, alphabetical order, chronological order, or some other sequence.
order, physical order, type order, sequential order, functional order, logical order, frequency order, importance order, consensus order, designation order,… For instance, the importance order sorts IO by decreasing rank of importance by placing first important IO and relegating secondary IO to the background.

**Randomness** - the opposite of sequentiality - promotes the absence of a particular ordering plan, that is a layout where the IO flow cannot be detected due to the lack of plan, or a disorganized, accidental, random one.

Continuity uninterrupts the visual connections existing between the IO. These connections are fundamental for preserving a unitized visual statement. Continuity can be achieved by uninterrupting steps from one IO to another. This is often the case in video sequences, series of snapshots, morphing pictures,… Continuity means the cohesion of the parts to the whole layout.

**Episodicity** - the opposite of continuity - interrupts the visual connections that may exist between the IO. Episodicity exploits the rupture of connection, the disconnection, or the loosing of these connections. Episodicity means the reinforcement of the parts of a layout without adding new meaning or message with all IO taken as a whole.

**Photographic Techniques**

Sharpness is a visual technique that is closely related to clarity of both physical state and expression. Having sharpness in a layout can be interpreted as having Clearly distinctive IO (e.g. information to be input by the user should be distinctive of information to be displayed by the system IO with precise outlines, hard edges, distinct margins.

The effect of sharpness is a distinct atmosphere, easy to assimilate. Diffusion - the opposite of sharpness - do not draw, place IO carefully, opting for less precision of character, but more fuzzy, wadded atmosphere, more feeling and warmth. Roundness) is the preference for round IO giving a smooth atmosphere.

**Angularity** - the opposite of roundness- is the preference for IO with angular, rugged outlines.

Stability is the expression of preference for IO that have clear base to rest on. When rectangular, squared IO are placed on their bases, the layout appears stable because of the stability of its inherent IO .

**Stress** - the opposite of stability - occurs when IO are not placed on their firm base or stability: a circle is a good example. But placing a lozenge, a rectangle or a triangle on one of its edges causes stress. When an IO is intrinsically irregular, the analysis and establishment of balance is more involved and intricate. Stress needs a stabilization process.

Levelling is a visual technique for automatically establishing balance through artifacts. IO are laid out so that balance axis will stand out. Through our automatic perception, balance can be emphasized (or rubbed out, respectively) when we recognize easily (with difficulty, respectively) the abstract visual condition of balance. This is often the case when IO are equally distributed in two columns with two alignment points per column.
Sharpening – the opposite of leveling - on the other hand destroys any automatic balance by placing IO on unexpected, unbalanced locations. Activeness reflects motion through explicit representation or implicit suggestion. The goal of activeness is to design an active and energetic layout with lively postures (e.g. arrows, stopped image in a video sequence, an action snapshot).

Passiveness - the opposite of activeness - withdraws any IO that could bring a dynamic effect. Passiveness relies on the technique of static representation, which presents an atmosphere of quiescence, resting by equilibrating IO.

Subtlety is a visual technique in order to make a fine distinction, shunning any obviousness and energy of purpose. Subtlety is often synonym with ingeniosity since it requires delicate, highly refined IO.

Boldness - the opposite of subtlety - looks for every obvious IO in its context. Boldness is often synonym with optimum visibility of all IO in the layout.

Representation subsumes subtletly since its intended purpose is to use IO that concretely represent the real world in details.

Abstraction - the opposite of representation - uses IO that abstract the real world in many ways. Icons, for example, can be representative if they simply translate a physical object or can be abstract if they mimic some action or just represents metaphors or major characteristics of the physical objects. For instance, concrete icons are believed to be better than abstract icons.

Realism is the natural technique of camera. Many tricks and conventions are able to replicate the same visual cues that our eyes convey to our brain when receiving an external image.

Distortion - the opposite of realism - tampers with realism, seeking control of effect through the deformation of the real IO in shape, form, color,…This technique covers zooming in and out, magnifying lens, fish-eye views (Furnas, 1986; Leung & Apperley, 1993), pictures cut in moved rows, teared pictures,… Distortion is a great way for catching the eyes and producing an intense response.

