# Visual Connections
# 10-24 June, 2008

# School of Information Technologies

The line between science, art and technology is blurred in a unique exhibition at the University of Sydney.

Some works in the exhibition are images of Information Visualisation – the science of taking large amounts of information and rendering them into two and three-dimensional surfaces to make maps and pictures of abstract data. Other pieces cross the line between art and science, exploring on canvas the issues of visual connection and the way technology has helped us make useful connections in an age of data deluge.

"Whether we deal in stocks, biology, medicine, sociology, politics, literature, marketing, engineering, industrial design or ecology, we all seem to be striving to find knowledge in a vast unmapped sea of data," says Professor Peter Eades, who helped organise the exhibition and is the Chair of Software Technology at the School of IT.

According to Professor Eades, Visual Connections explores the way we digest more and more data in a world that is rich in information and explores the natural extension of information technology into art.

"Artists have had a long tradition of exploring and communicating in visual ways," says Professor Eades. "The information they seek to express ranges from unspoken emotions to cold logic, from the perceptual to the cognitive. So there is a connection between these artists and these scientists who visualise information."

Professor Eades says that many techniques and tools classically used by artists – such as spaces of points, lines and surfaces, colours, symmetries, enclosures and connections – are now used algorithmically by computer scientists.

The University of Sydney

# Works


## Metro Map Metaphor

### K. Nesbitt

### 2003

The metro map is a well known network visualisation that people use to navigate between stations in a network. This navigation may be along a single track, but also allows for changing tracks at stations where the tracks connect. Distinct colours are used to identify each track. The tracks themselves are abstracted removing geographical detail, such as curves in the track. The display space in which the tracks are displayed is unusual as you cannot look at the map and determine the real world distance between stations, although ordering of stations is preserved.

In this image the metro map metaphor was adapted to help readers navigate the interconnected trains of thought in a PhD thesis. The tracks become high-level organising categories and the stations are concepts ordered in a logical way in the category. Just like the normal metro map the reader can change tracks of thought and navigate between connected concepts.

- *Nesbitt, K. (2004). "Getting to more Abstract Places using the Metro Map Metaphor". Eighth International Conference on Information Visualisation, London, IEEE Computer Society. pp488-493*

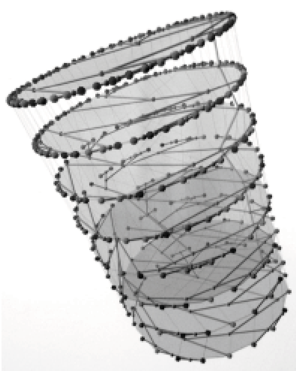
## Abstract Train of Thought

### K. Nesbitt

### 2003

This painting was created towards the end of my PhD at Sydney University. Looking from left or right it shows the process of abstraction which occurred in creating the original London Metro Map. The London map was the first metro to be displayed in this way and is often regarded as a milestone in the development of information visualisation. It was through the removal of real world detail such as distance and geography that the map was finally abstracted to the familiar network we are all used to navigating. Different lines on the network use different colours to distinguish them, a common mapping also used in many visualisations to represent categorical data. The unusual shape of the canvas highlights an often forgotten element of visualisation, which is the display space itself. The display space is the background space in which the figure or foreground elements are laid out and it determines how we interpret the picture. In a metro map the display space is complex as distance is not preserved but topological ordering (the order of stations) is. Of course the most important information is also preserved and that is the connection between stations.

- *Nesbitt, K. (2003). "Designing Multi-sensory Displays for Abstract Data". PhD Thesis, University of Sydney, Australia*



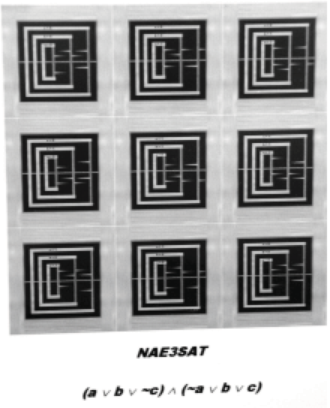
## Comparing Phylogenies

### U. Brandes, T. Dwyer, F. Schreiber

### 2004

Biologists estimate phylogenetic connections from a variety of wet-lab data such as DNA sequences using sophisticated computer algorithms. The estimation process is extremely complex and commonly outputs a number of hypothesised phylogenies; the skilled biologist likes to choose between the hypothesised phylogenies based on their experience. Tim Dwyer created this 2.5 dimensional visualisation to help with the choice. On each of the circular planes, a hypothetical phylogeny is drawn. Connections between the phylogenies are drawn between the planes. This image was created as part of the NICTA Valacon project.

