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Visualizing Digital Communication

by

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Abstract

As more people take part in online conversations, awareness of the varying conversational styles and the changing social mores that are afforded by different types of software is growing. However, this awareness is largely built on personal impressions as varying styles of social interactions are hard to discover in the text-based representations. The research in this thesis explores the visualization of social and temporal interactions as evident in digital communication. This is presented through the creation of three visualizations: Bubba Talk, Plant Post, and CrystalChat. In these projects, quantitative social data from digital communication is collected. This social data is parsed, mapped into visual representations, and developed with interaction methods. The first project, Bubba Talk, visualizes the spirit of a conversation with animation, focusing on participation level and the connections between the speakers. However, temporal cues are not apparent when the animation is over, the resulting visualization does not provide temporal cues. The second project, Plant Post on the other hand, places less emphasis on the speaker's interaction, visualizing instead the temporal aspects of postings. Rather than showing the social and temporal aspects separately, the third visualization I created, CrystalChat, visualizes both the social and temporal aspects of chat history, combining them into one 3D visualization.

Publications

Materials, ideas, and figures from this thesis have appeared previously in the following publications:

Neumann, P., Tat, A., Zuk, T. and Carpendale, S. (2006). Personalizing Typed Text Through Visualization. In *Poster Presentations of the IEEE Symposium on Information Visualization (InfoVis 2006)*, IEEE Press.

Neumann, P., Tat, A., Zuk, T. and Carpendale, S. (2007). KeyStrokes: Personalizing Typed Text with Visualization. In *Proceedings of Eurographics / IEEE VGTC Symposium on Visualization*, IEEE Press, To appear at http://dlib.eg.org.

Tat, A. and Carpendale, S. (2002). Visualizing Human Dialog. In *Proceedings of Conference on Information Visualization*, IEEE Press, 16-21.

Tat, A. and Carpendale, S. (2006). CrystalChat: Visualizing Personal Chat History. In *Proceeding s of the 39th Annual Hawaii International Conference on System Sciences*, IEEE Press. Volume 3.

Tat, A. and Carpendale, S. (2006). Visualizing Digital Text Conversation. In *ACM CHI Workshop on Social Visualization: Exploring Text, Audio, and Video Interactions (CHI 2006)*, ACM Press.

Tat, A., Kruger, R., Carpendale, S. and Dunning, A. (2006). Plant Post: Visualizing Temporal Aspects of Message Postings. In *Poster Presentations of the IEEE Symposium on Information Visualization (InfoVis 2006)*, IEEE Press.

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Dedication

I dedicate this thesis to my parents, Tina and Cuong. You have loved and cared for me all through my life. You have always wanted the best for me and would do anything for me to make sure I was always provided with what I needed. You have encouraged me to work hard and gave me confidence that I can accomplish anything I strive for. I feel honoured to have you as my parents.

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Chapter 1. Introduction

My research focus is on the creation of visualizations that enrich digital text-based communications. Digital communication continues to grow in the number of people who use it, in the number of messages sent, and in the new varieties and styles of software that support it. Digital communication includes email, instant messaging, chat rooms, bulletin boards, blogs, etc; this is changing the way we communicate with each other and affecting the ways in which we maintain our social groupings (Donath et al., 1998). One of the reasons for visualizing this data arises from the recognition that simple text communication is less rich than face-to-face communication and visuals can be added to augment the communication itself. Another reason to create visualizations is to provide ways to better understand people's interactions and the social networks that develop through digital communications. Visualization is one possible method by which patterns in digital conversations may be revealed. To this end, I have created three visualizations that explore possible ways of representing social and temporal interactions that occur in digital conversations.

This chapter is organized as follows. In Section 1.1, the context and motivation of this thesis work is outlined. In Section 1.2, a brief outline of the importance of Information Visualization and discussion of how Social Visualization is related to Information Visualization is provided with an explanation of the scope of this thesis research. Section 1.3 contains the main problem statements and thesis goals, describing the problem and goal for each of my three visualization projects. Section 1.4 outlines my design process and contributions. Finally, Section 1.5 provides the thesis organization, briefly indicating the contents of each chapter.

1.1 Context and Motivation

Social patterns are trends of how individuals interact with one other and in social groups through a period of time (Donath, 1995; Spiegel, 2001). During face-to-face conversations, one can gather a lot of information about a person's attitude and mood by observing one's tone of voice, facial expressions, and body language. In social events or parties, one is able to observe and sense how one person or a group of individuals interact with one another; for instance, individuals can be perceived as either gregarious or reserved. The intensity of a conversation can be judged by various aspects such as the amount of time individuals spent conversing or the amount of words exchanged between two individuals or a group of individuals. Paying attention to one's own and other individual's social patterns can give one a better sense of awareness in social situations.

Social patterns also exist in digital communications, but they differ from face-to-face communication in many aspects. For example, online chat tends to be extremely casual often consisting of short comments. Another difference is digital communication can be recorded and saved, for example, messages can be saved in email folders and instant messaging activities can be stored in history folders. Digital archive makes it possible to revisit text conversations. For instance, archives may be practical serving as a type of record of activities and commitments in the business world. In one's personal life, these materials are available for one to reminisce upon like a type of journal or diary. Digital archives also enable one to reflect upon one's personal growth and social interactions with individuals over a period of time. The ability to look at the quantity, frequency, emotional tone, etc. of digital conversations may help provide deeper social significance by enabling the review of social patterns in relationships.

There are many advantages to visualizing digital communication data. In the following paragraphs, some problems with textual communication are highlighted and benefits of visualizations are explained.

1) On the surface, social patterns are not obvious and noticeable in most textual communication tools provided already. For example, the software provided for online chat is usually formatted in simple text list, making social patterns hard to discover at a glance. Studies on the visualizations created by Donath and Viegas

[Donath et al., 2000] have successfully demonstrated how social patterns can be seen more easily with visual representations. More details of these visualizations are discussed in Chapter 2.

2) Simple text conversations are not as rich as face-to-face conversations [Kurlander et al., 1996]. Several factors such as the sound of an individual's voice, appearance and actions are omitted or compromised in text conversations. However, text can be augmented with graphical representations to reveal more emotional content. To be more expressive, people currently use extra punctuation in the form of what are called emoticons. This can be translated into visualizations by representing the quantity of punctuation by colour, shape or animation to emphasize an expression.

3) Text can fill screen space quickly. Having to switch back and forth through screens can be time consuming and irritating. This overload comes from having to remember and connect pieces of information together mentally. The more information that can be displayed together, the less one has to memorize and connect information to find relationships. Graphical representations can be used to replace and filter important textual data, so that more information can be seen at once. The more information that can be displayed at once, the more that information can be compared.

4) Studies have shown that highly effective business people keep all electronic communication and use them; however, over time easily accessing this abundant information can become difficult. Visualizations can be used to help people retrieve data more effectively and efficiently.

This thesis explores different ways to visualize digital communication in order to improve the quality of digital communication in textual conversations. In the next section, an explanation of how visualizing social patterns fits in the field of Information Visualization is presented.

1.2 Background

Information Visualization is an increasingly active field of research. Card et al. defines Information Visualization as "The use of computer-supported, interactive, visual, representations of data to amplify cognition" (Card et al., 1999, page 6). Part of the reason for the rising popularity of Information Visualization is that effective visualization can be valuable in allowing perception of patterns to merge by linking aspects of data together (Ware, 2000). For example, in mathematics, complex formulas can often be usefully presented in graphs or diagrams which can help make difficult concepts more understandable. The idea of being able to gather comprehensible information from an image is commonly held, evidenced by the saying "A picture is worth a thousand words". Other evidence of the importance of visual representation in our culture is illustrated by how marketers are also studying ways to effectively communicate and sell their products to customers by hiring graphic designers to create their logos and advertisements. Regardless of the field, communicating with visual graphics can be important in helping better communicate information that one is exposed to daily.

Social Visualization is a subset of Information Visualization focusing on the development of visual representations and interactive techniques intended to promote the understanding of social data in a digital space. Visual representations can be exploited to represent a large body of information, such as textual conversations, with a more efficient use of screen space allowing more information to be viewed at once. In addition, text conversations are made richer by providing additional visual information (Kurlander et al., 1996). It is easy to understand facial expressions and body gestures in real life; portraying these as graphical expressions lost in text conversations may bring one's text communication experiences closer to those in real conversations (1999; Viégas, 1999; Smith et al., 2000). Social Visualization is also useful because visuals provide better ways to understand individuals' interactions and awareness of social activities that develop around them (Erickson et al., 1999; Donath and Viegas, 2002). A considerable number of social visualizations have arisen in response to these ideas. Usually they focus on a particular type of online communication, for example: the visualization of email (Kerr, 2003; Viégas, 2004; Mandic and Kerne, 2005), of newsgroups (Xiong and Donath, 1999; Donath et al., 2001), of a particular aspect of the data such as the social network (Freeman, 2000; Sack, 2000; Mutton, 2004; Heer and Boyd, 2005) and of conversation initiation and response (Kerr, 2003; Viégas and Smith, 2004). For more detail, refer to Chapter 2 on related work.

Figure 1 provides a diagram that positions this research within the field of Information Visualization. This thesis concentrates specifically on Social Visualization, a visual representation of data that describes the patterns of social activities. Visualizations of digital communications lie within the field of Social Visualization. Within this thesis, three types of digital communications are visualized: transcribed conversations, asynchronous message-board systems and instant messaging (Figure 1.1). The next section will explain my design process in more detail and also the problems and goals for visualizing these three data sets.

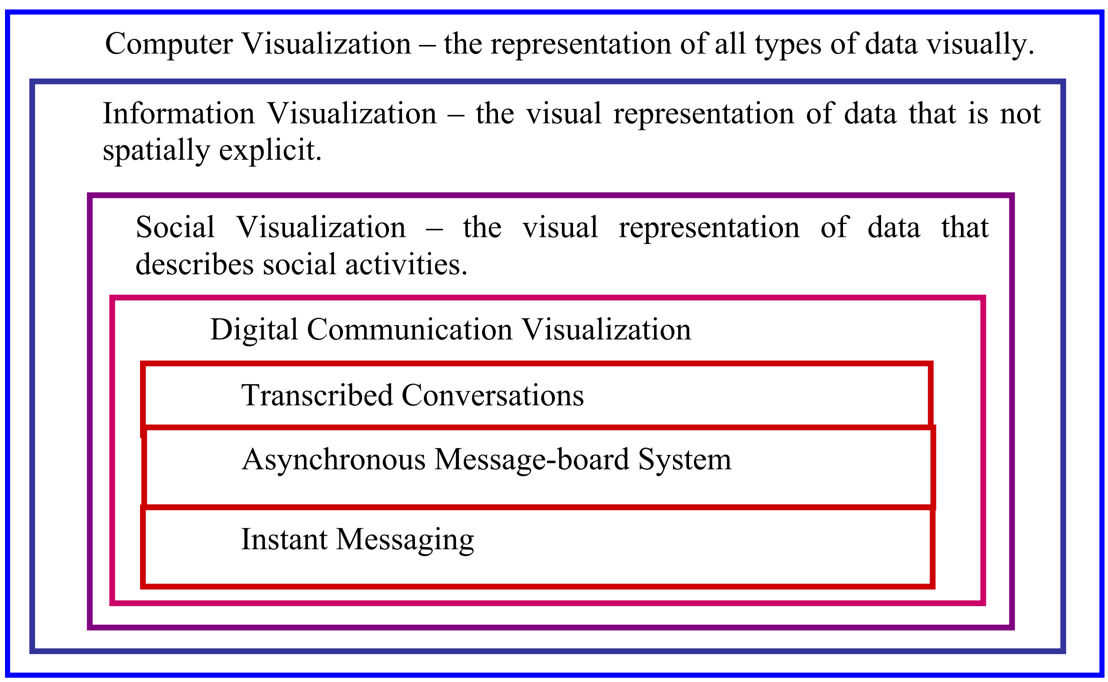


Figure 1.1: Setting digital communication visualization within the scope of more general visualizations

1.3 Problem Statements and Goals

As mentioned in Section 1.1, there are many advantages to creating social visualizations that may help address some of the problems that arise in textual communication. An important problem to consider is that social patterns are not obvious and noticeable in textual communication. The goal of this thesis is to create visualizations that will enrich digital conversations and reveal social patterns. Part of this goal is to do this without requiring extra effort on the part of the user typing the message. This entails exploring quantitative and qualitative data that can be obtained from examining and parsing digital conversations. The following describes the sub-problems and sub-goals for each of these visualizations with the different data sets used.

1.3.1 Bubba Talk: Transcribed Digital Conversations

Problem: Textual conversations lack the quality and tone of expression face-to-face conversations have.

Goal: The intention of Bubba Talk is to provide a visual impression of the quality and tone of the conversation that took place in the meeting. More specifically, the goal was to find visual mappings that respond to quantitative aspects of speech by each speaker such as number of characters, number of words, and number of punctuation.

1.3.2 Plant Post: Message Board Systems

Problem: Digital message board systems lack the temporal cues one has in the real world.

Goal: The goal is to create an interactive visualization that gives an impression of temporality for postings, in effect, to create visual representations for typing speed, time gaps between postings and age of a particular message.

1.3.3 CrystalChat: Instant Messaging Systems

Problem: Little work has been done that integrates both the social and temporal data into one visualization, especially with viewing the history of instant messaging systems.

Goal: The goal of this design is to integrate both the social network and the temporal aspect of textual conversations into one representational structure. Some initial goals are to visualize patterns that reveal information about temporal clustering, conversation initiation, conversation termination, length of conversations, length of postings, patterns of repeating or alternating postings, and emotional tone as represented by emoticons.

1.4 Design Process and Contributions

Designers are becoming more interested in the impact of how the visual appearances have on interfaces and visualizations (Kurosu and K., 1995; Kurlander, Skelly and Salesin, 1996; Tractinsky, 1997; Norman, 2002). Kurosu and Kashimura (1995) found that the visual appeal do in fact affect people's perceptions of usability, which in turn influences their attitude toward the system in the long run. Thus, the choices of representation and presentation style are important factors to be considered when designing visualizations.

To satisfy the problems and goals I have mentioned in the previous section and to make my visualizations more visually appealing, I have developed and followed a consistent design process based on my own personal ideas and workflow. While the visual appearance of these three examples differs considerably, the basic design methodology followed is the same for each of them. My design methodology has four processes. While there is some temporality to these processes, in that they are started in the order listed, there is considerable overlapping and back tracking within the development of a given case study.

1) Deciding on what data the visualization should be based. There is a wealth of possible data within a text conversation including social interaction, temporality and the varying quantity of text contributed by the different participants. The decision on what the focus should be is based on who is interested in the visualization and what they might want to learn.

2) My approach to visual problem solving tends to be formal. This means I am concerned with elements of form, space, and vision. For me design is a discovery process mainly done through concepts related to drawing as suggested by Graham Collier. Working within a market environment requires additional constraints. For example, in the business world, certain representations for visual cues can be limited for use. One business world example is there could be a case where only a certain amount of colours could be used to keep the identity and visual appeal of a business product. Thus, it is useful to practice exploring different visible variables that will work together as a representation while maintaining a visual appeal. This

step sets the stage for developing a unique but a consistently appealing visualization. Artistic approaches to visualization are often found in a variety of literature which deals with Art fundamentals, Design Concepts and Application, The search for unity.

3) Developing expressive mappings from the data to create a visual representation, adhering to the choice in step three. As closely as possible the graphical representation should resemble the data it is mapping. For example, if an exclamation mark is to be visualized, then the visual representation should look emphasized similar to what an exclamation mark is used for. This will help users identify and remember more easily the data mapped for each graphical representation.
4) Choosing interactions that enable an individual to use and manipulate the visualization as created in step three. In order to filter the important information that the user wants to interact with at any given moment, additional visual cues and/or camera paths (when dealing with 3D) need to be incorporated into the visualization. The system needs to make the user feel like he or she has control, but at the same time, there needs to be constraints as to what the user can do. Too much functionality and flexibility can overwhelm the users.

The following provides a brief description of the three visualizations to illustrate this design process:

1.4.1 Bubba Talk: Transcribed Digital Conversations

My first project, Bubba Talk, visualizes relative quantities and social connections, excluding the temporal aspects (Figure 1.2). The text data used was transcribed from a recorded conversation of a meeting. For this piece, visualization constraints are used. Within the visual limits of circles, pastels, and animation, I developed an abstract representation of social interaction patterns in conversation.

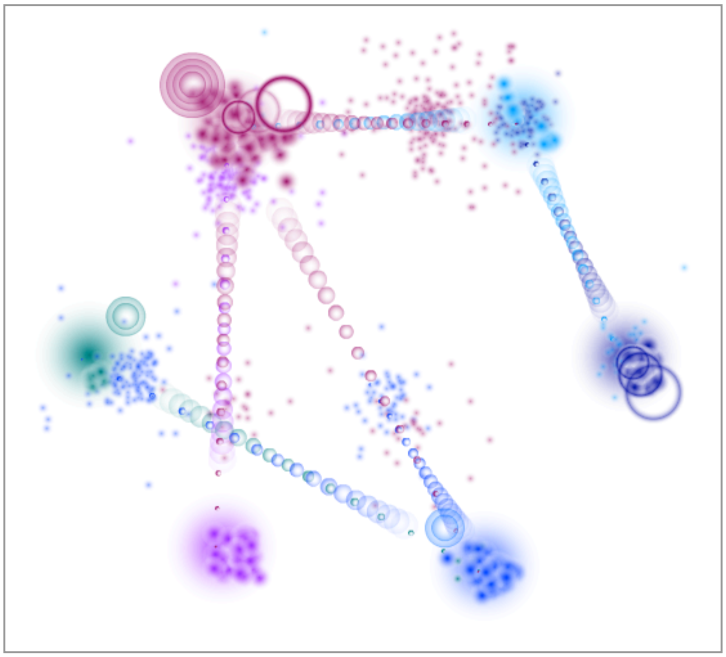


Figure 1.2: Bubba Talk visualizing the social network of a transcribed conversation

1.4.2 Plant Post: Message Board Systems

My second visualization, Plant Post, focuses on creating graphical representations for the temporal aspects of postings; however, with less concentration on the social aspects, Plant Post loses the social spirit of the conversation in the visualization (Figure 1.3). Plant Post is designed for an interactive art gallery setting. During the art show, the audiences were able to type a new message or add a message in response to the previous postings. In keeping with this data aspect, a visualization metaphor of a plant growing and aging is chosen. Using the same plant metaphor, word complexity is also incorporated into the same visualization by varying characteristics of leaves on the plant. Plant Post shows that historical information can be revealed by looking at the overall patterns of the metaphoric representation of a plant.

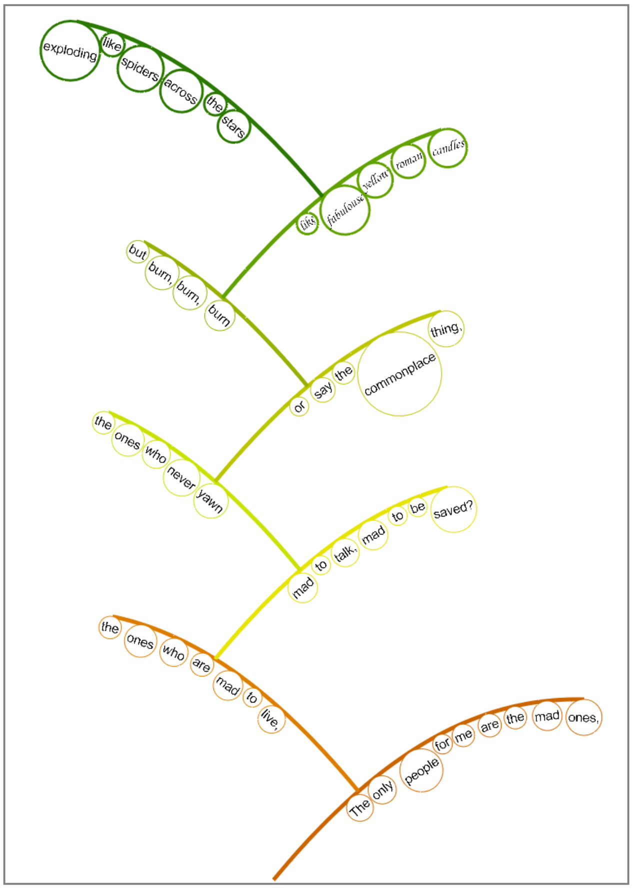


Figure 1.3: Plant Post visualizing the temporal aspects of a message board system

1.4.3 CrystalChat: Instant Messaging Chat History

CrystalChat integrates both the social and temporal aspects of textual conversations in one visual structure (Figure 1.4). This study of instant messaging systems explores the design space of developing representations that visualize the patterns of the social network and temporal aspects of instant messaging archives. CrystalChat focuses on visualizing the social interaction centered towards an individual, supporting personal use for self exploration of one's own chat history. The development of CrystalChat as a visualization that integrates social and temporal data involves the constraint of using 2D planes within a 3D environment. Here the constraint is the focus of the design process and the metaphor of a crystal with its multiple plane facets came later. The visualization of CrystalChat is one single visual structure that is capable of revealing temporal interactivity and providing information on one's social network through the quantity and frequency of message posting. This structure also provides the emotional content of chat dialog.

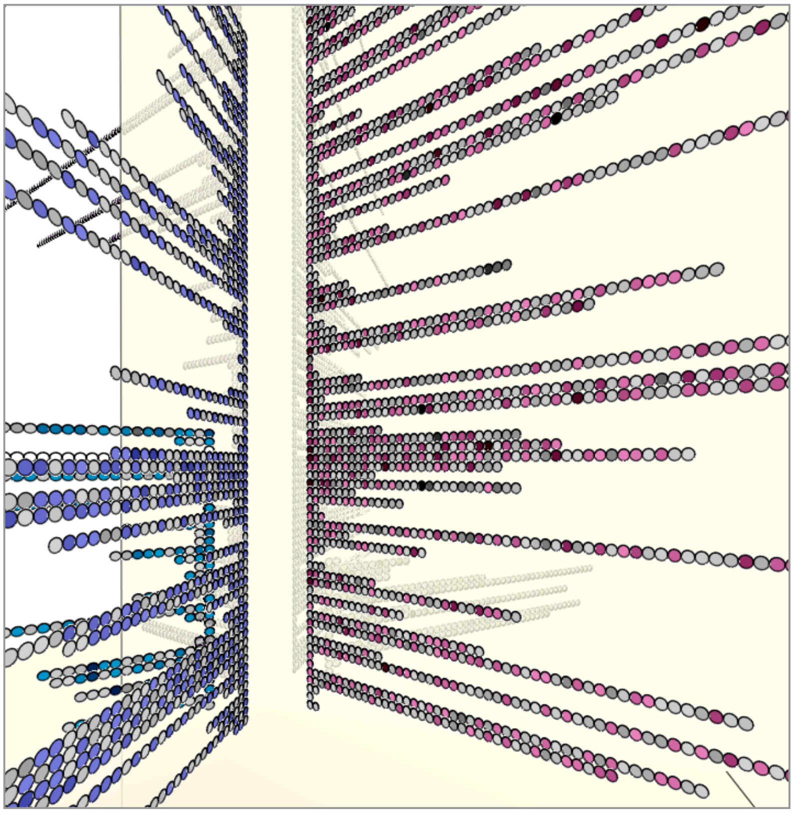


Figure 1.4: Visualizing both the social and temporal data of instant messaging history

1.5 Thesis Organization

In Chapter 2, examples of related work are introduced organized and grouped into two timelines. The first timeline includes what is thought to be the earliest visualizations on social networks. In the second timeline, more recent works of social visualizations are presented. Further, more detailed examples of works that visualize both temporal and/or social data are given along with a description of how most works that include both the temporal and social data are displayed separately into two different visualizations.

In Chapter 3, my visualization called Bubba Talk is introduced, which represents a transcribed conversation in a meeting. In this chapter, a discussion of the data parsed from the transcribed text conversation ensues followed by an explanation of how this data is mapped into visual representations. Moreover, how animation and visual traces can be used to represent the connection of each individual speaker is illustrated. In the end, I describe how Bubba Talk can overall reveal the spirit of the conversation.

In Chapter 4, I present is a visualization called Plant Post, created to visualize the temporal aspects of postings, in contrast to Bubba Talk discussed in the previous chapter. In this chapter, the temporal data recorded from each posting is explained and how the data is transformed into a metaphoric representation of a plant. Furthermore, how word complexity can be detected and how it can also be visualized as part of this plant is described.

In Chapter 5, my third project called CrystalChat, a visualization of instant messaging log history, is introduced. Combining the visualization ideas from Chapter 3 with Bubba Talk and Chapter 4 with Plant Post, the main idea behind the research presented in this chapter is the creation of a visualization that integrates both social and temporal data into one visual representation. Moreover, a description of how CrystalChat can reveal different social patterns and what the users' responses to these patterns is given.

In Chapter 6, the context of my work is explained from an art perspective. My viewpoints of how conversations look are described. In support of my views, my working process is explained and the reasons behind my works are indicated. Based on my experiences and involvement in an interdisciplinary degree with computer science and art, similarities and differences are laid out and the benefits of such a degree are revealed.

Chapter 7 draws the conclusion. In this chapter, the motivation behind my thesis work is reiterated and then a brief summary for each of my projects is given. Finally, a summary of my contributions is explained.

Chapter 2. Related Work

Social Visualization, a subset of Information Visualization, has been approached from many perspectives. Some of these include visualizing social data formed by chat activities, visually augmenting the chat itself, and providing some trace of social activities through time. Moreover, researchers have explored visualizing different types of data such as text, audio, and/or video data. Such social information has been visualized in many different forms of representations.

In this Chapter, I discuss social visualization research that is related to my work, narrowing the focus down to the two most related areas: social network visualization and recent visualizations of online communications. For both of these focus areas, social network visualization and online communications visualizations, I have created timelines: the first shows the early works of social network visualizations and the second shows the more recent social visualizations. Included in the time line for each visualization is an image, a brief statement and its reference. I have organized and grouped them as follows: In Section 2.1, I start with what is thought to be the earliest form of social visualization, social networks that make use of node and edge diagrams. In Section 2.2, I present examples of recent visualizations of online communications in categories that are based on the type of social data being visualized. These categories include: Online Chat, Transcribed Text, Real-time Typing, Email, Blogs, Online Dating, Wikis, Text Documents, and Audio and Video. In Section 2.3, I select examples of visualizations from the previous timelines that visualize temporal and/or social data. In this section, I describe how each of these visualizations presents the temporal aspect and the social aspects as separate visualizations, either in separate dialogs, separate screens or split screens.

2.1 Social Networks Visualization

According to Linton Freeman there has been a rich history of study on Social Networks and Sociograms since the 1930s (Freeman, 2000). He states that these studies have often created visualizations that take the form of either node and edge diagrams or matrix representations. In a node and edge diagram, the nodes represent the entities or actors of the social actions and the edges represent connections or relationships among actors. In the matrix display, the rows and columns represent social entities and the numbers and symbols represent social connections.

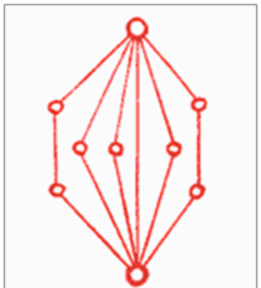
Since visualizations for social networks started in the 1930s and continue today, I have arranged social network visualization examples in a timeline. This timeline starts from Figure 2.1 and Figure 2.2 with Freeman's examples then continues with Figure 2.3 and Figure 2.4 with examples I have gathered from the more recent literature. Freeman states that there have been, over the last century, five distinct phases in the development of node and edge diagrams for social network visualization. The five phases are listed in the following and examples of these visualizations are shown in Figure 2.1 and Figure 2.2:

1) Hand drawn images in the 1930s – A variety of these graphics were created with artistic skill from the creator.
2) Computational node and edge drawn images in the 1950s – Creators began to use standard computational procedures to locate point positions.
3) Computer generated node and edge images in the 1970s – Computers used to produce graphics on machine images automatically.
4) Node and edge images on monitor screens in the 1980s – Images were displayed on computer monitors with colour.
5) Network images in the era of web browsers in the 1990s – World wide web opened up new possibilities for graphic display.

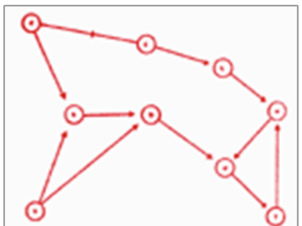
Figure 2.1 shows node and edge hand drawn images that occurred in the 1930s, 1950s, and 1970s. Figure 2.2 presents node and edge images displayed on the computer monitor in the 1980s and 1990s.

Using node and edge drawings for social network visualizations continues to be an area of an active research interest. Judith Donath seems to have created the earliest work of visualizations of social networks that use more than nodes and edges, examples include VisualWho (Donath, 1995) and Post History and Social Network Fragments (Viégas, 2004). Relationships and connections between people drawn through the use of proximity, size and highlights of colour are shown in examples in Figure 2.3. In more recent years, as shown in Figure 2.4, social network diagrams using the notion of node and edge diagrams still remain popular. However, with more recent advances in graphics, node and edge drawings have changed according to the layout and size of the nodes and even the way the edges are drawn are different.

1930



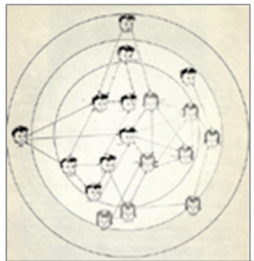
Moreno's image of a pattern of linkages (Freeman, 2000)



Moreno's image of who recognized whom among a collection of babies (Freeman, 2000)

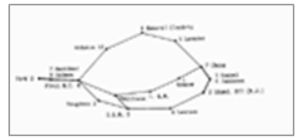
Friendships among fourth graders (Freeman, 2000)

1950



Grant's drawing of a target sociogram of a first grade class (Freeman, 2000)

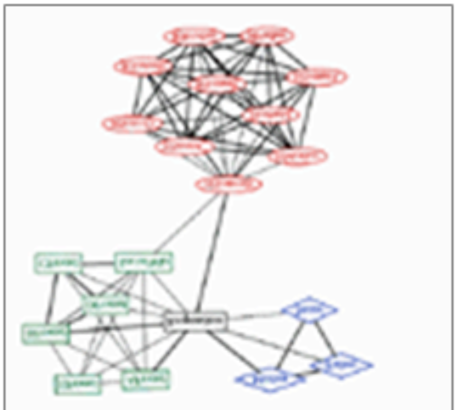
1970



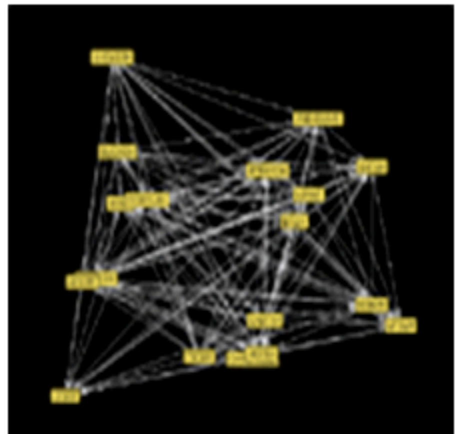
Individual and corporate proximities. This image was still drawn by hand, but the practice of programming computers to draw point and line images of networks actually began a bit earlier -- in the early 1970s. (Freeman, 2000)

Figure 2.1: Timeline 1 Part 1: Examples of hand-drawn Social Network Visualizations. All the images in this figure were drawn with nodes and edges. Each node represents an individual and each edge represents a relationship or connection between the individuals. The positions of the nodes were considered to show a comprehensible layout of the social network.

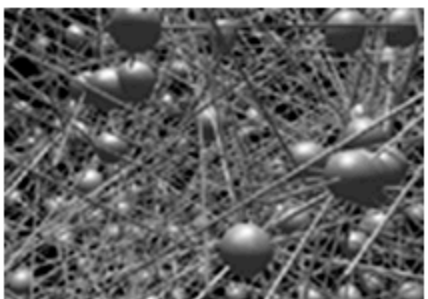
1980 **1990**



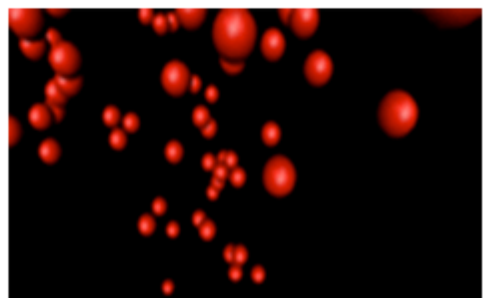
A Krackplot rendition of the data (Freeman, 2000)



JAVA image of spring embedding the data displayed (Freeman, 2000)



3D image of social links in Canberra, Australia. (Freeman, 2000)



VRML image of Webster's Australian friendship data. (Freeman, 2000)

Figure 2.2: Timeline 1 Part 2: Examples of computer generated Social Network Visualizations. The use of computers made it possible to run large sets of data and to produce large numbers nodes and edges efficiently. However, the layouts of the nodes in these images make the connection of edges hard to read and the images complex overall.

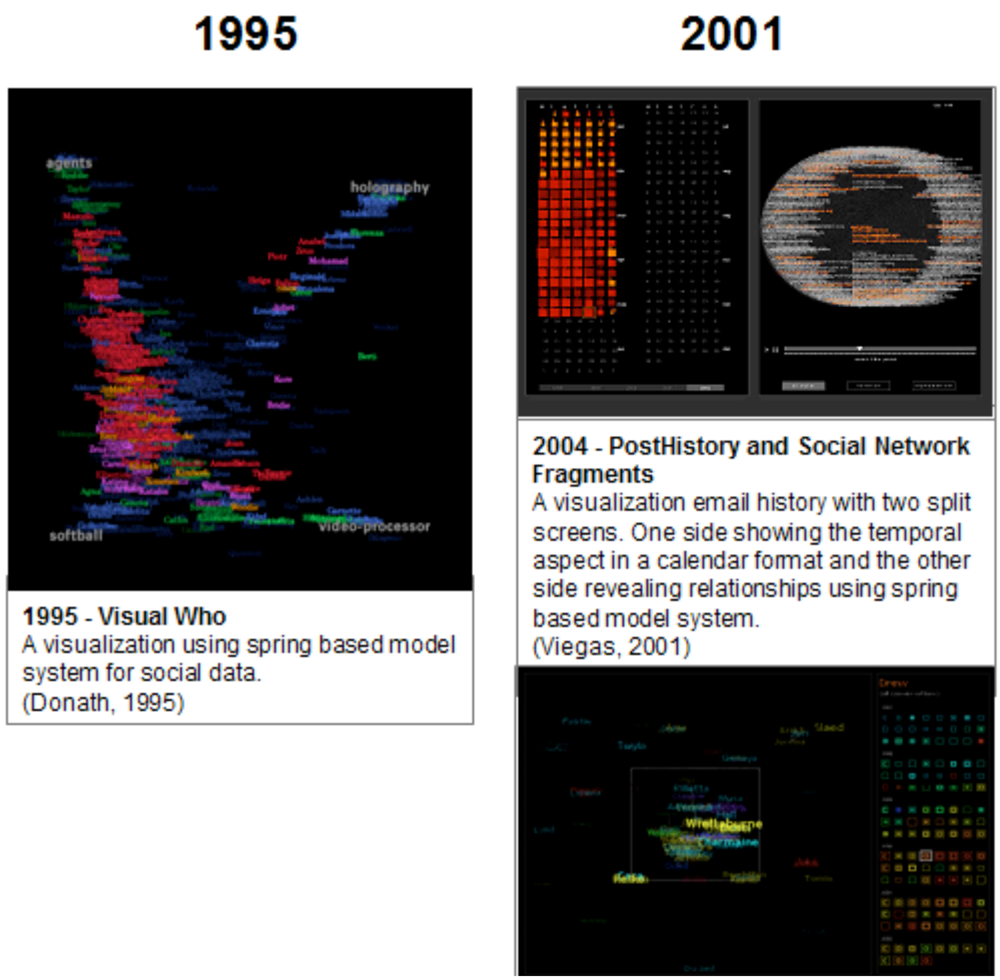
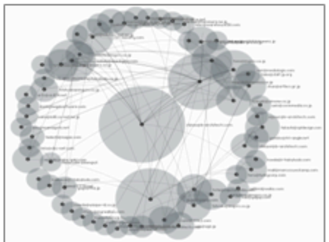
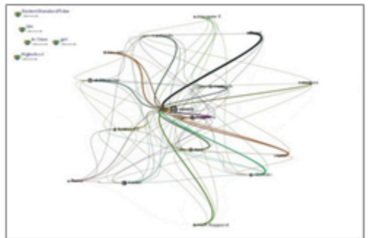


Figure 2.3: Timeline 1 Part 3: Examples of Social Network Visualizations without nodes and edges. The images in this figure were created in the MIT Laboratory. Here, relationships and connections between people are not only represented by nodes and edges but rather drawn with the use of text, proximity, size and highlights of colour.

