3.1 Texture Perception

Texture plays an important role in our visual perception. It can be thought of as that property of the object which superimposes specific patterns over electromagnetic radiation reflected from the surface. Perception of the patterns results in perception about the nature of the object's surface and the nature of the object itself.

1. Exploiting learned associations

The early childhood activity of exploring the surface of objects through sense of touch might be thought of as an act of building a database of linked associations between the surface reflectance properties and the feeling of texture on the skin. In due course, 'seeing' the texture in itself translates into an approximate 'feeling' of the surface without even touching it.

This phenomenon could help us encode data, conveying the nature of the data ..etc with textures. By matching the real-world affordance of the texture with the property of the data that we want to highlight to the user, we could build visualizations that the user 'gets' easily. For example, textures resembling rugged surfaces carry a connotation of strength and resilience, scaly textures tend to carry a uncomfortable connotation with them, while shiny steel textures carry a connotation of newness apart from strength. By exploiting the learned affordances of the real-world textures we can effectively highlight desired aspects of the data.

2. Tricking the brain

One of the crucial aspects of animation and games that helps in establishing the realism of the computer generated imagery is the quality of textures used on 3D models. It helps in coercing our brain to believe that it is seeing a real object as supposed to computer graphics tricks. Our visual system's reliance on textures can be utilized to render believable 3D worlds by possibly shaving off effort in other areas. Fractal textures, for example, has helped in depiction of realistic natural worlds (mountains, trees ..etc) with relatively lesser manual effort into other areas such as modelling.

In natural worlds, beings such as Octopus blend in with their surroundings in order to fool their predator / prey using not only colour, but also by simulating the texture of the surrounding environment to achieve a seamless blend-in into the environment. It might not be far fetched to imagine similar uses of texture for displays that blend in with the surroundings and appear only at the appropriate time. For example organic foldable displays of the future could be imagined to blend-in with our surroundings by mimicking the colour and texture of the surroundings until there is requirement for them to attract user attention.

3. Visualization

Reporting disk space utilization is a tricky visualization problem due to its recursive and homogenous nature. Treemaps [1] and other types of visualizations have been used to solve this problem. In Treemaps, colour and area are used to map the type of files and their disk usage in a recursively space-filling layout (Fig.1). Using colour alone to distinguish the various types of files is prone to various problems such as contrast effects, especially when small files are displayed embedded in large folders.

Besides we quickly hit the ceiling in terms of discernible colours.

One solution might be to use multiple coding: in addition to colour, adding texture to Treemaps. We can for example, use one type of texture for each type of file and even adjust the properties of the texture such as pattern frequency to encode a new variable (such as last date modified) or redundantly encode an existing variable such as space utilization. We can even create a hierarchy of textures based on their shared patterns and utilize it to represent the hierarchy of file types (for example all text files: plain text, office documents ..etc receive different textures from the same branch of the hierarchy thus sharing some perceptual commonality). Overall these techniques could improve the visualization by making the commonalities more discernible while also helping us obtain a good overall summary.

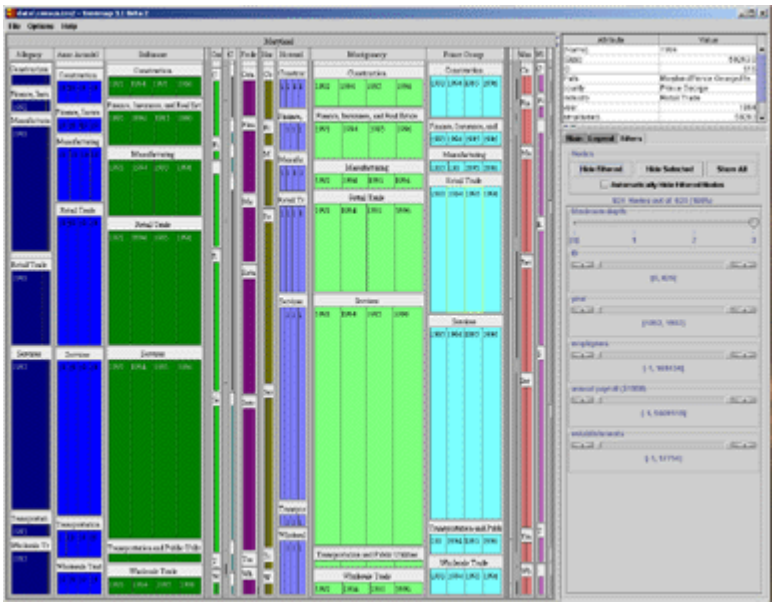

Figure 1. Example of an existing Treemap visualization

Textures thus form an important part of our visual perception. Ranging from primary tasks of perception such as helping us to discern the shape of objects and properties of the surface, their use extends well into conveying realism in computer generated imagery and dual encoding variables in demanding data visualizations. By taking advantage of textures, we can build better visualizations.

References

1. Treemap, a space-constrained visualization of hierarchical structures.
http://www.cs.umd.edu/hcil/treemap/