- *Ulrik Brandes, Tim Dwyer, Falk Schreiber: Visual Triangulation of Network-Based Phylogenetic Trees. VisSym 2004: 75-83*



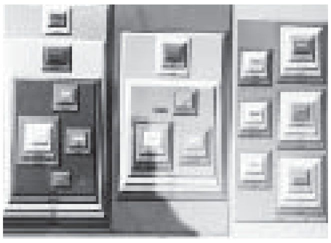

## Logic Engine

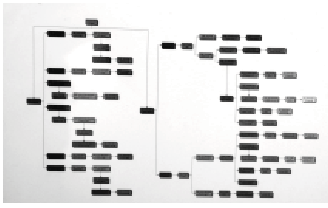
### C. Murray, C. Friedrich

### 2004

The logic engine is a hypothetical mechanical device used to give mathematical proof to the apparent difficulty of some geometrical problems. It connects a classical question in computational logic ("Not-All-Equal-3-Satisfiability") to layout questions for the mechanical device. At a deeper level, it provides a connection between combinatorial logic and mechanical computation. Eades, Whitesides, and others used the logic engine to prove that a number of problems in the Euclidean plane are among the most intractable computational problems. This image is a rendering of a still image from a computer simulation of the logic engine by Colin Murray and Carsten Friedrich.

- *Peter Eades, Sue Whitesides: The Logic Engine and the Realization Problem for Nearest Neighbor Graphs. Theoretical Computer Science 169(1): 23-37 (1996)*





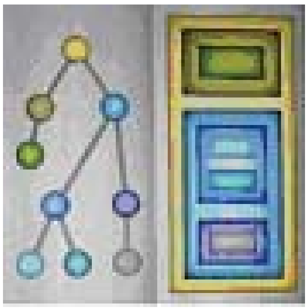
## Software Structure

### K. Pulo, M. Takatsuka

### 2008

Much of our daily activity is underpinned by software structures, from financial transactions to air conditioners to entertainment to automobile control. The size and complexity of this software grows with time, as new functions and capabilities are added. Software engineers spend much of their time gaining enough understanding of large systems to be able to maintain and modify them safely. Visualization tools that help to analyse the structure of large and complex systems are essential for software engineers. Kevin Pulo created these pictures of the software controller of a pump. The pictures represent the data in two different ways, using connections between nodes (left) and inclusion relationships between nodes (right). These images were created as part of the NICTA Valacon project.

- *Kevin Pulo, Masahiro Takatsuka: Inclusion Tree Layout Convention: An Empirical Investigation. InVis.au 2003: 27-35*



## Hierarchy and Enclosure

### K. Nesbitt

### 2008

Hierarchical networks are commonly used to display hierarchical relationships in data such as those that occur in object-oriented software (inheritance and aggregation). This picture shows that enclosure as well as connection can be used to represent hierarchical relationships. The two visualisations are equivalent with the same colour being used to represent equivalent nodes in the network diagram (left) with the those in the enclosure diagram (right).

This painting along with "Colour and Shape", were created for this exhibit. They are arguably more representative of science than art. That is, the appeal is less aesthetic and more conceptual in nature. The connection between art and science is one that is raised by the exhibit, as is the question of when does aesthetics become important in visualising information.

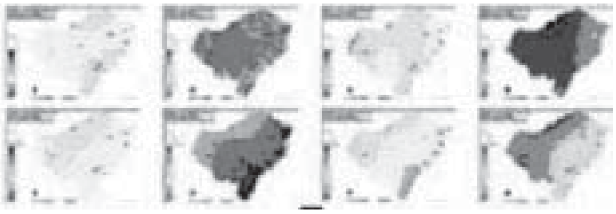
## Polyplane

### S. Hong, T. Murtagh

### 2004

These images represent the some social and information networks. One is the structure of the web pages of the School of Information technologies; another is the collaboration network of movie actors, centered on Kevin Bacon; another is a file system on a personal computer. The images were created by Seokhee Hong and Tom Murtagh, using the "polyplane method", where connected trees are drawn on static arrangements of 2D manifolds in 3D. In five of these pictures, the manifolds are reflection planes of platonic solids; in one of them the manifolds are concentric cones. The images were created as part of the NICTA Valacon project.


- *Seok-Hee Hong, Tom Murtagh: Visualisation of Large and Complex Networks Using PolyPlane. Graph Drawing 2004: 471-481*

## Seasonal Temperatures

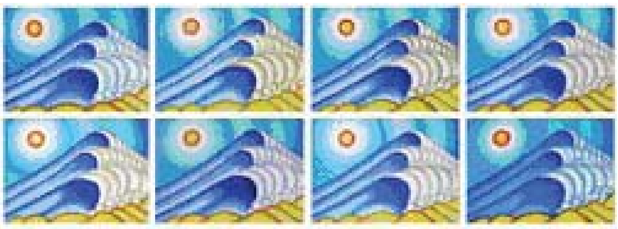
### K. Blackmore

### 2008

These map surfaces were interpolated from point-based station data collected by the Australian Bureau of Meteorology. They show seasonal minimum and maximum temperatures. Temperature is mapped to colour, so that higher temperatures are shown as red and lower temperatures are blue. Overlaying data onto maps is perhaps one of the oldest approaches used in information visualisation.