2003 **2004** **2005**

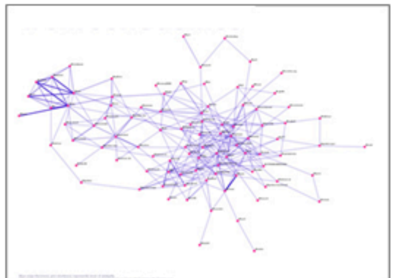


2003 - Social Circles
A visualization revealing social networks that emerge in mailing lists, using different sized nodes and slightly bent edges in a circular layout.
(http://www.marumushi.com/apps/socialcircles/socialcircles.cfm)

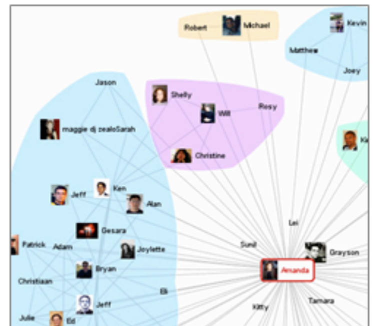


2004- Locus
A social network diagram of an instant messenger. Finds similar messages sent between people.
(Locus, 2004)

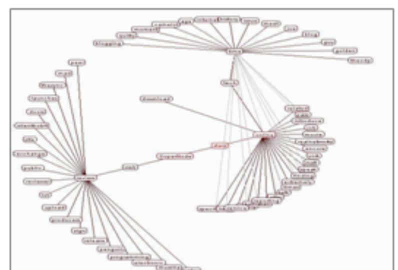
2005 - BuddyZoo
A visualization analysis tool that maps AIM buddy lists using different coloured nodes and edges in a circular layout.
(http://www.buddyzoo.com/)



2004 - PieSpy (Paul Mutton's Social Network)
A social network diagram that monitors sets of IRC channels. This diagram uses edge and node layout and time is shown by fading out edges.
(Mutton, 2004)



2005 - Vizter
Visualizing Online Social Networks of Friendster using spring layout and spring and mass system animation. Also uses context-hull and colors to separate groups.
(Heer, 2005)



2005 – NusEye
Social network of syndicated web content for user collaboration. A social network diagram using nodes and edges with a fan-like layout
(Jarrett et al., 2005)

Figure 2.4: Timeline 1 Part 4: More recent examples of Social Network Visualizations using node and edge diagrams. It is interesting to note that all these diagrams still use nodes and edges. The difference here is new algorithms are used to position and group nodes and new techniques are used to draw curved edges.

A variety of representations have been created for different purposes. The node has been used to represent different people, locations, postings, networks, etc. Social networks can be separated in three different types of relationships depending on the type of data used and what information needs to be presented.

1) One-to-one relationship – visualization of conversations between two people
2) One-to-many relationships (sometimes refer to ego-centric or personal social network) – visualization of conversations focused on one person and people that are connected to that one person
3) Many-to-many relationships – visualization of many people having conversations

In my research, Bubba Talk falls in category 3, many-to-many relationships and CrystalChat visualizes one-to-many relationships, category 2. The majority of Social Network visualizations represent a large number of entities, showing many-to-many relationships. Here, the social information from one person is present but detailed information of one person's relationships and connections with others can get lost in the many cases shown, when the visualization is based on the entire social community.

With the availability of new social software and data, researchers are trying to find new ways of visualizing social data. The exploration of new abstract representations has become very popular not only in the field of social visualization, but also in Information Visualization and Human Computer Interaction (Karahalios and Viégas, 2006). The next section presents a more recent overview of the variety of social data and visual representations used for social visualization.

2.2 Visualizations of Digital Communication

Over the past few years, there has been an increasing amount of social data sets available due to the increasing amount of software that is available for textual communication. The availability of this data has increased the number of inventions for new visualizations. I have created a second timeline to display several examples of social visualizations starting from 1995. These visualizations are placed, to the best of my ability, under the year the project was published online. Figure 2.5 provides an overview of social visualizations grouped in categories that are indicated by different colours. Since the images in this overview are of necessity small, I also provided additional Figures of each group and then more Figures are added to subsequently show the detailed images for some categories so that the details of the visualizations and its descriptions are easier to view. I choose to present this survey in this visual manner so that variations of visualizations can be compared. The names of each category are listed below respectively from least-related to most-related to my work: (I will also be discussing each one in this order)

1) **Audio and Video** grouping contains visualizations of audio and video data. This is at the bottom of Figure 2.5 and is on the background colour blue-green and the details are shown in Figure 2.6a and Figure 2.6b
2) **Wikipedias' visualizations** group is second to the bottom in Figure 2.5 and is on the background colour grey shown in Figure 2.7
3) **Text Documents** group contains examples of the visualization of the content of text documents and is on the background colour orange shown in Figure 2.8a and the details are shown in Figure 2.8b
4) **Online Dating** group is on the background colour pink shown in Figure 2.9
5) **Blogs** group is on the background colour blue shown in Figure 2.10
6) **Email** group is on the background colour green shown in Figure 2.11a and the details are shown in Figure 2.11b
7) **Online Chat** group is on the background colour yellow shown in Figure 2.12 and has four subgroups:
    a. **Chat rooms** subgroup is on a transparent purple colour laid on top of the yellow background colour shown in Figure 2.13a and the details are shown in Figure 2.13b
    b. **Message-board** subgroup is on a transparent pink colour laid on top of the yellow background colour shown in Figure 2.14
    c. **Instant Messaging** subgroup is on a transparent blue colour laid on top of the yellow background colour shown in Figure 2.15

d. **Others** subgroup are visualizations that does not belong in 7 a, b, or c but are still online chats. These lie on the background yellow shown in Figure 2.16

8) **Real-time Typing** group is on the background colour purple shown in Figure 2.17

9) **Transcribed Text** group is on the background colour light blue shown in Figure 2.18.

Figures starting from 2.6 to 2.18 are sections of categories taken from Figure 2.5. Some of these figures are also separated into a and b to provide a larger view of each visualization. I have also included in my own visualizations, Bubba Talk, Plant Post, CrystalChat, and KeyStrokes in Timeline 2 to show where my work lies in relation to other works.

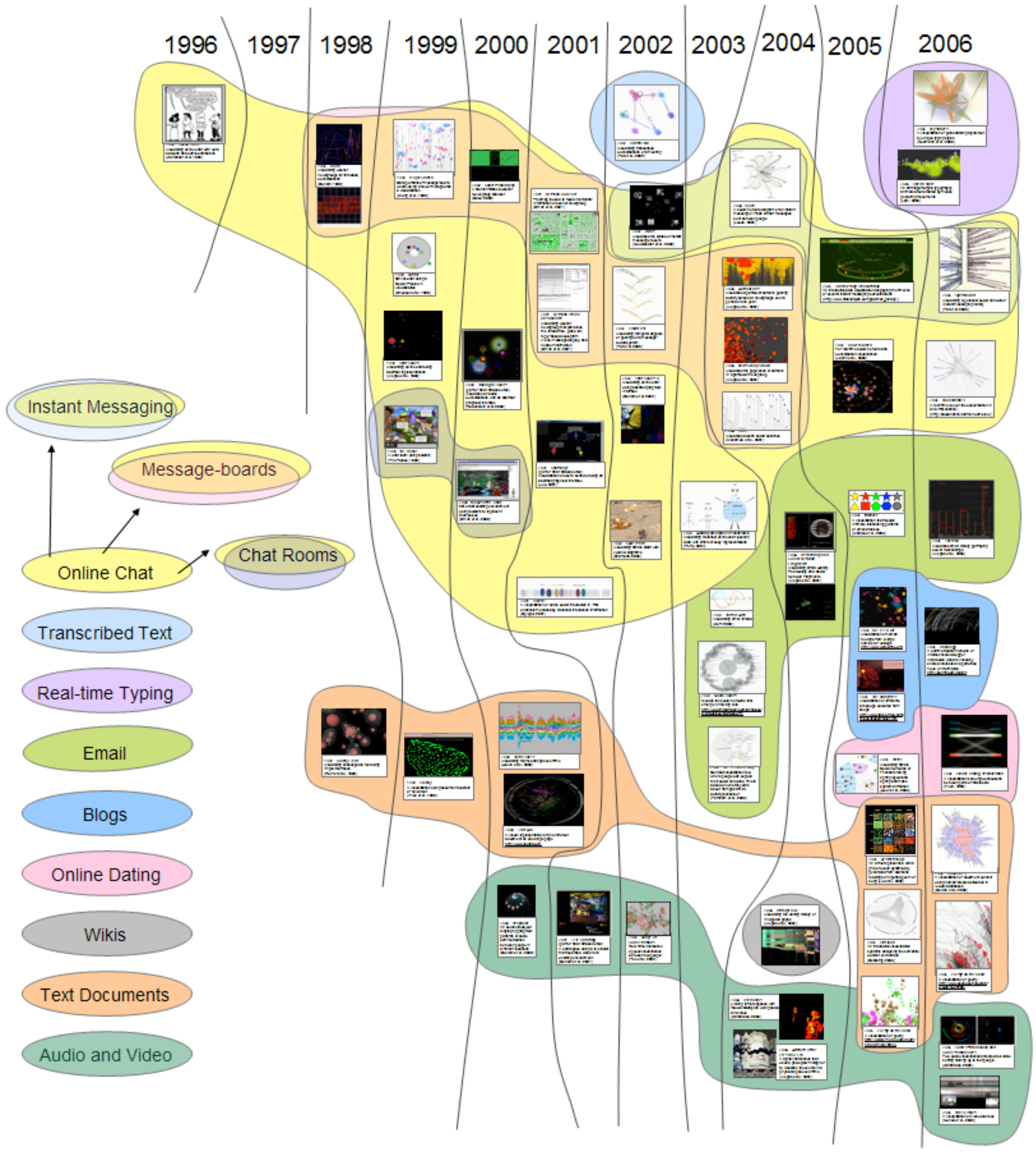


Figure 2.5: Timeline 2: Examples of Digital Communication Visualization. After the year 2002, there has been an increasing number in the creation of various social visualizations for the different categories of data available. (Look at Figures from 2.6 to 2.18 for a close up view of each of these categories)

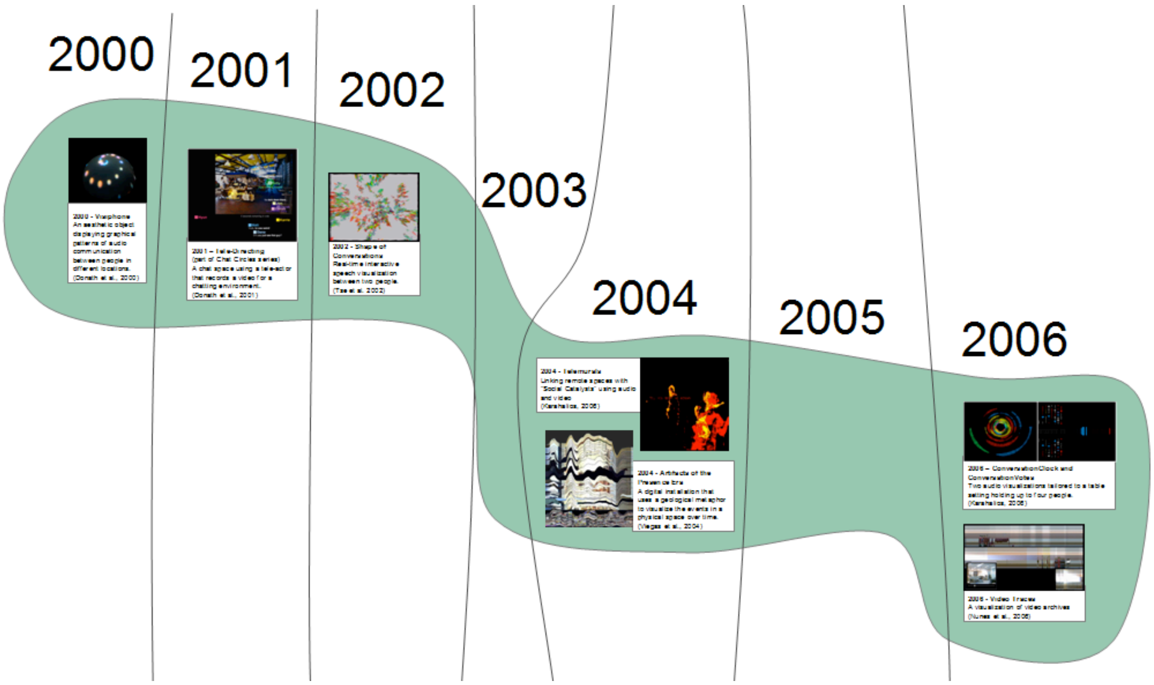
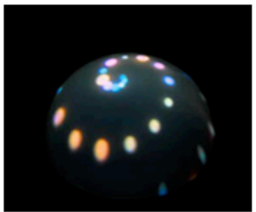
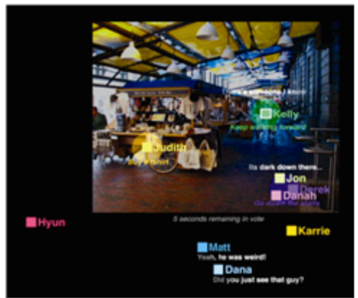


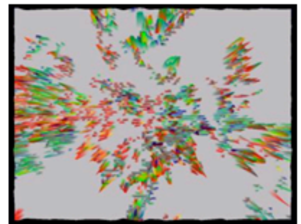
Figure 2.6a: Visualizations of Audio and Video Communication. Majority of these work were created in the MIT Lab and displayed in an art exhibition. (Look at Figure 2.6b for a close up view of each of these visualizations)



2000 - Visiphone
An aesthetic object displaying graphical patterns of audio communication between people in different locations.
(Donath et al., 2000)

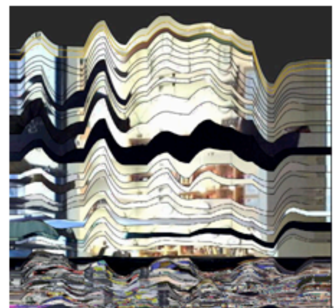


2001 – Tele-Directing
(part of Chat Circles series)
A chat space using a tele-actor that records a video for a chatting environment.
(Donath et al., 2001)

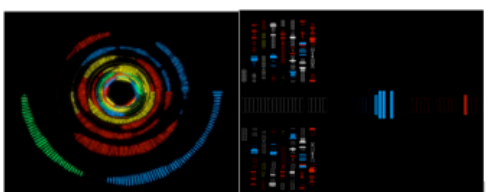


2002 - Shape of Conversations
Real-time interactive speech visualization between two people.
(Tse et al. 2002)

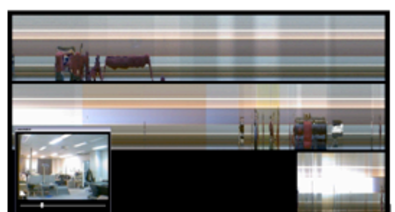
2004 - Telemurals
Linking remote spaces with “Social Catalysts” using audio and video
(Karahalios, 2006)



2004 - Artifacts of the Presence Era
A digital installation that uses a geological metaphor to visualize the events in a physical space over time.
(Viegas et al., 2004)



2006 – ConversationClock and ConversationVotes
Two audio visualizations tailored to a table setting holding up to four people.
(Karahalios, 2006)



2006 - Video Traces
A visualization of video archives
(Nunes et al., 2006)

Figure 2.6b: Visualizations of Audio and Video Communication in details from Figure 2.6a.

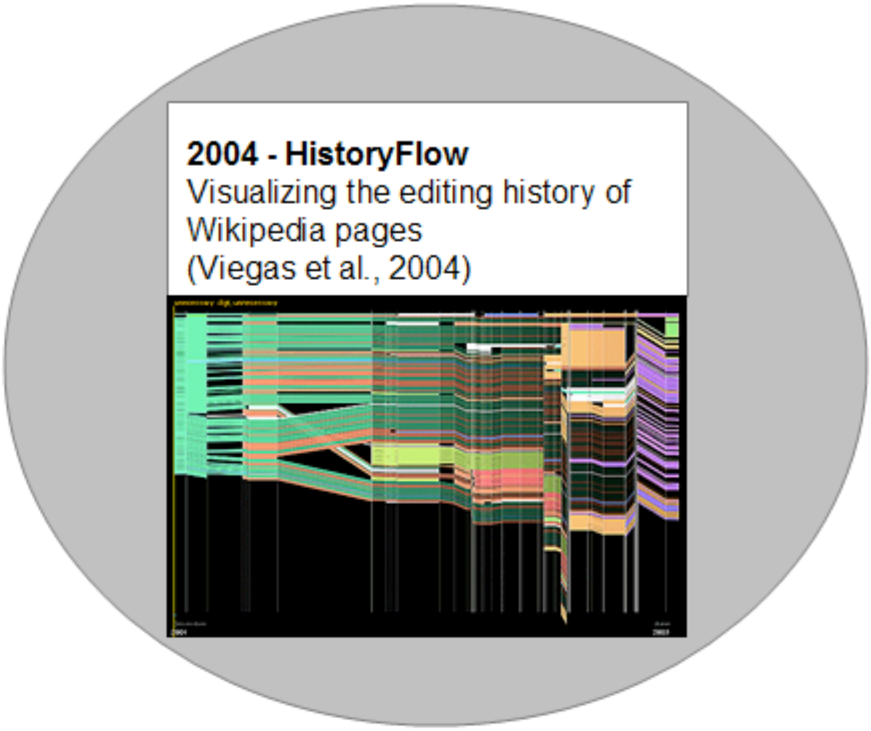


Figure 2.7: A Visualization of Wikipedia pages. Wikipedia is still fairly new and there have not yet been much visualization for this particular data. I am interested in how they have used this horizontal layout to represent time, similar to ThemeRiver (Figure 2.8b) and Artifacts of the Presence Era (Figure 2.6b)

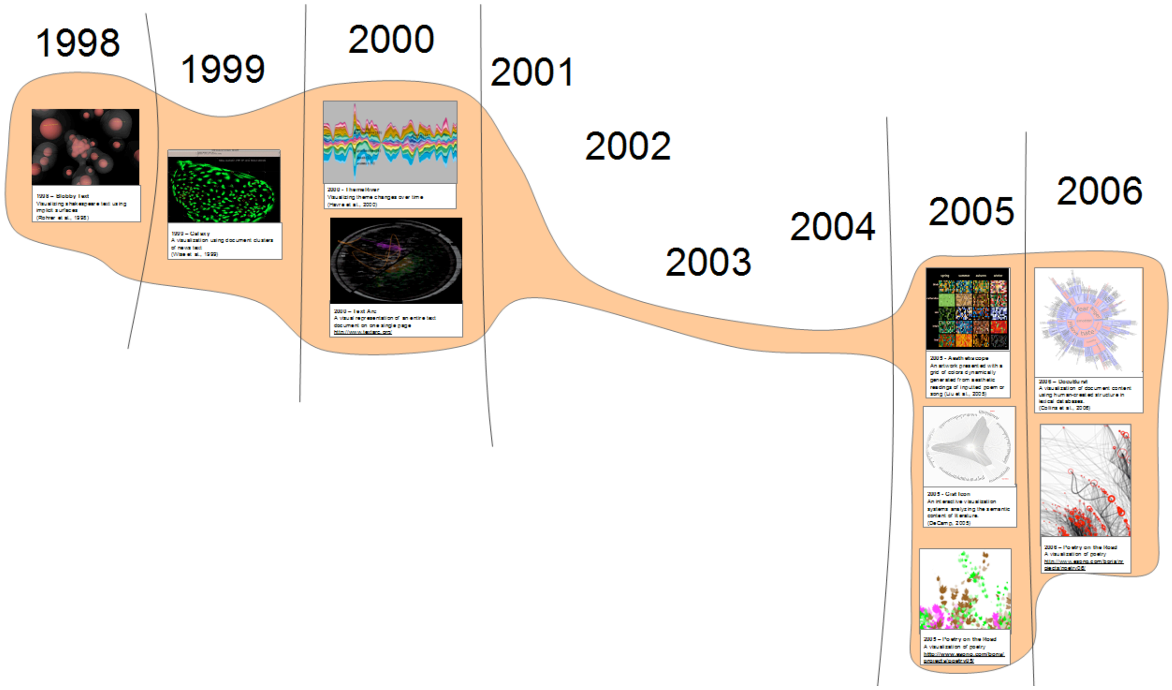
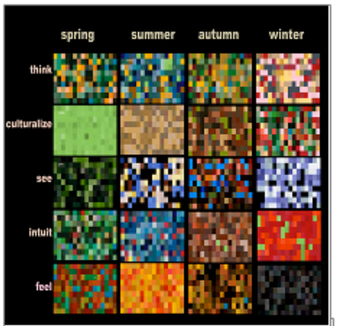
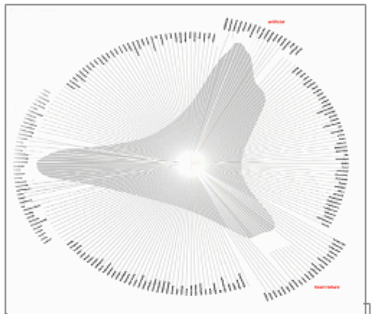


Figure 2.8a: Visualizations of Text Documents. A variety of interesting visualizations have been created to represent large sets of documents and the content of one particular document. (Look at Figure 2.8b for a close up view of each of these visualizations)

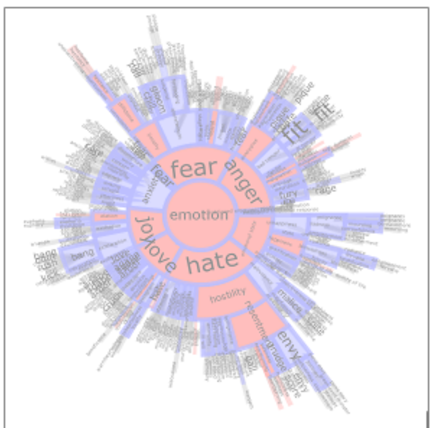


2005 - Aesthetiscope
An artwork presented with a grid of colors dynamically generated from aesthetic readings of inputted poem or song (Liu et al., 2005)

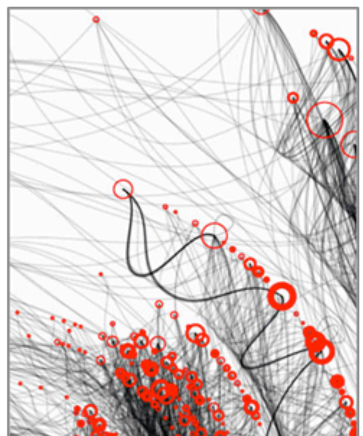


2005 - Gist Icon
An interactive visualization systems analyzing the semantic content of literature.
(DeCamp, 2005)

2005 – Poetry on the Road
A visualization of poetry
http://www.esono.com/boris/projects/poetry05/



2006 – DocuBurst
A visualization of document content using human-created structure in lexical databases.
(Collins et al., 2006)



2006 – Poetry on the Road
A visualization of poetry
http://www.esono.com/boris/projects/poetry06/

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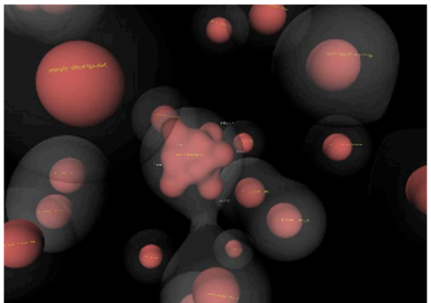
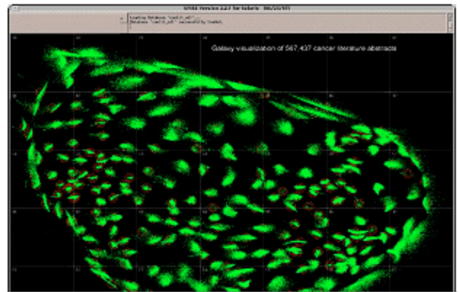
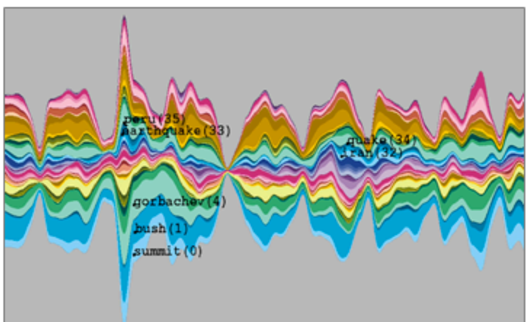


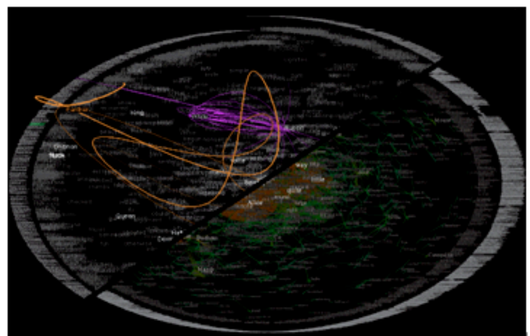
1998 – Blobby Text
Visualizing shakespeare text using implicit surfaces
(Rohrer et al., 1998)



1999 – Galaxy
A visualization using document clusters of news text
(Wise et al., 1999)



2000 - ThemeRiver
Visualizing theme changes over time
(Havre et al., 2000)



2000 – Text Arc
A visual representation of an entire text document on one single page
http://www.textarc.org/

Figure 2.8b: Visualizations of Text Documents in details from Figure 2.8a. These visualizations are looking more organic compared to social network images in the earlier years.

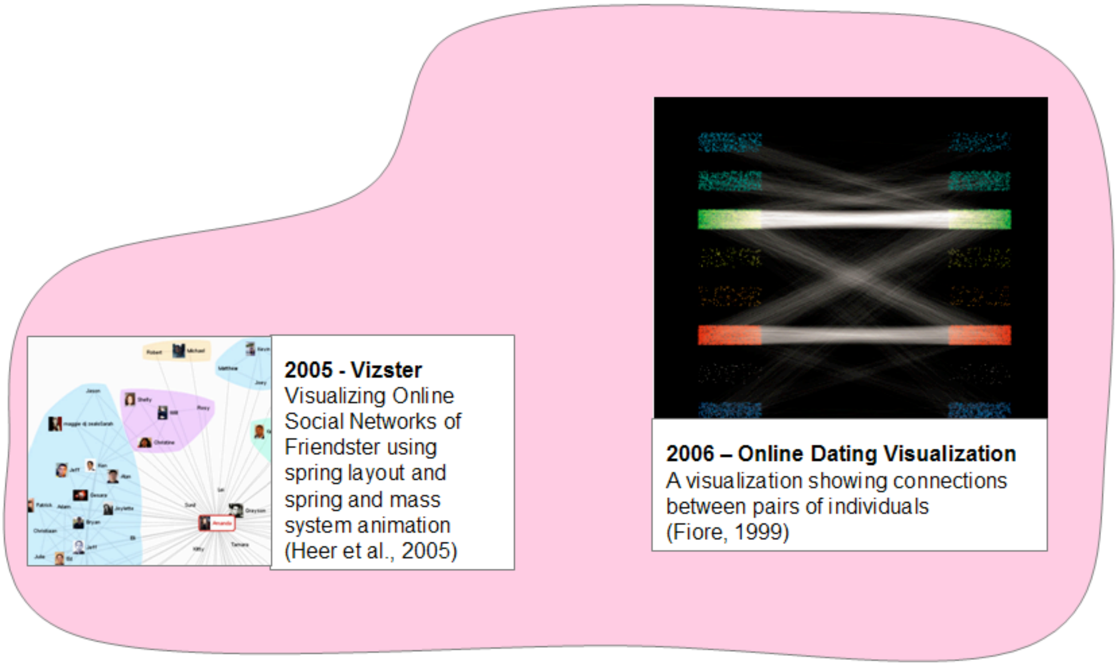


Figure 2.8b: Figure 2.9: Visualizations of Online Dating. Vizster can also be categorized in Online Chat and is also in Timeline 1 (Figure 2.4). I place Vizster in this particular category because Friendster is also considered as an online dating network and I wanted to compare this social network visualization with the Online Dating Visualization on the right. Both of these Visualizations use both nodes and lines, but the visualization on the right have nodes arranged in columns and rows to categorize the entities, which is different from the other social networks shown in Timeline 1 (Figure 2.4).

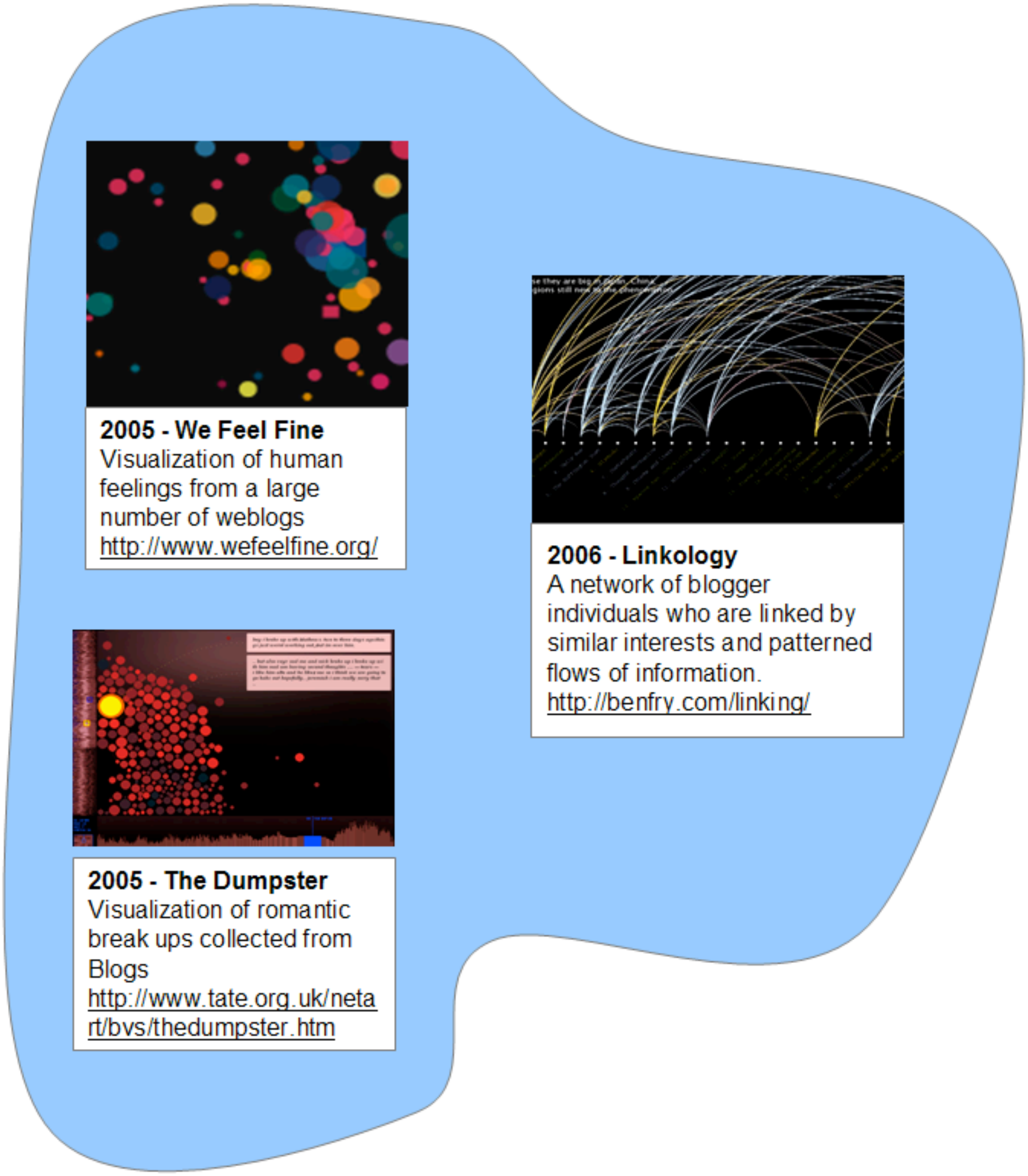


Figure 2.10: Visualizations of Blogs. We Feel Fine and Dumpster are online visualizations with visually appealing graphics and animations, which have attracted many people. Linkology, on the other hand, has no animation but gives more information of the connection between individual bloggers.

