NZ329130, PCT/NZ98/00098 and PCT/NZ99/00021 are gaining increasingly widespread recognition and acceptance due to their enhanced capabilities compared to conventional single focal plane displays.

[0016] The basic principle of known multi-focal plane displays is that the viewer consciously applies their attention to one of the focal planes individually or to a composite image found by the combination of images displayed on at least partially transparent screens.

[0017] Therefore, although the viewing experience may be enriched by the potential sense of depth provided by such composite displays, it has not been utilised thus far as a means of enhancing the reading/image assimilation speed of the viewer, nor of using the information displayed on one focal plane to improve the net effect on a user consciously viewing the display on a separate focal plane. Such improved effects could include improvements in comprehension, perception, retention, recall, interpretation and/or association with related information.

[0018] The manner in which human beings process visual information has been the subject of extensive and prolonged research in an attempt to understand this complex process. The term preattentive processing has been coined to denote the act of the subconscious mind in analysing and processing visual information which has not become the focus of the viewer's conscious awareness.

[0019] When viewing a large number of visual elements, certain variations or properties in the visual characteristics of elements can lead to rapid detection by preattentive processing.

[0020] This is significantly faster than requiring a user to individually scan each element, scrutinising for the presence of the said properties. Exactly what properties lend themselves to preattentive processing has in itself been the subject of substantial research. Colour, shape, three-dimensional visual clues, orientation, movement and depth have all been investigated to discern the germane visual features that trigger effective preattentive processing.

[0021] Researchers such as Triesman [1985] conducted experiments using target and boundary detection in an attempt to classify preattentive features. Preattentive target detection was tested by determining whether a target element was present or absent within a field of background distractor elements. Boundary detection involves attempting to detect the boundary formed by a group of target elements with a unique visual feature set within distractors. It maybe readily visualised for example that a red circle would be immediately discernible set amongst a number of blue circles. Equally, a circle would be readily detectable if set amongst a number of square shaped distractors. In order to test for preattentiveness, the number of distractors as seen is varied and if the search time required to identify the targets remains constant, irrespective of the number of distractors, the search is said to be preattentive. Similar search time limitations are used to classify boundary detection searches as preattentive.

[0022] A widespread threshold time used to classify preattentiveness is 200-250 msec as this only allows the user opportunity for a single 'look' at a scene. This timeframe is insufficient for a human to consciously decide to look at a different portion of the scene. Search tasks such as those stated above maybe accomplished in less than 200 msec, thus suggesting that the information in the display is being processed in parallel unattendedly or pre-attentively.

[0023] However, if the target is composed of a conjunction of unique features, i.e. a conjoin search, then research shows that these may not be detected preattentively. Using the above examples, if a target is comprised for example, of a red circle set within distractors including blue circles and red squares, it is not possible to detect the red circle preattentively as all the distractors include one of the two unique features of the target.

[0024] Whilst the above example is based on a relatively simple visual scene, Enns and Rensink [1990] identified that targets given the appearance of being three-dimensional objects can also be detected preattentively. Thus, for example a target represented by a perspective view of a cube shaded to indicate illumination from above would be preattentively detectable amongst a plurality of distractor cubes shaded to imply illumination from a different direction. This illustrates an important principle in that the relatively complex, high-level concept of perceived three-dimensionality may be processed preattentively by the sub-conscious mind. In comparison, if the constituent elements of the above-described cubes are re-orientated to remove the apparent three dimensionality, subjects cannot preattentively detect targets which have been inverted for example. Additional experimentation by Brown et al [1992] confirms that it is the three-dimensional orientation characteristic that is preattentively detected. Nakaymyama and Silverman [1986] showed that motion and depth were preattentive characteristics and that furthermore, stereoscopic depth could be used to overcome the effects of conjoin. This reinforced the work done by Enns Rensink in suggesting that high-level information is conceptually being processed by the low-level visual system of the user. To test the effects of depth, subjects were tasked with detecting targets of different binocular disparity relative to the distractors. Results showed a constant response time irrespective of the increase in distractor numbers.

[0025] These experiments were followed by conjoin tasks whereby blue distractors were placed on a front plane whilst red distractors were located on a rear plane and the target was either red on the front plane or blue on the rear plane for stereo colour (SC) conjoin tests, whilst stereo and motion (SM) trials utilised distractors on the front plane moving up or on the back plane moving down with a target on either the front plane moving down or on the back plane moving up.

[0026] Results showed the response time for SC and SM trials were constant and below the 250 msec threshold regardless of the number of distractors. The trials involved conjoin as the target did not possess a feature unique to all the distractors. However, it appeared the observers were able to search each plane preattentively in turn without interference from distractors in another plane.

[0027] This research was further reinforced by Melton and Scharff [1998] in a series of experiments in which a search task consisting of locating an intermediate-sized target amongst large and small distractors tested the serial nature of the search whereby the target was embedded in the same plane as the distractors and the preattentive nature of the search whereby the target was placed in a separate depth plane to the distractors.

[0028] The relative influence of the total number of distractors present (regardless of their depth) verses the number