Both time (seasons) and space (geography) are incorporated into this display. For example, the temperature patterns that occur in this display are due to changes in seasonal and geographical variations. Tufte, who has written a number of seminal works on information visualisation, identifies the use of both temporal and spatial data in a display as a key design principle. Connecting time and space in this way is often a key to finding cause and effect patterns in information.


- *Tufte, E. (1983) The Visual Display of Quantitative Information, Graphics Press, Connecticut, USA*

## Jailbreak Eight

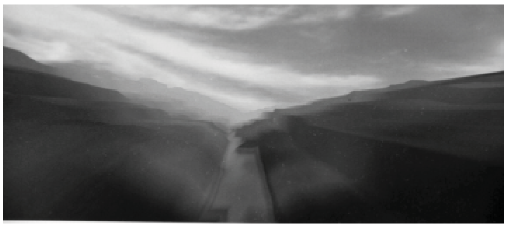
### K. Nesbitt

### 2007

Tufte recommends designers to use "variation in data" and not "variation in design". This is exemplified by the use of multiples or repeated design elements where only the data is varied. The same design pattern or template creates a strong connection between the elements, a common space in which the changes in data can be examined.

This painting also uses the same basic pattern with a slight variation in colour between pictures. They form a set and have much in common with the use of "small multiples" in information displays. Designers of such displays often use repeated design patterns to highlight variations in data and it is common to use colour in the same way to separate data categories.


- *Tufte, E. (1990) Envisioning Information, Graphics Press, Connecticut, USA*



## Bid Ask Landscape

### D. Merrick, B. Orenstein, K. Nesbitt

### 2003

This is a picture of BHP bid-ask data rendered as a 3D landscape that evolves over time. It was implemented as an interactive 3D virtual environment that allows the user to fly along the river. The visualisation is designed to allow real-time, short term analysis of market trends, in particular the connection between buyers, sellers and market price. As you travel along the "river" you are moving further forward in time. The green hills to the right represent buyers of the stock and the yellow hills to the left represent the sellers. The height of the hills indicates the number of buyers and sellers at different prices. The river itself shows the gap between buyers and sellers where trades are actually occurring. The rivers width shows the difference in price between buyers and sellers. The more distant, left or right from the river the further the buyers prices (bids) and seller's prices (asks) are from the current trading price.

The originally idea for this display was developed by Bernard Orenstein of eStats Capital.


- *Nesbitt, K. and Barrass, S. (2004). Finding Trading Patterns in Stock Market Data, IEEE Computer Graphics and Applications, September-October 2004, pp45-55.*


## Hills of Chaos, River of Time

### K. Nesbitt

### 2005

This painting was based on the Bid Ask Landscape and was painted as I explored the generic nature of this visual metaphor. The Bid Ask Landscape was a 3D display generated from stock market data to explore the short term temporal patterns that evolved from the balance of buyers and sellers in the market. However, the idea behind the display is more general and can be used to examine temporal patterns that occur in any balanced system where two opposing forces are competing. Many systems can be modelled by considering the connection between cooperating-conflicting forces. Philosophically this pattern is similar to yin and yang. Scientists might prefer to think of this picture as akin to the ideas described in a recent book called "The Complementary Nature".

You can travel along the yin-yang (yellow-green) valley and try and predict which way the river turns. Predicting the direction of the river in the Bid-Ask landscape was equivalent to predicting which way the stock market was trading, left was down, right was up. In this picture it well depend on the opposing forces you adopt in your mental mapping.


- *Kelso, S. and Engstrom ,D. (2006), The Complementary Nature, MIT Books, Boston, USA*


## Information Metaphor

### K. Nesbitt

### 2001

An "Information Metaphor" describes how data is mapped to elements in the information visualisation. The world itself is a map of information in which we use our perceptions to find patterns. The problem for the scientist is to choose mappings between the data they are using and our perceptual units in a way that best allows for useful and "honest" patterns to be found. The mapping or metaphor determines how data is connected to the visual representation. In this picture data may be mapped to the colour of the flowers, or the number and shape of petals in the flower. So, for example, stock market data may become like flowers were we try to pick the best one. Perceptual elements like colour, size and shape are indeed generic tools for the visualiser and can be used in many ways to represent all types of data. Although the characteristics of the data and the way it is displayed needs to be optimised for the application domain.

This exhibit shows mainly static examples, however information visualisation can also allow interaction with the display. The butterfly and dragonfly in this picture act as icons, symbolising two distinct styles of navigating information. I think of dragonfly navigation as targeted hunting for patterns using logical rules and butterfly navigation as a more intuitive browsing or reactive search of the environment.

## Butterfly-Dragonfly : Ambient Stock Market

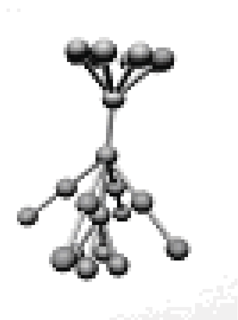
### X. Shen

### 2005

This is designed as an ambient piece of art or information display. It is a display that is meant to be noticed but not intrusive in any way. This display is based on a real painting and displays four consecutive time periods of stock market data. (With the most recent period on the right.) Icons are used, with a dragonfly indicating the stock price has fallen over the last time period. A butterfly indicates the price has risen over the last time period. So, for example, when four butterflies appear it indicates the price has risen for four consecutive periods. Likewise, four dragonflies indicates that the price has fallen during last four periods. Either of these might be a good time to trade. By contrast a mixture of butterflies and dragonflies indicates that the market is ranging (both rising and falling) and this is generally a less favourable time to trade.