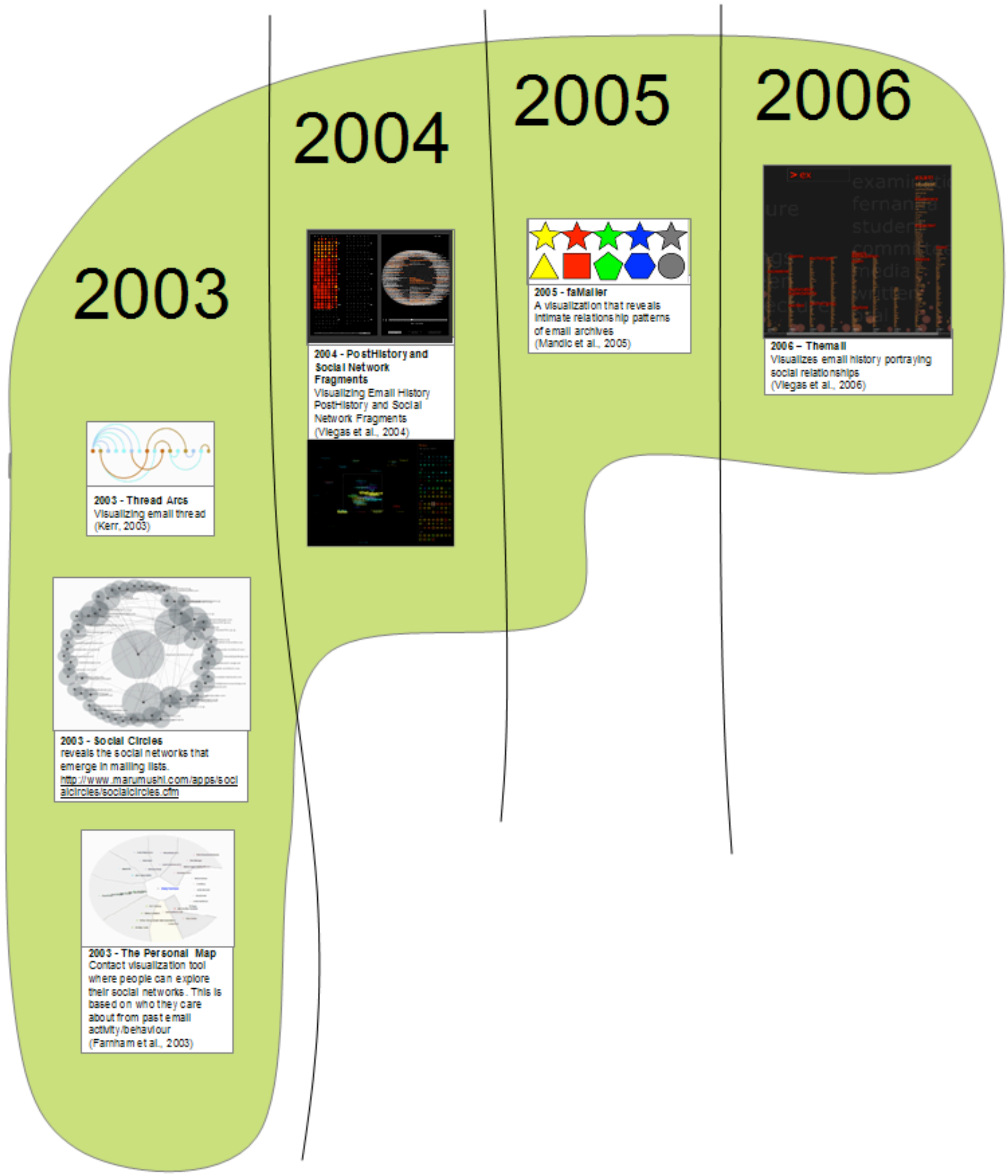
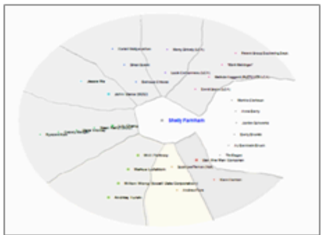
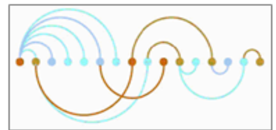


Figure 2.11a: Visualizations of Email. A variety of interesting 2D graphical visualizations are being explored. (Look at Figure 2.11b for a close up view of each of these visualizations)

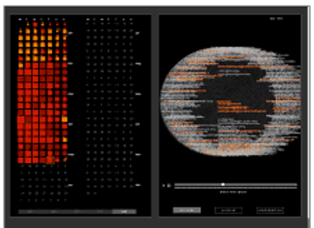


2003 - The Personal Map
Contact visualization tool where people can explore their social networks. This is based on who they care about from past email activity/behaviour (Farnham et al., 2003)

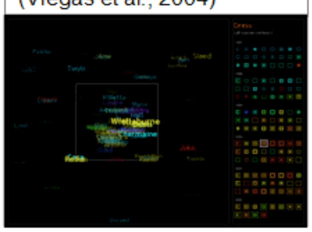
2003 - Social Circles
reveals the social networks that emerge in mailing lists.
http://www.marumushi.com/apps/socialcircles/socialcircles.cfm



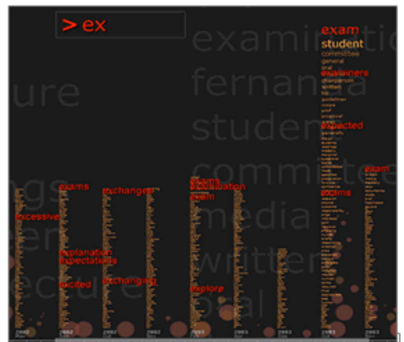
2003 - Thread Arcs
Visualizing email thread (Kerr, 2003)



2004 - PostHistory and Social Network Fragments
Visualizing Email History PostHistory and Social Network Fragments (Viegas et al., 2004)



2005 - faMailer
A visualization that reveals intimate relationship patterns of email archives (Mandic et al., 2005)



2006 – Themail
Visualizes email history portraying social relationships (Viegas et al., 2006)

Figure 2.11b: Visualizations of Email in details from Figure 2.11a

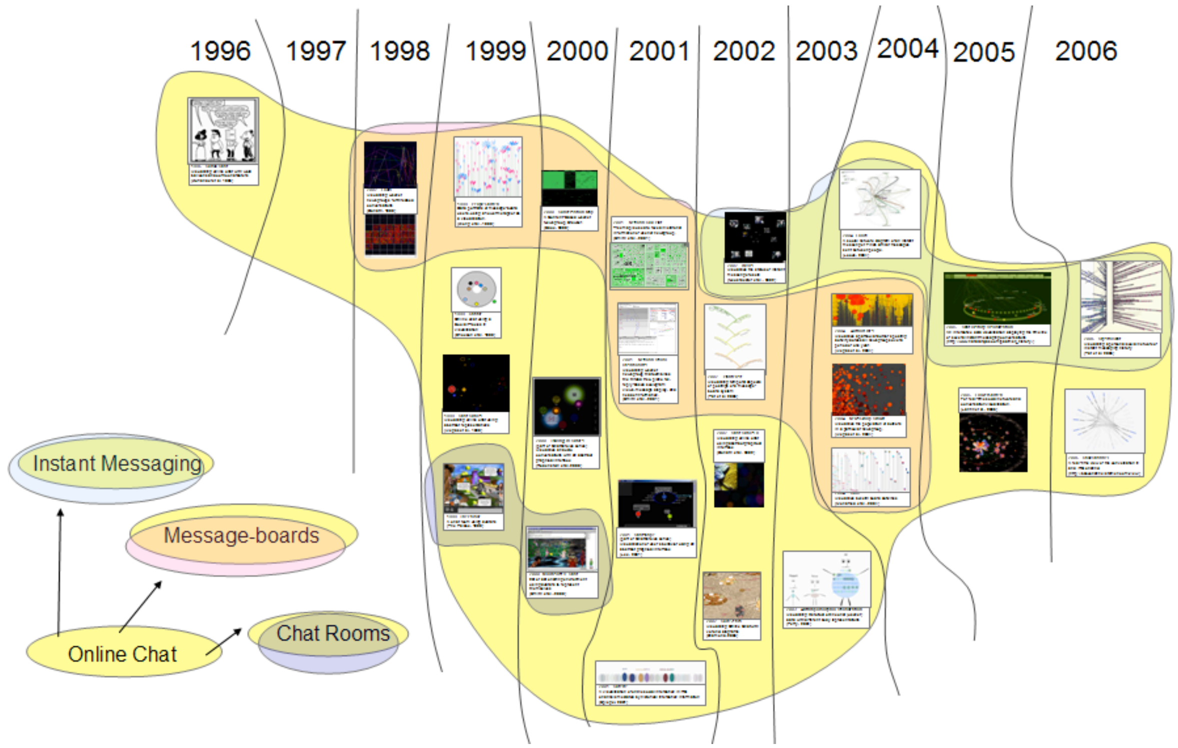


Figure 2.12: Visualizations of Online Chat. Online Chat Visualization started in 1996 with Comic Chat (Kurlander, Skelly and Salesin, 1996). An increasing number of online chat visualizations were created, starting 1999.

Figure 2.13: Visualizations of Chat Rooms. Both of these visualizations uses avatars in a virtual world and require extra work on part of using typing the message to make gestures and to express themselves. While adding extra features for the user to express and gesture in chat communication is important, studies shows that these additional options were seldom employed by non-novice users (Smith, Farnham and Drucker, 2000).

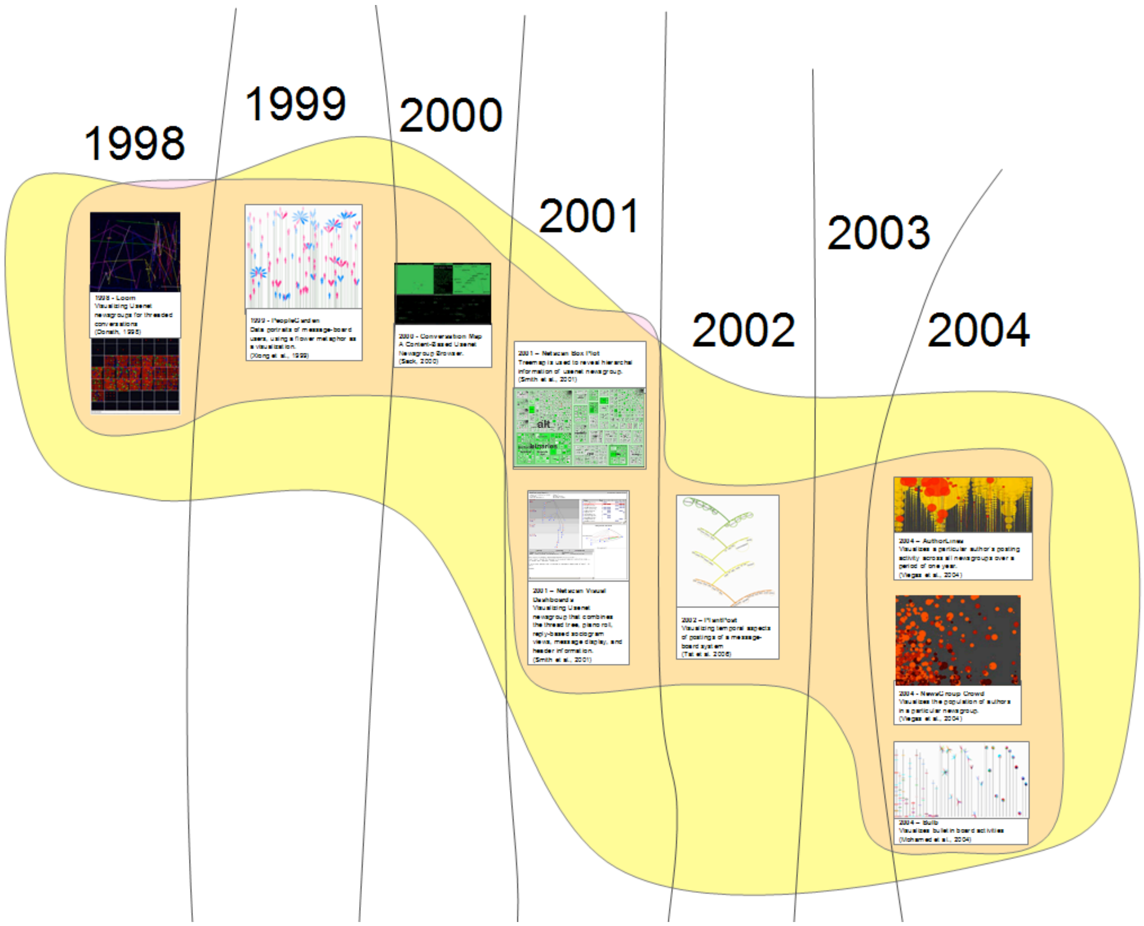
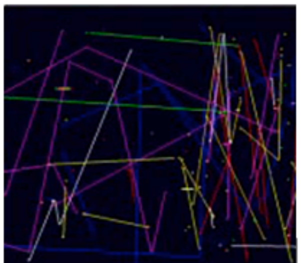
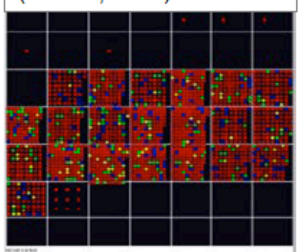
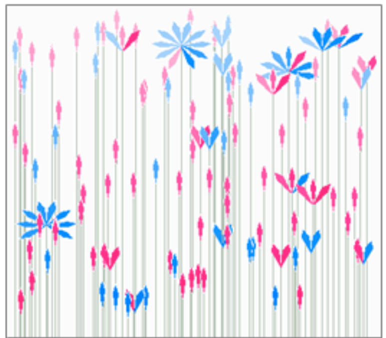


Figure 2.14a: Visualizations of Message-board Systems. It is interesting to note that three of the images such as PeopleGarden, Plant Post and the Bulb used a plant metaphor to give representation of a message posting. (Look at Figure 2.14b for a close up view of each of these visualizations)

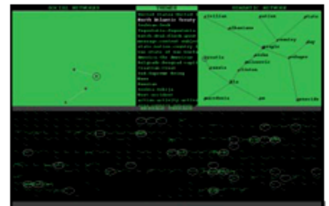


2002 - Loom
Visualizing Usenet newsgroups for threaded conversations
(Donath, 1998)

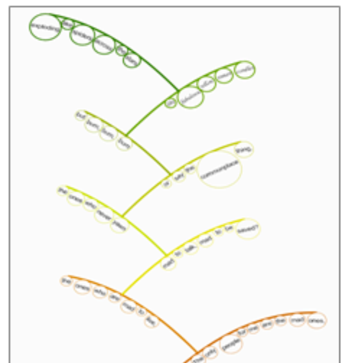




1999 - PeopleGarden
Data portraits of message-board users, using a flower metaphor as a visualization.
(Xiong et al., 1999)

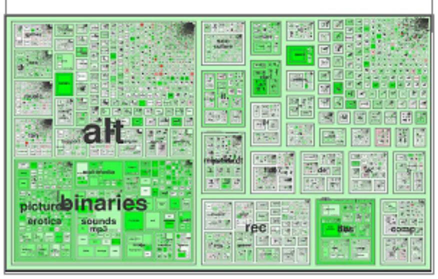


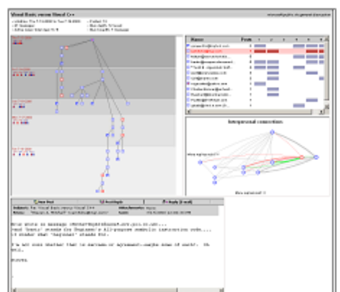
2000 - Conversation Map
A Content-Based Usenet Newsgroup Browser.
(Sack, 2000)



2002 – PlantPost
Visualizing temporal aspects of postings of a message-board system
(Tat et al. 2006)

2001 – Netscan Box Plot
Treemap is used to reveal hierarchical information of usenet newsgroup.
(Smith et al., 2001)

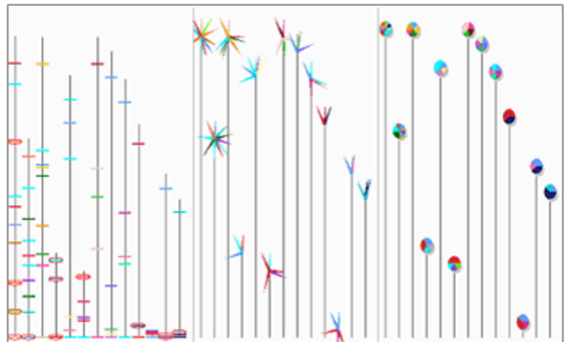




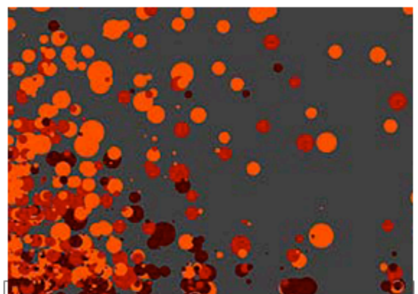
2001 – Netscan Visual Dashboards
Visualizing Usenet newsgroup that combines the thread tree, piano roll, reply-based sociogram views, message display, and header information.
(Smith et al., 2001)

Continues on next page

2004 – AuthorLines
Visualizes a particular author's posting activity across all newsgroups over a period of one year. (Viegas et al., 2004)



2004 – Bulb
Visualizes bulletin board activities (Mohamed et al., 2004)



2004 - NewsGroup Crowd
Visualizes the population of authors in a particular newsgroup. (Viegas et al., 2004)

Figure 2.14b: Visualizations of Message-board Systems in details from Figure 2.14a.

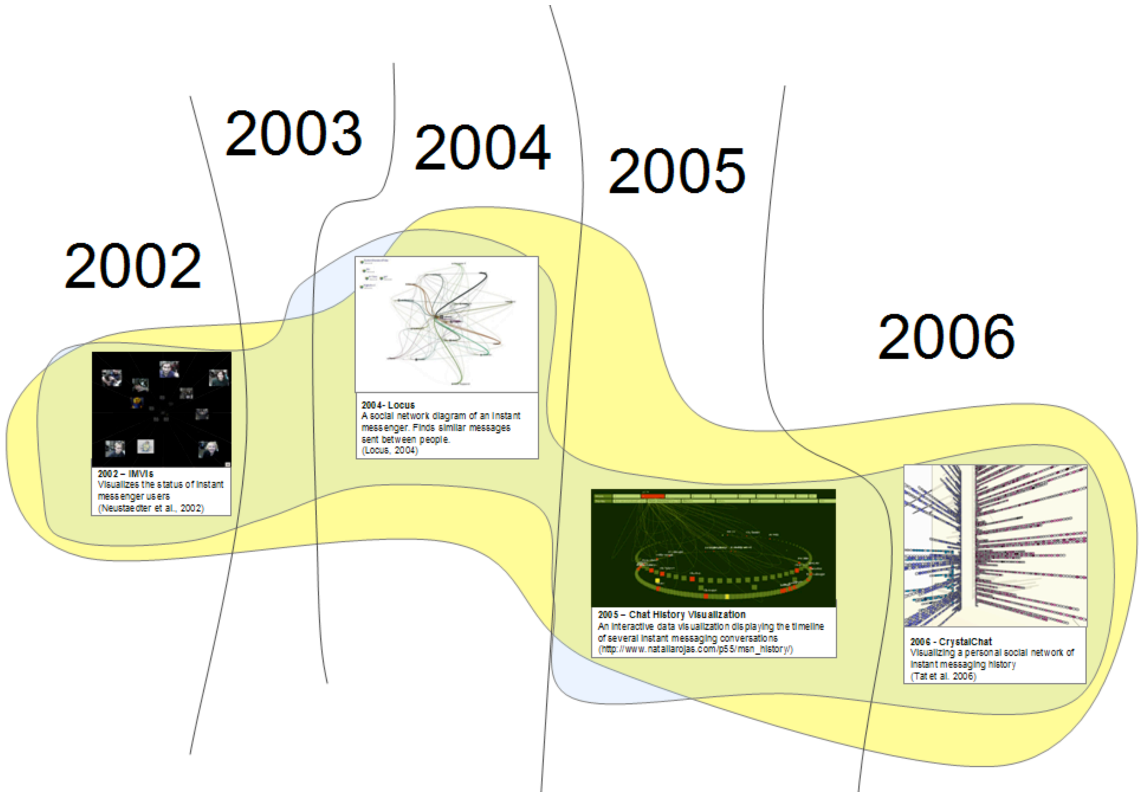
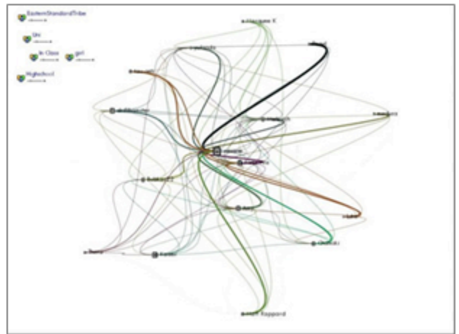
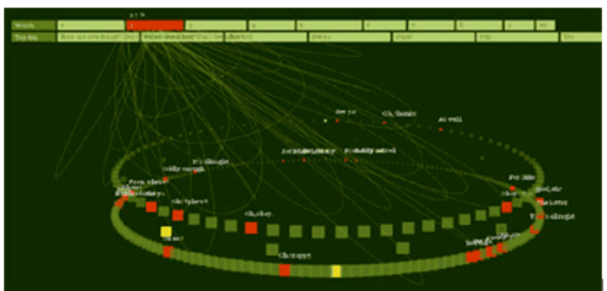


Figure 2.15a: Visualizations of Instant Messaging. 3D graphical representations for Social Visualization are being explored to represent time. (Look at Figure 2.13b for a close up view of each of these visualizations)

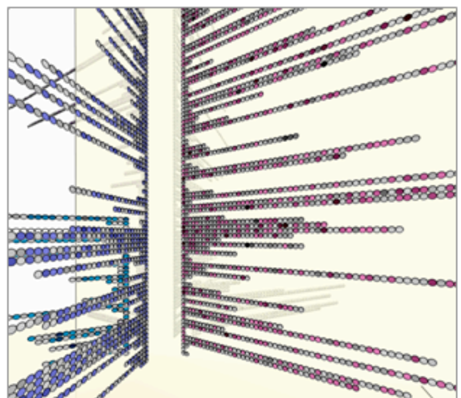


2004- Locus
A social network diagram of an instant messenger. Finds similar messages sent between people.
(Locus, 2004)

2002 – IMVis
Visualizes the status of instant messenger users
(Neustaedter et al., 2002)



2005 – Chat History Visualization
An interactive data visualization displaying the timeline of several instant messaging conversations
(http://www.nataliarojas.com/p55/msn_history/)



2006 - CrystalChat
Visualizing a personal social network of instant messaging history
(Tat et al. 2006)

Figure 2.15b: Visualizations of Instant Messaging in detail from Figure 2.13a.

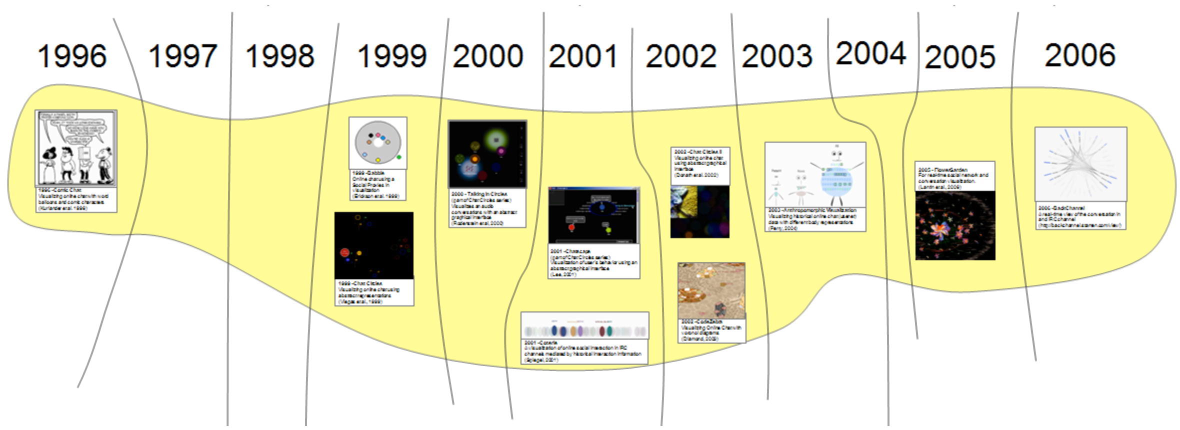
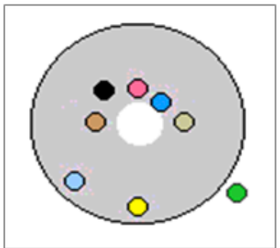
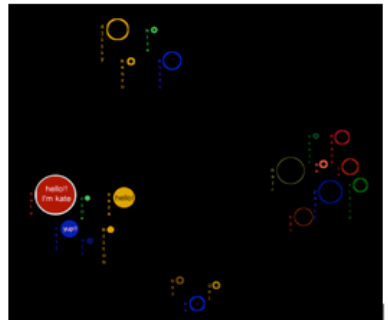


Figure 2.16a: Visualizations of Other Online Chat Systems. The entities in these visualizations are presented in a smaller scale compared to most of the social networks visualizations shown in Timeline 1. Erickson makes an interesting point about social visualization with scalability, “Ambiguity is useful: suggest rather than inform.” (Erickson, 2003) It has been proven that users can make an overall impression of what is happening with a focus on small amounts of activities.

1996 - Comic Chat
Visualizing online chat with word balloons and comic characters
(Kurlander et al. 1996)



1999 - Babble
Online chat using a Social Proxies in visualization
(Erickson et al. 1999)



1999 - Chat Circles
Visualizing online chat using abstract representations
(Viegas et al., 1999)

2000 - Talking in Circles
(part of Chat Circles series)
Visualizes an audio conversations with an abstract graphical interface
(Rodenstein et al, 2000)

2001 - Chatscape
(part of Chat Circles series)
Visualization of user's behavior using an abstract graphical interface
(Lee, 2001)

2001 - Coterie
A visualization of online social interaction in IRC channels mediated by historical interaction information
(Spiegel, 2001)

Continues on next page

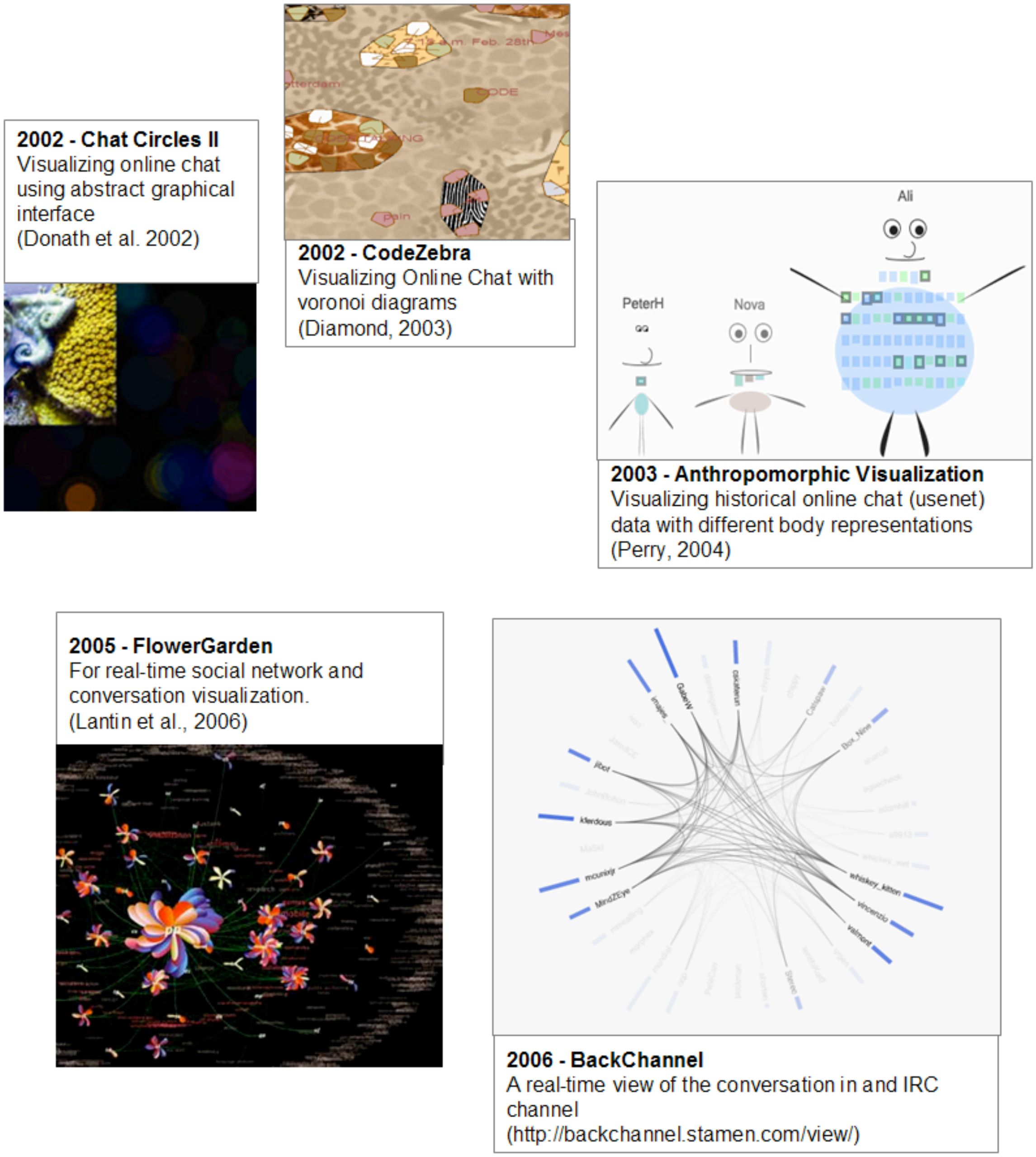


Figure 2.16b: Visualizations of other Online Chat Systems in details from Figure 2.16a.

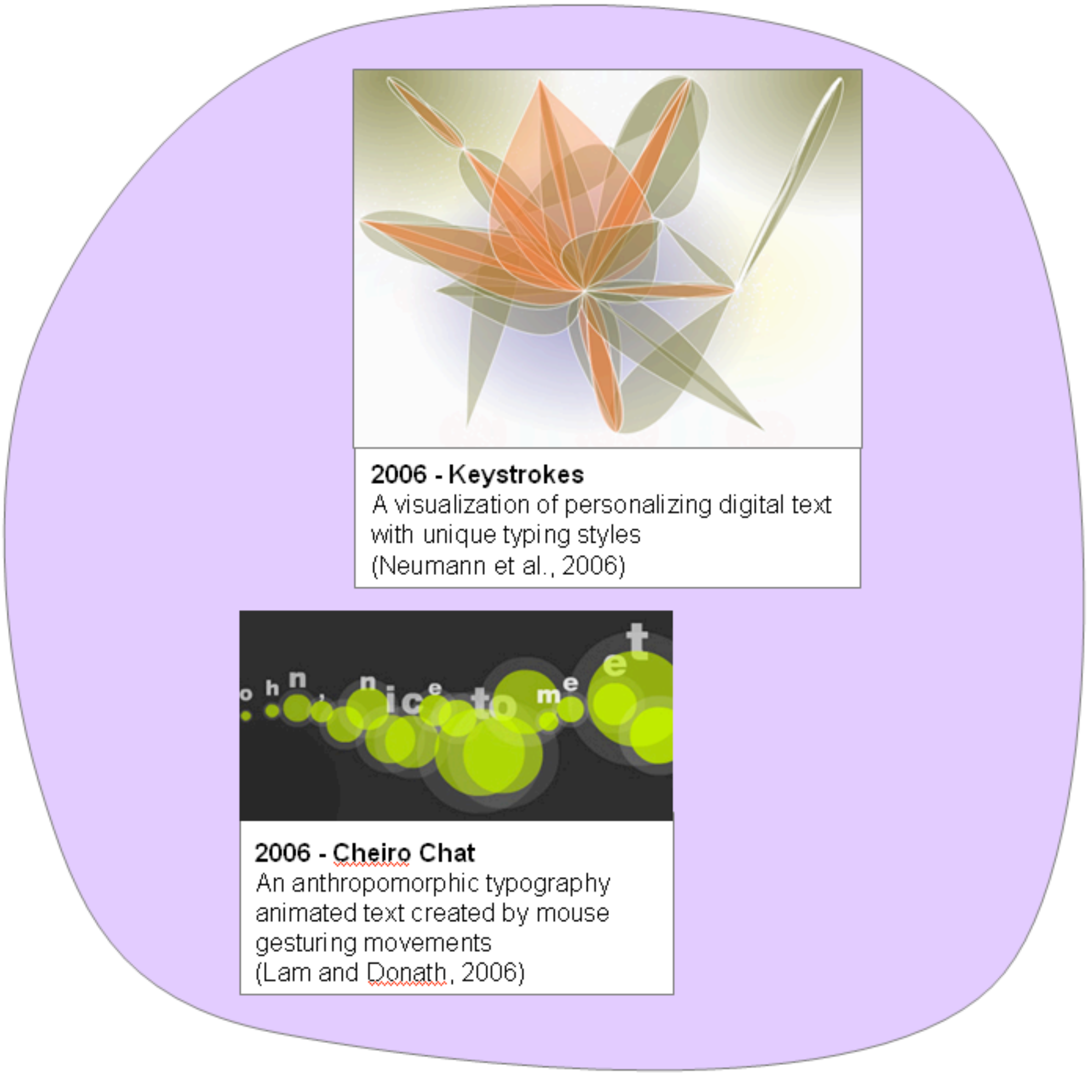


Figure 2.17: Visualizations of Real-time Typing. The aesthetics and animation of both these visualizations have raised the interest of many people.

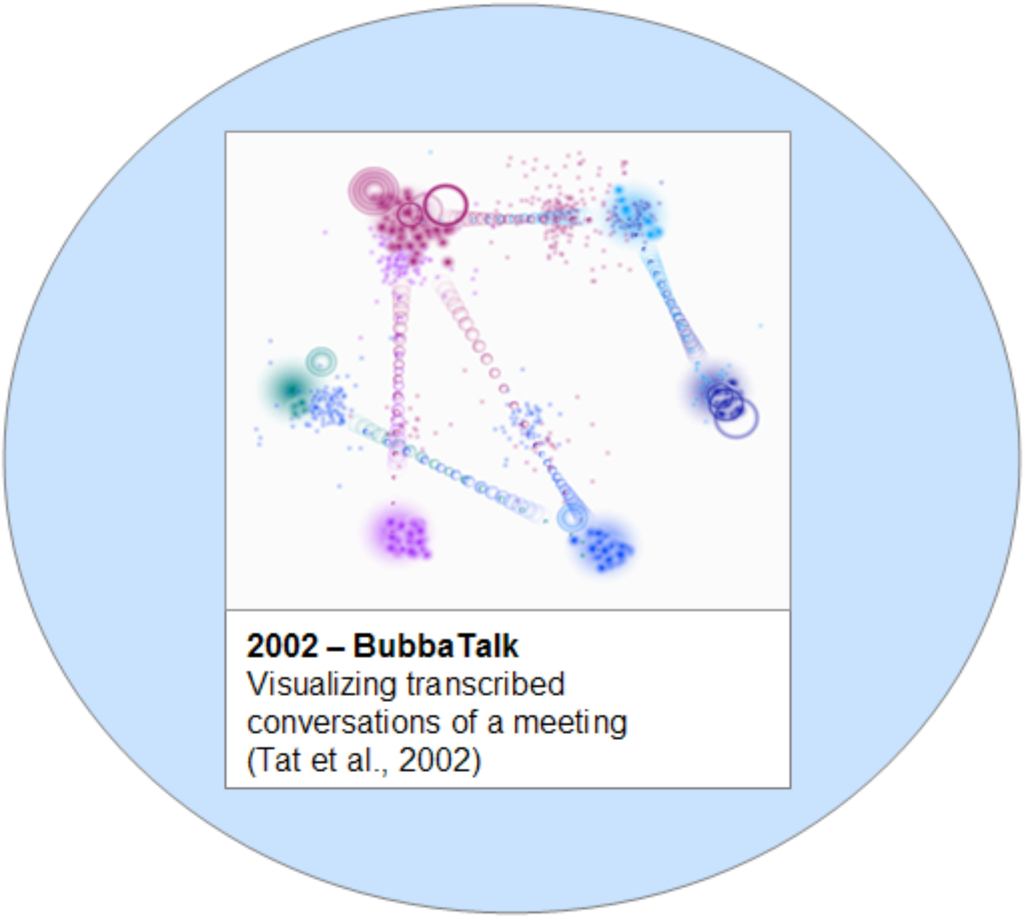


Figure 2.18: A Visualization of Transcribed Text. A small scale of entities with animation is visualized to capture the spirit of the conversation.

Most chat spaces are primarily text-based, though some graphic symbols that represent each person are often included. Several 2D and 3D chatting environments such as The Palace (1999) and Microsoft V-Chat (Smith et al., 2000) (Figure 2.15) use avatars to represent the users. Comic Chat (Kurlander, Skelly and Salesin, 1996) (Figure 2.16) augments text space by providing tools to support the use of some aspects of comic strips such as word balloons and comic characters. These programs allow each person to represent themselves with avatars or comic characters through the use of simple expressions and gestures. One of the problems with this type of representation is that it can be misleading since expressions are predefined. Another problem is all these augmentations require effort on the part of the user to express emotion. While this presentation is charming, most people still opt for the simplicity and speed of text entry.

For this thesis, I am not interested in representational style of avatars and comics but rather, the fact that these support the incorporation of emotional information into the delivery of messages.

It is my intention to explore the creation of abstract visualizations, thus, it is interesting to see the different use of abstract representations to visualize the many types of social software available. Timeline 2 displays social visualization examples of email, blogs, online dating, wiki, and audio/video conversations. It is interesting to see that almost all of these visualizations are in a 2D form. Also, a majority of these visualizations uses curves, circles, colour and proximity for representations. Particularly relating to my research, I discuss the abstract representation of online chat (including instant messaging systems, messaging board systems and chat room) in more detail. Chat Circles I, II and Series (Donath and Viegas, 2002) (Figure 2.16b) provide an abstract visual system in which the chat takes place. In Chat Circles, each individual is represented as a circle which expands to hold their message's text. In order to 'hear' or see the words of another's posting, the circle must be close to the others. Social groupings form and adjust spatially, indicating who is listening to whom. Another abstract visualization is the Babble System (Erickson, Smith, Kellogg, Laff, Richards and Bradner, 1999) which is a chat system that allows the history of users' presence and activities during an online conversation. A visualization designed to accomplish this is called "the cookie" (Figure 2.16b). The Cookie represents users as coloured dots on a larger circle and the proximity of the dots indicate how recently users were involved in the conversation. The closer to the center of the circle a particular dot is, the more recent the user was involved. As mentioned in Section 2.1, social network visualizations of online communication often use some form of graph structure in which the nodes represent entities and edges represent relationships between entities with many interesting and different representations. Thread Arcs (Kerr, 2003) as one example, shows a representation where each node (circles in this case) represents an email message and each edge shows the relations between email messages. What is different about this visualization compared to the majority of the social network visualizations mentioned in Section 2.1 is that the nodes are arranged horizontally and the edges are drawn with arcs (Figure 2.11b). Another social network visualization example that uses nodes and edges, is a work created by Fiore (2006) which represents romantic relationships between two individuals. This social visualization is also presented slightly different due to the arrangement of the nodes that is similar to one of Freeman's example (Figure 2.1) where females are arranged on one side and males are arranged on the other side. What is unique and interesting about this visualization is that each column has rows to categorize each sex, for example whether they are single, married, divorced, etc. PostHistory and Social Network Fragments (SNF) (Viégas, 2004) are two visualizations that reveals email history. PostHistory displays one person's direct interactions with their email contacts and SNF represents multiple people's relationships with each other. Both of these visualizations use representations different from nodes and edges. In both of these visualizations, the type of relationship they have with the central person is indicated by colour and the strength of their relationship is denoted by font size. While both visualizations report that the central person found meaning in these representations, they can become complex and cluttered thus, hard to decipher.

