



UPPSALA
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IT 12 007

Examensarbete 15 hp
Mars 2012

Out of Space

Creating an Interactive Visualization

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Abstract

Out of Space

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When attempting to visualize large amounts of data a question arises on how one is to display all of it while avoiding to confuse the viewer. The predicament at hand is one of balancing a loss of information and a loss of comprehension. The objective of this thesis is, through the means of an interactive visualization; to find a well proportioned solution to this problem. The method used is genius design instead of the more favoured user-centred design. The problem is tackled by the use of theories from Human-Computer Interaction and Information Visualization resulting in a design largely influenced by a principle of Ben Shneiderman. The result is a thorough design based on known theories and my own ideas. Although untested in practice, the approach should be considered if faced with the same problem in the future.

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Summary in Swedish

Ett vanligt förekommande problem då stora mängder data ska visualiseras är att ytan allokerad för visualiseringen inte är stor nog för att visa all data. Detta är ofta ett problem relaterat till att hitta en balans mellan tappad data och försämrade läsbarhet av datan. För mycket data kan leda till att visualiseringen blir svårtolkad och genom att skära bort en del av datan så kan också en del av meningen gå förlorad. Målet för denna uppsats är att genom att skapa en interaktiv visualisering hitta en bra balans mellan dessa.

Som arbetsmetod för uppsatsen valdes den populära och erkända användarcentrerad design bort till förmån för den mindre erkända genidesign. Istället för att involvera användare i processen så angreps problemet primärt med teorier från människa-dator interaktion och informationsvisualisering samt med personlig innovation. I synnerhet var följande princip av Ben Shneiderman vägledande under utformandet av lösningen: *"Översikt först, zoom och filtrering, sedan detaljer på begäran"*.

Resultatet är en design med många lager av funktionalitet där mycket tid har lagts på att utforma en dynamisk zoom-funktion. Det är en interaktiv visualisering där åskådaren får samspela och interagera med datan för att hitta det som är av intresse. Även om lösningen inte är testad i praktiken så borde den beaktas av någon som står inför samma problem i framtiden.

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1 Introduction

During an innovation process many thoughts and ideas are shared. This is without doubt a good aspect but it also poses a problem when one attempts to visualize the process. The question that arises is how one is to handle the large amount of information displayed while avoiding to overflow and confuse the viewer. The predicament we have in hand is one of balance. A balance needs to be struck between a loss of information and a loss of comprehension. On one hand one could remove excess information thereby denying the viewer of the full range of information. On the other hand, displaying all the information available will result in an impractical and perplex view. My goal is to come up with a design that can handle this balance well.

I begin the paper by giving a background and discussion of the problem and then move on to my methodology. The methodology for my design process is based on genius design. I then present the underlying theories used, for instance Ben Shneiderman's principle "*Overview first, zoom and filter, then details on demand*". Then I present my results consisting of a proposed design. Lastly I discuss the methods used and the resulting design.

1.1 Background

A software platform for open innovation is being developed to generate innovation and share intellectual property. It is a research project at Tongji University in Shanghai. On this platform people will be able to create innovation projects, either public or private, which they can then discuss and contribute ideas to. Different ideas from different people will generate a sharing environment where people's involvement in the project will be measured and intellectual property calculated from this.

This paper will address the time view of a project on the platform. A graphical user interface is needed to show details about the progression of the project from the perspective of time. Using theories of Human-Computer Interaction and Interaction Design a design of the time view will be developed along with this paper in which the process of the design is captured and discussed.

1.2 Problem

The time view of the project is meant to give an overview of how the project has progressed and at the same time be able to provide detailed information if needed. Every thought and idea, essentially, will correspond to one node in the time view of the project making the number of nodes very large. For example, if a user creates a post with a picture of a design that could be used in the project, this post will be one node in the time view. Furthermore, the comments on this post will not be separate nodes in the time view, but the chance of there being a lack of space is still great. With a large amount of nodes in the view it will be difficult for the view to fulfil its initial meaning of providing an overview.

That is the problem that this paper will address. To reach a solution different ways of displaying the nodes will be considered and discussed. There are a lot of questions that need an answer, such as: Which information should be displayed? How to provide the user with a good overview? Is there a good way for the user to interact with the time view to get desired information? etc.

1.3 Methodology

The foundation for this paper will lie in principles and theories of Human-Computer Interaction (HCI).

1.3.1 Design Process

The design process used is based on the four basic activities in interaction design.[2]

1. *Identifying Needs and Establishing Requirements*

The objective of this phase is to research the problem and gain a broader knowledge of what is expected from the solution. This phase will end with a brainstorming session to gather all the ideas that will undoubtedly surface during the research.

2. *Developing a Design*

By combining the newly gained knowledge about the problem from the previous phase, HCI-theories and personal skills, a design to solve the problem and conform to the requirements is developed.