In this exhibit 30 sec time periods are simulated, so the display is updated every 30 seconds. Every ten minutes the simulation changes the overall market trend to be indicative of either a rising (lots of butterflies), falling (lots of dragonflies) or ranging (mixed) market. You might "notice" these larger trends or other interesting patterns occurring.

- *Nesbitt,K. and Shen, R. (2006) Butterfly/Dragonfly – An Ambient Display of Stock Market Data. Journal of Engineering, Computing and Architecture, Scientific Journals International, V1 (1), 2006.*



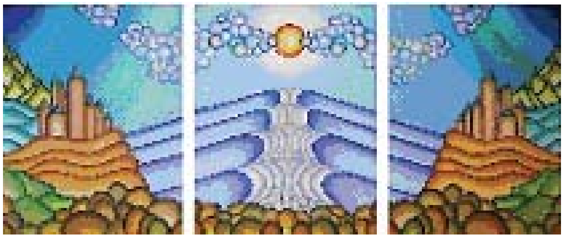
## Tree with Pyramid Symmetry

### S. Hong

### 2003

Symmetry is a fundamental concept in science and art. Networks may have combinatorial symmetries (called "automorphisms"); in some cases this combinatorial symmetry can be represented geometrically. Mathematicians have explored the connections between automorphisms of combinatorial structures and symmetries of geometric structures for hundreds of years. The general problem of drawing a network so that its combinatorial symmetries are displayed geometrically is computationally difficult; efficient general algorithms are not known. In the early part of this century, Seok-Hee Hong began to investigate efficient algorithms for restricted kinds of networks. She found very efficient algorithms for the cases when the network is a tree, a series parallel graph, or a planar graph. This is an image of a 23-node tree, drawn with maximum symmetry according to Seok-Hee's algorithms. It has the symmetry group of a pyramid. The image was created by Seok-Hee Hong and Tom Murtagh, as part of the NICTA Valacon project.

- *Seok-Hee Hong, Peter Eades: Drawing Trees Symmetrically in Three Dimensions. Algorithmica 36(2): 153-178 (2003)*



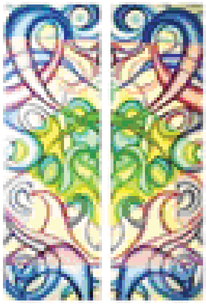
## Symmetry Breaking

### K. Nesbitt

### 2008

This painting explores the conceptual issue of how information is encoded in symmetry (or asymmetry). Although I tried to paint both sides of the picture the same they are slightly different - where I made mistakes. The eye is actually very good at detecting both differences in shape and colour and even smaller variations in the position of objects within the visual space. Therefore I had to be most careful with these attributes of the picture when painting it. What I found while painting was that the further apart the elements became the more latitude I had to make errors. With elements close to the line of symmetry I had to be very careful to maintain the symmetry. This is no doubt because the eye had to travel longer distances at the lateral edges of the picture to compare elements and cognitive issues such as short-term memory also became involved.

The frame of the picture is an old window frame, and the frame of reference, context, display space or viewpoint are all important aspects I explore in my painting. People often forget or ignore the ground, frame or space on which information is interpreted and yet it is, I contend, the most foundational component to the design of all information displays.

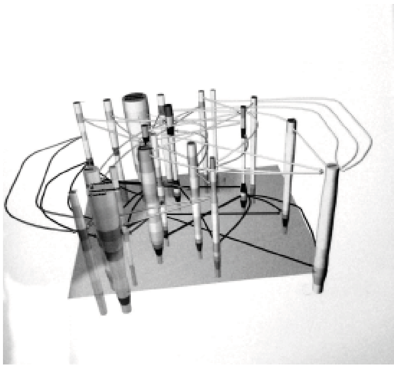


## Double Vision, Mirror Image

## K. Nesbitt

## 1999

This painting shows a number of elements that are frequently used in the design of information displays. Many of these elements are related to what are called the "Gestalt principles". Symmetry is used to create the highest level structure in the work. Similarity, in this case colour, is used to create a lower level of structure in the picture. Much of the lowest level structure in the picture is created using the continuity and of curved and straight connections, although variations in hue support this structure. Some people also find meaningful shapes in the picture, although none were intended. This is described as familiarity, and can actually be a problem in information visualisation as people may find meaningful shapes or patterns in data were none actually exist.