There exist a number of different text-based conversation visualizations, but only a minority of them focuses on the temporal aspects. In the next section of this chapter, I discuss the related works that look at the temporal data of online chat conversations.

2.3 Social and Temporal Visualizations

There are several ways of presenting temporal data and a common approach is to use timelines. These timelines make intervals, patterns, and repetitions of series of events more visible. For example, LifeLines (Plaisant et al., 1996) is a timeline that visualizes personal histories. This interface begins with a single screen overview and then allows the user to focus on details upon request with rescaling and filtering tools provided. The Babble System (Erickson and Laff, 2001) also uses a horizontal timeline to represent temporal social activity. Each user is represented by a different coloured row. The positioning of the vertical lines indicates the time at which a particular message was entered. Chat Circles (Viégas, 1999) uses vertical timelines, where each vertical line represents a user and the placement of each horizontal bar on the line indicates when a message was typed. As time progresses, the vertical lines grow downward. One of my projects, CrystalChat uses both a vertical and horizontal display to represent different portion of temporal data in chat history.

The visualization of temporal social data can also be taken from a different approach by using a metaphoric representation. ThemeRiver (Havre et al., 2000) uses a river metaphor to visualize thematic variations over time and across a collection of documents. The river flows through time, and the width of the river at any node in time reflects the thematic correlation of documents that are temporally collocated. The horizontal flow of the river can be navigated by panning horizontally both left and right. This similar representation of time also appears in Artifacts of the Presence Era (Viégas et al., 2004) and Baby Voyager (Wattenberg, 2005). PeopleGarden (Xiong and Donath, 1999) and BULB (Mohamed et al., 2004) uses a flower to represent data portraits for each user. In PeopleGarden, each flower represents a person and each pedal represents a posting. Here time is reflected for each individual but not for the message itself. My project, Plant Post (described in detail in Chapter 2, Section 2.2) is a visualization to represent several temporal aspects of data of postings in a message-board system. Similar to PeopleGarden, Plant Post also uses a plant to metaphorically represent temporal data. However, the difference is that Plant Post visualizes the temporal aspects of each posting and not for each person.

There are many visual systems that have considered social activity, social networks, and the temporal aspects in one system. However, these components are either shown in separate screens or in two visualizations. For example, both Chat Circles and Babble have included visualizations of social activities and timelines, but in two separate visualizations. The work that is most related to CrystalChat is the side by side visualizations of PostHistory and SNF; however, they are still in separate windows or screens. With multiple screens, the user would have to learn to relate the two graphical representations to see a pattern. One can lose one's point of reference when switching from one visualization interface to another. Their studies reveal that visualizing personal email habits supports personal narration and recall.

It might be possible to say that Mutton's (Mutton, 2004) visualizations combine the temporal and social data in one visualization, however, this visualization only provides minimal evidence of temporality by fading the visualization as time passes. As time progresses eventually old parts of the graph will disappear. On the other hand, CrystalChat is a visualization that combines the social network and the temporal aspect into one 3D structure. All the social information remains and does not disappear with time, so that people can go back in time to view the conversations history.

2.4 Summary

Social visualizations have become increasingly popular due to both the increasing amount of social software (data) available and because the visualization of this data has been proven to be useful in revealing social patterns. Social Network visualization has been used for many years mostly because of its success in the showing patterns and connections between people. However, there are limitations in which the common node and edge representations do not reveal enough social information. For this reason, new types of visualizations are being created; some use avatars and comic characters to allow users to express emotional content. However, limitations to this style of representation have led to more abstract styles of representation.

My work for this thesis focuses on exploring abstract representations for social visualization, emotional content and temporal social data. While there are researchers who are exploring and creating abstract visualizations, there is little that explores the combination of presenting both the temporal and social data of textual conversation in a single representation within a visualization.

Chapter 3. Patterns of Social Connections and Quantities

In my goal to create visualizations that can enrich digital conversations and reveal patterns in social interaction, my first step is creating Bubba Talk, a visualization of transcribed conversations. Human dialogue is so complex that definitively analysing patterns of conversation may well be near to impossible. Within a conversation, all the complexities and ambiguities of natural language exist; also, each speaker has his/her own speech characteristics and moods. Examining these characteristics through text-only dialog can be a demanding cognitive task. It is possible that this task can be made more convenient if there is a way of visualising all this information at once through graphical patterns. Graphical patterns can revolve around the conversation, creating an abstract piece of artwork. From these patterns, one may be able to see more readily how a given speaker is connected to another speaker during a conversation. In this chapter, I will discuss the different visualisation techniques that I created to represent several aspects of a conversation, primarily visualizing social patterns. The next chapter describes Plant Post which visualizes the temporal aspects. Then in chapter 5, CrystalChat is introduced, a visualization that integrates both the social and temporal data into one graphical representation.

3.1 Introduction

I created the visualization of Bubba Talk to demonstrate how text listings can be mapped into abstract representations (Tat and Carpendale, 2002). By visualizing the social networks of a transcribed conversation of people in a meeting, patterns of social interactions can be revealed. My intention is to provide a visual impression of the quality or tone within a conversation. While this information may be available by examining these characteristics as they exist in the text dialog, this can be a demanding cognitive task because the whole conversation can not be viewed at once. One would have to inconveniently switch back and forth between postings in order to compare conversational characteristics. This task can be made more convenient and enjoyable if there is a way of visualising all this information at once through graphical patterns. Bubba Talk generates visual patterns from simple conversational elements such as tempo, punctuation and character usage. The graphical patterns, as a result, will revolve around the conversation, contributing to both artistic impression and usability of the interactive space. Figure 3.1 shows the patterns of one conversation.

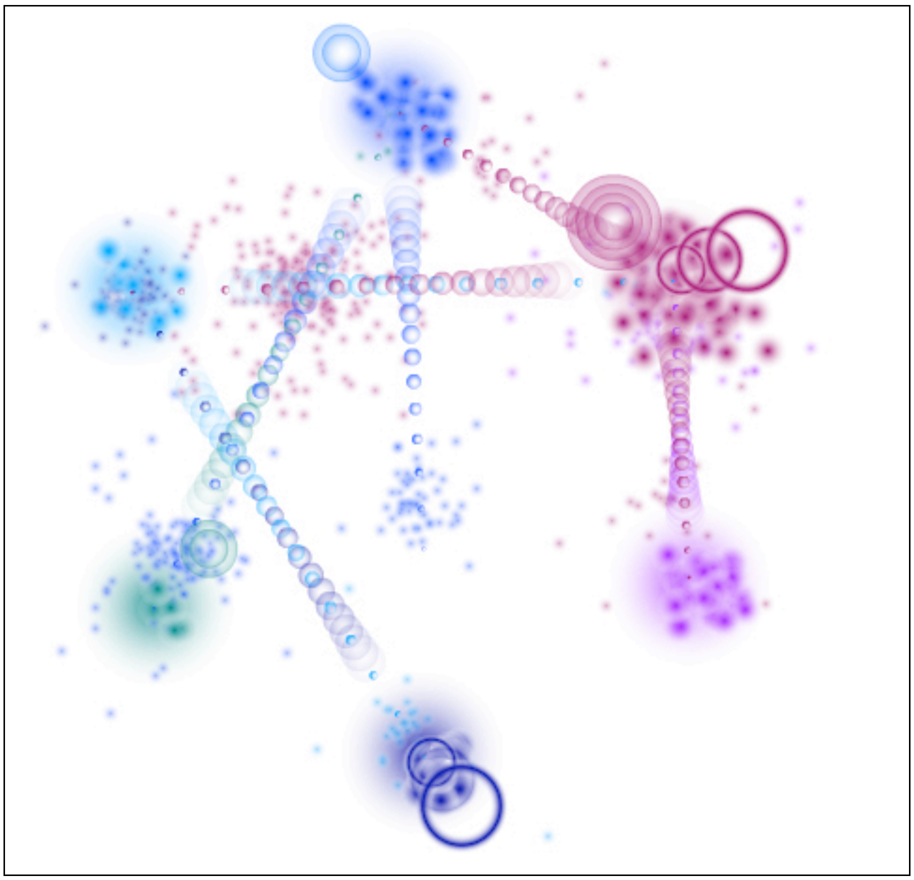


Figure 3.1: Graphical pattern of a conversation

There are several research challenges in this project such as deciding what the data should be based on, retrieving that data from the postings, creating meaningful mappings from the text data into a visual representation, and developing an overall pattern from this mapping while keeping variations in the patterns both distinctive and spatially explicit. Within a conversation, each of us is capable of assimilating subtle nuances of the spoken word to develop our own understanding. Many of the conversational subtleties that enrich our communications are lost during typed communications. People have resorted to using capitals (CAPS), punctuation, and emoticons to make their text messages more expressive.

3.2 The Approach

Bubba Talk currently gathers input data from textual conversations. One of the underlying design principles is to use data that is “for free”, meaning data is obtained with no extra work required on the part of the person creating the conversation or chat posting. This requires exploring data to discover what is inherently available that may contribute to visualization. In Bubba Talk, the focus is on the quantity of words and characters spoken, punctuation used, who talked to whom and how often they talked to that individual.

This visualization is intended to give an impression of the spirit and timbre of the conversation. When one starts to look at the readily parse-able aspects of typed communication, one may realize that there are many options. Initially, I have looked at:

- the response relationship,
- the use of capitals,
- the use of exclamation marks,
- the number of words, and
- the number characters.

Presenting this information together in one visualization first involves deciding about the layout of each individual speaker. In Bubba Talk, speakers are initially laid out in a circle so that connections between each individual can be easily seen (Figure 3.2a). Where as in Figure 3.2b the speakers are not laid out in a circle and as a result, there are overlapping lines and some of the connections are covered. For this reason in Bubba Talk speakers are initially placed in a circle, but if the initial setting is not preferred the viewer has the choice to interactively move the speakers around.

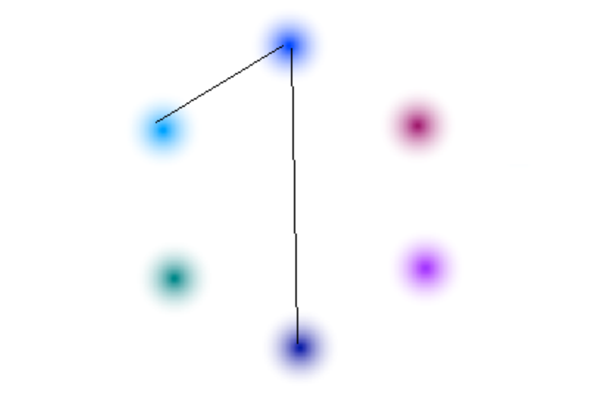


Figure 3.2a: A circular layout of circles with no lines over lapping.

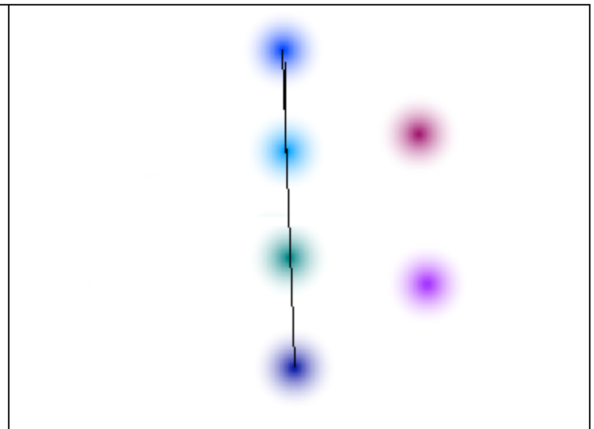


Figure 3.2b: A linear layout of circles with lines over lapping.

Different colours are chosen to distinguish one speaker from another. The colours of each individual were chosen in a manner that creates an overall combination of subtle colours. The same colour is used for all the other aspects of the visualization that relate to the same speaker.

3.2.1 The response relationships

There is a need to present connections between the speakers to see how one speaker responds to another. The direction in which the speaker is talking to whom is important, so a simple line between two speakers will not be sufficient. For example, in Figure 3.3, one can not tell whether speaker one (blue) is talking in response to speaker two (red) or the other way around.

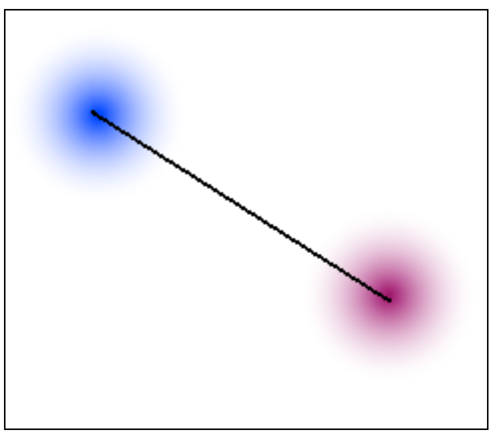


Figure 3.3: A non-directed connection

A simple solution to this problem is to draw an arrow to see the direction of connection, but a simple arrow is not as interesting to look at, thus, another approach is to use animation.

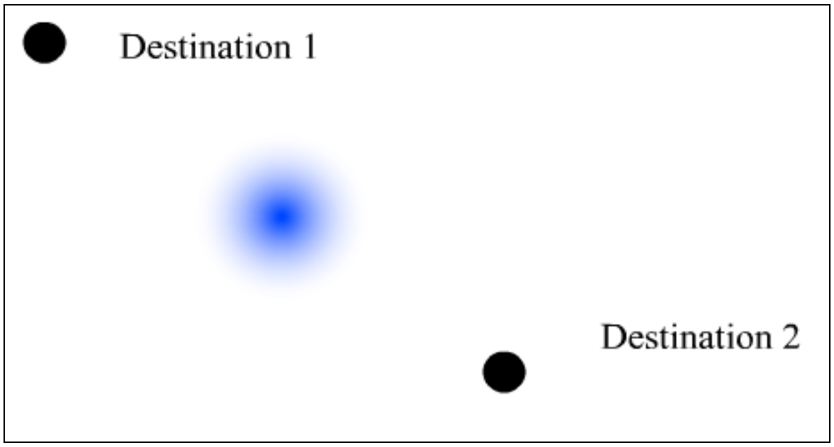


Figure 3.4: Animated connection shows no direction when stopped

Animation is effective in displaying the direction of motion while the object is moving, but once the object stops, the sense of motion is lost. This is shown in Figure 3.4.

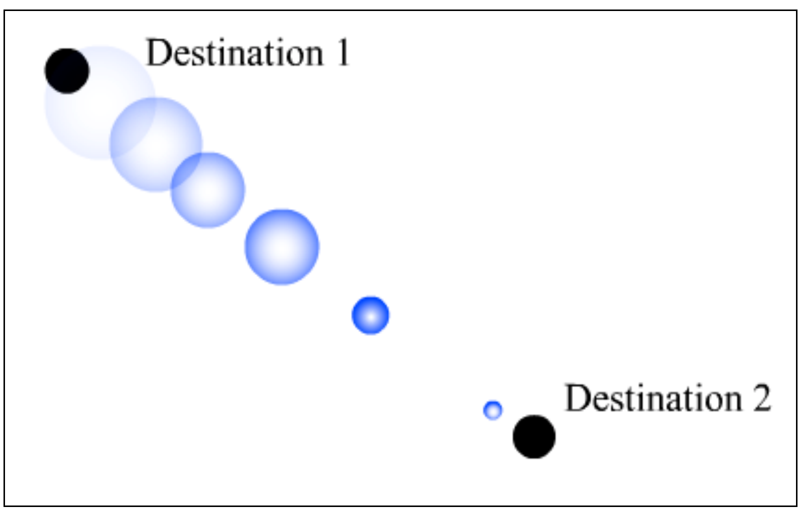


Figure 3.5: Circles of decreasing size indicate direction

For that reason, an additional graphical representation is used to show the order of who is speaking next and who is speaking to whom. The circles become smaller and less faded as they approach the target to emphasize the direction of movement. For example, in Figure 3.5, Destination 1 and 2 are Speakers 1 and 2, respectively. In this case, Speaker 1 will be talking in response to Speaker 2; in other words, Speaker 2 spoke first and then Speaker 1 spoke right after.

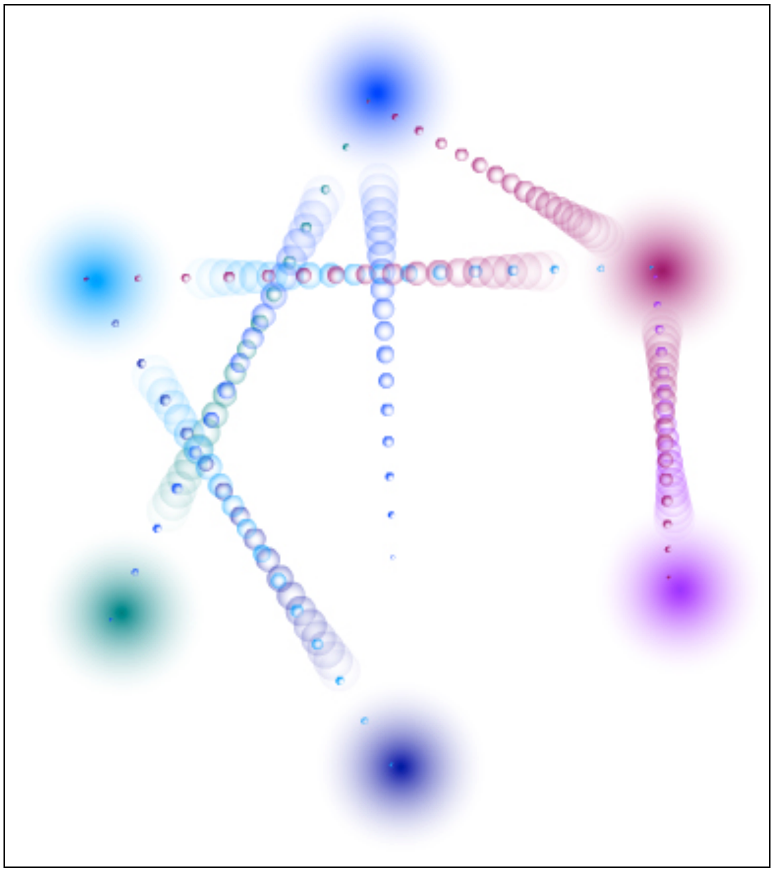


Figure 3.6: The response relationships

Figure 3.6 shows the connections visualization from a conversation between six people. The connection lines are drawn with repeated circles. The larger circles emanate from the speaker and get smaller as they approach the person that is being spoken to. Notice how by this method of directional communication is apparent.

3.2.2 The use of capitals

In online communications repeated use of capitals has come to indicate that speaker is shouting or trying to capture attention. Capitals are also used in the beginning of sentences and used in abbreviations. For this program capitals will only be assumed to indicate yelling and trying to grab someone's attention if they are used repeatedly. Flashing or flickering animation are often used to gain individuals' attention and will be used for this purpose in Bubba Talk. The number of circles represents the number of capitals used (Figure 3.7).

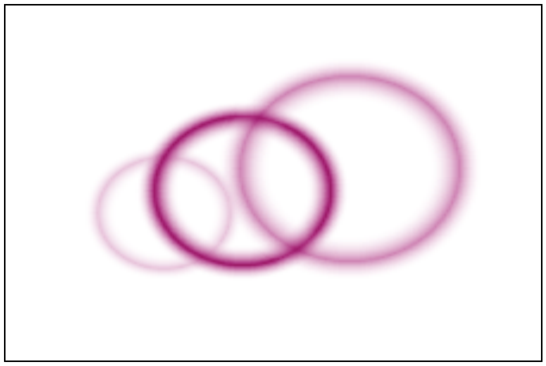


Figure 3.7: The capitals representation vibrates when animated

3.2.3 The use of exclamation marks

Exclamation marks are used to either exaggerate or emphasize a point. Exaggerations are often used in cartoons or animation by enlarging a specific feature of a person or an object. In this case, every time a speaker uses an exclamation mark an animated circle will grow in size. As the speaker uses more exclamation marks, more circles will be created with a size bigger than the previous one (Figure 3.8). Each circle is transparent so the previous circles are not covered. This way the user can see how many exclamation marks there are by counting the number of circles created.

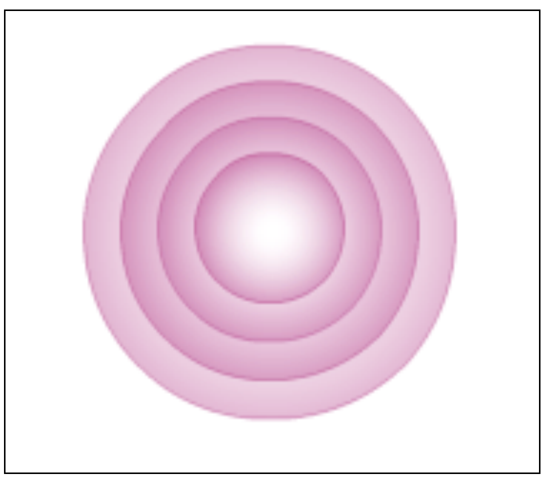


Figure 3.8: Repeated exclamations

3.2.4 The number of words

Each word in the posting is represented by a circle that hovers around the speaker (Figure 3.9). This builds up giving a general impression of quantity of contributions to the conversation.

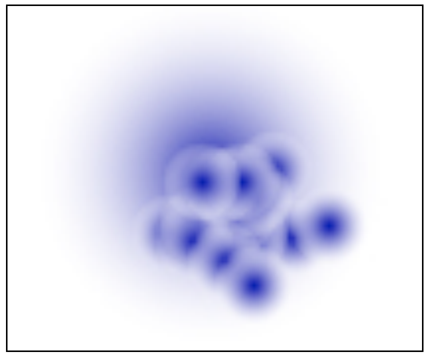


Figure 3.9: The words from one speech hovering around and overlapping with the speaker's representation

3.2.5 The number of characters

Similarly, each character is represented by a smaller circle (a dot). The dots travel from the current speaker to the previous speaker. Character dots disperse slightly so that they can be seen distinctly. Figure 3.10 illustrates the representation of two speakers. The green person spoke a simple utterance; perhaps "hello" since it only has five characters. The blue person had a much lengthier response.

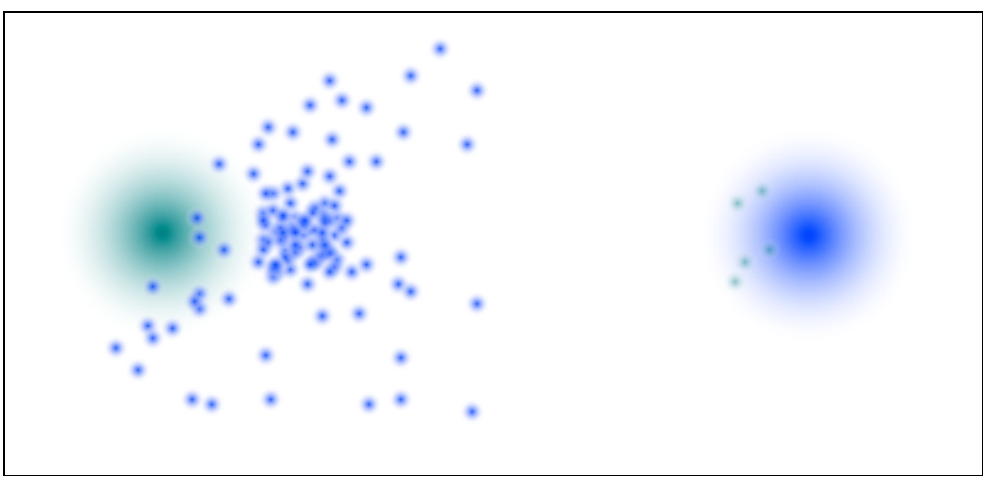


Figure 3.10: Small dots representing the characters travel towards the person to whom they are addressed

The advantage of making the dots equal to the number of characters or words is that a sense of quantity can be distinguished (Figures 3.9 and 3.10).

3.2.6 Motion

Rather than moving particles at a constant speed, physics is required to imitate a realistic motion of an object, travelling from one destination to another. For instance, if a car was moving too fast and does not slow down at a red light, the car will go past the red light. The car would normally have to decelerate as it approaches the red light in order to stop at the appropriate destination. This realistic movement effect can be calculated from Formula [A], so that the object travels only half the remaining distance every time.

Formula [A]

Where we want to go = where we are + ((where we want to go – where we are)/2)

Formula [A] can be applied at every frame so that the object will actually appear to slow down as it approaches the target destination (Figure 3.11). Technically speaking the object will never approach the exact point of the final destination by using this formula because the object travels only half the remaining distance every time. In this case, it will not matter because the distance between where the object is and the final destination will eventually become so small that it will not be visible.

Formula [B]

Where we want to go = where we are + ((where we want to go – where we are)/n)

From formula [B], the variable ***n*** is a measure of how quickly the equation reacts to change. This is a summary of how different values ***n*** can approximate how an object moves.

If $n < 0$, the object will accelerate past target.

If $n = 0.5$ the object will oscillate around target.

If $0.5 < n < 1$ the object accelerates past the target and comes back the other way, then the object will eventually stop at the target after a few bounces.

If $n = 1$ the object will get to the target immediately with no realistic effect.

If $1 < n < 2$ the object will slow down as the particle gets closer to the target.

If $n > 2$ the object will never reach the target.

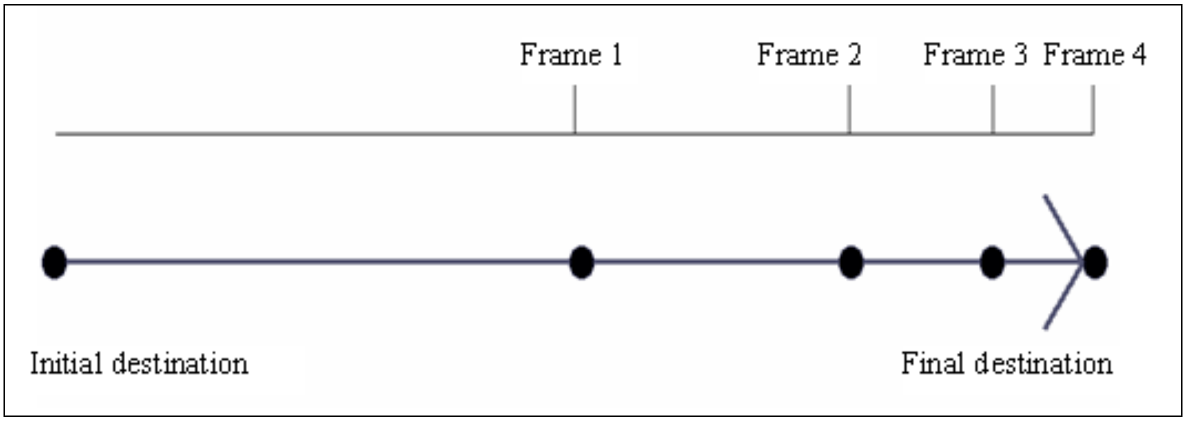


Figure 3.11: Slowing down when approaching a target

This movement effect is useful in moving one object, but if there was more than one object such as in the Bubba Talk, an adjustment to the algorithm will be needed. The problem with using the original formula is that all the duplicated objects will follow the same path so that all the objects will start overlapping one another and will end up appearing as one object. To create a natural movement avoiding too many overlapping dots, a swarming behaviour algorithm is used. A swarm travels as whole to a single destination, but individual swarm members have slightly different destinations. As a result, each individual in the swarm will land slightly to one side of its neighbour as shown in Figure 3.12.

Using formula [B], one can apply this swarm effect by adding a random number to (where we want to go – where we are) and the *n* value will also need to be adjusted to get the right speed movement toward the target. This motion is applied to the character representations and to the word representations. The characters travel as a swarm to their intended destination. The words merely swarm around the person who said them.

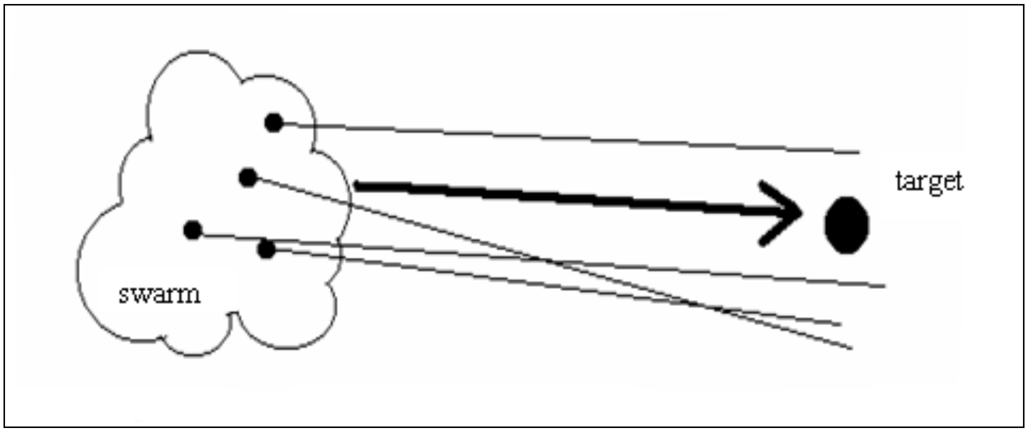


Figure 3.12: Swarm Diagram.

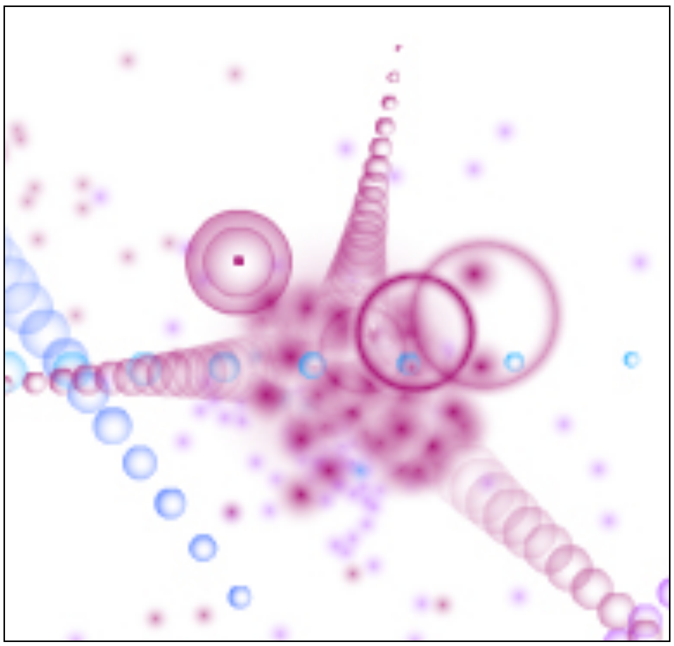


Figure 3.13: One person talking to people all around them gives a general party air.

The dark arrow indicates the principle direction. The lines indicate the directions of individual particles.

3.3 Emerging Patterns of Conversation

The individual components can be viewed as a whole (Figure 3.1) or in any chosen combination. Figure 3.13 shows a close up of one speaker in a conversation. This speaker has spoken to other speakers located in three directions and has used both exclamation marks and a section of all capitals. Figure 3.14a shows the word contributions to this conversation. Figure 3.14b shows the characters and Figure 3.14c shows the use of capitals and exclamation marks. As more individuals start to speak, more patterns will be generated and will eventually clutter the screen. This can be addressed in that part of the conversation fade with time or only a chosen subset of the visualizations to be displayed.

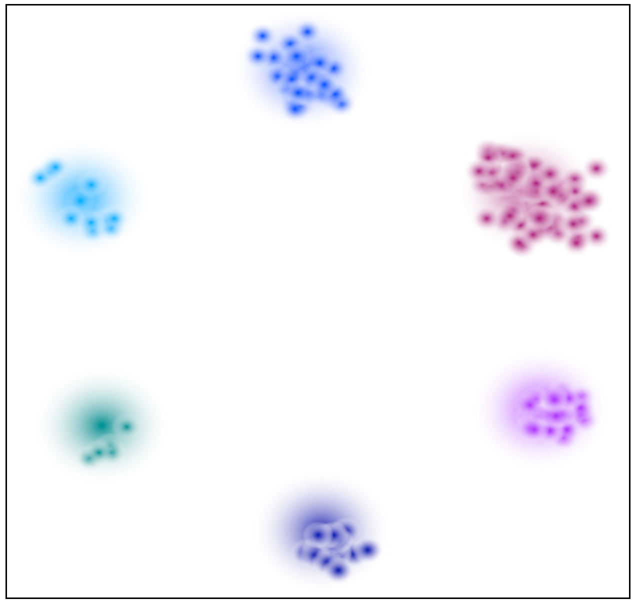


Figure 3.14a: Number of words spoken by each person is represented by the number of circles hovering around each speaker.

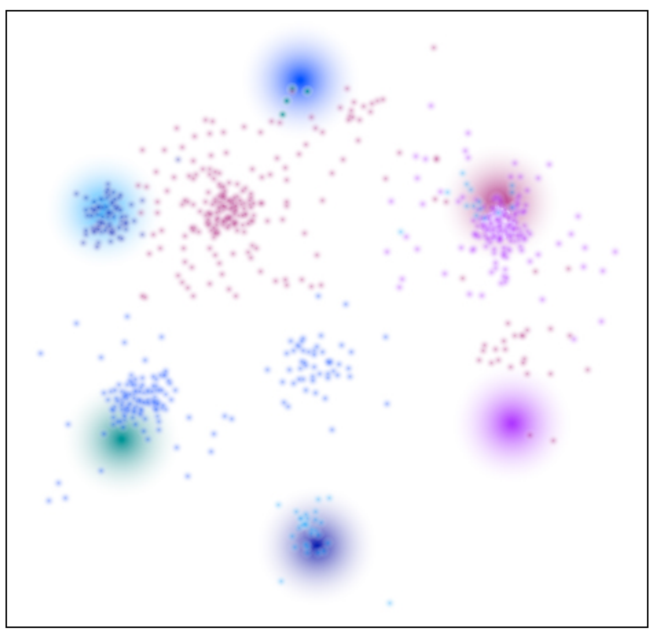


Figure 3.14b: Number of characters spoken by each individual is represented by the number of dots moving away from the speaker.

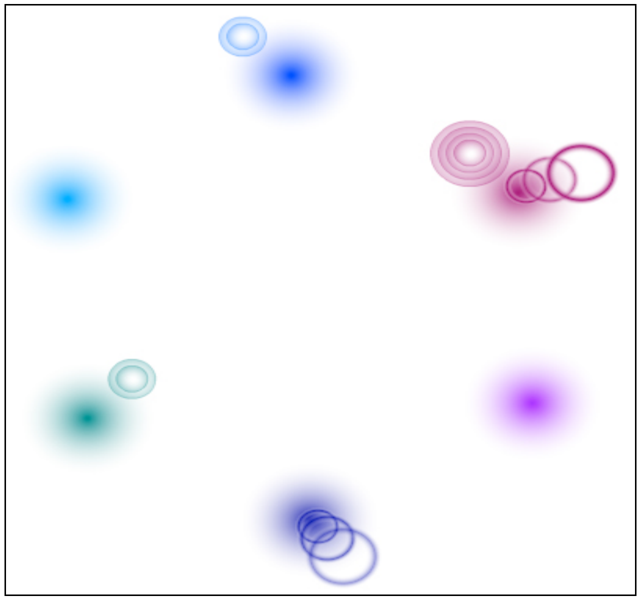


Figure 3.14c: Number of punctuation, such as exclamation marks and CAPS, are represented by numbers of flash and moving circles.

3.4 Implementation

Bubba talk was created with the programming language C++ in conjunction with Macromedia Flash 5.0 using Action Script. I first built a program in C++ to read in the transcribed conversation and to parse the text so that it can return the number of characters, words, exclamation marks, and CAPS for each messages. Then I used, Macromedia Flash, a software application that allowed me to create simple graphics and animation. I also used Action Script which is a scripting programming language embedded in Flash in order to program the motion animation described in Section 3.2.6 .

3.5 Bubba Talk Summary

Bubba Talk has shown that many characteristics of a text conversation can be visualized. From looking at the resulting patterns, one can see each speaker's participation level. Analogous colours and variations on a single shape, the circle, are used exclusively for all the representations. Bubba Talk is created to explore visual ideas for representing human dialog and serves to show how graphical patterns can be used to visualize and reveal certain aspects such as individuals' mood while they are speaking and of the connections between the speakers.