3. *Evaluating the Design*

The evaluation of the design will be fairly short and informal. It will involve potential users who will give their feedback after considering a prototype drawn on paper.

4. *Refining the Design*

The feedback and results from the evaluation will be considered and the design will be improved where it is needed and possible.

I have modified the process to suit the problem and the project in question. A big factor in modifying the process was the time which limits the potential scope of the process. There is not enough time for extensive user surveys and developing a range of alternative designs that will all be evaluated by users in the end. What I needed was a process that is concise and to the point. That means potential users will only be involved at critical moments and the interaction with them will be informal and not documented to every detail. This is to save time and focus more on innovation and use of known HCI principles and design patterns. More discussion about the decision to only involve users sporadically in the process can be found in the section labelled *User-Centered Design vs Genius Design*.

Throughout the process different HCI principles will be applied and known HCI theories consulted.

1.3.2 User-Centered Design vs Genius Design

A discussion I feel is relevant for this paper is the involvement of users in the design process. How much should the users be involved? What difference does it make? To discuss this further I will introduce the concepts of User-Centered Design and Genius Design[5]:

- *User-Centered Design*

User-Centered Design is the traditional methodical approach in which iteration and interaction with users is the way to reach a design. In each stage of the design process the users' needs, wants and limitations will be considered. It is a way to optimize the design around the user rather than making the users adapt to the design. User-Centered Design is a very successful method as the design is constantly being moulded to what the users want at the same time as risks are being discovered.

- *Genius Design*

Genius Design abandons the core values of User-Centered Design and instead relies heavily on the skills of the designer. No extensive research about and interaction with users is carried out. The intuition, experience and expertise of the designer are the major parts challenged when using this method.

This project is limited by time which becomes a good reason to consider Genius Design. User-Centered Design demands a lot of time to be put aside to interact with the users and follow the iterative steps of the method. Genius Design on the other hand is much quicker as all the decisions are made completely by the designer.

Another reason why Genius Design might be better for this specific project is that it will require me to be innovative and drive it forward. I will be challenged to use my creativity and knowledge to create the design. This paper serves to test my full potential.

The final design process I decided on has therefore strayed quite far from User-Centered Design and only in the evaluation stage will users be consulted. It will save time and challenge me more. As this is a paper to evaluate if I can apply what I have learnt, the Genius Design method can possibly make that job easier. One could on the other hand argue that User-Centered Design is a big part of HCI and my skills in that area should be evaluated. I believe that the skills I have to exhibit using the Genius Design method will be of more value to evaluate. A conclusion I would like to make is that it is of less significance which method is used, what matters in the end is the quality of the result.

2 Theory

2.1 The Problem of Space

The main problem to solve was the lack of space when the number of nodes to be displayed is high. By looking at the suggested initial node that is presented below in Figure 1 it is evident that it will not take many nodes before a whole time view is full. A modification of the node is required to be able to display a larger amount of them. The first step towards finding a suitable modification is to consider how the human memory works. This section will be comprised of my findings and discuss various possible approaches to solving this problem.

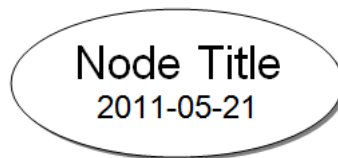


Figure 1: The initial design of a static node

2.2 Perceptions of the Human Mind

Our memory is a very complex entity that an interaction designer needs to have a good understanding of in order to make a good design. Because of its complexity there are various acknowledged theories out there but the most common and powerful theory suggests that the memory is divided into three different memory systems.[1, p. 536] The three systems are sensory memory, short-term (or working) memory and long-term memory.

- *Sensory Memory*

The sensory memory is the part of memory where what we have seen or heard is kept for a very short time. It can be seen as a part of the perception process and the information itself is not processed much. A design consideration related to the sensory memory is to make sure important events are focused on. The human mind can handle numerous events simultaneously but, due to the limitation of what can be processed to the short-term memory, events in the periphery might be lost.

- *Short-Term Memory*

The short-term memory consists of information from the sensory memory that we turn attention to and information that is retrieved to here from the long-term memory. It is here where the information is consciously perceived and processed. The information becomes activated which means that it is searchable with rapid speeds. A price we pay for this rapid search is that the short-term memory has a very limited capacity. The modern estimates of the capacity is at 4-5 items.[6] This needs to be carefully considered when making designs and a useful technique to deploy is chunking.[1, p. 339] Chunking groups information in a meaningful way making it easy to store chunks of information and thereby enlarging the storage capacity.

- *Long-Term Memory*

The long-term memory is where anything from facts to skills is stored permanently and the capacity is here basically unlimited. Memories can last from just a minute

to a lifetime. Two important mechanisms in the long-term memory are recall and recognition.[1, p. 539] Recall is the function that searches the memory for a particular piece of information without any clues. Recognition is the less effortful function as enough clues are given to makes it possible to decide in the search if the current piece of information found matches the wanted piece of information. The best practice is to enable the user to use recognition rather than recall in the design.