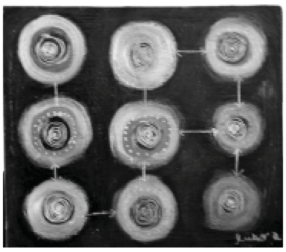
## Money Movement

## T. Dwyer

## 2004

This is a picture of money movements by fund managers between market sectors on the London Stock exchange over a one-year period. Each column represents a market sector. Time increases vertically along the columns. Arrows between the columns indicate large movements of money from one sector to another. The Capital Markets CRC is a research organisation based in Sydney that provides new technologies and improvements in market design. Visualizations such as these can be used by market designers and regulator to design and monitor market activity. Tim Dwyer created this image with support from NICTA and the Capital Markets CRC.

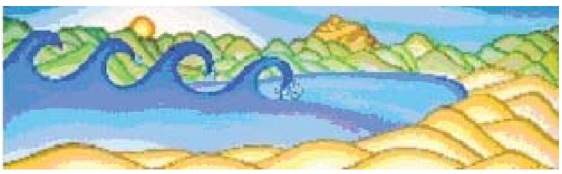

- *Tim Dwyer, David R. Gallagher: Visualising changes in fund manager holdings in two and a half-dimensions. Information Visualization 3(4): 227-244 (2004)*

## We All Relate

## R. Azuma

This painting by Sydney artist Reiko Azuma is inspired by the teachings of the 13th century Buddhist monk Nichiren, about the inseparability of people and their environment. Finding patterns in social networks is a common application for network visualisation. The painting seems to echo the modern social scientists pictures of social networks.



## Half Palindrome Point

## K. Nesbitt

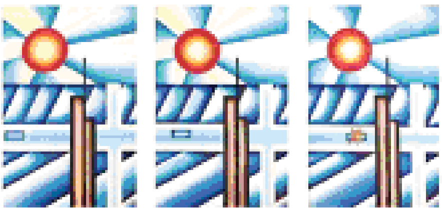
## 2007

Tufte often refers to the importance of incorporating both "time and space" as a narrative into the display and uses the well-known image by Minard, showing the disastrous retreat of Napolean's army from Moscow as an exemplar of this design approach. This connection between time and space is incorporating into this picture, with the breaking waves showing a suspended moment in time, but also implying the transition that occurs from the unbroken to the broken wave as it approaches the shore.

This picture also explores the conceptual question of whether there is information in symmetry? I think from the perspective of information theory, mathematicians would say that symmetry contains no extra information. However, the information that, "symmetry exists" is a key piece of information. I was lazy and only painted half of this picture, half of the palindrome. Can you visualise the other half?

Unfortunately I couldn't so I photoshopped the complete picture. Below is how it looks. I realised after doing this just how important visualisation can be to understanding patterns in data, to make them more "concrete", even when you know they exist. Indeed, it is often said a visualisation helps to create an external map of the information which assists both communication, understanding and discovery.


- *Tufte, E. (1983) The Visual Display of Quantitative Information, Graphics Press, Connecticut,USA*

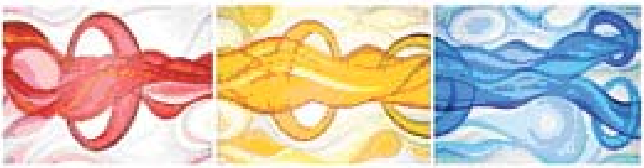


## Modern Day Tragedy

**K. Nesbitt**

**1984**

The connection between of space and time are often critical to understanding events. In this work the same space is used in each of the three pictures, although the space is designed in an odd way with two viewpoints overlapped (a top down and sideways view). The display shows a single event with time segmented into three discrete moments, much like frames in a movie or animation. Time, whether continuous or discrete is often an important element of information visualisation and is frequently used as a key dimension when designing an information display.

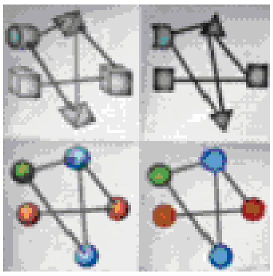


## Primary Red, Yellow, Blue

**K. Nesbitt**

**2007**

The components of colour; namely hue, saturation and intensity are often described as perceptual parts of colour and can all be used to represent information. In this painting hue (red, yellow, blue) is used to divide the picture into three parts or categories. Saturation (amount of colour) and intensity (black and white) are used to help separate the abstract figure from the background. The flowing lines of the work connect across the three parts of broken space. Like many of my pictures the space is designed in a very complex way, implying a continuous field but also discrete parts in the space. The picture is intended to represent an idea evolving and you may read it from left to right as one idea becomes two or from left to right as two ideas converging to become one. In this way time is represented running both forward and backward.



## Shape and Colour

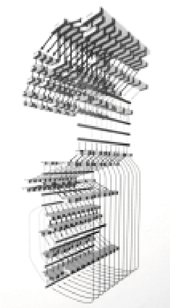
**K. Nesbitt**

**2008**

Network diagrams are commonly used to display information using nodes and links. The links show a relationship or connection between nodes. Further information about the nodes can be displayed using an attribute such as colour or shape. This painting subdivides the display space to allow four paintings of the same network to be compared. It shows the equivalence of shape (top pictures) and colour (bottom pictures) for displaying information. For example triangular nodes and blue nodes are equivalent.