While the sequencing of the conversation is visible during the animation, the temporal ordering of who started the conversation first is lost in the resulting visualization. The next chapter discusses another visualization that explores visual representations for the temporal aspects of typed conversation.

Chapter 4. Revealing Temporal Patterns

In this Chapter, I describe Plant Post, a visualization intended to reveal temporal patterns in digital communications. In Chapter 3, while the sequencing of the communication events is visible in Bubba Talk during the animation, the temporal ordering of who initiated the conversation as well as who spoke after whom is lost in the resulting visualization. To explore visualizing the temporal aspects of digital communication, Plant Post was created to visualize the temporal data of textual postings using different graphical representations.

4.1 Introduction

Plant Post was created working with a colleague, Russell Kruger, in a computer science and visual art course. Plant Post records and visualizes the variety of temporal data that is available from messages posted by people (Tat et al., 2006). Real world conversations are full of informative and enriching temporal cues. For instance, we notice how fast someone speaks or how quickly one person responds to a comment. Similarly, digital text-based conversations also come into existence over time. Many types of temporal information are present in text postings, such as typing speed, response time, etc., but this information tends to get ignored in the simple text list that is commonly displayed as a representation. The addition of visuals in digital text can reveal these temporal characteristics and make conversations more informative and interesting. The temporal data associated with the posting can be made more apparent if it is mapped into a graphical representation. This Chapter describes the design of Plant Post by explaining the data and mapping techniques to create a meaningful visualization for temporal information in digital conversations.

Plant Post is created to visualize a textual conversation for a message-board environment. This message-board environment is similar to the writings on the walls of bathroom stalls: a single user posts a message, and later, other users can reply to the message or start a new conversation. The underlying motivation for our work is twofold. First, we explored the visualization of time in text-based conversation in an attempt to make viewing text-based conversation more graphically informative. Second, we were interested in how nature based metaphors, such as plant growth and decay, can be used to visually express temporal aspects of conversations. In addition, visualizations of word and reading complexity are also incorporated. The Plant Post was an installation displayed in the Nickle Art Museum at the University of Calgary (September 1- 13, 2003), allowing different individuals to interactively post a message one at a time, and to reply to previously posted messages or add in new postings (Figure 4.1 and Figure 4.2). This setup allowed audiences at the exhibition to type in comments about the rest of the exhibition.

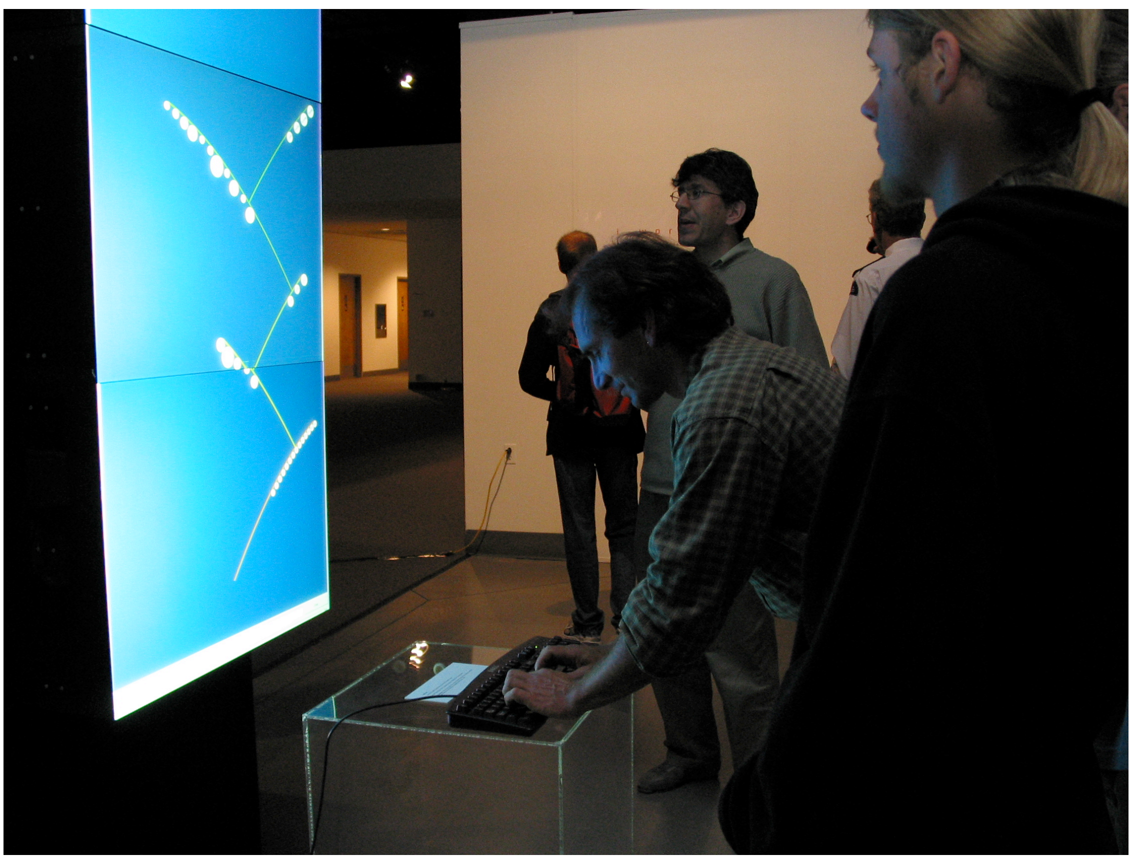


Figure 4.1: Plant Post Installation at the Nickle Art Museum. This set up allowed patrons to type in comments about the art show.

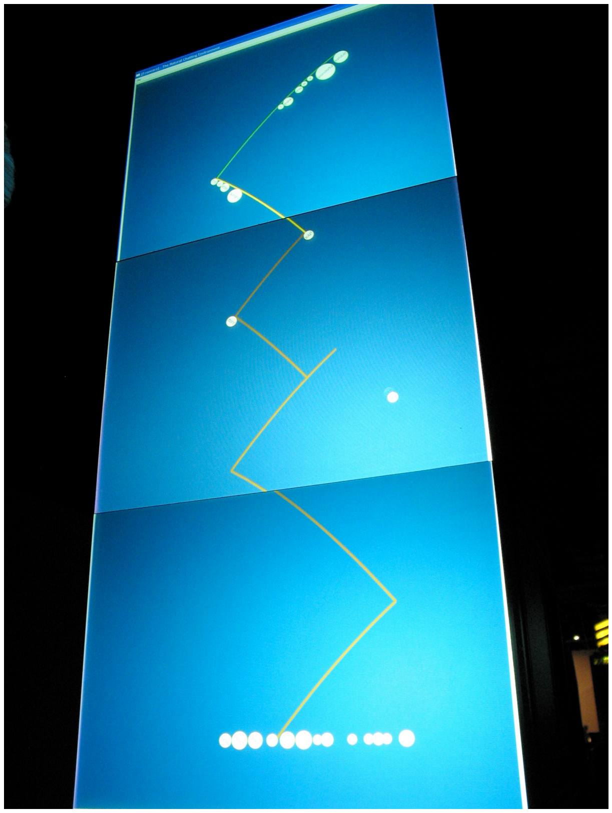


Figure 4.2: This image shows the result of patrons typing in messages over a period of time.

4.2 The Approach

Our approach was to create a visualization that maps the temporal data of a message into a metaphorical representation of a plant. The nature of a plant was used because plants have the visible characteristics of growth and decay through time. For most plants, the height and colour gives a good visual indication of how old the plant is. Unlike the nature of plants, electronic text conversations give no visual sense of age. In Plant Post, the physical characteristics of plants were incorporated into text conversations such that the overall conversation and messages will have qualities similar to a real plant that people can relate to. More details on specific qualities are explained in later sections.

Another reason why a plant structure can be a good visualization for time is that the sequence in which the postings occurred are more intuitive. For example, we know that the first branch (posting) started growing at the bottom and the newest branch will be at the top of the plant. Most timelines are horizontal and read from left to right. Perhaps this is more natural for western cultures because English writing is usually written and read from left to right. However, other cultures such as Asian cultures read their writings downwards starting from the right to left, so the understanding of the western timeline may not be as intuitive for other culture as it would be for western cultures. So which direction is the correct way for reading time? There is no global answer to this question because different cultures read and write in different directions, thus, the direction for reading time will also vary. For this reason, a plant can be a good visualization for time in that most plants grow in an upwards direction, so time can be read more naturally from bottom to top.

4.3 Data

The data originates from an individual typing in a message in the text box at the bottom of the screen and then hitting the enter key. Later, another message will be typed in response to the previous message and again, another message will be entered. This is a continuous process and eventually the combination of all the messages becomes a conversation. At any point in time, an individual may decide to start a new conversation by clearing off the old conversation and typing in the first new message.

Text-based postings in a conversation have various time components that are addressed in our visualization. These include:

- Length of time since a message has been posted – When a message is typed and the enter key is pressed, time is recorded for that particular message. The length of time is measured by the current time minus the time the enter key was last pressed.
- Time between message postings – The time between when the previous message is finished to the start of the next message being typed.
- Rate at which a message was entered – The time between when the start of the message typed and when the entered key is pressed. This is then divided by the number of characters.

In addition to these time components, two measurements of message complexity are used:

- Flesch reading index – measures on a scale from 1-100, with 100 being a message that is easiest to read
- Grade level of message – measures from 1-12, with 12 being the most complex end of the scale.

All this data can be obtained without asking the person who is creating the message to do any extra work. Simply typing in the text of their message is all that is required. Patrons at the gallery had no trouble interacting with this installation. The different types of visual cues that are used to represent both the time components and message complexities are described in the next section. These cues were created by using different attributes of the plant.

4.4 Mapping Data to a Visual Form

The nature-based visualization metaphor we have used is that of an abstract stylized plant. The plant is purposely designed in a simple form to avoid complexity and distraction to the actual text content of the representation.

4.4.1 Conversation Representation

The leaves are drawn as a circle and both represent and contain a word. The diameter of the circle depends on the length of the word. Branches are drawn as s-shaped Bezier curves to represent the length of a message. The length and shape of the branch is determined by the length of the message. Short messages will appear as a straight line. Longer messages will be a curve that is concaved downwards and really long messages will grow into a sideways S-curve. Figure 4.3a shows really short messages resulting with fairly straight branches, Figure 4.3b shows medium length messages that have a downwards curve and Figure 4.3c holds a longer messages with s-curves laid horizontally.

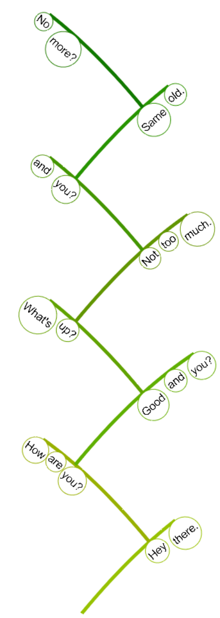


Figure 4.3a: Short length messages were being typed resulting with short and straight branches

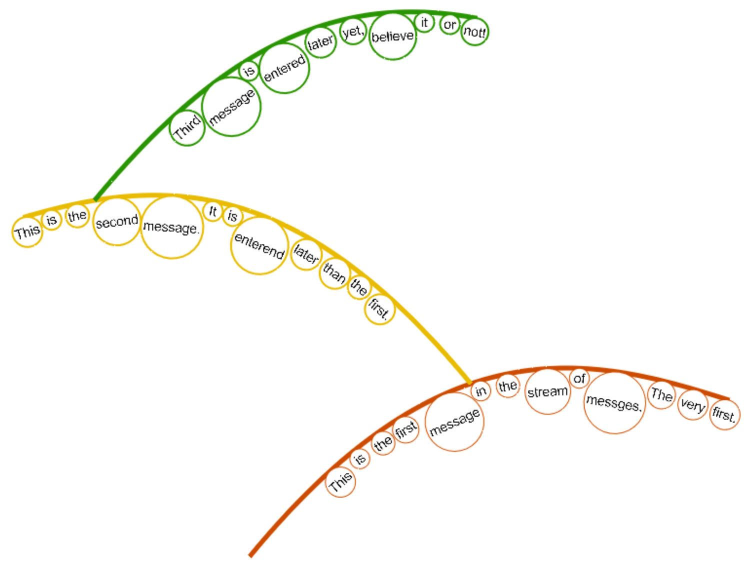


Figure 4.3b: Medium length typed messages will create downward curved branches

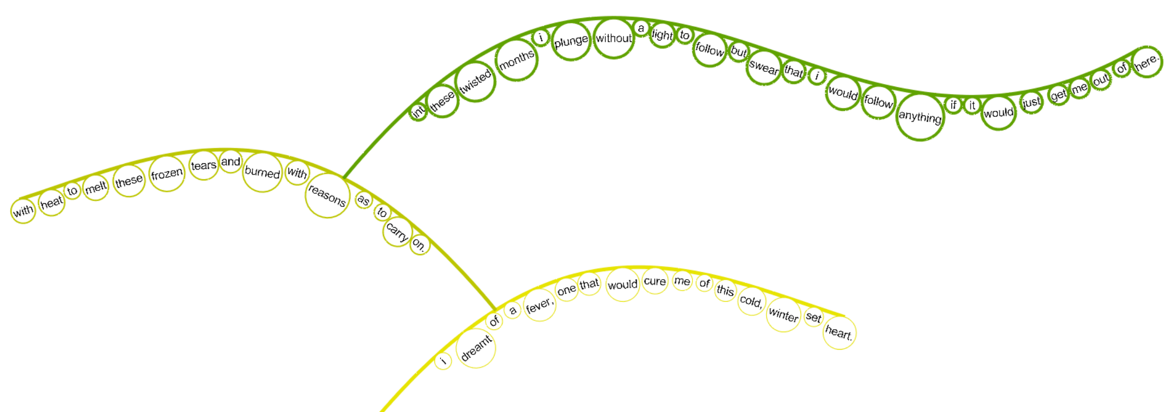


Figure 4.4c: Long length messages will have longer branches and will curve like a sideways S-curve.

4.4.2 Time Representation

The three visual cues *colour, animation*, and *position* are applied in the visual design to enhance the character of a plant as well as help create a meaningful representation of time. The change of *colours* in autumn is a strong indication of the time when summer has ended and the start of winter is near. Depending on the *colour* change of the leaves and grass, we can approximately sense how far away winter is from the present time.

In Plant Post the colour of the leaves and branches start out green and slowly change to yellow, orange, red and finally brown. The temporal analogy we used is the changing colours that are seen in plants throughout the year to give a visual impression of time passing of each message. As well, the order of colours in this sequence matches the order of colours in the RGB colour wheel, allowing changes between colours to be subtle and easy to algorithmically determine (Figure 4.4).

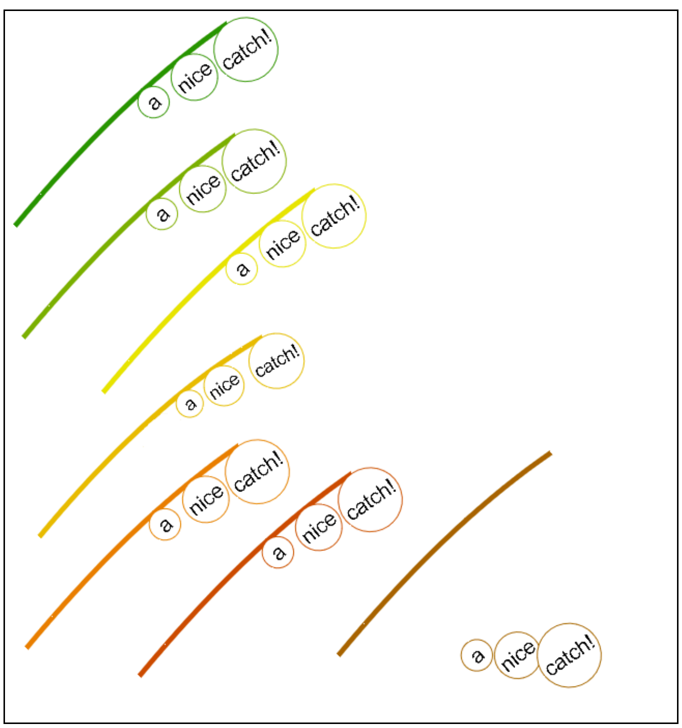


Figure 4.4: Colour change of branches. As time passes, each message branch will age like the fall leaf colours of green, yellow, orange, red and then brown

When a new message is entered, the branches are *animated* in that they grow at a rate that reflects the rate at which the message was entered. The faster a message was entered, the faster the branch grows. As the branches begin to enter the latter stages, another *animation* starts to occur where the leaves of the branch begin to fall. The smallest leaves containing the shortest words on each branch fall first and the longer, hence, more likely informative words remains on the branch for a longer period of time (Figure 4.5).

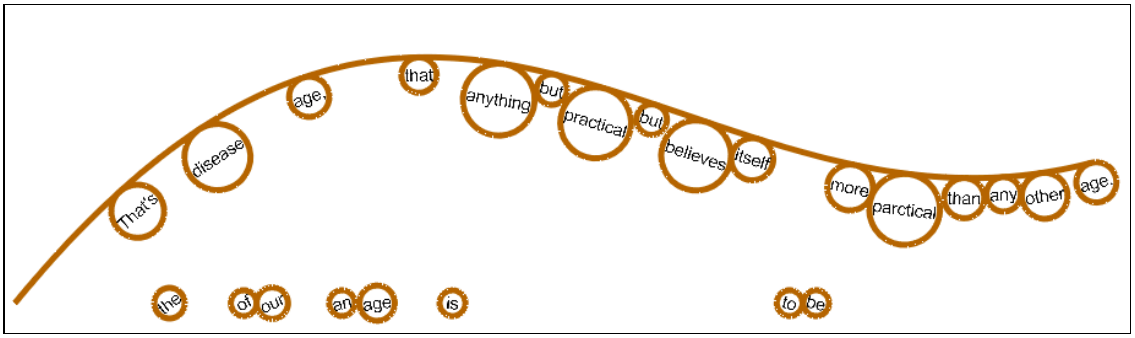


Figure 4.5: The shorter words fall first and then the longer words fall after

The leaves on the branch nearest the bottom begin falling first. When all of these leaves have dropped, the leaves on the next branch begin falling and so on. As well, the path a particular leaf takes varies randomly (Figure 4.6). Some leaves follow a wide, curving path, while others follow a straighter path. This randomness is meant to mirror the falling of leaves in real life.

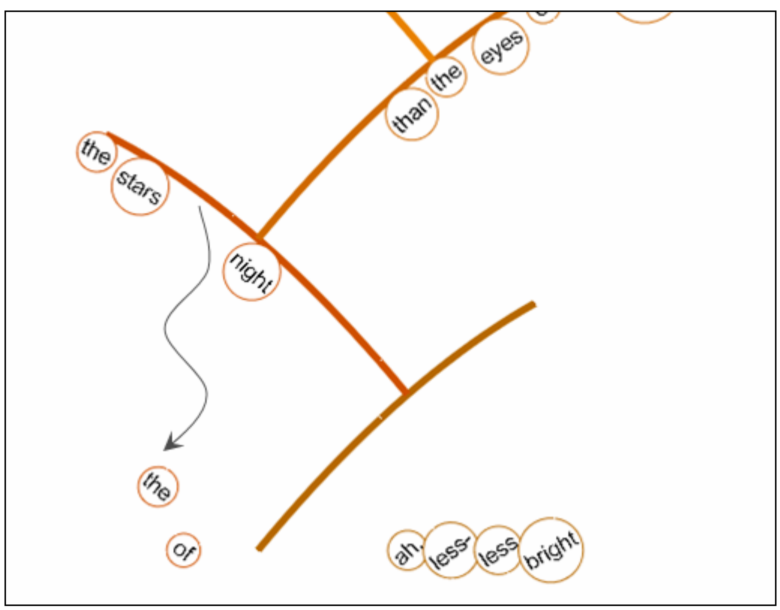


Figure 4.6: The arrow shows the curved path the leaf was falling.

The branch *positioning* indicates the length of time between message postings. The further along the previous branch that a new branch begins to grow, the longer the period of time elapsed between postings (Figure 4.7).

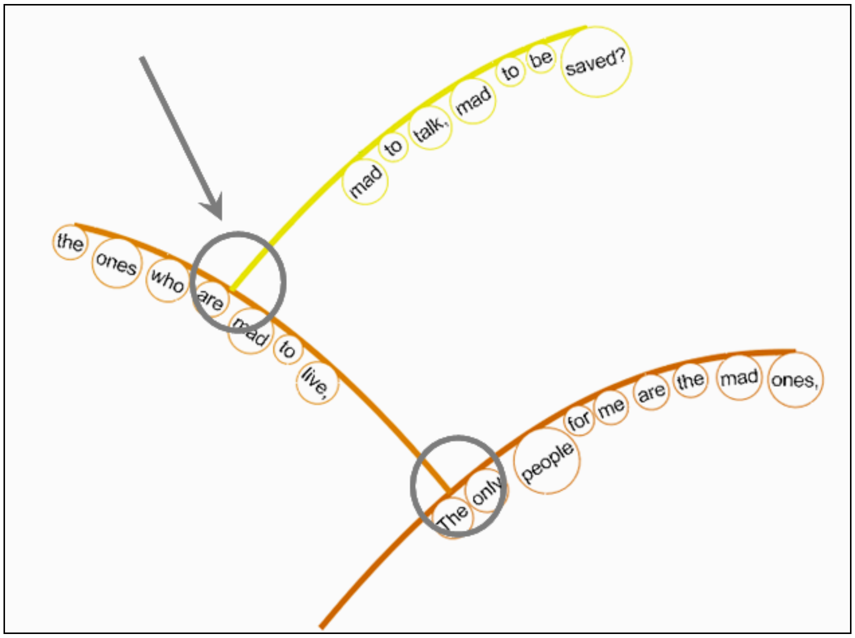


Figure 4.7: The position at which the branch starts to grow will depend on the amount of time between when the two messages typed. The longer it takes for the next message to be typed, the further along the branch of the previous message the next branch will start to grow.

4.4.3 Word Complexity Representation

In addition to the visual mappings described above, the complexity of a message is also visually reflected in the plant. Two measures of message complexity are used: 1) The Flesch reading index measured on a scale from 1-100 with 100 representing a message that is easiest to read and 2) The grade level of the message measured from 1-12 with 12 representing the most complex end of the scale. The text font used is mapped to the Flesch reading index, where a message with reading ease in the lower half of the scale, hence more difficult to read, is indicated by an italicized font (Figure 9). A message with reading ease in the upper half of the scale is indicated by a regular font, which itself is easier to read (Figure 10 below). The thickness of the circles or leaves is mapped to the grade level, with a higher grade level being reflected by thicker circles (Figures 9, 10 and 11).

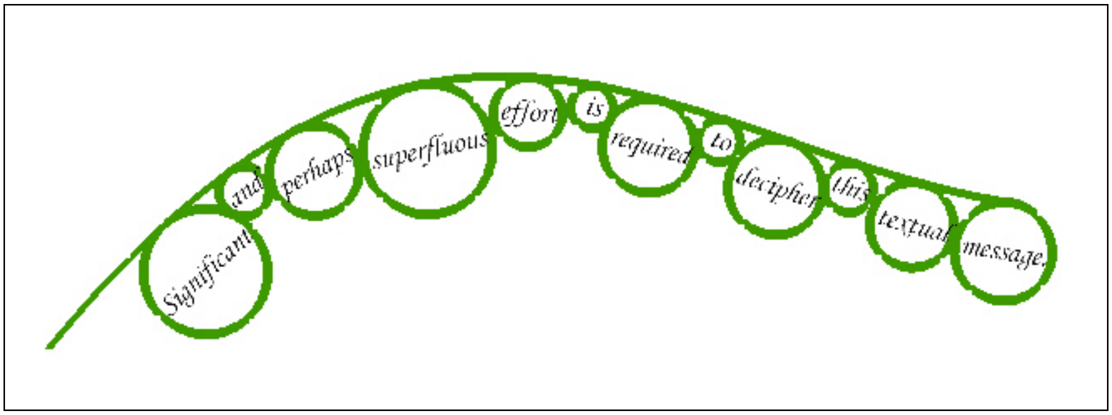


Figure 4.8: Complex Message

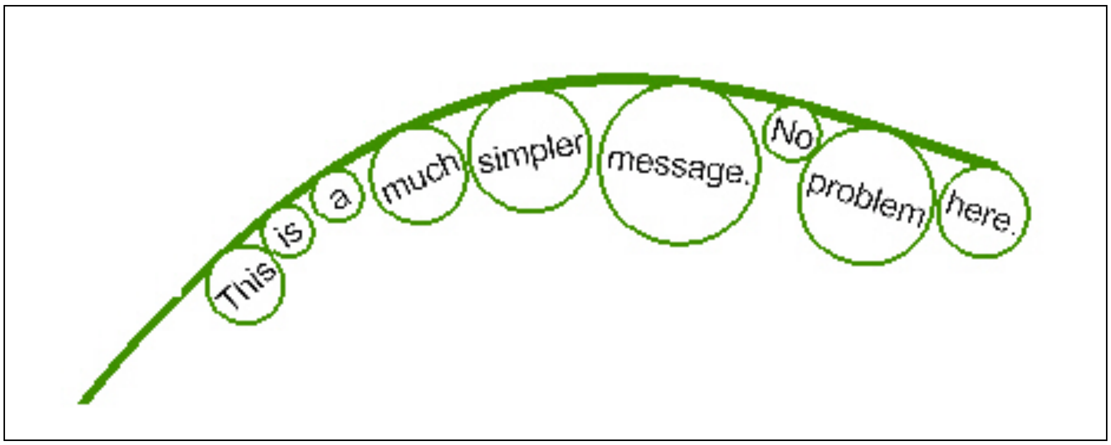


Figure 4.9: Simpler Message

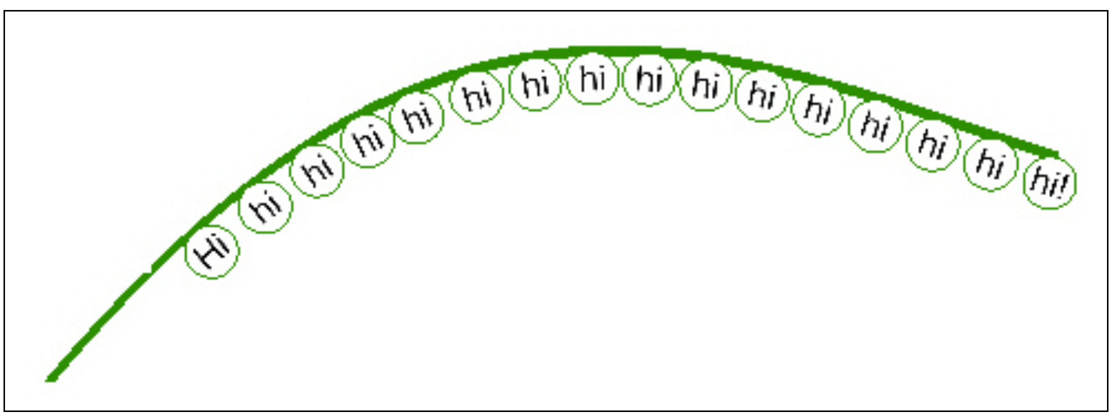


Figure 4.10: Simplest Message

4.5 Emerging Patterns of Conversation

From this overall design, it is possible to get a glimpse of the unique flavour of different conversations based on the shape of the resulting plant (Figures 4.3, 4.11, and 4.12). For instance, conversations with short messages appear more linear, and in a sense, more straight forward (Figure 4.3a). In contrast, conversations with longer messages appear more visually complex due to the increased curvature of the branches (Figure 4.11). Conversations with messages that vary between these two extremes look quite different (Figures 4.3c).

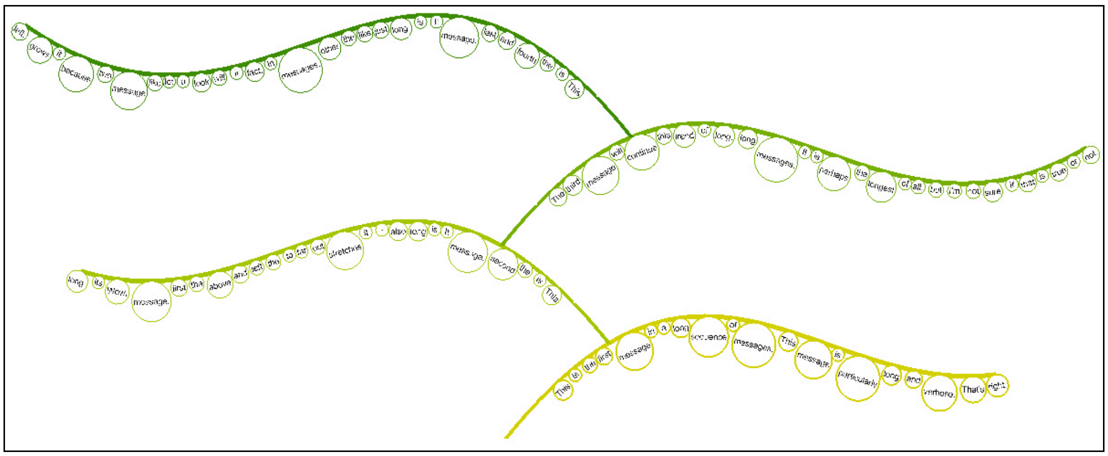


Figure 4.11: Longer typed messages create curvier branches, thus, appear more visually complex.

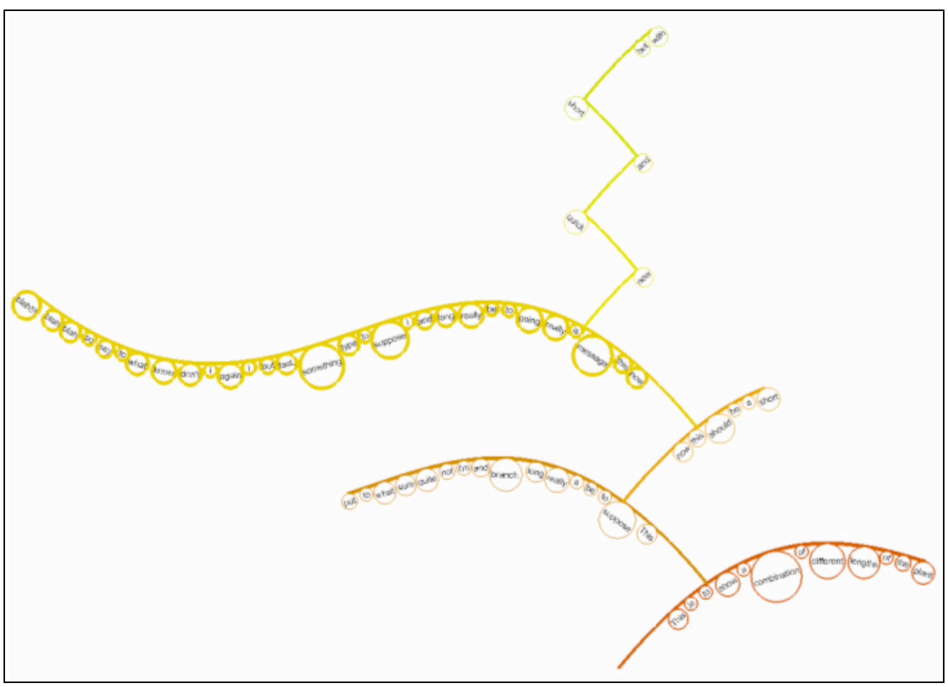


Figure 4.12: This image show a mix of both long and short messages.

4.6 Implementation

We used a cross-platform application called Qt to develop Graphical Interface (GUI) for people to type in text. In Qt, we used a QGLWidget for displaying an OpenGL wire framework for drawing the plant. The programming language we used was C++. Bezier curves were used to draw branches and a circle formula was used to draw the leaves.

4.7 Plant Post Summary

Plant Post has shown that many temporal characteristics of text postings can be visualized. From looking at the resulting patterns, one can see the age of messages and how quickly each message responded to the previous message. When several conversations are viewed beside each other, the characteristics of each conversation can be inferred visually by observing the overall shape of the plants and the characteristics of each plant. These characteristics include the colour of each branch, the length of branches, the number of branches, and the thickness of the leaves.

While the general temporality of the postings is visible in this visualization, we lose the social connection between the messages and connection between the individuals that posted the messages. In the next chapter, I present CrystalChat, which incorporates visualizations of both the social and temporal aspects of digital conversations into one visualization.

Chapter 5. Integrating Social and Temporal Patterns

My overall goal for this thesis is to explore variations of representing social and temporal patterns that exist within digital communications. The first project, Bubba Talk, discussed in Chapter 3, visualizes social connections and different aspects of quantitative data, giving an impression of who talks to whom and how much a given person is contributing to the conversation. While temporal aspects are evident during Bubba Talk, they are lost in the resulting visualization. Plant Post, presented in Chapter 4, is a visualization that focuses on the temporal aspects of postings. While the general temporality of the postings is apparent in Plant Post, social connections are not visible such as the connections between the messages and the connections between individuals who posted the messages. This chapter introduces a new visualization called CrystalChat, which focuses on both the social and temporal aspects of the history of instant message text conversations. This visualization integrates the social network and temporal aspect of conversations into one graphical structure.

5.1 Introduction

I created CrystalChat to visualize the social network and temporal aspects of one's personal chat history (Tat and Carpendale, 2006). Rather than showing online social networks that indicate who talks to whom for a large group of people, CrystalChat reveals the patterns in a personal network that includes only those people who chat with a particular person over a chosen period of time. As mentioned in Chapter 2, temporal and social aspects to date have been presented separately with two different representations, either juxtaposed in separate windows within a given visualization system (Erickson, Smith, Kellogg, Laff, Richards and Bradner, 1999; Viégas, 1999) or with split screens

(Viégas, 2004). So far, visualizations that have combined both of these aspects in one visual representation have been shown in the traditional social network form of nodes and edges (Mutton, 2004) and have used only animation to show temporal aspects in some ways like Bubba Talk. For example, Mutton's (2004) 2D visualization leaves evidence of temporality by fading the graph layout as time passes so that the older parts of the graph eventually disappear entirely. CrystalChat is a visualization that combines the social network and the temporal aspects in one 3D structure, such that all the social information remains and does not disappear with time, thus, people can go back in time to view the conversation's history.

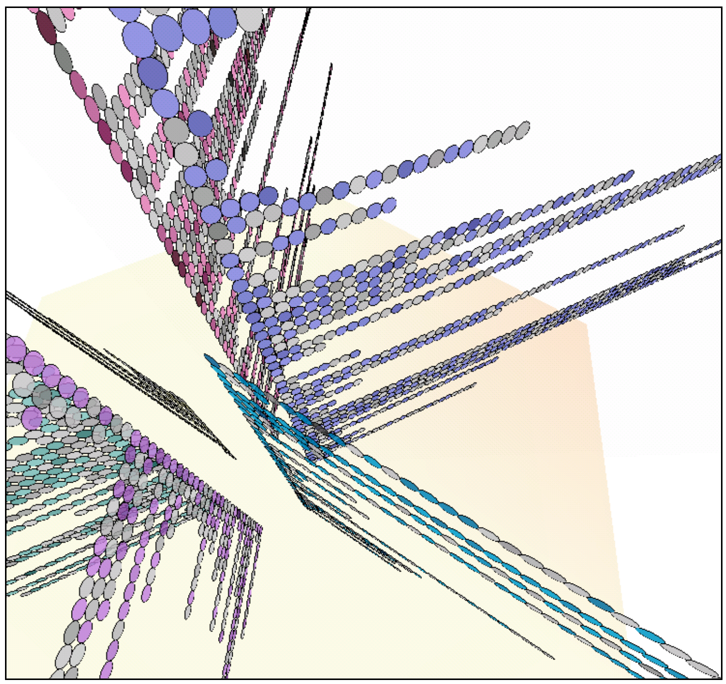


Figure 5.1: A view looking down at the structure of conversations in CrystalChat.

CrystalChat visually traces conversations left by MSN instant messaging. While casual conversations are typically fleeting and traditionally leave no record, they have been and continue to be a significant part of our day-to-day interactions. Some varieties of online communication tools, such as instant messaging (IM), seem particularly well suited for casual conversations where people use single words, sentence snippets and complete each other's phrases. Unlike spoken conversations, online communication does leave a digital trace. However, viewing chat history is not intended as a distraction during the chat, it is a tool intended for after-conversation use. Chat history is typically displayed as a temporally ordered list and quickly fills available screen space. As a result, we can only view a small segment of the history at a time and the text list itself does not make social interaction patterns easy to discern. CrystalChat focuses on visualizing social interactions centralized around one person, supporting self-exploration of one's own chat history (Figure 5.1).

