FACEBOOK3D

By

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STATEMENT

Interactive 3D Visualization techniques will improve the accessibility and usability of information dense social websites

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CHAPTER I

INTRODUCTION

With the advent of Web 2.0, social networking websites like Facebook, MySpace and LinkedIn have become hugely popular. According to (Nilsen, 2009), social networking websites have global[1] figures of almost 250 millions unique users among the top five[2], with the time people spend on those networks increasing 63% between 2007 and 2008. Facebook alone saw a massive growth of 566% in number of minutes in the same period of time. Furthermore their appeal is clear, they enable users to easily form persistent networks of friends with whom they can interact and share content. Users then use those networks to keep in touch with their current friends and to reconnect with old friends.

However, online social network services have rapidly evolved into highly complex systems which contain a large amount of personally salient information derived from large networks of friends. Since that information varies from simple links to music, photos and videos, users not only have to deal with the huge amount of data generated by them and their friends but also with the fact that it's composed of many different media forms.

Users are presented with increasing challenges, especially as the number of friends on Facebook rises. An example of a problem is when a user performs a simple task like finding a specific friend in a group of 100 or more friends. In that case he would most likely have to go through several pages and make several clicks till he finds the one he is looking for. Another example is a user with more than 100 friends in which his friends make a status update or another action per day, resulting in 10 updates per hour to keep up. That is plausible, especially since the change in direction of Facebook to rival with Twitter, by encouraging users to update their status as they do on Twitter.

[1] USA, Brazil, United Kingdom, France, Germany, Italy, Spain, Switzerland and Australia

[2] Facebook, MySpace, Classmates Online, Orkut, LinkedIn

As a result, to better present the web of information connected to a user the use of better visualizations is essential. The visualizations used nowadays on social networking sites haven't gone through major changes during their lifetimes. They have added more functionality and gave more tools to their users, but still the core of their visualization hasn't changed. The information is still presented in a flat way in lists/groups of text and images which can't show the extra connections pieces of information. Those extra connections can give new meaning and insights to the user, allowing him to more easily see if that content is important to him and the information related to it.

However showing extra connections of information but still allowing the user to easily navigate through it and get the needed information with a quick glance is difficult. The use of color coding, clusters and shapes becomes then essential to attain that objective. But taking into consideration the advances in computer hardware in the last decade and the software platforms available today, there is the opportunity to take advantage of 3D. That opportunity comes in because we are at a phase were the hardware and the software available is ready for the use of 3D in the web. With the use of the extra dimension brought by 3D, visualizations can be constructed to show the content and its related information to the user at the same screen and in a clear way. Also it would allow a great deal of interactivity.

Another opportunity to create better information's visualization presents itself in the form of the open APIs, specifically the ones made available by the social networking sites. Those APIs allow any developers to create their own applications or sites taking advantage of the huge amount of information there is on those networks. Specifically to this case, they open the door for the creation of new social network visualizations.

Nevertheless, the third dimension is by itself not enough to create a better interface for a social networking website, there are some challenges to overcome. One of those challenges is to make the user understand what the system is doing during the interaction with the user. Even though that is important in 2D visualizations, it becomes essential in 3D due to the extra dimension. To overcome that challenge it's necessary the use of the principles of animations defined by the artists at Walt Disney Studios (Johnston, et al., 1995). By applying those principles in the development of the interface, the actions of the system in response to the user inputs became clear and understandable.

Furthermore, a user study needs to be performed so the users' main goals and motivations, while navigating the social network, are revealed. Their goals and motivations are important in the construction of an interface that reflects the user expectations for the interface, but also helps in the development of appropriate metaphors. Those metaphors have an important role in the interface, because if correctly chosen they help the user understand the elements of the interface instead of making him memorize it.

The last challenge is the use of 3D visualization on the web, since there have been several attempts to bring 3D into it, mainly with the various versions of VRML which were destined to failure due to the hardware limitations at the time. However, in the last couple of years there has been a movement to make the necessary tools to finally allow

developers to use 3D in a useful way, using X3D or OpenGL but especially flash. This thesis argues that there is a need for a better social network visualization that shows all the dimensions of the information connected to the user and that allows him to move through it. But there are several characteristics the new visualization has to possess in order for it to present a real gain in usability to Facebook's users. The first quality is to have the friends at the core of its design, and the second to make use of the metaphor of circles of friends to separate users in groups taking into consideration the order of friendship. To achieve that several methods have to be used, from the use of 3D to get an extra dimension for presenting relevant information, to the use of direct manipulation to make the interface comprehensible, predictable and controllable. Moreover animation has to be use to make all the action on the screen perceptible to the user.