After considering how these memory systems work and their limitations I can make adjustments to the design of the node. To summarize the key points; the short-term memory should not be overloaded, chunking should be used and recognition should be supported. With these considerations and the original problem of space in mind I chose to make the node dynamic.

To be able to fit more nodes to the time view they will start at a small size and not contain any information in the form of text. Instead they will at this stage communicate meaning by the means of colour and position. But as the user moves the mouse around the time view, the now dynamic nodes will change their size and present an amount of information that is proportional to their distance from the mouse cursor. That is, the closer a node is to the mouse cursor, the bigger it will be and the more information it will show. Shortly put; the user shows interest with the mouse cursor and the time view responds by showing more information where interest is indicated.

The concept of this is that the group of nodes close to the mouse cursor will be in focus and sorted out from the rest. As a consequence of this the short-term memory is not overwhelmed with information from all the nodes. The coding of the information will also help to give the user a quick overview at the lowest level (when there is no zoom) as colours are easier to digest than a whole bunch of text. The process of coding the information will be discussed further in the upcoming section titled *Information Visualization*.



Figure 2: The evolution of a node.

As text often is quite a square element the choice of having the node in a round shape is not efficient. By adjusting it to a rounded rectangle the text fits better and the node can be scaled down to a smaller more efficient size if needed.



Figure 3: The same evolution but with a more efficient shape.

2.3 Information Visualization

Information visualization can be defined as "the use of computer-supported, interactive, visual representations of abstract data in order to amplify cognition"[3, p. 515] and is important for the solution of the problem of this paper. One can also speak about the term interactive visualization.[1, p. 349]

The core of this concept is described well by Card and especially good are the following points[3, p. 515] describing how the "amplified cognition" is achieved by:

- increasing the memory and resources available to people,
- reducing the search information,
- helping people to detect patterns in data,
- helping people draw inferences from the data,
- encoding data in an interactive medium.

Good practice is to keep these points in mind which I have when visualising information on an interactive stage. They were really helpful for me and kept me inside the frames of a good visualization design. Furthermore I let a known principle or mantra from an acknowledged visualizations developer guide me during the process of the development:

Overview first, zoom and filter, then details on demand.

- Ben Shneiderman [1, p. 349]

It corresponds greatly to my thoughts about how to solve the problem and thus became the backbone of the design. The concept is to first provide a full overview of the whole set of data, to allow zooming in to focus on details when required, to provide filtering options for the data, and lastly to give the user the opportunity to see more details on demand.

When applied directly to the problem at hand an overview is the first component to consider. This overview will be in form of unexpanded nodes without any text. The nodes will be of different colours signalling different things depending on the filter options. This is done with reference to item three in the list supplied earlier on the page, to help people detect patterns in the data and give the data meaning. The next step is the zoom function which has been described already in the section called *Perceptions of the Human Mind*. It acts as a magnifying glass centered on the mouse cursor. Filtering options will be added to the side of the time view. These options will let the user select what data to look at from the perspective of time. Lastly, there will be the option to click one of the nodes to bring up a detailed description of the node and a link to the source of it. Further details can be found in the next section; *Results*.

2.4 Mental Models

I want to highlight mental models as it is an aspect I had in mind while coming up with some of the design and functionality of the time view, for example the filters. A mental model is a mental representation of a person's understanding of a real life device. The model shows how the person reasons to use the device in question. Norman believes that mental models are incomplete and unstable.[1, p. 33] People forget details and their ability to keep different models separated is not that good. He also thinks that mental models are unscientific as people easily leave them if there is an easier way (less mental effort) to solve a problem. In addition, if something goes wrong people tend to rather start over than to

try to recover from the error. All these flaws pointed out by Norman are good to keep in mind when using a mental model and try to steer away from them or just adapt the model to work around them.

Mental models are good to use when you're interested in measuring the learnability and ease of use of a device. People develop a mental model of how they think the system works through interaction with the system. This model is used to reason about the system, to tell how the system will behave and explain why the system reacts as it does.

A mental model that is meant to be reused with this design is the mental model of interacting with a magnifying glass. Most people know that when they move a magnifying glass around it will make the things under it appear to be larger. On some of them it's also very similar to the zoom function used here as the center of the magnifying glass will be larger than on the sides. All this is useful as the function gets much easier to learn and use.

3 Results

3.1 Requirements

The requirements for the time view are not very comprehensive. Coming in to the project only one requirement was present, that is it should be an interactive visualization. After the research stage a few other requirements were added that act as a framework for what a good interactive visualization is.

The most important requirement found for the time view is that it needs to give a good overview of the project and its process while simultaneously enabling the user to show more details about information that is interesting. This means that there is a requirement of depth in the interaction. Furthermore a requirement for a good overview is that of pattern detection. If patterns can be detected in the process they can be used to evaluate the process and for example make decisions on how to improve the methods of work.