The images on the left are 3D representations of the same 2D networks on the right of the picture. Another issue that is frequently debated in information visualisation is the advantage, or not, of using 3D layouts as opposed to 2D layouts of data. One "problem" that occurs in 2D displays of large networks is "crossing links" that can make interpreting the connections difficult.

This problem is avoided in 3D displays, although other problems such as occlusion and navigation occur in 3D displays.



## Multiple Metabolic Pathways

**T. Dwyer**

**2004**

The use of three dimensions in Information Visualization became cool in the early 1990s, when three dimensional rendering hardware first became affordable on personal computers. However, researchers soon found that three dimensional pictures were not as effective as they were cool. A few years ago, Tim Dwyer began experimenting with 2.5 dimensional visualization (where the third dimension is used in a very restricted way), and found that it was much more effective than either 2 or 3 dimensions. Biologists use metabolic pathways (series of chemical reactions that modify biological molecules) to describe the critical processes that occur within a cell. Tim used his 2.5D methods to produce this picture of a number of connected metabolic pathways. This image was created with support from NICTA.


- *Tim Dwyer, Hardy Rolletschek, Falk Schreiber: Representing Experimental Biological Data in Metabolic Networks. APBC 2004: 13-20*

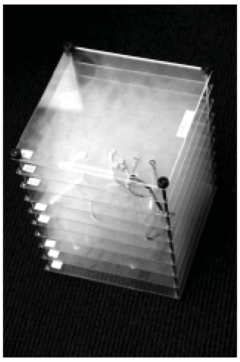
### Alice

**W. Bradford Paley**

**2003**

W. Bradford Paley has been doing visual work on computers since 1973, creating visual displays of complex data for Wall Street since 1985, and has been recognized for contributions to the design and art worlds (e.g. at MoMA and the Whitney, by NYSCA and NYFA) since 1998. He practices in New York City and often teaches at Columbia University. Paley visited the Valacon project at NICTA in 2004. This is Brad's picture Lewis Carroll's famous work. The text of the novel is around the outside; the words of the novel are rendered within, with size, position, and colour depending on attributes of occurrences in the text.

- *W. Bradford Paley: Information Esthetics: from MoMA to Wall Street. INFOVIS 2003*



### Worm view of Inflation and Unemployment

**T. Dwyer**

**2004**

This is a three dimensional picture of the connection between inflation and unemployment for eight countries over a ten year period. Classically, three dimensional models are visualized on a 2D computer screen using a number of graphic methods to create depth cues, such as motion, backplane clipping, and/or restricted depth-of-field. Tim Dwyer made this physical model in order to test the effectiveness of the visualization without the confounding effect of differing depth cues. This image was created with the support of the NICTA Valacon project and the Capital Markets CRC.

- *Tim Dwyer, David R. Gallagher: Visualising changes in fund manager holdings in two and a half-dimensions. Information Visualization 3(4): 227-244 (2004)*

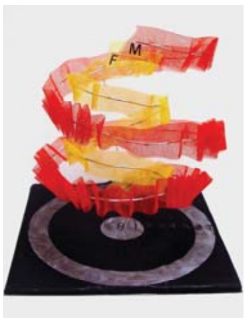
### Haptic Shoes

**X. Fu and D. Li**

**2004**

Xiaoyan Fu and Dahai Li created this haptic information display. The heels of the shoes contain a wireless receiver and some microcontrollers. The insole contains some vibrating devices. Price and volume information from an online stock market feed are relayed to the shoes, which then pass the information on to the wearer using vibrations. Non-visual information displays such as this will become more common as we move toward the era of pervasive computing. The shoes were constructed with support form the Capital markets CRC and NICTA.

- *Xiaoyan Fu, Dahai Li: Haptic Shoes: Representing Information By Vibration. APVIS 2005: 47-50.*
- *Nicole Manktelow, The tale of the v-v-v-vibrating shoes, ABC Science Online, 27 January 2005.*



### DataLix

**A. Wallace**

**2005**

dataLix represents the unemployment of men and women in Australia between 1978 and 2005. The idea of a helix was used as the basis for the design; human helix DNA being a representational form itself. The spirals evoke a passing and ongoing time narrative and the twin strands represent males and females respectively. A revolution in a spiral represents a passing of ten years. The shape of the revolution is based on the percentage of people looking for work, and is scaled around the centre. The coloured fabric covering the wire data structures highlights the change in data; the fabric bunching represents a sudden or dramatic change in data, while gradual change is represented by a move flat, uniform style. Data patterns emerge from the installation. Between 1978 and 1988 there was dramatic change in data in men looking for work, and this was repeated almost exactly ten years later. Men and women also share a relationship in that they seem to follow each others' patterns in the amount of people looking for full time work; men always at a higher percent.

## 100% Cotton

### J. Heppell

### 2008

The sculpture illustrates the impact that clothing production has on the environment. Completely made from an old 100% cotton singlet, the sculpture is intended to be an interactive, tactile process of information discovery.