5.2 The Design Goals

In order to visualize one's personal chat history in a single structure capable of revealing both social and temporal patterns, we developed the following design goals:

- To reveal one person's chat activities using data available from chat log history.
- To make individual messages apparent while still maintaining the link between the message's visual representation and its text contents.
- To indicate the beginning and ending of a 'conversation' as defined by the opening and closing of the chat dialog box.
- To represent one's interactions with each person as a distinct visual grouping in one's chat network.
- To provide a structure linking the interactions with all people in one's chat network.
- To be able to show temporality, including sequencing as in which message is followed by which message and frequency to indicate the comparative length of time between messages.
- To provide an indication of the emotional content of the chat dialog as indicated by punctuation and emoticons used.

5.3 The Data

While CrystalChat currently uses history log data from MSN Messenger, this visualization structure can easily be applied to other instant messaging systems. The history log data develops as follows:

- Chat messages are received in real time and these text messages are then stored in history log files that are ordered consecutively according to when the text message was received and written.
- The log files are formatted as an xml ordered list (Figure 5.2).
- This file contains data about the time the message was posted, the person who posted it, the person receiving it, and the contents.
- Each message has a time stamp with the time, day, month and year.
- Each message also includes a "To" and "From", which shows the user's friendly (nick) name.
- The colour and type of fonts used in the original message are also included in this xml file. The end of an individual message is indicated when a person hits the enter key or presses send.
- The xml file also includes information on when the user closes the message dialogue window which determines when a conversation ends.
- There is a file like this for every different person with whom one chats with. This data format lends itself to revealing chat patterns between oneself and one other person. Viewing two separate files in this format comparing conversations with more than one person difficult.

Date	Time	From	To	Message
10/7/2003	10:52:09 AM	Disc Girl (Kristen)	Annie	hi
10/7/2003	10:52:12 AM	Annie	Disc Girl (Kristen)	hey
10/7/2003	10:52:18 AM	Disc Girl (Kristen)	Annie	we going for lunch?
10/7/2003	10:52:31 AM	Annie	Disc Girl (Kristen)	yes do you want to go at 11:15?
10/7/2003	10:52:34 AM	Annie	Disc Girl (Kristen)	instead
10/7/2003	10:52:47 AM	Annie	Disc Girl (Kristen)	nice pic
10/7/2003	10:54:08 AM	Disc Girl (Kristen)	Annie	ok
10/7/2003	10:54:11 AM	Disc Girl (Kristen)	Annie	11:15 is fine
10/7/2003	10:54:19 AM	Disc Girl (Kristen)	Annie	thanks. I got it take for work
10/7/2003	10:54:32 AM	Disc Girl (Kristen)	Annie	I'm supposed to have it on msn so I look professional
10/7/2003	10:54:38 AM	Annie	Disc Girl (Kristen)	haha
10/7/2003	10:54:39 AM	Disc Girl (Kristen)	Annie	how did you know about this hotmail account?
10/7/2003	10:54:48 AM	Annie	Disc Girl (Kristen)	i just guessed
10/7/2003	10:54:52 AM	Disc Girl (Kristen)	Annie	oh wow
10/7/2003	10:54:54 AM	Disc Girl (Kristen)	Annie	you're smart!
10/7/2003	10:54:58 AM	Annie	Disc Girl (Kristen)	i thought it would be easier
10/7/2003	10:55:05 AM	Disc Girl (Kristen)	Annie	yes. this is great

Figure 5.2: Each history file contains a time stamp, the person sending, the person receiving and the text contents.

5.4 The Approach

The intention behind CrystalChat is to visualize one's personal chat history. Online social networks are complex structures often forming general graphs as the number of interconnections between people grows. In contrast, one's connections to those people who are part of one's personal chat history can be represented simply as a hub and spoke diagram. This hub and spoke diagram can be seen in Figure 5.3, where the hub – a void in the centre – represents oneself, and each spoke represents each person one chats with. However, there is more data in chat history than is evident in this view. This includes data about temporal clustering, conversation initiation, conversation termination, length of conversations, length of postings, patterns of repetitive or alternating postings, and emotional tone as represented by emoticons.

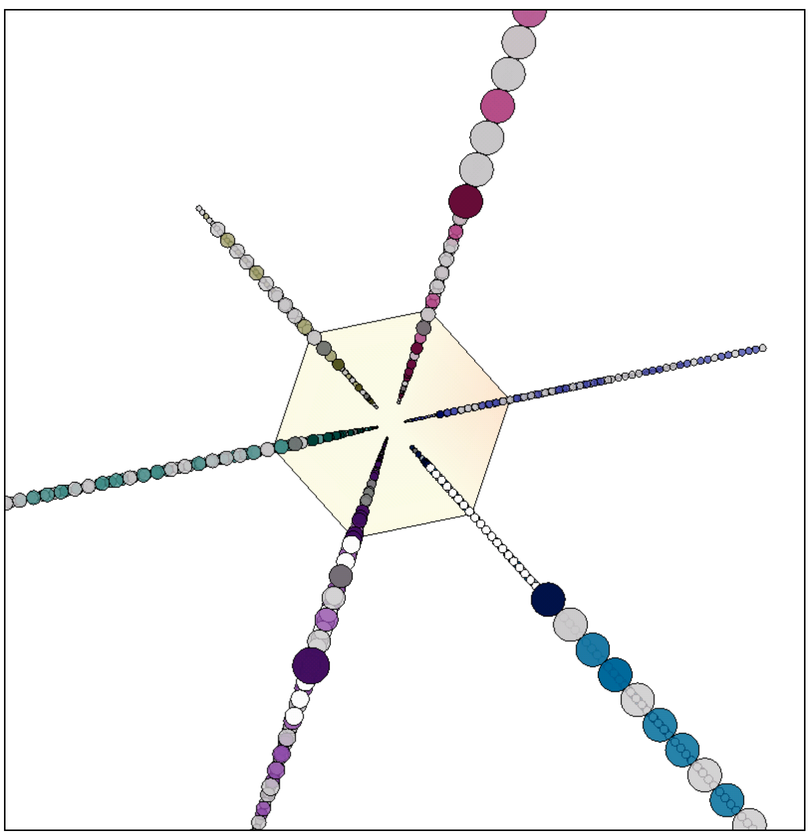


Figure 5.3: Top view showing the void central hub and six spokes that each represent conversations with a given person.

My approach is to assign as much of this data as possible to different visual variables (Bertin, 1983) and draw the spoke edges accordingly. This approach involves making use of the visual variables that have not been used in the basic diagram to characterize the spokes. For instance, since location and orientation are used to create the hub and spoke diagram, this leaves visual variables such as colour, size, shape, value (light and dark), and texture. These visual variables can be used to represent different aspects of conversations.

To include as many details as possible about temporal patterning and to incorporate the actual text of the posting within the visualization, we extend these spokes into 3D. Figure 5.1 shows an aerial view slightly offset from the top, while Figure 5.3 show a view directly from the top. These Figures 5.1 and 5.3 reveal how the spokes representing the conversations with one person have turned into facets in which the temporal patterns can be revealed.

5.4.1 Building a conversation from a sequence of messages

When viewed from above, each spoke represents all the conversations with one person. When viewed from the side, these spokes are revealed as flat facets containing all the details of the conversations with a single person. As shown in Figure 5.4, the conversations are temporally sequenced starting from the bottom so that the most recent conversation is always at the top. This order makes more sense when viewing from the top, since the most recent conversation is in front.

Each person in an individual's chat file has a facet in the crystal. The number of facets represents the number of people that were chosen to be displayed. All figures used for this explanation display six different people. Figure 5.1 and Figure 5.4 show some evidence of these multiple facets along the left hand side. Each facet starts from the empty central hub and points outward like spokes in a wheel. Figure 5.3 shows the top view of the six spokes. The central open region is small but important for the readability of the individual facets. Facets are placed a bit apart from each other to help people's ability to maintain visual distinctions between the facets and, as a result, to comprehend which part of the visualization they are exploring.

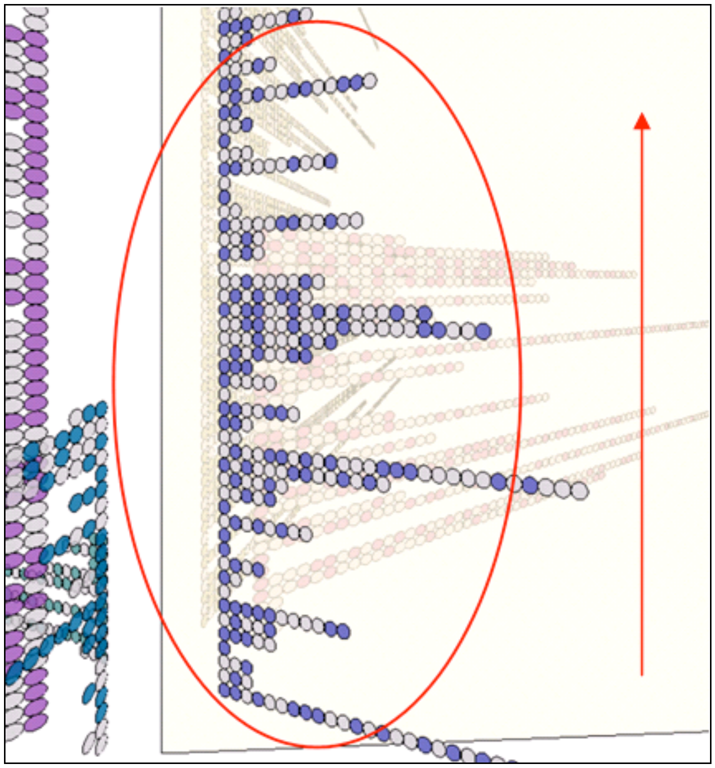


Figure 5.4: Temporal ordering of a facet. Conversation reads starting from the bottom, upwards.

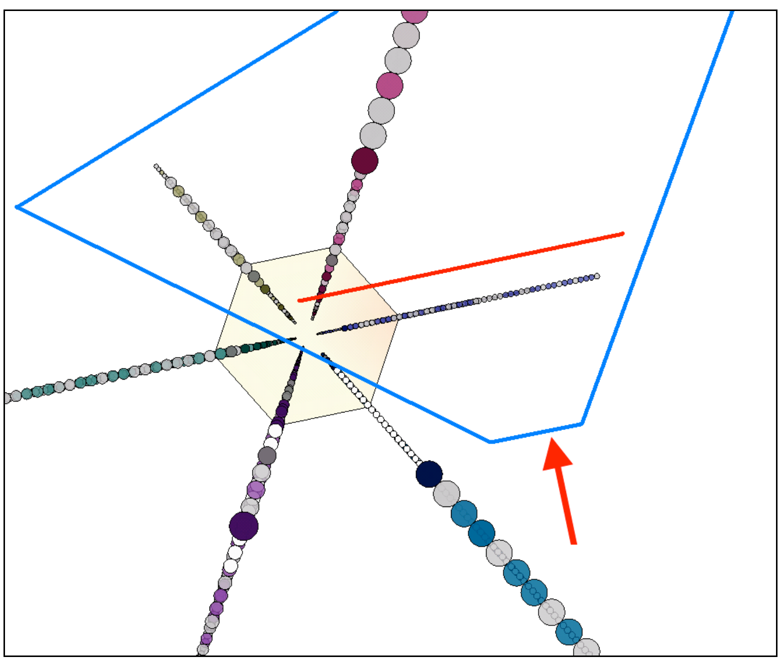


Figure 5.5: The camera location from top view. The red arrow indicates the viewpoint, the blue triangle indicates the field of view and the red line indicates the translucent shield. The facet in front of the translucent shield is the facet viewed in Figure 5.4.

The default side view is to have a single facet approximately centered on the screen. The view in Figure 5.4 shows one facet when viewed between two facets. From the top view, Figure 5.5 shows where the camera is located and its viewing range. The red arrow indicates the camera's viewpoint and the blue triangle shows the field of view. From the diagram, one can see that several other facets would also be in the field of view. To clarify the view of the facet that is being examined, a translucent shield is placed directly behind it. This is shown in Figure 5.5 by the red line. This translucent plane placed behind the current facet increases readability and makes it possible to expand the number of facets displayed. The translucent plane can also be used for the subtle display of additional information from the top view. This is described in section 5.4.5.

5.4.2 Building a facet from a sequence of conversations

Each facet is composed of a series of conversations which are constructed as follows. A coloured disc represents a single message (Figure 5.6) and each colour indicates a different person (Figure 5.7). In these images, the person whose chat network is displayed is represented by a neutral colour grey so that all colour choices for other people will show well in contrast. Left to right reading sequencing is used to order these messages; that is, the messages are arranged so that the first message in the conversation starts on the left. A conversation is defined, as in the data, by the opening and closing of the chat window. One row of message discs represents a conversation (Figure 5.8).

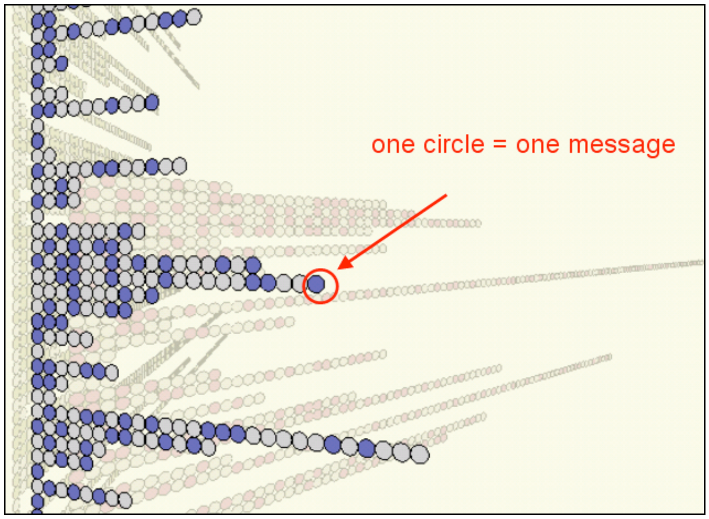


Figure 5.6: As indicated in red, one circle represents one message in CrystalChat.

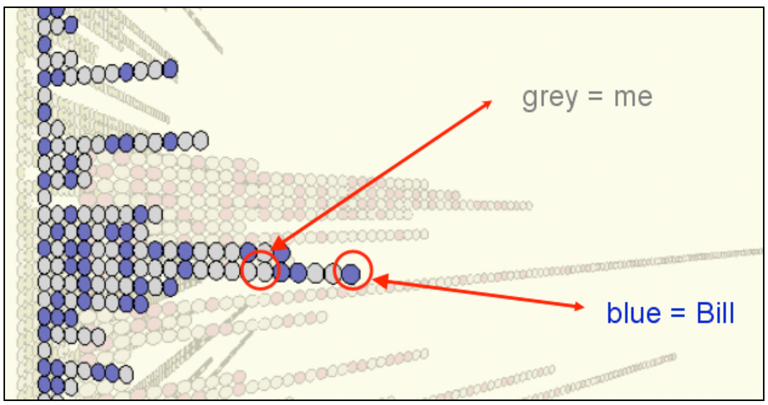


Figure 5.7: Colour is used to identify individual people.

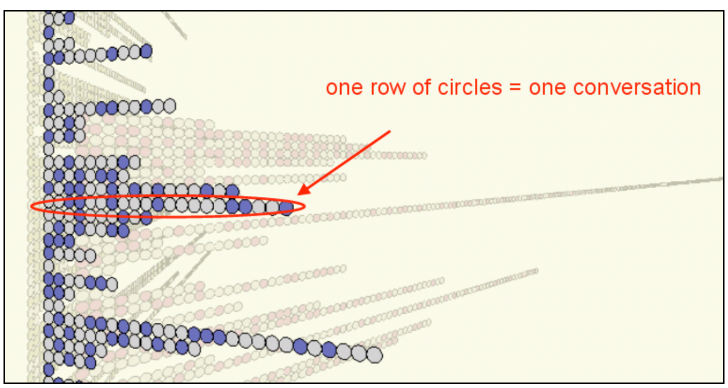


Figure 5.8: The row in CrystalChat represents the conversation that occurred within a given message window.

5.4.3 Including the text data in the visualization

As declared in our design goals, all the text details are still connected with each message disc. One can explore each of the conversations in detail by selecting it. The conversation will open diagonally to maintain both the temporal ordering and to provide space for the text of each message to be displayed (Figure 5.9). The colour of the text corresponds to the colour used to represent the person who sent the message.

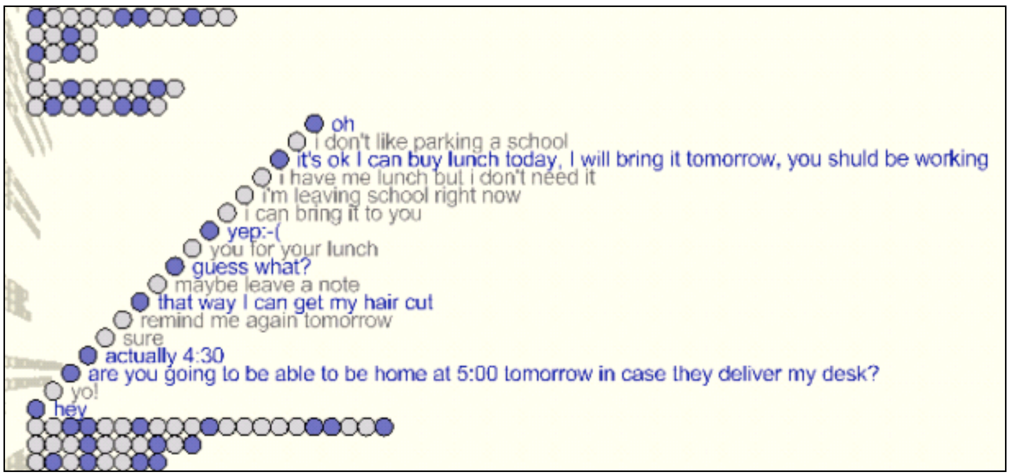


Figure 5.9: The text of one conversation displayed.

5.4.4 Augmenting the basic structure

CrystalChat is created in a form of an interactive hub and spoke structure. The spokes extend into 3D as planes that we refer to as facets. With the structure as described at this point, the simple view from the top (Figure 5.10) does not provide much in the way of additional information. It simply shows the number of facets available and is helpful in supporting the creation of a mental model of the structure as it rotates with smooth animation. When viewing from the top, the discs automatically rotate, showing their flat side and making their colour visible. Within a facet, every time a conversation occurs, the conversation row is placed on top of the previous row in a stack. Thus, the varying sizes of the message circles, from the top perspective view, indicate the relative number of conversations in each facet shown in Figure 5.10.

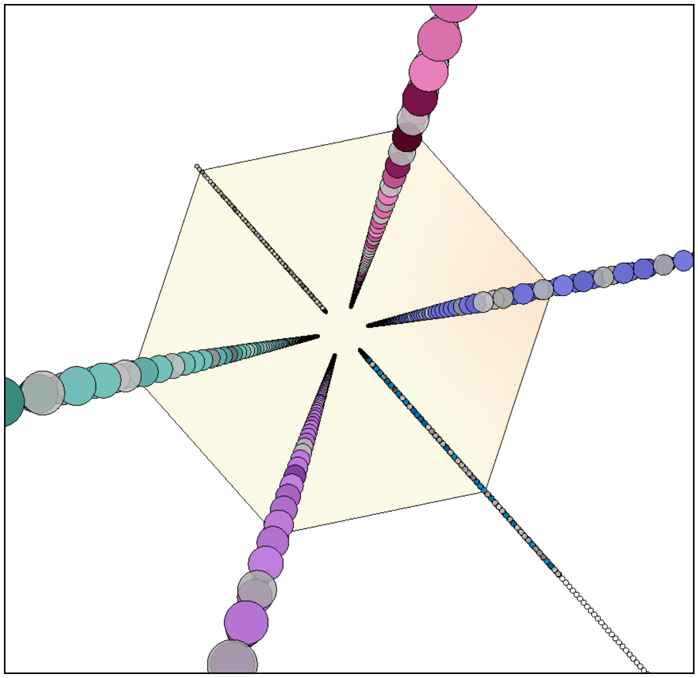


Figure 5.10: Top view – one can approximate number of conversations that occurred with one person by comparing the sizes of the circle.

All the illustrations, thus far, have presented the messages as temporally ordered and the conversations as ordered by start time. Time has been treated as an ordered variable. To display more precise relative sequence information, the actual times of conversation postings can be included. In Figure 5.11, the gaps between messages represent the amount of time that occurred between the conversations. This mode of representation takes more space but does reveal the temporal interspacing of conversations between different people, thus providing relative time spacing. The timeline is still vertical and time progresses upwards. In this view, when temporal data is used explicitly, each row of messages corresponds to the conversations in one day. A greater distance occurring between two conversation rows means that more days have occurred in between those two conversations.

In the temporal spacing mode, there can be more than one conversation occurring in one day causing conversation rows to overlap. From both the side and top view, these overlapped conversation rows that occur in the same day can be fanned out like playing cards in a dealt hand (Figure 5.12). Using this feature, one can determine the amount of conversations that occurred during one particular day by seeing the number of conversation lines as they are fanned out.

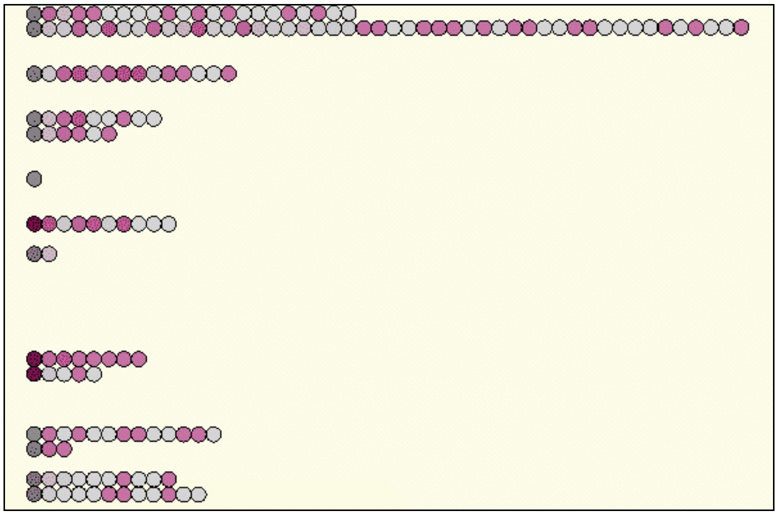


Figure 5.11: Temporal spacing.

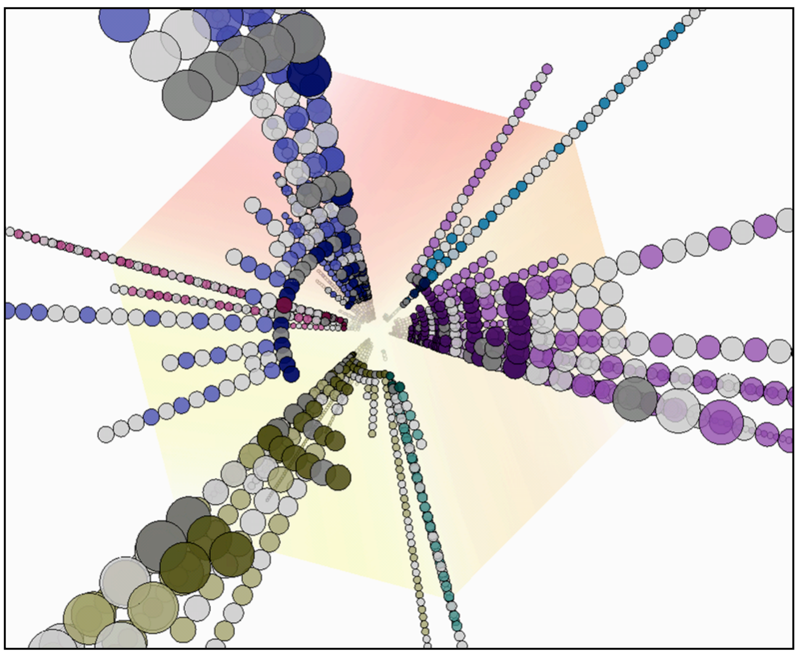


Figure 5.12: Top view with temporal spacing - each facet is spread in a fan to see more than one conversation occurring in one day.

5.4.5 Showing Emoticon Content

We mentioned earlier that translucent planes were added for readability on the side view. These translucent planes slightly obscure the objects behind the plane without removing the awareness of it. This translucent and subtle colour of the plane can be used again to display information about conversational tone. The use of emoticons and punctuation in messages are evident with gradient colour change of the plane.

Consider the view from the top (Figure 5.13). Here, each corner of the translucent plane corresponds to one's conversations with a given person. The hexagonal shape results from the choice to display one's conversations with six people. One can also move the translucent plane towards the viewer or away from the viewer, which has the effect of bringing into focus what is above and subduing what is below the plane. This interactive repositioning of the translucent plane moves through one's chat history. The neutral colour of the plane is pale yellow. Moving the screen up or down to a different level will also cause colour changes as the use of emoticons changes.

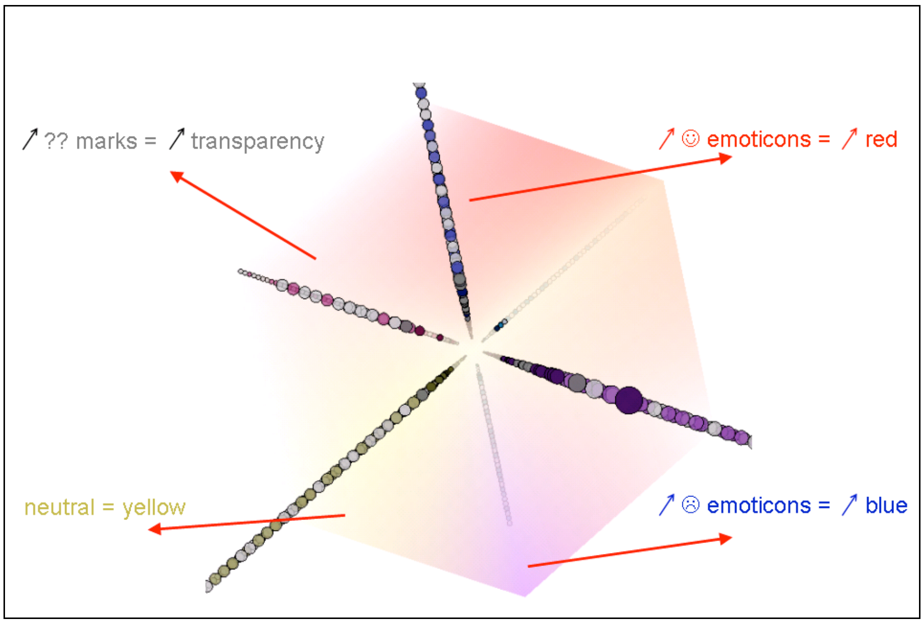


Figure 5.13: The colours of the translucent plane change according to the amount of emoticons used.

5.5 Interacting with CrystalChat

There are several significant views for CrystalChat's 3D structure. Camera paths and smooth animation are applied to allow the user to navigate CrystalChat through different views in a wheel-like structure. In creating navigation interactions with CrystalChat, our purpose is not to limit the navigation power but to provide enough interaction paths that give freedom without causing the viewer to lose themselves in 3D screen space.

The camera paths are set in 3D space so that the user can pan, scroll, and zoom in and out, similar to what can be done in 2D spaces, and more. For the side views, the 3D camera paths are set so that one can rotate forward or backward, viewing the different facets in the structure. Further, navigations include panning upwards, downwards, and side-to-side, as well as, zooming in and out. From the top view, the user can zoom in and zoom out, shifting forward and backwards through time. This provides a rich 3D structure that contains possibilities of visual comparisons between several conversations within an easy-to-use navigation scheme that is a simple extension to 2D navigation.

Switching from the side view to the top view or vice versa, the camera is animated automatically along a smooth camera path, guiding the viewer's eye to understand what is being done. How this camera path is shaped and how fast the camera moves is also important. In general, we are familiar with the idea of moving through 3D space via camera paths through our experiences in movies. This idea has been successfully used in interfaces such as a 3D desktop (Light and Miller, 2002). While we have not formally studied this, people (including the authors) outright refused to use a version with total 3D freedom and happily use the camera path navigation without mentioning it as an issue. In this structure, the camera paths allow the freedom wanted and provide the user with the feeling of simple control and understanding view transitions.

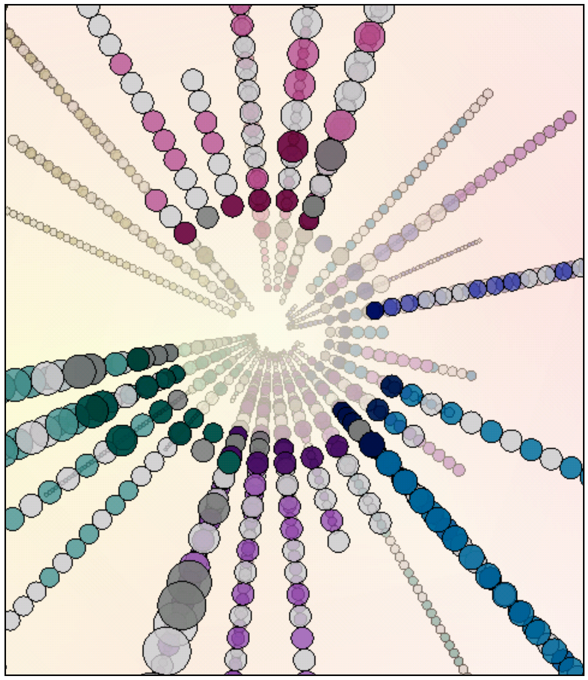


Figure 5.14: Top view with no time filters applied.

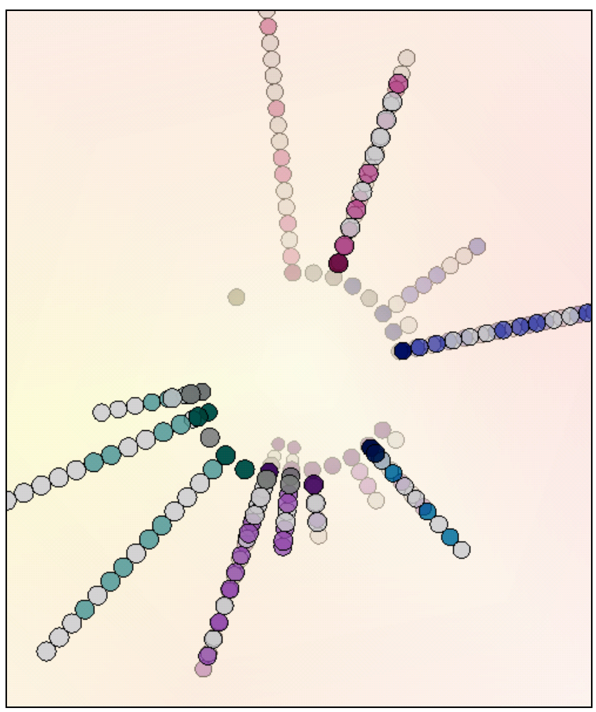


Figure 5.15: A time filtered selection.

There are also filtering features available. More occlusion problems start occurring when looking from top view. The filters allow users to filter conversations by selecting a certain time frame. Figure 5.14 has no filters applied and Figure 5.15 is filtered for a specific time period. This way, different conversations from different people can be identified by their colours more easily.

5.6 Emerging Patterns

Through the CrystalChat visualization, there are several patterns that became more visible in comparison to a simple text list. In Figure 5.16, one can see that the person with the green disc initializes the conversation more often. The number and frequency of message posting varies for different people. From the visual pattern in Figure 5.17, we can see at a glance that the number of messages sent between the two people varies in that the person in grey sends more messages than the person in pink. Note also that the person in grey often sends a series of consecutive messages.

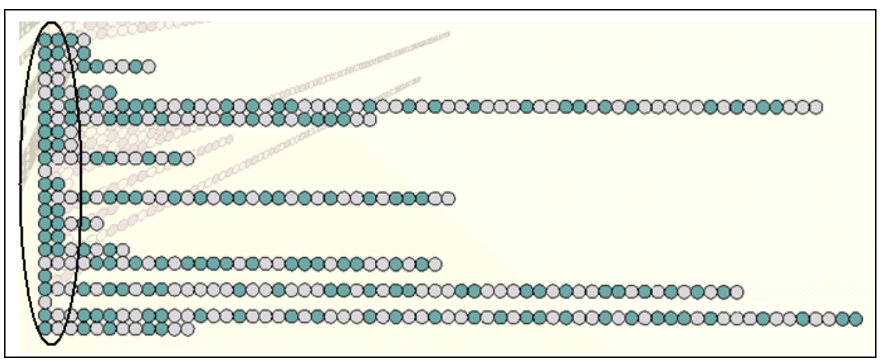


Figure 5.16: The person in green has started the majority of the conversations.

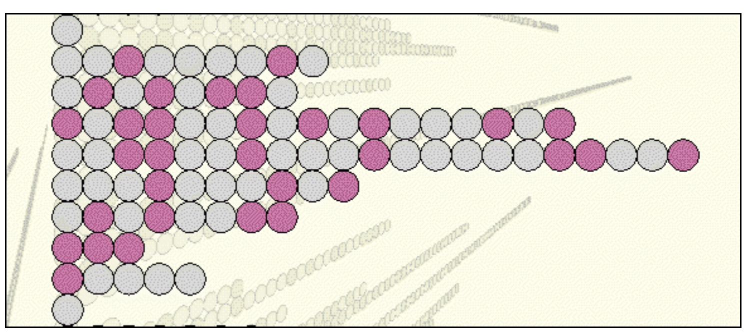


Figure 5.17: The number and frequency of message posting varies for different people.

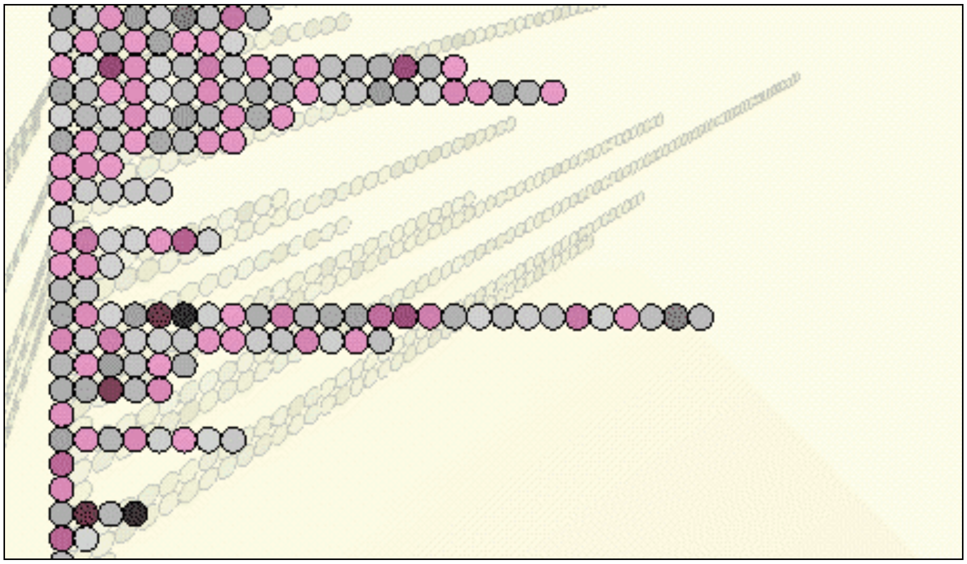


Figure 5.18: The darker the colour value of the message circle, the more characters that are typed for that message.

When the text view is expanded, colour coded letters show which person has sent longer messages (Figure 5.9). The value of the colour changes to represent the length of the messages. For example, the darker the value means the longer the messages. We use this term value to mean the relative lightness or darkness of a given hue by increasing or decreasing the RGB values. As shown in Figure 5.18, one can spot at a glance which messages are more verbose and which messages consist of quicker word responses.

5.7 Users' Responses

An informal study has been performed with some friends and people in the lab. This study shows that people are able to detect personal social patterns from using CrystalChat. Moreover, it is interesting to find that when people see a pattern, they would either explain the pattern's appearance or they would realize personal social patterns about themselves. The following lists some examples of patterns that people saw and the comments they made when they saw the patterns.

- Length of conversations - "Holy…That's a long conversation... This must have been the time when he was drunk."
- Initiation - "I never initiate my conversations with him because he is always so busy."