3.2 Proposed Design

3.2.1 Overview

The overview is the first stage of this interactive visualization. At this stage the nodes will all be shown and they will all be small to be able to fit in the view. Upon this static overview more layers of functionality will be added to make it more dynamic.

Important for the overview is that the user is able to group the data and see patterns. If you enable this in the design you will also give meaning to the data. To find out how to do this, one of the earliest contributions to the science of perception can be used.[4] The Gestalt School of Psychology looked into how we perceive pattern, form, and organization in what we see. They observed that we organize what we see in particular ways in an effort to make sense of it. There are six principles after which we group the information we see: proximity, similarity, enclosure, closure, continuity and connection. I have chosen to work mostly with proximity and similarity. In some filtering options the position and proximity will signal some sort of relation. When it comes to similarities I have chosen to work with colour before shape to signal coherence.

Colour is preferred over shape because colour, in this case, is better for enhancing pattern detection. Colour can also be extended to give extra meaning if needed in the future by adjusting the brightness of the colour. Also experimentation with shapes might cause more problems with space and add to the original problem.

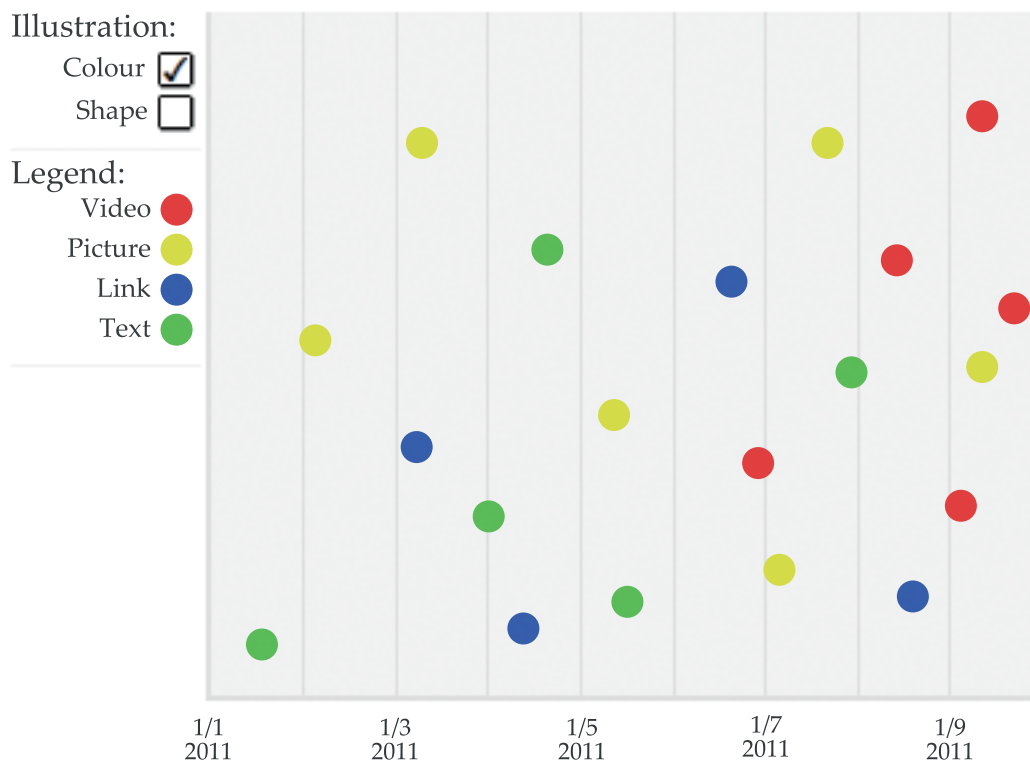


Figure 4: An overview of the type of nodes created in the project.

Looking at Figure 4 we get an overview of the type of nodes that have been created in the project. This example does not provide us with an extensive set of information but it is possible to see that posts with video only started to appear at the later stages of the project for example.

The choice of illustration for the user is added mostly for people that are colour blind. The preferred and default illustration is colour as it does not interfere with the zoom function. The shape alternative assigns a shape (square, triangle, octagon, etc.) to each type of node. As the shape evolves into a more mature node (as visualized in Figure 3) it will lose its original distinct shape and morph into the general node-shape. At the same time the node will present the content and therefore the character of the node is not fully lost in the morph. It is recognised that there is some loss in the morph with the shape illustration selected, that is why the colour illustration is the default and preferred selection.

The two alternatives for illustration can also be used together. As expected this will result in the nodes being shown with both colour and shape. Although redundancy springs to mind the addition of colour to the shapes can actually aid the colour blind as different shades from the colours can (in some cases) still be detected by them.