It allows the user to connect the quantity of water and pesticides needed to create a singlet with meaningless item itself. Several data attributes related to cotton cultivation are translated by observing original multi-sensory cues such as the relative weight, textile-based graphical depictions or number of slits, which can all be discovered in a sequential way. Put together, the different parts were specifically designed to resemble the shape and form of the flower of a cotton plant.

## Keyboards!

### A. Duckmanton

### 2008

This work physically illustrates the usage of keyboards.

Key frequency - How often each letter of the alphabet is used in normal use of the keyboard is translated in a key's height.

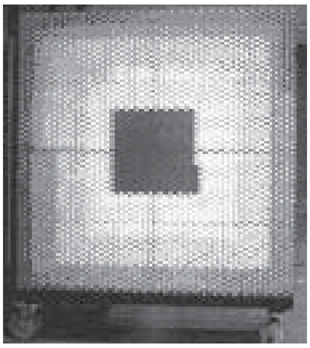
Speed of data creation - How fast it takes to create data using different mediums - handwriting, typing, conversational speech, is represented by the relative flickering speed of the Num Lock, Scroll Lock, Caps Lock lights(when connected)

Dell stock market quotes - The monthly levels of Dell's stock in the past 12 months are represented by a scatter plot formed by the 12 Function F-keys at the bottom.

Power consumption – The amount of power used by the keyboard compared to the entire computer, by way of the relative lengths of the shredded power cord.

RSI percentage - Percentage of RSI compensation cases compared to all compensation cases in the USA by the relative number of blue versus white rubber keys on the numerical pad on the right.

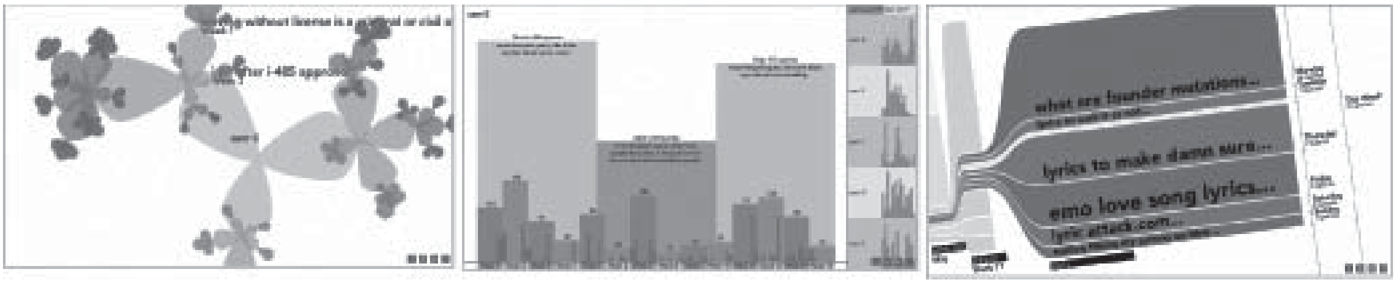
## Iraq 100



### M. Tomitsch

### 2008

This work exploits the visual experience of public low-resolution screens for conveying data. A large-scale "pixel chart" represents civilian war casualties in Iraq over time. The time that has passed since the beginning of the war (5 years) is mapped onto a 100 minutes timeframe, mediating an aesthetic but disturbing impression of the deathly impact that the war had on the Iraqi civilian population. The data is retrieved from an online database that collects information about casualties. Victims are grouped by age (e.g. babies, children, male adults, female adults) and each victim is represented by 1 pixel. Colours are mapped to the groups of victims. Each casualty is presented as a bright flashlight mapped onto the timeframe of 100 minutes. The visualisation gives insights on the distribution of the casualties in Iraq, both over time and age groups. The LED screen is used to emphasis the physical reality of the data through its striking brightness and large-scale pixels.




## Life in Search / Search for Life

### A. Lau

### 2008

This work consists of 3 digital, screen-based, interactive works that are specifically designed to research and illustrate the principles of information aesthetics.

1. Information visualisation: a bar graph technique which uses effective and direct mapping.

2. Information aesthetic visualisation: a technique which employs effective mapping merged with a stylistic, artistic approach.

3. Visualisation art: a technique that exploits the interpretive mapping of the same data.

The dataset used for this research was released in August 2006, with good intentions, by researchers from the AOL Research Group. The two gigabytes dataset details 21 million search queries from over 650 000 users. The three data mapping techniques differ in the subjective highlighting of the data attributes, hereby aiming to engage the in alternative ways. To ensure the validity of the evaluation, the data, as well as the graphical and visual style of the three works is kept consistent.

## Market Moon

### Elodie Marie

### 2008

This ambient visualisation is based on a work of Russian surrealist Sergey Tyukanov. It displays the state of five shares (chosen by the user) on the stock market. Each share is depicted on one or two floors of the moon, where we can see a tree, a flower and a number of people; these encode the value and the velocity of the share. The tree represents the health of the share for a short term. As the share price increases during the day, the tree grows. If the value of the share decreases for a day or more, there is no tree. The flower represents the longer term state of the share. If the flower is red, the share has decreased significantly in the last week; yellow represents the opposite case. A large number of people roaming around the tree indicates a high share price.