- Size of file - “I thought I talked to this person way more than I talked Susan.”
- Length of Messages - “I just realized my girlfriend’s messages are a lot longer than mine and I thought I was the one that talked more”
- Temporal clustering - “Oh I didn’t talk to anyone at all during this period… this was during the Christmas holidays and that’s when I probably didn’t even touch my computer at all”

Using this tool prompts people to reminisce and tell stories about their personal history. As mentioned in (Viégas, 2004), this use parallels the common use of photo albums. People enjoy gathering around a set of pictures and hearing about the events that occurred when those pictures were taken. Similarly, viewing previous instant messaging conversations can trigger this type of story-telling, another interesting use of this tool. In addition, one person mentioned that using CrystalChat could also be very similar to viewing their personal diary, if they were to read their conversations by themselves. Previously, conversations were often only ‘hashed’ over in the case of a disagreement. In contrast, this type of story-telling is clearly pleasurable.

Moreover, patterns seen in CrystalChat confirmed people’s own relationships with others. For instance, an individual reflected how his personal relationship had changed in the past months as he was able to see the social pattern through the visualization that he did not have as many conversations with his friend anymore. Even though CrystalChat currently does not show the name of the person they are talking to, people were able to identify who the person was by reading the conversation. Another example is that an individual realized that she had longer conversations with women than she did with her male friends.

This program not only allows people to discover their own personal patterns but also allows them to reflect upon themselves and influence them to change their social behaviour in the future. A person commented, “I don’t have as many conversations with this person anymore, and this is probably something I should do more often.” Another person realized that the majority of the conversations she initiated were mainly questions. This gave her pause to consider whether this social pattern was something she should change.

There are also additional comments made on the design of CrystalChat. The initial reaction for most participants is they thought the conversation starts from the top rather than from the bottom. This seems more intuitive for them since text readings usually start from the top. Next, the quantity of how much they spoke to one person was misconceived as they thought that the higher the conversation rows are stacked, the more they spoke to that person. Whereas, the width of each conversation row also determines the quantity of how much is spoken. Moreover, a majority of the participants prefer to have the actual text messages revealed with the animation moving downwards rather than upwards. Again, this seemed more intuitive for people as text readings are usually read from top to bottom. As for interacting with CrystalChat, all the participants liked the animated camera rotation and said that it really helped them know which part of the 3D structure they were viewing.

5.8 Discussion

There are certainly advantages and disadvantages to archiving conversations such as instant messaging. Lovejoy and Grudin (2003) mention that ephemeral conversations, such as instant messaging, encourage casual and informal exchanges, but once conversations are archived people tend to write more formally and less casual. This may be an issue, but if chat histories are used in an informal setting or if the system is set in a way where only the authors have viewing permission, users would feel more comfortable becoming less formal in a conversation. As mentioned earlier, CrystalChat is a user-centric system where only the author can view their own conversation history, so in this case, casual conversation can still be encouraged.

The general design structure of CrystalChat can be used with other types of messaging applications with some limitations. While cell phone text messaging would be appropriate because exchanged messages are generally short, some decisions would have to be made if CrystalChat were applied to visualizing email messages. For instance, a facet could represent an email thread, or a facet could represent one person, with each row representing one email and each circle representing a sentence or a word. However, limitations would arise because the text in emails tends to be longer.

Theoretically, this 3D structure can support a considerable amount of information. Each conversation from a new day can be stacked on top of the ones from the day before. Conversations also can be very long as there are no boundaries for the length of conversation rows. Technically speaking, however, computers can only store a maximum amount of information before run-time response becomes unbearable. Interaction with the system can become tedious as panning from the bottom to the top will take longer as the years of conversations increases. Similarly, reading long conversations by panning left and right can also be a limitation.

5.9 Implementation

I used Microsoft Visual Studio .NET to create the Graphical Interface for CrystalChat and to allow mouse and keyboard interaction with the 3D visualization. I used Tao.OpenGl, a .NET binding for OpenGL and the programming language I used was C#.

5.10 CrystalChat Summary

CrystalChat visualizes one's personal log history and is capable of revealing both social and temporal pattern as well as showing interactivity. The patterns revealed come from instant messaging data that includes information about temporal clustering, conversation initiation, conversation termination, length of conversations, length of postings, patterns of repetitive or alternating postings, and emotional tone as represented by emoticons. With CrystalChat, individual messages are apparent and still linked to their textual content so that any given conversation can be opened at will. Messages within a conversation are grouped and conversations are associated with the person involved.

Providing a graphical interface that represents conversation through an interesting graphical environment can encourage people to view their past conversations and examine their own social behaviour. While existing patterns emerge visually through effective social visualization, peoples' memories of the past can surface and story-telling can occur. Furthermore, personal social habits can be realized and can influence one's future social interaction.

Chapter 6. What a conversation looks like to me

There is an increased interest in cross-disciplinary degrees such as computer science and visual art. However, to involve and combine these two degrees is not an easy process and experience. There are many contradictions and differences between these disciplines within the working processes and the way we talk about these practices. Generally, computer science makes statements based on facts and proofs. On the other hand, art is largely subjective and often visceral. Regardless of the differences between art and computer science, they both have common ground: to explore, experiment, and problem solve. In my previous Chapters, I have described my work from a computer scientist point of view, explaining my projects. In this Chapter, I will discuss my works from an art stand point.

The projects I have created are generally based on the same family of digital communication data. Instead of following the traditional information visualization cult where collected information is presented from one point of understanding, I want to visualize what a conversation looks like to me – as something organic and ever-changing. I have chosen to work with this particular type of data because the interpretation of language and communication depends largely on an individual's history, culture and context, which leads to the idea of multiple interpretations. In the real world, we all experience social events and conversations in our own way; we make assumptions and predictions of people based on how they look, how they talk, how they react in social situations, etc. In order to align digital conversational data more closely to how an individual experiences a conversation, the visualization itself needs to be created from an individual's point of view.

6.1 Introduction

"If you know exactly what you're going to do, what's the good of doing it? Since you know, the exercise is pointless. It is better to do something else."

Picasso

In the past few years, most of the information visualizations generally looked the same, one example being that most of the visualization uses similar colour choices and making representations visually appealing were not being accounted for. Also, existing visualizations in Computer Science literature are not suitable for revealing all the social patterns that exist in digital communication. Thus, I wanted to invent new visualizations that were different and at the same time, I still wanted to present social information with representations that are simple for the viewer to understand. Thus, I had the following goals:

1) Create comprehensible information visualizations of digital communication data
2) Provide a flavour and an impression of social activities by inventing new ways of visualizing data
3) Influence people's behaviour through visualizations of their own social data

Most painters would not pick up a paint brush and randomly paint colours on the canvas without any thought. There is a long process of planning, exploring, experimenting, making decisions, and making corrections - if they do decide to paint randomly, that was probably a well thought out decision. In creating my visualizations, I go through the same process. I use the computer as an art tool, very much like how I would use a paint brush on a canvas. I would first do research on visual art/computer science literature in relation to my topic of interest. Then I would learn about the different algorithmic techniques that I can create visual patterns with. Whether I am using previous existing algorithms, inventing new algorithms, or mixing both together, only with exploring, experimenting and even making mistakes, would I work out the right combination of code to formulate my visualizations. Like most artists, I will juggle within the limitation of my art tool and make more decisions based on what is possible and what is available.

My first choice was to use a computer to present my interpretations of what conversations look like. I have chosen to use a computer for many reasons. One advantage of using computers is that many conversations now occur online, for example email, instant messaging, etc., and what is being said can be recorded. This archive of conversational data opens the door for new ideas and different interpretations of the way we communicate and see social patterns. My intention is to convey a variety of social behaviour from different people using different types of digital communication. I want to produce graphics and animations that do not necessarily fall into existing patterns, such as information visualization patterns that exist in science literature, or patterns that exist in current graphic software.

In the following discussion, I include my two visualization projects, Bubba Talk, Plant Post (shown at the University of Calgary in the Nickle Arts Museum). As well, my Glass and Wine of Kressman art installation (shown at the University of Calgary in Little Art Gallery) and KeyStrokes, a recent visualization that augments typing which I designed in collaboration with two of my colleagues.

6.2 Bubba Talk

The visualization of Bubba Talk was created without following the traditional rules of Information Visualization. (The details of this work are explained in Chapter 3). According to Ware (2000), when we are using multiple colours to represent different entities, colours must be distinct to help people distinguish between them more easily. I challenged this theory by using colours that are not extremely different from each other and instead used all pastel colours.

I chose pastel colours that are soothing. These colours can be distinguished from each other, but they are not too different so that the colours will not fight for the viewer's attention. I kept in mind that we do not want to overwhelm the viewer with outrageous colours in the beginning, but subtly let the viewer know the existence of six different people – the people are not the focus of what is being visualized in this case. What is being visualized is the conversation itself, so before the conversation starts, nothing in the image should grab the viewer's attention. However, once the conversation begins, other visual effects should take place to give more distinction between the speakers by the way they talked. To compensate for the colours that have already been used, I needed to create other visual effects to convey parts of the conversation. These effects included animation and use of position as outlined below.

Why circles?

In a sense, the shape of a circle makes a conversation more inviting in comparison to a rectangle or a square. Lets take a dinner table for instance, a round table allows each person to sit evenly spaced out and everyone can face each other more directly compared to a table that has corners. In a square or rectangle table, individuals would have to choose a side to sit on and they would not be able face certain people directly, especially if the table is long. It is more difficult to have a conversation with people that are not directly sitting across.

Why only circles?

I wanted to use only circles because I wanted this shape to lie in harmony with one another. Having a variety of shapes displayed at once can be distracting especially when dissimilar shapes have different pre-attentive effect (Ware, 2000, page 166). I wanted the circles of people to stand out based on what they said, how much they said and not on their initial appearance. I wanted to focus on the differences between the quantities of how much is being said.

Why fuzzy edges?

The circles are also surrounded by a soft edge because I wanted to give a subtle and silent effect at the beginning before the conversation starts. The fuzzy edges also help distinguish one circle from another when they overlap. (Figure 6.1)

Why burst out and then hover?

In Bubba Talk, when an individual speaks, the small circles (dots) move towards the last person who spoke and the larger circles remain hovering around the original speaker. As we speak in real life, we can not see visually what is being said but what was being said still remains and stays in our memory, thus the circles will stay near the speaker.

Why burst out and then travel in the direction of the person spoken to but not quite reach them?

I wanted to create motion that will capture how a conversation will look when one person talks to another person. When a speaker starts to speak, dots move sporadically towards the last person that spoke, almost creating a “spitting effect” of movement, so that the words are literally travelling towards the person the speaker is talking to (Figure 6.2)

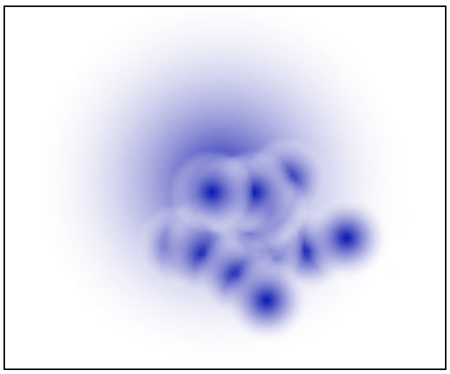


Figure 6.1: Circles overlapping with soft edges so that each circle can be distinguished from each other.

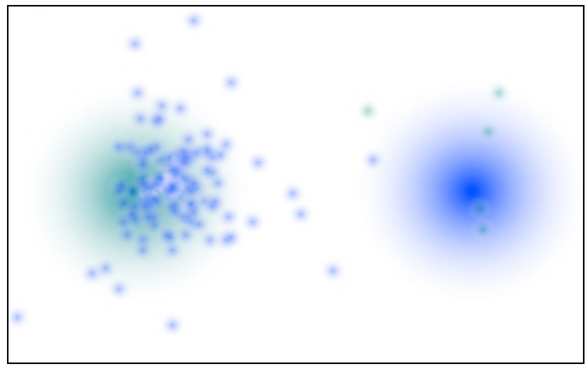


Figure 6.2: Circle of words traveling from one direction to another as one speaks

6.3 Plant Post

Many difficulties and differences can be found when a computer scientist and visual artist collaborate. Plant Post was a project created in partnership with Russell Kruger, a fellow graduate computer science graduate student, during a visual art and computer science collaboration course. The process that was most complicated was coming up with an idea for the project that reflected both our interests. As we were getting used to each other’s working style, we had to change our project a few times before we came to a final decision. My partner wanted a well thought out plan from the beginning, for example, knowing how the visualization would look at the end and whether it was possible to implement before he would carry out the idea. I was more used to having a rough idea in mind and not knowing how the end result would be and the final appearance of my project would come from experimenting with programming. In the end, we learned to accommodate each other’s working style, before we made a final decision on an idea for the project (Details of this project are explained in Chapter 4). I first drew some rough sketches in Adobe Illustrator of how the final visualization might look. (Figure 6.3)

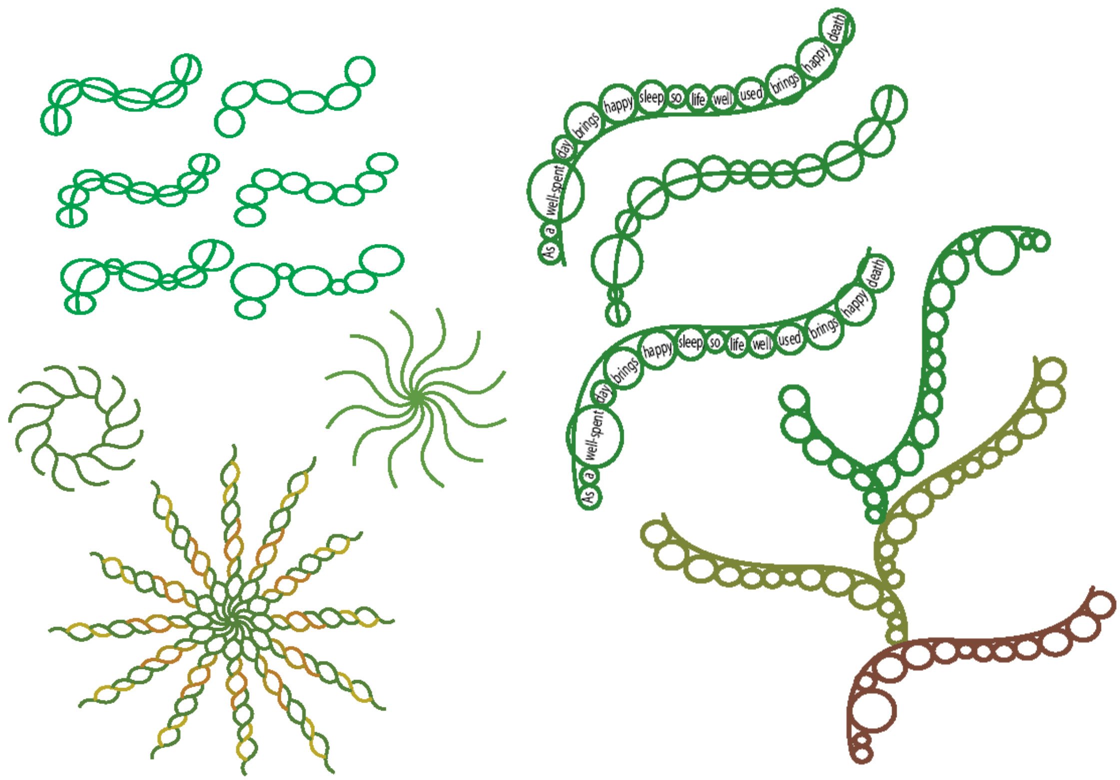


Figure 6.3: Several brainstorming designs sketched in Adobe Illustrator.

Then we had to find out whether this idea was possible to implement before we both went ahead with the project. The challenge was to find an algorithm that would imitate the original design as closely as possible. Once we both figured out that this idea was possible to implement, we carried on with the idea and started to code.

I also found it interesting to compare the initial design with the final implemented visualization. The sketched version of the plant tends to look less rigid and structured compared to a computer generated version of the plant. (Figure 6.4a and Figure 6.4b)

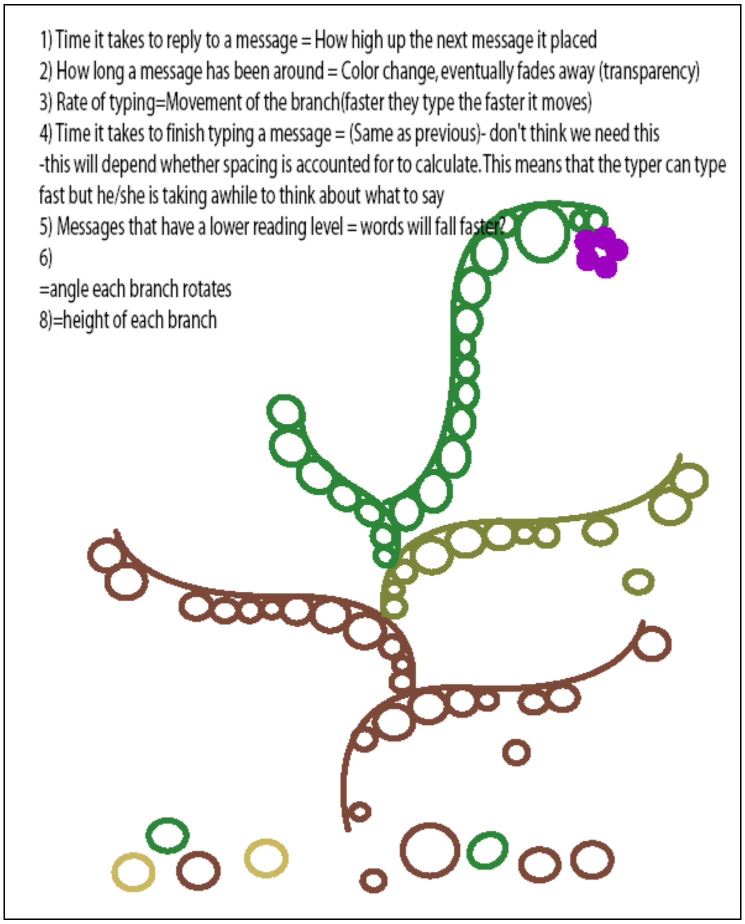


Figure 6.4a: The chosen design before implementation

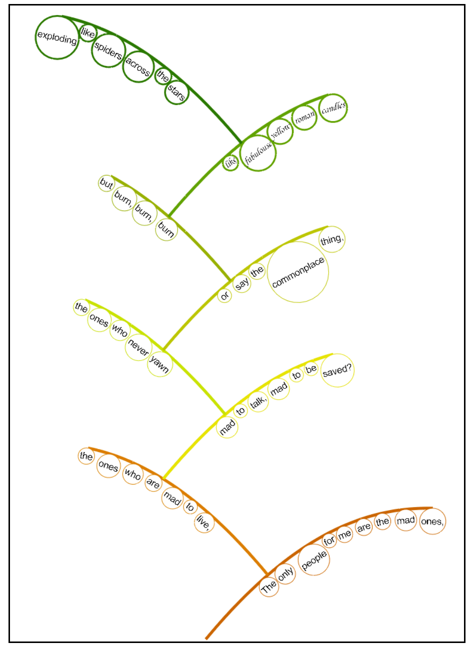
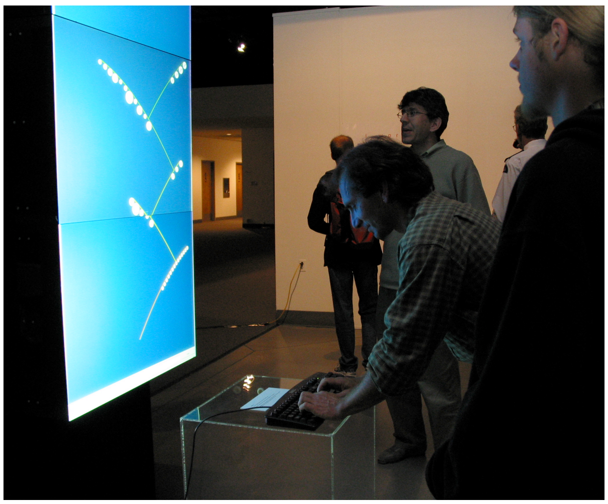


Figure 6.4b:The result after implementation

When our program was completely implemented, Plant Post was ready to be set up in the Nickle Arts Museum, along with other computer science/visual art works. This entire exhibition was called "i-works". We wanted the plant to be displayed on a screen that would allow room for the plant to grow upwards. We wanted the plant to grow taller than the people, so the size of this virtual plant would be almost as tall as a physical medium-sized plant. In order to do this, we used three Module Ambient Displays (MAD) boxes (Schmidt, 2005) that were stacked on top of one another vertically. (Figure 6.5) We picked a dark blue colour for the screen to symbolize a sky-like background for a plant to grow in. (Figure 6.5). Plant Post was set up so that the audience would see this piece last, so people were able to type in comments about the whole exhibition after seeing it. We made our piece interactive because we wanted to engage the audience in our work and to see their posting age and decay over time. When a message is typed, a branch with leaves containing the words will start to grow and eventually change colours as it decays over time. (The details of this work are explained in Chapter 4). Leaves will then start to fall and disappear similar to conversations in real life much like a *semiotic ghost.*



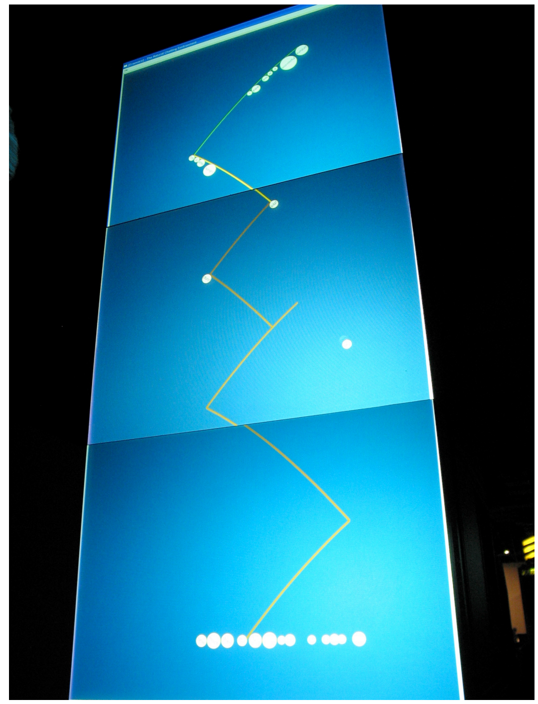


Figure 6.5: Different angle view of the installation of "Plant Post"

6.4 Glass and Bottle of Kressmann

My installation of "Glass and Bottle of Kressman" is an important part of my thesis because it allowed me to view the visualization of text-based communication as part of a work of art. This work of mine was inspired by Pablo Picasso's Cubist work, "Glass and Bottle of Suze" (Figure 6.6). Picasso's work involves displaying text as information as well as using text as part of his art work. In Primitivism Cubism Abstraction: The Early Twentieth Century t… .Francis Frascina uses semiotics as a methodology to analyse Picasso's complex work. This analysis places emphasis on how meaning can be constructed through abstract structures juxtaposed with real materials. What I became aware of when reading Fracina's writing is that it was possible to use text (in this case new paper articles) as a way of conveying information as well as at the same time aesthetic appeal. Constructed as a collage, he uses abstract shapes to suggest a table and a conversation and uses both the shapes and the text in the newspaper to reveal interrelationships.

In parallel to Picasso's Cubist work, I am interested in abstract representations of conversations in both 2D and 3D space. In Picasso piece of "Glass and Bottle of Suze", 3D objects are represented by a sideways view of a glass and bottle and a top view of a blue table collapsed together in a 2D plane. Objects on his collage can also portray deeper meaning to his work such as how a table, a bottle of wine, and a glass can suggest a conversation. This interesting play of representations in Picasso's piece is the reason why I have included his work in my installation. In my piece of "Glass and Bottle of Kressman", I imitated Picasso's work of "Glass and Bottle of Suze" in today's modern world.

Pablo Picasso (Spain, 1881-1973) Glass and Bottle of Suze, 1912
Pasted paper with gouache and charcoal 25 3/4 x 19 3/4"
University purchase,

Kende Sale Fund, 1946

Figure 6.6: The original Painting Pablo Picasso. (This image was founded on http://www.hayalevi.com)

The planning, gathering of materials, and preparing for this installation was a large part of creating this work; all the materials I used and the way I had objects arranged, had specific reasons. The sketch of my installation is shown in Figure 6.7. A photograph of the way the installation was set up is shown in Figure 6.8 and Figure 6.9 in different angles.

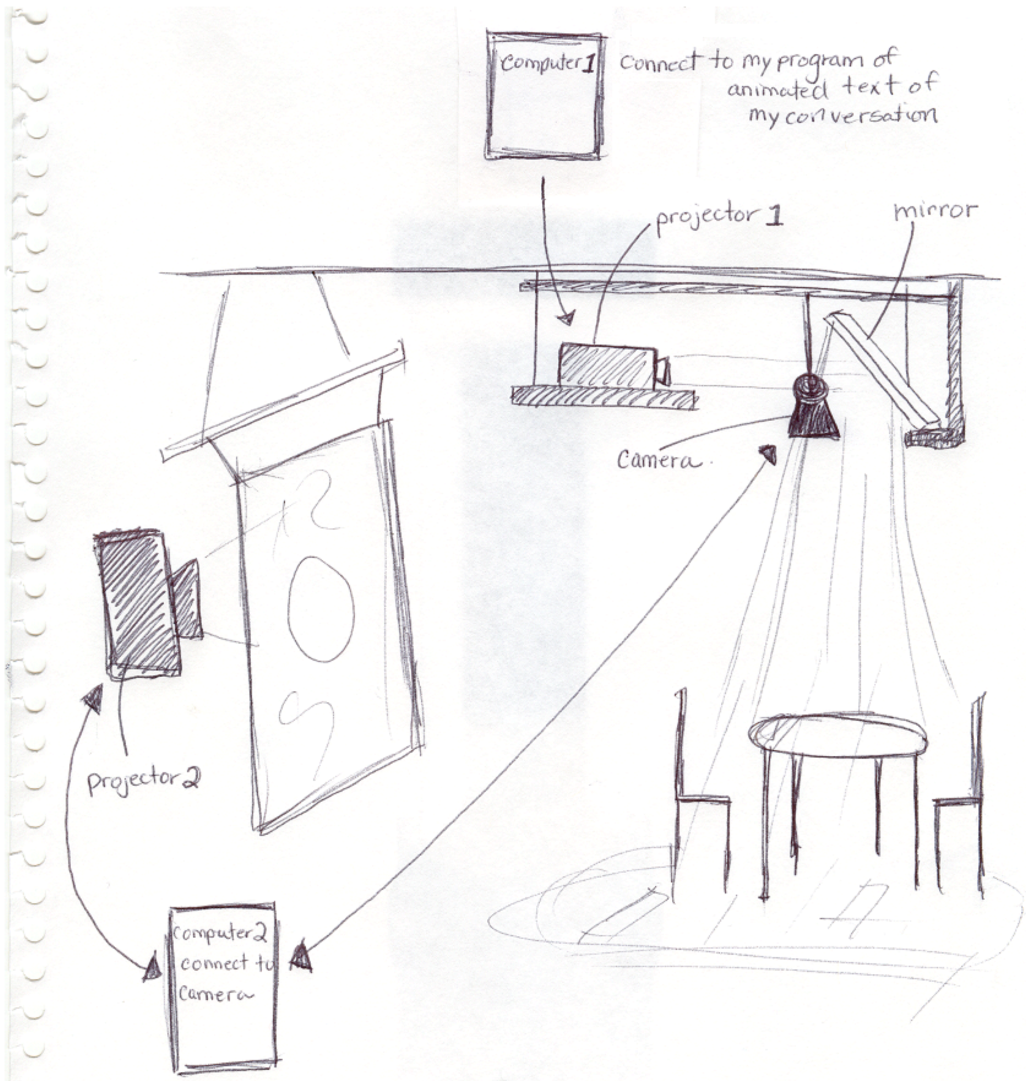


Figure 6.7: A sketch of my installation set up. Projector 1 was hung on the ceiling projecting an animated image created by Computer 1. This animated image was first projected towards a mirror and then reflected on top of the table, chairs and floor. A camera facing downwards also hung from the same ceiling area, capturing this scene from above. This recorded image was connected to Computer 2, which was connected to Projector 2, and then projected behind a large piece of paper.

Figure 6.8: A view of the way the table and chair was set up.

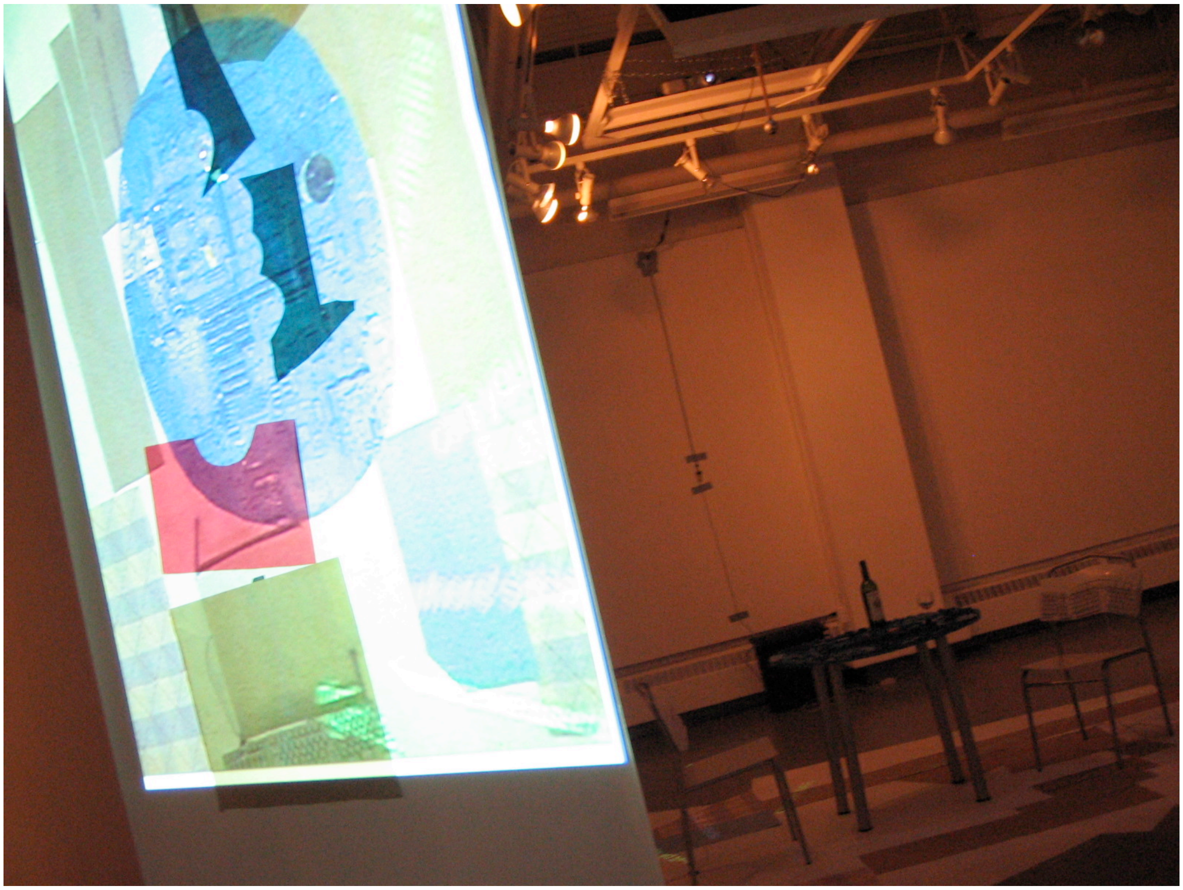


Figure 6.9: A view looking from behind the projected image of the imitated work of Picasso's and on the right side shows the set up of the table and chairs. Also, the top right of this image shows the projector and camera.

The projector from the ceiling projected an animation of a digital text conversation on to a tilted mirror which reflected on to a table, two chairs and floor (Figure 6.10a). To do this, I implemented a program that created an animation of an instant messaging text conversation, randomly floating. With the animation of floating text projected on to the table and chair, I also placed a finished wine glass on the table to suggest a conversation of the past (Figure 6.10 b).

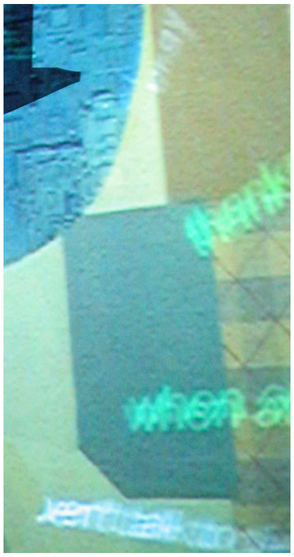


Figure 6.10a: Animation of text conversation floating on the floor.

Figure 6.10b: A wine glass with left over wine inside suggesting a finished conversation.

With the animation of text floating on top of the chairs and a table, made out of only computer parts of steel and plastic (Figure 6.11). I wanted to give more hints of an existing electronic conversation. I also wanted to make this camera run in real-time so that the camera will also record the audience interacting with my art work. The recording of this camera then was connected to another computer and was projected on to a paper from behind. The result of the projection is seen in Figure 6.12. The assemblage of papers on the floor (Figure 6.13) was arranged in a way so that the camera, facing downwards from the top, would capture an image that would resemble Picasso's work (Compare Figure 6.6 with Figure 6.12). The paper on the floor also collected foot prints of the audience. Thus, I wanted to capture people on camera and keep traces of people's footprints on paper even when they are gone as another record of human interaction.

Figure 6.11: Close up view of the material used for the Table and chair that consist of only computer parts, plastic and steel.

Figure 6.12: A photographed image of a projection of a video taken from top view.

Figure 6.13: Assemblage of different colouring of papers on the floor

My work involves the exploration and experimentation of applying computer technology to art within the space of the Little Gallery. The complexity of information that ties visual art and computer science together is to be reflected in my work. My piece is concerned with creating representations and these representational components are as follows.

1) Computer – stored and programmed data
2) Projection – colour and light
3) Surface – materials
4) Mirror – reflection
5) Camera – reproduction in real time

The physical properties of each of these components have discrete representational significance. In a technological context, there is a play between objects and illusion in 3D representations and spaces. The complex relationships construct a world which is both familiar and unfamiliar at the same time.

6.5 KeyStrokes

KeyStrokes was a program created by myself, Petra Neumann, and Torre Zuk (Neumann et al., 2006 ; Neumann et al., 2007). KeyStrokes is a real-time visualization that captures different aspects of typing styles from different people. Different visual representations were used to imitate art techniques following the painting process to create a visualization that the writer can identify with. These include background and foreground objects as well as stroke styles, splattering effects, and the movement of a paint brush. Before I explain the artistic side of my design process, I will give a bit of background on how Keystroke works.

The position and size of the strokes are created by what letter is typed and by how fast someone types. The way this works is that each letter and common punctuation key is set at a fixed location corresponding to the physical English QWERTY keyboard layout (Figure 6.14 a).

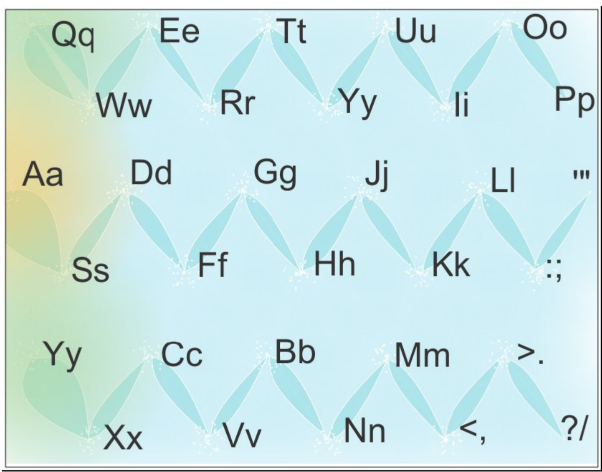


Figure 6.14a: The location of where there each stroke will begin from typing in a letter.