3.2.2 Zoom

The zoom function is meant to be intuitive and should therefore not be difficult to understand. It can be described as a magnifying glass around the mouse cursor and the nodes touched by it will increase in size. As the size increases more information will be fitted in the node as soon as it is big enough to fit the information. The node is bigger the closer it is to the mouse cursor. The evolution of a node when affected by this zoom function is shown in Figure 3 in section *Perceptions of the Human Mind*.

3.2.3 Ordering

If you look back at Figure 4 you can see that in that overview the y-axis has no label or meaning. Therefore the position of the nodes also do not communicate any meaning.

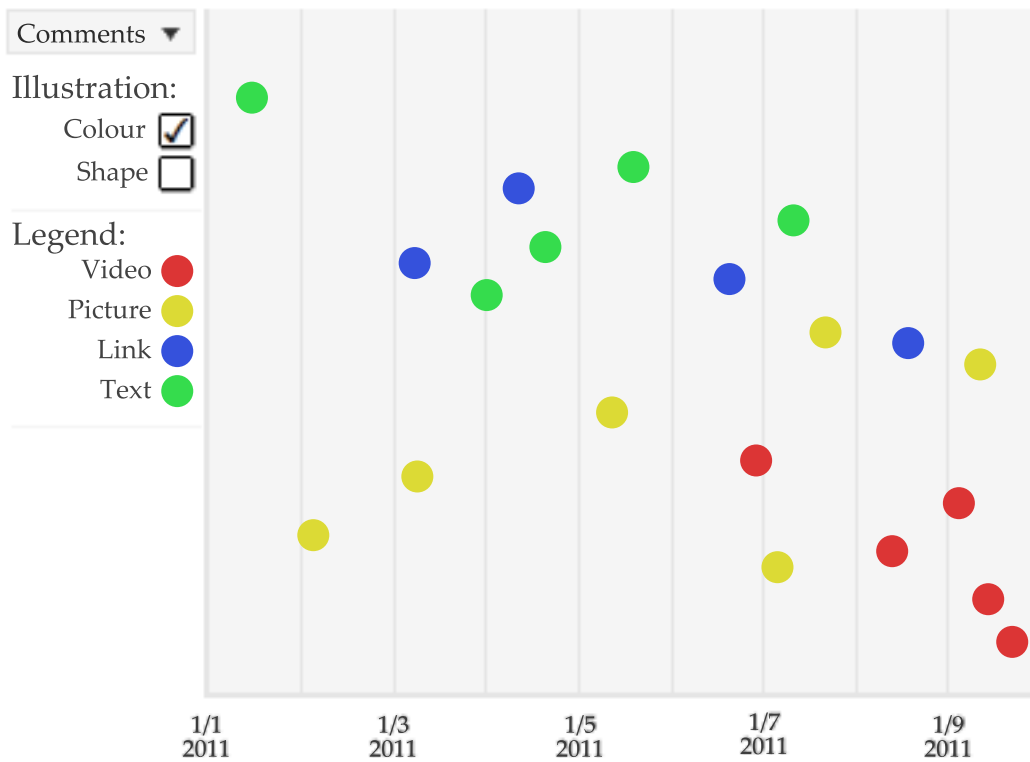


Figure 5: A time view ordered on the amount of comments each node has.

By adding a ordering button next to the y-axis, the user is able to choose the y-axis label and use that to order the nodes. This puts the y-axis in play and gives meaning to the position of the node. This can be a very powerful tool to instantly visualize what the user is looking for. Take a look at Figure 5 where the ordering option *comments* is chosen. The position of the nodes in relation to the y-axis communicate how many comments each node has. A hint is given by Figure 5 that link and text nodes has more comments and it is also possible to tell that the newest nodes have generally and expectedly less comments since they have had less time for discussion.

The goal is that the choice alone is enough for the user to intuitively understand that the y-axis now corresponds to the number of comments the node has. Hence, a node

positioned at the top means that it has a lot of comments and on the contrary a node with a position at the bottom of the view has only a few comments. If this would turn out to be an incorrect assumption, then a clearer y-axis label could be added. I tested this on users of different levels of computer literacy. Even though it took varied amount of time they all understood that they could choose a different y-axis ordering by choosing from the list located where the y-axis label is usually located. It should also be said that the name of this list of alternatives, which is visible when nothing is chosen, is *Y-Axis Ordering*.

3.2.4 Filtering

The data is now starting to have some meaning and the next step is to give the user a possibility to focus in on the data and find their desired information. This is done by filtering. By altering the settings on the filters the user can choose to only view the data that is interesting for the user and still keep all the other interaction features such as zooming and details on demand.