Flatness do not use any technique for providing perspective, so erasing the natural feeling of dimension and space.

Depth - the opposite of flatness - tries to render perspective by replicating the environment through effects of light, shade, gradient of color, overlapping.

Computer Forensics is a scientific discipline which is concerned with the collection, analysis and interpretation of digital data connected to a computer security incident; it is sometimes also called digital forensics. Since any device, data or other resource subject to a forensic examination may be subsequently used as evidence in a court of law, Computer Forensics puts special emphasis on the correct treatment of potential evidence to prevent it from being altered or tampered with. Because of the same reason, any technique or tool used during an investigation has to meet strict standards, and any conclusions drawn must be scientifically reasonable. It is important to note that an Incident Response procedure can sometimes include a full forensic investigation.
Computer Forensics, or Digital Forensics, is a forensic science that deals with obtaining, analyzing and presenting *digital evidence*, which can be defined as any data stored or transmitted using a computer that support or refute a theory of how an offense occurred or that address critical elements of the offense such as intent or alibi. By employing accepted and proven techniques and principles, which are also applied in other forensic sciences, admissibility in a court of law and credibility of the evidence is achieved. This includes for example a high level of objectivity in every step of an investigation, and the use of reliable, repeatable and well-documented methods throughout the examination.

A *computer security incident* can be defined as “a violation or imminent threat of violation of computer security policies, acceptable use policies, or standard security practices. Incident Response deals with computer security incidents in a well-defined manner to detect incidents, minimize the damage done to the organization, fix the weaknesses that were exploited and return to normal operations. In the field of computer security, new threats such as boot networks and modular malicious code have emerged, while well-known attack tools such as rootkits and trojans remain dangerous by constantly using new and improved techniques. Since not all of these attacks can be prevented, Incident Response (IR) has become an important component of IT security management, because it provides procedures for detecting and containing computer security incidents to restore normal computing services as quickly as possible. Many attacks nowadays are already motivated by profit, attempting to achieve financial gain by identity theft, extortion, fraud, or theft of confidential information. With criminal acts becoming more common in computer related incidents, the need for valid evidence for these crimes also rises. The field of *Computer Forensics* (CF) aims at providing such evidence. IR and CF are two highly related topics, and it is questionable whether a strict separation makes sense at all. Certainly, both investigate a large number of different computer security incidents or offenses, sometimes use identical tools and methods and also share some of the key phases of the investigation, although they may set different priorities. However, the specific view of the investigative process in IR and CF respectively may sometimes be too narrow to achieve optimal results in either case. On the one hand, a CF investigation may lack the proper management that is enforced in an IR investigation, where the investigative efforts are coordinated with all parts of an organization, e.g. legal counsel, Human Resources and business executives. Without these, the “bigger picture” of an incident might not be seen. On the other hand, the scientific standards of a CF investigation can give benefit to an IR procedure, as it promotes objectivity throughout the whole process and a precise and well-documented analysis.

Cyber security is the collection of tools, policies, security concepts, security safeguards, guidelines, risk management approaches, actions, training, best practices, assurance and technologies that can be used to protect the cyber environment and
organization and user’s assets. Organization and user’s assets include connected computing devices, personnel, infrastructure, applications, services, telecommunications systems, and the totality of transmitted and/or stored information in the cyber environment. Cyber security strives to ensure the attainment and maintenance of the security properties of the organization and user’s assets against relevant security risks in the cyber environment.

CONCLUSION
The main contribution of visual techniques relies in its ability to locate a screen, perhaps a multimedia screen, on table 1 to find out whether its visual impact is more oriented toward harmony or constrast. By summing up techniques used in each category, it is possible to rank screens by comparison. Visual techniques per se do not claim that a screen oriented towards harmony is better than a screen oriented towards contrast or vice versa. Rather, it helps designers to more precisely estimate the impact of such a screen, depending on the target audience. If a “traditional” audience is expected, perhaps with efficiency goals in mind, it is likely that visual techniques in the domain of harmony will be preferred. Instead, if a “non-traditional” audience is targeted, visual techniques in the domain of contrast may catch more attention than the traditional ones. Furthermore, they may also increase the visual cognitive load. This decision is a trade-off between usability and desired visual impact.

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