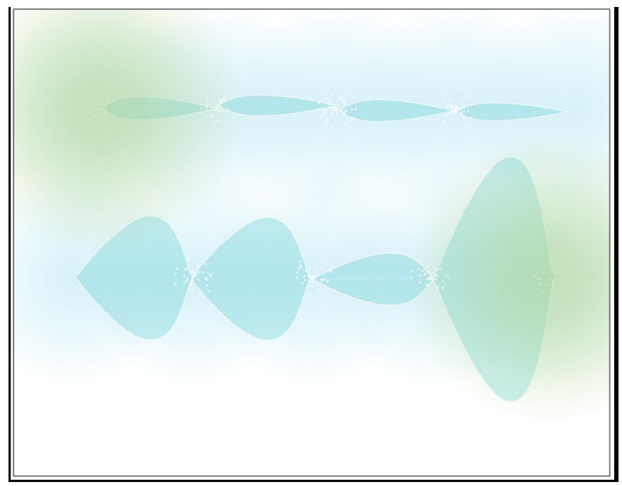


Figure 6.14b: The shapes fo the strokes.

When a key combination has been pressed, we connect the two key locations with a translucent stroke in analogy to the strokes created with a brush or pen. Similarly to a hand-written message where the features of the writing can tell us how the pen has been moved, we show how and where the hands and fingers have been moved on the keyboard. Figure 6.14a shows a visualization of strokes and key locations where each key on the keyboard has been pressed continuously from left to right for the three rows of letters on the keyboard (not including number keys). The strokes connecting each key combination can also reveal the movement of hands and fingers. In Figure 6.14b, the top row of strokes was typed quickly resulting in narrow strokes. Compare this to the second row where keys have been pressed very slowly resulting in much wider strokes depending on the amount of time between key releases. Strokes are wider close to the first key in a combination indicating the temporal sequence of key presses. The top row, in this image, has been pressed from left to right, whereas the lower connects keys from right to left showing the movement of the fingers. For many people, writing style can also be distinguished by how many times letters have been erased, retyped, or replaced. We show the use of backspacing between key combinations by a curved white line connecting the two keys while erasing the previously created stroke. In Figure 6.15 the thicker white curved line is drawn to imitate a crossing out motion in hand-written text where mistakes are not completely erased even when an eraser or white-out are used.

Figure 6.15: A trace of backspacing uses of curved lines similar to a paint stroke

We show message patterns through the frequency of letters and key combinations. The frequency of key combinations becomes visible through the overlap of the translucent strokes and white outlining. The frequency of a letter is emphasized through a translucent circle in the background. When a key is more frequently pressed, the colour of the circle will change from cool to warm colours. To aid discrimination and comprehension, we additionally encode repeated key presses with a splash of white dots around the key location increasing the radius and spread of the splash after each key press. The change in background colour is used to add dynamics and to balance the whole composition. Figure 15 shows all of the mentioned characteristics combined.

The interaction with our visualization is simple. As soon as one starts to type, the visualization space is filled with strokes in real-time and recently placed strokes are animated. The animation shows the strokes vibrating in the display for a short period of time to enforce the dynamic nature of the visualization and to show where the user has left off on the image. Typed messages can also be shown below the visualization (Figure 6.16). We noticed two different usage patterns during the use of our program. Many people tended to compose a meaningful text that was conveyed in the visualization (Figure 6.16a and Figure 6.16b). Others started to create actual paintings after learning how and where KeyStrokes were displayed in the visualization. The typed words did not have any meaning attached to it but the visualization created new semantics like in Figure 6.17 where a floral pattern was created.

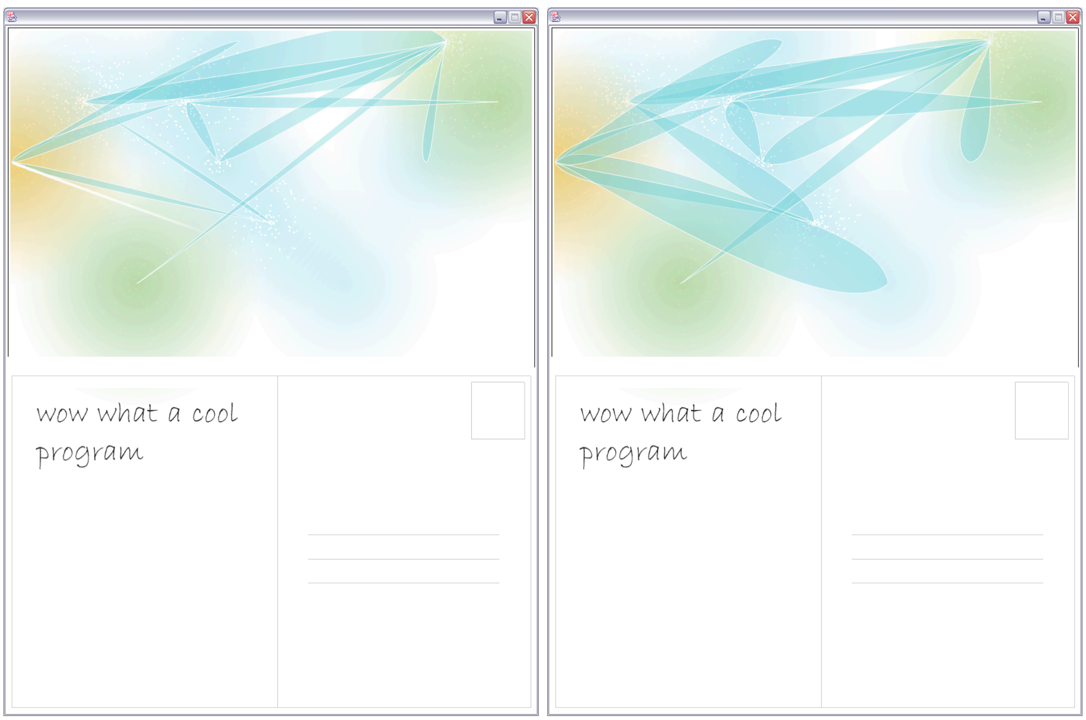


Figure 6.16: A meaningful message on an electronic postcard created by two different people.

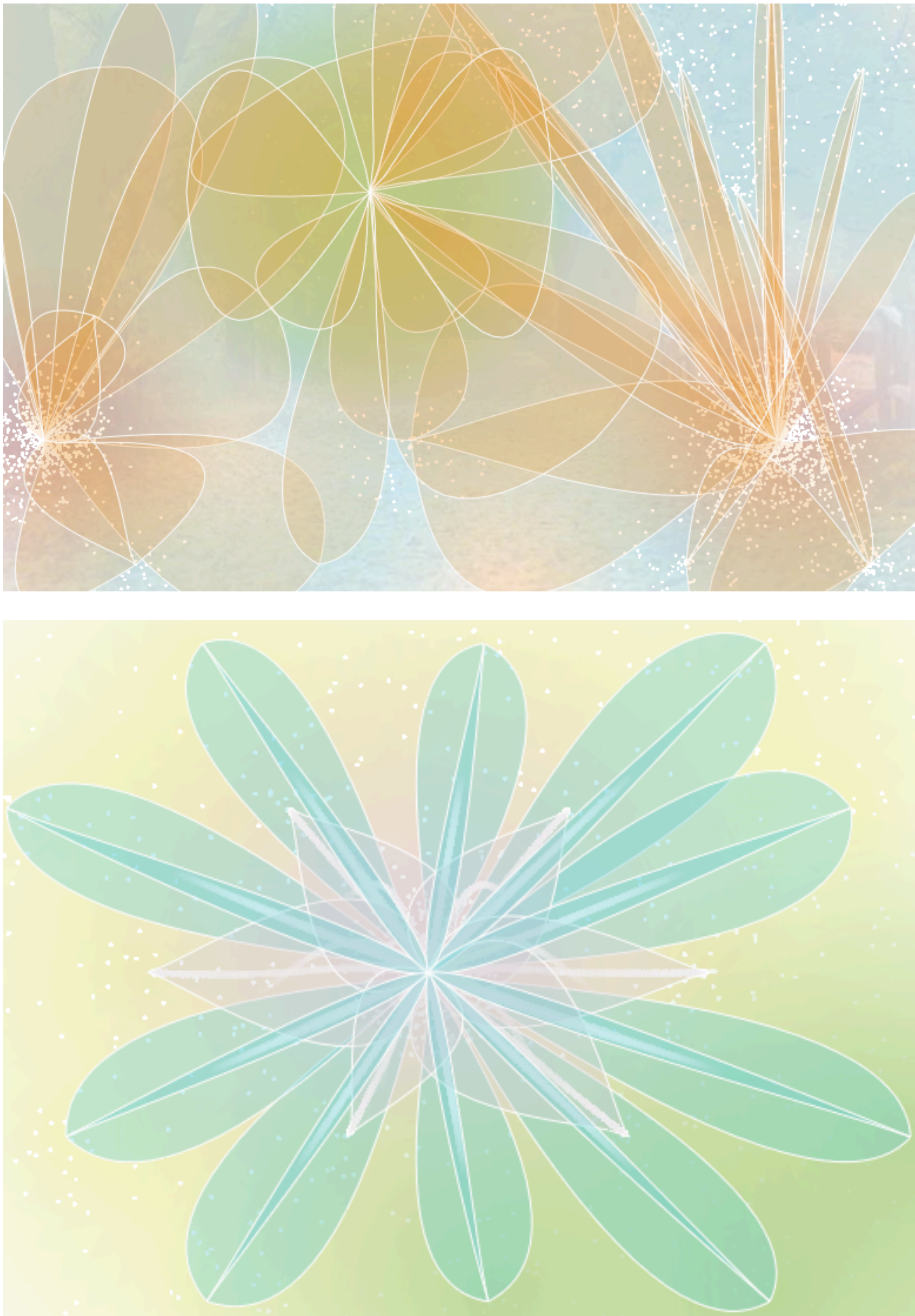


Figure 6.17: A message with visual semantics but no meaningful words.

With KeyStrokes, people can use language to make an abstract image. As a result the tool itself becomes a learned tool. People can create images in a more controlled manner by learning how different strokes are created. Not only can this visualization can become art but the participant themselves can make art by using Keystrokes.

6.6 Summary

My experiences in the art and computer science field led to my interest in attaining an interdisciplinary degree. On the computer science side, I enjoyed learning the algorithms and the mathematics involved in programming interactive 2D and 3D computer graphics and animation. In fine arts, I enjoyed learning the context behind the art works and choosing the medium and objects that will best represent the meaning behind my work. The combination of both of these fields allowed me to build visualizations involving the creation of algorithms and to explore meaningful representations.

There are similarities and differences in both computer science and art. A similarity I found in both fields is that they both involve solving problems. However, I found that the approaches solving problems from both fields varied from each other. With a computer science assignment, it was easy to judge when an assignment is complete based on whether the code created runs properly. In computer science, there is usually one goal to be reached: make a program work. This is similar to a mathematical question – we know a question has been solved once that one answer is figured out. However, in art, there is no one definitive answer. In fact, we are encouraged to think of multiple solutions. My approach to solving a visualization problem and the final appearance of the visualization has the influence of both sides of the fields. This is shown through the different visualizations I have created to represent digital conversations.

Chapter 7. Conclusion

Digital trace of text conversations opens new possibilities for analyzing and reviewing past conversations. By revisiting the information of text conversations, one is able to reminisce upon this material like a journal or diary. Not only can such a reflection be used to show personal and social awareness but also, one can discover and analyze overarching interaction patterns with other people. The discovery and analysis of these patterns could produce a powerful social tool in which social awareness can both positively and negatively affect how people view themselves and their social relationships with others as described in Chapter 5. In return, this may change how people socialize with others in future conversations. Thus, the ability to look at the quantity, frequency, emotional tone, etc. can provide deeper social significance in visualizing text conversations.

However, there are many problems that arise with text conversations. The initial problem with text conversation is that much of the rich, abundant information of face-to-face conversations is lost. Body language, tone of voice and facial expression is hidden in text; thus, recorded text is clearly impoverished. Another problem with text conversations is the sheer volume of visual space required for display. This makes comparisons between conversations of more than one person on the same screen visually cumbersome. A third problem with text conversations is that social patterns cannot be picked out at a glance as there are no visual cues. Plain text only represents the meaning of the words themselves. Whereas, visual cues such as colours and shapes can be used abstractly, thus, more appropriate for identifying visual patterns. For instance, if the words used to describe the emotional state of anger were highlighted in red within a body of text, it would be much easier to pick out and identify the frequency, quantity, and in general the tone of the message that was written.

A variety of new visualizations have been created in response to these problems are listed in Chapter 2. These visualizations capture and present salient social information that is not easily noticeable in plain text. By providing a visual representation, this kind of social information can be discerned more easily and expressed with more information.

The choices of representation and presentation style are important factors to be considered when designing visualizations. Therefore, I have created and followed a consistent design methodology for visualizing social and temporal interactions in digital conversation. The visual appearance of my visualizations differs considerably, but the basic design methodology followed is the same for each of them. Here is a summary of the four basic processes that was mentioned in Chapter 1.

1) Deciding on what data the visualization should be based on who is interested in the visualization and what they might want to learn.
2) Choosing a metaphor and/or constraints. This step sets the stage for developing a unique but consistent visual appeal.
3) Developing meaningful and expressive mappings from the text data to a visual representation, given the choice in step two.
4) Choosing interactions that enable a person to use and manipulate the visualization to have a good fit with the representation as created in step three.

The following sections encapsulate the three digital conversation visualizations I created.

Bubba Talk: Transcribed Digital Conversations

The intention of Bubba Talk was to provide a visual impression of the quality and tone of the conversation that took place in the meeting. For this visualization, text data was transcribed from a recorded conversation of a meeting. For this piece, visualization constraints were used; within the visual limits of circles and pastels, I developed an abstract representation of social interaction patterns in conversation. More specifically, the goal was to find visual representations that responded to volume of postings, number of characters, number of words, and number of punctuation.

The Plant Post: Bulletin Board Message Systems

The Growing Message Post was designed for an interactive art gallery setting. Viewers were able to walk up to this system and type a new message or add a message in response to the previous postings. The data focus was on temporality such as sequencing, time gaps between postings and age of a particular message. In keeping with this data aspect, a visualization metaphor of a plant growing and aging was chosen. Using the same plant metaphor, word complexity was also incorporated into the same visualization by varying characteristics of the plant such as changing the thickness of the leaf lines. On this message-board conversation, length of time since last posting was used to position the start of the new posting and the age of each posting would change colours like autumn and eventually each leaf, containing a word inside, would fall to the ground below.

CrystalChat: Instant Messaging Chat History

This study of Instant Messaging Systems explores the design space of developing representations that visualize the patterns of the social network and temporal aspects of instant messaging archives. CrystalChat focuses on visualizing the social interaction centered around one person, supporting personal use for exploring one's own chat history. In developing CrystalChat as a visualization that combines social and temporal data, I work with the constraint of 2D planes within a 3D environment. Here the constraint is the focus of the design process and the metaphor of a crystal with its multiple planer facets came later. The goal of the design is to combine the social network and the temporal aspect into one 3D representational structure. Patterns were created to reveal information about temporal clustering, conversation initiation, conversation termination, length of conversations, length of postings, patterns of repeating or alternating postings, and emotional tone as represented by emoticons.

Discussion

These three visualizations show that many characteristics of a digital text conversation can be visualized. By analyzing the resulting patterns of Bubba Talk, one can see who was speaking with whom, who was interacting the most, and one can gain some impression of the speaker's emotional state. With the Plant Post visualization, one is able to gather historical information of postings by looking at the overall patterns visually afforded by the metaphoric representation of a plant. Different visual characteristics of the plant can also convey word and reading complexity. The visualization of CrystalChat as one single visual structure is capable of revealing temporal interactivity and providing information of one's social network through quantity and frequency of message postings. This structure also provides the emotional content of chat dialog.

In all my projects, representations were carefully chosen to help make social information more apparent in textual conversations as well as visually appealing. While existing patterns emerge visually through effective social visualization, peoples' memories of the past can surface and storytelling can occur. Furthermore, personal social habits can be realized and can influence one's future social interaction with people. The application of simple design methodology allows graphical patterns to revolve around the conversation, creating abstract structures. These visualizations are created differently in comparison to traditional information representations. From the positive responses given by many people, the appeal of these visualizations plays a big part in gaining peoples' attention and positive attitude view upon these systems. However, one must be careful not to get too carried away with aesthetic considerations as accurate and precise representations of information are still important. Providing visualizations for people to view their own conversation through an inviting graphical environment can encourage and allow people to view their past conversations and examine their own social patterns.

Appendix A. References

(2003), Social circles, http://www.marumushi.com/apps/socialcircles/.

(2004), Locus, http://locus.e-mu.org/index.php.

Peotry on the Road (2005 and 2006), http://www.poetry-on-the-road.com/.

Bertin, J. (1983), Semiology of graphics: Diagrams, networks, maps., University of Wisconsin Press.

Card, S., Mackinlay, J. and Shneiderman, B. (1999), Information visualization, using vision to think, San Francisco, Morgan kaufmann Pubulishers, Inc.

Collins, C. (2006), Docuburst: Document content visualization using language structure. In *Poster Presentations of the IEEE Symposium on Information Visualization (InfoVis 2006)*, IEEE Press.

Decamp, P., Frid-Jimenez, Guiness, J. and Roy, D. (2005), Gist icons: Seeing meaning in large bodies of literature. In *Poster Presentations of the IEEE Symposium on Information Visualization (InfoVis 2005)*, IEEE Press.

Diamond, S. (2002), Codezebra, http://www.codezebra.net

Donath, J. (1995), Visual who: Animating the affinities and activities of an electronic community. In *Proceedings of the third ACM International Conference on Multimedia*, ACM Press, 99-107.

Donath, J., Karahalios, K. and Viégas, F. (1998), Visualizing conversations. In *Proceedings of the 32nd Hawaii International Conference on systems sciences (HICSS 1998)*, IEEE Press Volume 2.

Donath, J., Karahalios, K. and Viégas, F. (2000), Visiphone. In *Proceeding of International community for auditory display (ICAD 2000)*.

Donath, J., Lee, H. Y., Boyd, D. and Goler, J. (2001), Loom2: Intuitively visualizing usenet, http://smg.media.mit.edu/projects/loom2/.

Donath, J., Spiegel, D., Lee, M., Dobson, M. and Goldberg, K. (2001), Collaborative tele-directing. In *CHI '01 extended abstracts on Human factors in computing systems*, ACM Press, 331-332.

Donath, J. and Viegas, F. (2002), The chat circles series: Explorations in designing abstract graphical communication interface. In *Proceedings of the Conference on Designing interactive systems: processes, practices, methods, and techniques*, ACM Press, 359-369.

Erickson, T. (2003), Designing visualizations of social activity: Six claims. In *CHI '03 extended abstracts on Human factors in computing systems*, ACM Press, 846-847.

Erickson, T. and Laff, M. (2001), The design of the 'babble' timeline: A social proxy for visualizing group activity over time. In *CHI '01 extended abstracts on Human factors in computing systems*, ACM Press, 329-330.

Erickson, T., Smith, D., Kellogg, W., Laff, M., Richards, J. and Bradner, E. (1999), Socially translucent systems: Social proxies, persistent conversation, and the design of "babble". In *Proceedings of the SIGCHI conference on Human factors in computing systems (CHI 1999)*, ACM Press, 72-79.

Farnham, S., Portnoy, W., Tursky, A., Cheng, L. and Dave, V. (2003), Personal map: Automatically modeling the user's online social network. In *Proceeding of Human Computer Interaction (INTERACT 2003)*, IOS Press, 567-574.

Fiore, A. (2006), Revealing communication patterns in an online dating system. In *ACM CHI Workshop on Social Visualization: exploring text, audio, and video interactions (CHI 2006)*, ACM Press.

Freeman, L. (2000), "Visualizing social networks," Journal of Social Structure, Volume 1.

Havre, S., Hetzler, B. and Nowell, I. (2000), Themeriver: Visualizing theme changes over time. In *Proceedings of IEEE Symposium on Information Visualization (Infovis 2000)*, IEEE Press, 115-123.

Heer, J. and Boyd, D. (2005), Vizster: Visualizing online social networks. In *Proceeding of the IEEE Symposium on Information Visualization (Infovis 2005)*, IEEE Press, 32-39.

Jarrett, A. and Dennis, B. (2005), Nuseye: Designing for social navigation in syndicated content. In *Diversity in Computing Conference, Richard Tapia Celebration of 2005* 17-19.

Karahalios, K. and Viégas, F. (2006), Social visualization: Exploring text, audo, and video interaction. In *CHI '06 extended abstracts on Human factors in computing systems (CHI 2006)*, ACM Press, 1667-1670.

Karahalios, K. A. B., T. (2006), Conversation clock. In *Proceedings of the First IEEE International Workshop on Horizontal Interactive Human-Computer Systems (TableTop 2006)*, IEEE Press.

Kerr, B. (2003), Thread arcs: An email thread visualization. In *Proceedings of IEEE Symposium on Information Visualization (Infovis 2003)*, IEEE Press, 477-482.

Kurlander, D., Skelly, T. and Salesin, D. (1996), Comic chat. In *Proceeding of the 23rd annual conference on Computer graphics and interactive techniques*, ACM Press, 225-236.

Kurosu, M. and K., K. (1995), Determinants of the apparent usability. In *Proceedings of IEEE SMC*, IEEE Press, 1509-1513.

Lam, F. (2006), Cheiro. In *ACM CHI Workshop on Social Visualization: exploring text, audio, and video interactions*.

Lee, M. (2001), Chatscape.

Light, J. and Miller, J. (2002), Miramar: A 3d workplace. In *Proceedings of IEEE International Professional Communication Conference (IPPC 2002)*, IEEE Press, 271-282.

Liu, H. and Maes, P. (2005), The aesthetiscope: Visualizing aesthetic readings of text in color space. In *Proceedings of 18th International FLAIRS Conference Special Track on AI in music and art*, AAAI Press, 74-79.

Mandic, M. and Kerne, A. (2005), Using intimacy, chronology and zooming to visualize rhythms in email experience. In *CHI '05 extended abstracts on Human factors in computing systems*, ACM Press, 1617 - 1620

Mohamed, R., Reguson, J., Mac Cormick, A. and Elsweiler, D. (2004), Developing bulletin board visualisations In *Proceedings of the International Conference on web based communities (IADIS 2004)*, IADIS Press, 11-18.

Mutton, P. (2004), Inferring and visualizing social networks on internet relay chat. In *Proceedings eixth International Conference on Information Visualization (IV 2004)*, IEEE Press, 35-43.

Neumann, P., Tat, A., Zuk, T. and Carpendale, S. (2006), Personalizing typed text through visualization. In *Poster Presentations of the IEEE Symposium on Information Visualization (InfoVis 2006)*, IEEE Press.

Neumann, P., Tat, A., Zuk, T. and Carpendale, S. (2007), Keystrokes: Personalizing typed text with visualization. In *Proceedings of Eurographics / IEEE VGTC Symposium on Visualization*, IEEE Press, To appear and will be available at http://dlib.eg.org.

Neustaedter, C., Greenberg, S. and Carpendale, S. (2002), Imvis: Instant messenger visualization. In *Proceedings of the 2002 ACM on Computer suppported cooperative work video program. (CSCW 2002)*, ACM Press, 6.

Norman, D. (2002), Emotion and design: Attractive things work better., Interactions Magazine**:** 36-42.

Nunes, M. (2006), Video traces. In *ACM CHI Workshop on Social Visualization: exploring text, audio, and video interactions (CHI 2006)*, ACM Press.

Paley, W. (2002), Textarc: Showing word frequency and distribution in text. In *Poster Presentations of the IEEE Symposium on Information Visualization (InfoVis 2002)*.

Perry, E. (2004), Anthropomorphic visualization: A new approach for depicting participants in online spaces In *CHI 2004, extended abstracts on Human factors in computing systems*, ACM Press, 1115-1118.

Plaisant, C., Milash, B., Rose, A., Widoff, S. and Shneiderman, B. (1996), Lifelines: Visualizing personal histories. In *Proceedings of the SIGCHI Conference on Human factors in computing systems CHI 1996*, ACM Press, 221-227.

Rodenstein, R. and Donath, J. (2000), Talking in circles: Designing a spatially-grounded audioconferencing environment In *Proceedings of SIGHCHI Conference Human factors in computing systems (CHI 2000)*, ACM Press, 81-88.

Rohrer, R., Ebert, D. and Sibert, J. (1998), The shape of shakespeare: Visualising text using implicit surfaces. In *Proceedings of the IEEE symposium of Information Visualization (InfoVis 1998)*, IEEE Press, 121-129.

Sack, W. (2000), Conversation map: A content-based usenet newsgroup browser. In *Proceedings of the 5th International Conference on intelligent user interfaces* ACM Press, 233 - 240

Smith, M., Farnham, S. and Drucker, S. (2000), The social life of small graphical chats. In *Proceedings of SIGHCHI Conference Human factors in computing systems (CHI 2000)*, ACM Press, 462-469.

Smith, M. and Fiore, A. (2001), Visualization components for persistent conversations. In *Proceedings of the SIGCHI conference on Human factors in computing systems (CHI 2001)*, ACM Press, 136-143.

Spiegel, D. (2001), Coterie: A visualization of the conversational dynamics within irc, MIT, Master's Thesis.

Tat, A. and Carpendale, S. (2002), Visualizing human dialog. In *Proceedings sixth International Conference on Information Visualization (IV 2002)*, IEEE Press, 16-21.

Tat, A. and Carpendale, S. (2006), Crystalchat: Visualizing personal chat history. In *Proceedings of the 39th Annual Hawaii International Conference on system sciences (HICSS 2006)*, IEEE Press Volume 3.

Tat, A., Kruger, R., Carpendale, S. and Dunning, A. (2006), Plant post: Visualizing temporal aspects of message postings. In *Poster Presentations of the IEEE Symposium on Information Visualization (InfoVis 2006)*, IEEE Press.

Tractinsky, N. (1997), Aesthetics and apparent usability: Empirically assessing cultural and methodological issues. In *Proceedings of SIGCHI conference on Human factors in computing systems (CHI 1997)*, ACM Press, 115-122.

Viégas, F., Howe, E. and Donath, J. (2004), Artifacts of the presence era: Using information visualization to create an evocative souvenir. In *Proceedings of the IEEE Symposium on Information Visualization (Infovis 2004)*, IEEE Press, 105-111.

Viégas, F. and Smith, M. (2004), Newsgroup crowds and authorlines: Visualizing the activity of individuals in conversational cyberspaces. In *Proceedings of the 37th Hawaii International Conference on system sciences (HICSS 2004)*, IEEE Press Volume 4.

Viégas, F., Wattenberg, M. and Dave, K. (2004), History flow: Studying cooperation and conflict between authors. In *Proceedings of the SIGCHI conference on Human factors in computing systems (CHI 2004)*, ACM Press, 575-582.

Viégas, F. A. D., J. (1999), Chat circles. In *Proceedings of SIGCHI conference on Human factors in computing systems (CHI 1999)*, ACM Press, 9-16.

Viégas, F. A. D., J. (2004), Digital artifacts for remembering and storytelling: Posthistory and social network fragments. In *Proceedings of the 37th Hawaii International Conference on system sciences (HICSS 2004)*, IEEE Press Volume 4.

Ware, C. (2000), Information visualization, perception for design, San Francisco, USA, Morgan Kaufmann Publishers.

Wattenberg, M. (2005), Baby names: Visualization and social data analysis. In *Proceeding of the IEEE Symposium on Information Visualization (Infovis 2005)*, IEEE Press, 1-7.

Wise, J., Thomas, J., Pennock, K., Lantrip, D., Pottier, M., Schur, A. and Crow, V. (1995), Visualizing the non-visual: Spatial analysis and interaction with information from text documents. In *Proceedings of IEEE Symposium Information Visualization, (InfoVis 1995)*, IEEE Press, 51-58.

Xiong, R. and Donath, J. (1999), Peoplegarden: Creating data portraits for users. In *Proceedings of the 12th annual ACM symposium on User interface software and technology*, ACM Press, 37-44.

Appendix B. Co-Author Permission Forms

Appendix C.

Appendix D. http://www.thepalace.com/ (1999), The palace, http://www.thepalace.com/.

Appendix E.

Appendix F. Bertin, J. (1983), Semiology of graphics: Diagrams, networks, maps., University of Wisconsin Press.

Appendix G.

Appendix H. Donath, J. (1995), Visual who: Animating the affinities and activities of an electronic community. In *Proceedings of the third ACM International Conference on Multimedia*, ACM Press, 99-107.

Appendix I.

Appendix J. Donath, J., Karahalios, K. and Viégas, F. (1998), Visualizing conversations. In *Proceedings of the 32nd Hawaii International Conference on systems sciences (HICSS 1998)*, IEEE Press Volume 2.

Appendix K.

Appendix L. Donath, J., Lee, H. Y., Boyd, D. and Goler, J. (2001), Loom2: Intuitively visualizing usenet, http://smg.media.mit.edu/projects/loom2/.

Appendix M.

Appendix N. Donath, J. and Viegas, F. (2002), The chat circles series: Explorations in designing abstract graphical communication interface. In *Proceedings of the Conference on Designing interactive systems: processes, practices, methods, and techniques*, ACM Press, 359-369.

Appendix O.

Appendix P. Erickson, T. (2003), Designing visualizations of social activity: Six claims. In *CHI '03 extended abstracts on Human factors in computing systems*, ACM Press, 846-847.

Appendix Q.

Appendix R. Erickson, T. and Laff, M. (2001), The design of the 'babble' timeline: A social proxy for visualizing group activity over time. In *CHI '01 extended abstracts on Human factors in computing systems*, ACM Press, 329-330.

Appendix S.

Appendix T. Erickson, T., Smith, D., Kellogg, W., Laff, M., Richards, J. and Bradner, E. (1999), Socially translucent systems: Social proxies, persistent conversation, and the design of “babble”. In *Proceedings of the SIGCHI conference on Human factors in computing systems (CHI 1999)*, ACM Press, 72-79.

Appendix U.

Appendix V. Freeman, L. (2000), "Visualizing social networks," Journal of Social Structure, Volume 1.

Appendix W.

Appendix X. Havre, S., Hetzler, B. and Nowell, I. (2000), Themeriver: Visualizing theme changes over time. In *Proceedings of IEEE Symposium on Information Visualization (Infovis 2000)*, IEEE Press, 115-123.

Appendix Y.

Appendix Z. Heer, J. and Boyd, D. (2005), Vizster: Visualizing online social networks. In *Proceeding of the IEEE Symposium on Information Visualization (Infovis 2005)*, IEEE Press, 32-39.

Appendix AA.

Appendix BB. Karahalios, K. and Viégas, F. (2006), Social visualization: Exploring text, audo, and video interaction. In *CHI '06 extended abstracts on Human factors in computing systems (CHI 2006)*, ACM Press, 1667-1670.

Appendix CC.

Appendix DD. Kerr, B. (2003), Thread arcs: An email thread visualization. In *Proceedings of IEEE Symposium on Information Visualization (Infovis 2003)*, IEEE Press, 477-482.

Appendix EE.

Appendix FF. Kurlander, D., Skelly, T. and Salesin, D. (1996), Comic chat. In *Proceeding of the 23rd annual conference on Computer graphics and interactive techniques*, ACM Press, 225-236.

Appendix GG.

Appendix HH. Kurosu, M. and K., K. (1995), Determinants of the apparent usability. In *Proceedings of IEEE SMC*, IEEE Press, 1509-1513.

Appendix II.

Appendix JJ. Light, J. and Miller, J. (2002), Miramar: A 3d workplace. In *Proceedings of IEEE International Professional Communication Conference (IPPC 2002)*, IEEE Press, 271-282.

Appendix KK.

Appendix LL. Mandic, M. and Kerne, A. (2005), Using intimacy, chronology and zooming to visualize

Appendix MM. rhythms in email experience. In *CHI '05 extended abstracts on Human factors in computing systems*, ACM Press, 1617 - 1620

Appendix NN.

Appendix OO. Mohamed, R., Reguson, J., Mac Cormick, A. and Elsweiler, D. (2004), Developing bulletin board visualisations In *Proceedings of the International Conference on web based communities (IADIS 2004)*, IADIS Press, 11-18.

Appendix PP.

Appendix QQ. Mutton, P. (2004), Inferring and visualizing social networks on internet relay chat. In *Proceedings eixth International Conference on Information Visualization (IV 2004)*, IEEE Press, 35-43.

Appendix RR.

Appendix SS. Neumann, P., Tat, A., Zuk, T. and Carpendale, S. (2006), Personalizing typed text through visualization. In *Poster Presentations of the IEEE Symposium on Information Visualization (InfoVis 2006)*, IEEE Press.

Appendix TT.

Appendix UU. Neumann, P., Tat, A., Zuk, T. and Carpendale, S. (2007), Keystrokes: Personalizing typed text with visualization. In *Proceedings of Eurographics / IEEE VGTC Symposium on Visualization*, IEEE Press, To appear and will be available at http://dlib.eg.org.

Appendix VV.

Appendix WW. Norman, D. (2002), Emotion and design: Attractive things work better., Interactions Magazine: 36-42.

Appendix XX.

Appendix YY. Plaisant, C., Milash, B., Rose, A., Widoff, S. and Shneiderman, B. (1996), Lifelines: Visualizing personal histories. In *Proceedings of the SIGCHI Conference on Human factors in computing systems CHI 1996*, ACM Press, 221-227.

Appendix ZZ.

Appendix AAA. Sack, W. (2000), Conversation map: A content-based usenet newsgroup browser. In *Proceedings of the 5th International Conference on intelligent user interfaces* ACM Press, 233 - 240

Appendix BBB.

Appendix CCC. Smith, M., Farnham, S. and Drucker, S. (2000), The social life of small graphical chats. In *Proceedings of SIGHCHI Conference Human factors in computing systems (CHI 2000)*, ACM Press, 462-469.

Appendix DDD.

Appendix EEE. Spiegel, D. (2001), Coterie: A visualization of the conversational dynamics within irc, MIT, Master's Thesis.

Appendix FFF.

Appendix GGG. Tat, A. and Carpendale, S. (2002), Visualizing human dialog. In *Proceedings sixth International Conference on Information Visualization (IV 2002)*, IEEE Press, 16-21.

Appendix HHH.

Appendix III. Tat, A. and Carpendale, S. (2006), Crystalchat: Visualizing personal chat history. In *Proceedings of the 39th Annual Hawaii International Conference on system sciences (HICSS 2006)*, IEEE Press Volume 3.

Appendix JJJ.

Appendix KKK. Tat, A., Kruger, R., Carpendale, S. and Dunning, A. (2006), Plant post: Visualizing temporal aspects of message postings. In *Poster Presentations of the IEEE Symposium on Information Visualization (InfoVis 2006)*, IEEE Press.

Appendix LLL.

Appendix MMM. Tractinsky, N. (1997), Aesthetics and apparent usability: Empirically assessing cultural and methodological issues. In *Proceedings of SIGCHI conference on Human factors in computing systems (CHI 1997)*, ACM Press, 115-122.

Appendix NNN.

Appendix OOO. Viégas, F., Howe, E. and Donath, J. (2004), Artifacts of the presence era: Using information visualization to create an evocative souvenir. In *Proceedings of the IEEE Symposium on Information Visualization (Infovis 2004)*, IEEE Press, 105-111.

Appendix PPP.

Appendix QQQ. Viégas, F. and Smith, M. (2004), Newsgroup crowds and authorlines: Visualizing the activity of individuals in conversational cyberspaces. In *Proceedings of the 37th Hawaii International Conference on system sciences (HICSS 2004)*, IEEE Press Volume 4.

Appendix RRR.

Appendix SSS. Viégas, F. A. D., J. (1999), Chat circles. In *Proceedings of SIGCHI conference on Human factors in computing systems (CHI 1999)*, ACM Press, 9-16.

Appendix TTT.

Appendix UUU. Viégas, F. A. D., J. (2004), Digital artifacts for remembering and storytelling: Posthistory and social network fragments. In *Proceedings of the 37th Hawaii International Conference on system sciences (HICSS 2004)*, IEEE Press Volume 4.

Appendix VVV.

Appendix WWW. Ware, C. (2000), Information visualization, perception for design, San Francisco, USA, Morgan Kaufmann Publishers.

Appendix XXX.

Appendix YYY. Wattenberg, M. (2005), Baby names: Visualization and social data analysis. In *Proceeding of the IEEE Symposium on Information Visualization (Infovis 2005)*, IEEE Press, 1-7.

Appendix ZZZ.

Appendix AAAA. Xiong, R. and Donath, J. (1999), Peoplegarden: Creating data portraits for users. In *Proceedings of the 12th annual ACM symposium on User interface software and technology*, ACM Press, 37-44.

Appendix BBBB.

Appendix CCCC.

Appendix DDDD.