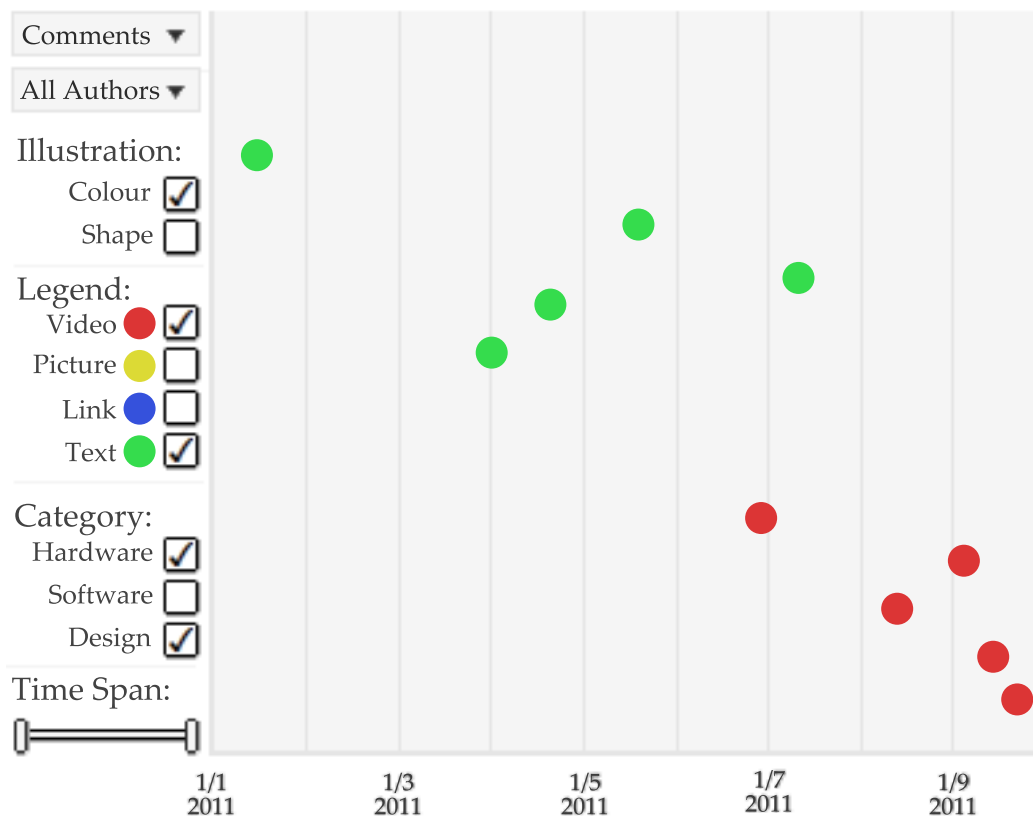


Figure 6: An example of filtering options applied to the time view.

In Figure 6 the example in Figure 5 is extended with some filters applied to it. The layout of the filtering options is done to support chunking and existing mental models. By presenting the data in meaningful groups (chunks) the storage capacity of the memory is increased and the interface is easier to digest for the user. Furthermore I tried to make the functions look and behave like other similar functions. By sticking to a standard, the same mental model can be used for my functions and thereby the user can reuse the mental

model of the function that already exists in memory. I will discuss this further in the section named *Mental Models*.

The first filtering option is authors. By clicking the button originally labelled *All Authors* a drop-down list of the authors appear and a selection can be made of which authors to show. A sensible design decision is to not restrict the users in this process. Thus, more than one author should be able to be selected from the list. If the number of authors is big the list will be a indexed multi-column list to fit them all. If even more space is needed the list will become scrollable.

The next filtering options are on *Type* and *Category*. They are basic filters to choose which kind of nodes to view. The *Type* option is combined with the *Legend*. The layout uses check boxes to indicate chosen types and categories to be displayed. Checkboxes are well known and therefore a good choice.

The last filter is a slider. This slider enables the user to adjust the time span which is displayed. It has two anchor points that can be moved. This slider relies on the standards used in the western world where we read from left to right and we see the left-most part as the starting point and the right-most part as the end. Here, left means the start of the time span and right means the end of it. As the slider is moved, a date will appear hovering above the slider to signal the actual date to which the user has filtered to. This is important as it is normal to want to filter to a specific date and with regular feedback it is also easier to control the slider.

3.2.5 Details on Demand

The last layer to this interactive visualization is called details on demand and it is a layer that provides the full details of a node upon a request from the user. It is implemented so that if the user clicks any node, the node will be focused and enlarged in front of all the other nodes temporarily halting the rest of the interaction. When the node is at this stage it will present its details including a description of what the node is about, a link to the original post, name of author, etc. The user will then have to close this detailed view in order to go back to the normal interaction with the zoom and the filter. The detailed view can be closed by either clicking a close button in the top right corner or by just clicking outside of the detailed view.

3.3 Collision Handling

Collision handling when the nodes increase in size by the zoom function is an intricate matter. The original problem of space is re-introduced. I have considered many different ways of handling it. I tried letting the nodes overlap each other. The node closest to the mouse cursor would then always be on top of the other nodes present in the same space. This alternative would keep the positions of the nodes static and therefore it would be easier to follow what happens as nothing moves, it would simply get bigger or smaller. A big downside with this is that a lot of content will be hidden as the overlapping happens.