# People

**Reiko Azuma** was born in Japan and came to Sydney in 1992. She is an artist whose works explore connectedness between humans and their environment.

**Karen Blackmore** is a postdoctoral researcher at the University of Newcastle and is working on a project looking at regional climate change. Her current interests include modelling and map making.

**Alex Duckmanton** is a 3rd Year student in Design Computing and is supervised by Andrew Vande Moere in the Faculty of Architecture, Design & Planning

**Tim Dwyer** graduated with a PhD from the School of Information Technologies in 2005. His thesis synthesised and analysed pictures of financial and biological systems in two and a half dimensions. He now works for Microsoft Research in Seattle.

**Peter Eades** is Professor of Software Technology at the University of Sydney and a Distinguished Researcher at NICTA.

**Carsten Friedrich** completed a PhD in the School of Information Technologies in 2003. His research has encompassed animation methods for abstract information displays. He has worked in the Capital Markets CRC, dtecht (a company that markets and supports a health fraud detection system), and CSIRO.

**Xiaoyan Fu** graduated with a master's degree from the University of Sydney in 2004, and worked with the Valacon project at NICTA to produce visualizations of many large and complex data sets. He now works Teradata Australia..

**Jessie Heppell** is a 3rd Year Design Computing student supervised by Andrew Vande Moere in the Faculty of Architecture, Design & Planning

**Seok-Hee Hong** is a Senior Lecturer and ARC Research Fellow at the School of IT. Her research covers the visualisation and analysis of large and complex networks, including the theory and practice of graph drawing.

**Andrea Lau** is currently a Design Computing PhD Student, who is supervised by Andrew Vande Moere in the Faculty of Architecture, Design & Planning. She is interested in how the persuasive power of data visualisation can be applied to new application areas so that it can be used and seen and appreciated by more people, in more places.

**Dahai Li** did a masters degree in Information technology at the University of Sydney and is now enrolled in a PhD in the School of Electrical and Information Engineering.

**Elodie Marie** is a student of the Paris XI University who will graduate next year with a masters degree specialised in Information Technology. Elodie has a special interest in the analysis of market data. She is currently visiting the School of Information technologies, working on financial art visualization.

**Damian Merrick** completed a PhD in Visualization in the School of Information Technologies in 2007, associated with the Dmist project in NICTA. He also worked on the Valacon and Banesh projects in NICTA. He is current working in a company creating software solutions to water problems.

**Colin Murray** has recently completed his PhD thesis at the University of Sydney, as part of the NICTA Valacon project. His research work broadly investigates innovative information displays, including haptic as well as visual media. His current work is in CAS, a Sydney company that provides banking and payment services for small business users of internet and front-counter purchases.

**Tom Murtagh** completed Bachelors degrees in Science and Engineering at the University of Sydney in 2005. He worked as a research assistant in the School of Information Technologies.

**Keith Nesbitt** graduated with a PhD from the School of IT in 2003; his thesis gave design principles for multisensory information display. He is now a Senior Lecturer in the School of Design, Communication and Information Technology at the University of Newcastle (www.knesbitt.com).

**W. Bradford Paley** has been doing visual work on computers since 1973, has been recognized for contributions to the design and art worlds (e.g. at MoMA and the Whitney). He practices in New York City and often teaches at Columbia University. He was a visitor to the University of Sydney and the Valacon project of NICTA in 2004.

**Kevin Pulo** completed a PhD at the University of Sydney, as part of the NICTA Valacon project, in 2004. His dissertation presented innovative ways of browsing large information spaces. He now works at the APAC National Facility within the ANU Supercomputer Facility.

**Andrew Vande Moere** is a lecturer at the Key Centre of Design Computing & Cognition in the University of Sydney. His research interests include aesthetic data visualization and visual design, from screen-based media over ambient to wearable applications. Andrew is also the author of the information aesthetics weblog (http://infosthetics.com), a website collecting intriguing forms of representing information in engaging and beautiful ways.

**Xiaobin Shen** completed his PhD "design and evaluation of ambient displays" at the school of IT, University of Sydney in 2006. He now works as a research fellow at the University of Melbourne.

**Martin Tomitsch** is a PhD Student at Vienna University who is currently working with Andrew Vande Moere in the School of Architecture. He is interested in the duality of the virtual and the physical world, bringing them together in an explorative approach that is grounded on new interaction paradigms, often placing information technologies into unsought contexts.

**Andrew Wallace** was a 3rd Year Design Computing in the Faculty of Architecture, Design & Planning.

**Many of the works in this exhibition are based on research done by staff, students, and visitors at the University of Sydney. Researchers include Ulrik Brandes (University of Konstanz) Masahiro Takatsuka (University of Sydney), Falk Schreiber (IPK Gatersleben), David R. Gallagher (University of New South Wales), Sue Whitesides (McGill University), Hardy Rolletschek (IPK Gatersleben).**