Another alternative considered was to adjust the positions of the nodes so that they never overlap but instead move to make space for each other. Then it would be possible to always see the full nodes but it will also create a problem as the nodes will start pushing other nodes out of the view. Another problem with this solution is that if the position of the node has a meaning it will be lost when zooming ensues and the nodes start shifting and moving around.

My final alternative and solution to the collision handling problem is a functionality found in the software calendar Datelens[7]. This scalable calendar interface developed by

Ben Benderson at the University of Maryland has a function that dynamically scales the axes of the view. Applying this to the time view means that when the mouse is hovered over the nodes and thereby zoomed in on, the x-axis (which represents time) will expand accordingly and create space for the nodes to in turn also expand. The essence of this is visualized in Figures 7 and 8.

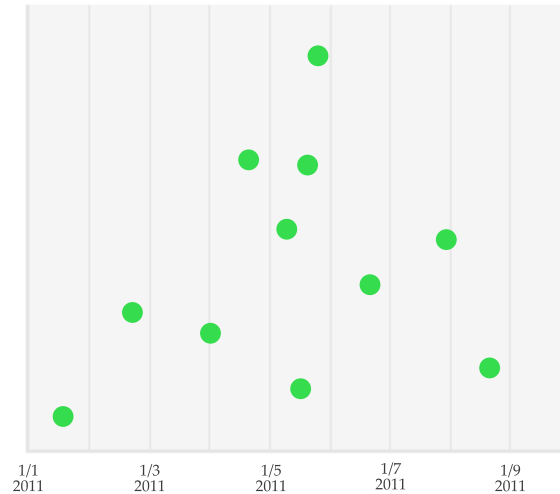


Figure 7: Without zoom.

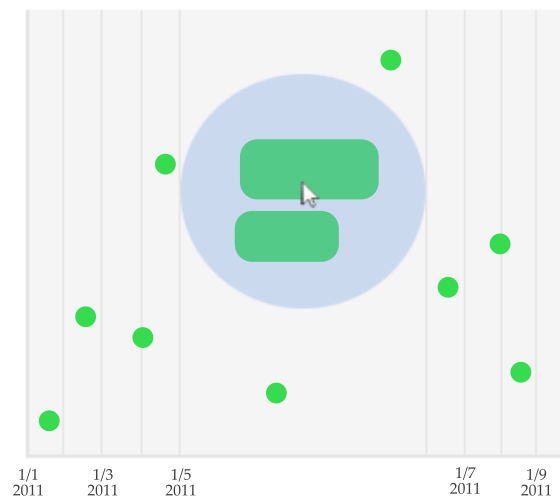


Figure 8: With zoom.

The blue circle around the mouse is optionally visible when using the time view. It represents the size of the zoom function. Everything that hits the circle will be of subject to the zoom function. Another detail is that it is possible for the user to change the radius of this circle to better suit the specific view the user is working with. Plus and minus buttons will do the job but it is also possible to change it by using the scroll on your mouse. Hopefully this will give more power and agility to the user while navigating the time view.

A fluid effect where space is smoothly created and at the same time filled with nodes adjacent to the cursor is experienced now. This will work especially well when there are a lot of nodes at the same place and there is no space for the expansion of the nodes.

3.4 Alternative Solutions

3.4.1 Overview

The overview uses the y-axis to give meaning to the vertical position of the node. An alternative approach considered was to instead use the size of the nodes to communicate the same meaning. For example, in Figure 5, the y-axis is set to have number of comments as a unit. This means that the vertical position of the node corresponds to how many comments the node has. An alternative solution would be to have the size of the node correspond to the number of comments made to the node. The bigger the circle the more comments the node has.

This is aesthetically very pleasing and a powerful way to visualize information. But, it was not right as a solution for this problem as it could (as so many other things) interfere with the main problem, which is lack of space. To be able to show the difference between the nodes properly some nodes would have to be relatively big. The solution used suits better as all the nodes can be very small and still have a meaning.

3.4.2 Zoom

An alternative solution I considered was to implement a zoom function in which you only see a part of the time view and then you can move around. This solution would take advantage of the mental model most people already have from using various maps on the internet, for example Google Maps. You navigate by "pinching" (clicking and holding) with the mouse and then moving the map in the desired direction. Since this mental model already exists for most people it would be very easy to use from the first time. This would also solve the problem of space but I abandoned the idea as I think it strays away from the original purpose of the time view: to give an overview.

3.4.3 Details on Demand

Details on demand refers to the function of clicking the nodes to bring up more details about it. Another way to show details could be to have a box with the details appear when you hover the mouse cursor over the node. This is a very direct way to show the details and the user will use the mouse cursor to show interest in more details. This would not work together with the zooming function chosen. The box with details would be in the way of the magnified nodes and therefore work against the zoom function. The flow of the zoom function where details are revealed close to the mouse cursor would be disrupted.

A way to get around that problem would be to place the box with information on the outside of the time view. When a node is hovered, the box outside would show the details of that node. This consideration works but for me it is not a satisfying solution because of the difficulties involved with moving the mouse cursor over the nodes and at the same time keeping track of a box outside of the time view.

4 Discussion

I now go on to discuss the method used in this paper, the potential risks with the zoom function and the subject of user control. Starting with the method used which was a version of genius design. I did not spend much time interviewing users to find out how they wanted to interact with the time view and what their suggestions were. Instead I trusted myself and my skills to come up with and evaluate the design, without interference from thoughts and ideas from potential users.

I want to point out that I believe that in most cases a User-Centered approach is the best approach. I am not discussing which of the two methods are best on a general plane. I am only discussing this subject inside the frames of this thesis.

Having said that, I believe the design process was good for me. I felt like I had a clean canvas to work with. If you initially receive other people's perceptions, you will get some ideas for how to approach and design the task upon you. But also your canvas might be filled with ideas from users that have no understanding of HCI, which means the ideas can be inaccurate, inadequate or erroneous. When these ideas are already in your mind and on your canvas it can be difficult to get rid of them, your own ideas might be contaminated and you can get stuck inside a smaller frame of thought.

After doing some research about interactive visualizations I sat down with my empty canvas and started brainstorming. This brainstorming was very good straight after information gathering. I had a lot of ideas in my head that I extracted and put on paper.

The most significant part of the design for me was the zoom function (the fisheye effect). It was a big part of the solution and yet I question why it is something that you seldom see very often in practice. Some issues that need to be discussed is how easy it is to understand and if it perhaps reintroduces the problem of space when creating space for the nodes that are in focus.

It is not a difficult function to use. All you do is move your mouse to the place where you want more information. But, the question is if the user will grasp the full spectrum of what happens when the zooming starts. The axis will adjust and move in to an irregular state where a certain length on the axis will translate into different values in different places. This might not be obvious at first use but the visual representation of this change should be enough to understand it rather quickly. The other issue is one of space yet again. When creating space for the focused nodes all the other nodes need to fit in an even smaller space. I don't think this is a very big issue because this happens when you have found what you want to look closer at. As you are looking closer at your point of interest, it does not matter greatly if the rest of the nodes become slightly smaller or are placed a bit tighter next to each other. They are secondary in this scenario.

Proceeding to the subject of user control now. I want to highlight two occasions where I encountered this issue, one where I gave the user control and the other where I did not. The reason that user control is an issue is that when you hand control over to the user you cannot guarantee that the user will use it in a good way. It is good to protect the user as much as possible from their own possible mistakes.

The first encounter was with the choice of illustration for the time view. I want the user to use colours to represent different types of nodes but there is also an alternative to use shape. The shape alternative is present to aid the colour blind. The issue here is that the user might choose the inferior shape illustration even if they aren't colour blind. In my opinion, aiding the colour blind must be prioritized and I therefore chose to keep the choice for the user. One can also discuss if it is better to have a button that says "for colour blind" or similar. That might refrain more non colour blind users from using shapes.

The second encounter was in the filters. My first thought was to let the user have sliders for the number of comments and views of a node so that they can filter on those criterias. I decided that this is unfavorable as those statistics are not good to filter by. This is because they have no direct connection to the importance of the nodes. Even though they might be good filtering options in some rare cases, the possibility of the user loosing important data is too big.

To conclude the discussion it is apparent that there are still issues that need to be addressed before this solution can be deployed and used. The most pressing issue being that it is untested. It needs to be tested so that the intuitiveness and usability of the design can be assured. Having said that, I believe this paper is a good first point of attack when faced with the same problem of space.

References

- [1] Benyon, David (2010). *Designing Interactive Systems: A comprehensive guide to HCI and interaction design* Second ed. Pearson Education Limited.
- [2] Preece J., Rogers Y. & Sharp H. (2002). *Interaction Design: Beyond Human-Computer Interaction*. John Wiley & Sons.
- [3] Card, Stuart (2007). *Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications*. Second ed. Lawrence Erlbaum Associates.
- [4] Few, Stephen (2011): Data Visualization for Human Perception. In: Soegaard, Mads and Dam, Rikke Friis. "Encyclopedia of Human-Computer Interaction".
http://www.interaction-design.org/encyclopedia/data_visualization_for_human_perception.html
- [5] Hawley, Michael (2009): Design Research Methods for Experience Design.
<http://www.uxmatters.com/mt/archives/2009/01/design-research-methods-for-experience-design.php>
- [6] Cowan, Nelson (2001). *The magical number 4 in short-term memory: A reconsideration of mental storage capacity*. Cambridge University Press.
Available at <http://web.missouri.edu/~cowann/pubs.html>
- [7] Datelens, <http://www.cs.umd.edu/hcil/fishcal/>