Additionally, with the opportunity given by the 3D enabled hardware, the flash platform, through the use of the flash engine Papervision3D and the Facebook platform, all is in place to make the visualization possible. But even though it's all in place, there are challenges to overcome like making the system actions in 3D understandable to the user and creating correct metaphors that would allow the user to understand the information and options available to him.

This thesis document is divided in six chapters, with Chapter 2 reviewing the literature relevant to the work described in this thesis. In Chapter 3 the design stage that resulted in the application presented in this thesis is described. In Chapter 4, the development stage, describing the architecture and the components that compose the application. In Chapter 5 the usability test process is explained and the results obtained through it are presented and analyzed. To finish, Chapter 6 presents the conclusions that were arrived in this thesis.

CHAPTER II

STATE OF THE ART

2.1 INTRODUCTION

This chapter presents the literature on what the work in this thesis is based. It starts with research that examined the Facebook community, in order to see who uses social networking websites, what they use it for and what motivates the use. Thus it presents an overview of what type of people use Facebook and an understanding of the main activities performed by users.

Then an overview on 3D visualizations technologies is given, starting with an introduction on the historical background of perspective and then the presentation of some 3D visualization technologies that were created to bring 3D to the internet but failed in the process.

That is followed by a subsection on animation which gives a brief introduction on the history of the principles of cartoon animation and then presents four of those principles, which were adapted to 3D animation. It's also explained how the use of animation, more specifically cartoon animation, on user interfaces can make them more usable and how it allows more actions to be performed at the same time without losing the user.

Two of the most notable social networks visualizations systems, SocialAction and Vizster, are presented describing their focus and their visualizations. Through that it'll be possible to see the main difference between them, other similar systems and the application presented here.

The theory of direct manipulation is then presented, showing the characteristics a user interface needs to have to successfully implement it in order to build interfaces that are comprehensible, predictable and controllable. Subsequently, two different types of constraints in user interfaces will be shown and also what can they bring to the table in respect to building highly interactive interfaces.

The chapter ends, with the presentation of two 3D components that demonstrate the potential that 3D has as an effective method of presenting content to a user, whether the content is structured or unstructured information.

2.2 SOCIAL NETWORKS

The term social network is commonly used to describe websites like Facebook and MySpace. However the term is descended from anthropological studies on the effect of urbanization in Africa. But it was J. A. Barnes, in 1954, who influenced by that work and his studies on the social ties of a Norwegian fishing village, who coined the term. Those studies led him to the conclusion that social relationships could be represented as a set of nodes in a graph, which are joined by lines to form a total network of relations.

With the explosion of the internet people started using software to connect with other people, effectively forming virtual social networks. In the last years, the birth of websites like Facebook, MySpace and LinkedIn have made the construction of those connections easier and indeed such sites have become a second home for many users.

Researchers studying these communities have examined who uses social networking websites, what they use it for and what motivates the use. One of those researchers was (Joinson, 2008) in which a study was performed using two groups of Facebook users, adopting the two stages approach described by Churchill (Churchill, 1979). The first stage was set up to see how they used Facebook and what they enjoyed about their use, having those results used on the execution of the second stage.

Through the study he found out that those users mainly used the site to "keep in touch" with friends, having only a small number of users that used it to make new contacts. Another thing he found out was differences in uses depending on age, gender and occupation. On the gender side, the factors "social connection" (re-connecting with lost contacts and maintaining contact with existing friends) and "photographs" (posting and viewing of photographs) were more important to females than to males. Females were also more likely to increase the privacy definitions on their profiles.

The age was also correlated to how much time users had been registered on Facebook, the regularity with which they visited, the number of hours they used the site in a week and the number of friends they had linked to their profile. In all of those cases, younger users were associated with a higher usage level and a bigger number of friends. In the privacy aspect, younger users were more likely to have increased the privacy of their profiles, maybe due to the higher number of friends amongst younger users.
The study also suggested that "keeping in touch" comprised two main functions. The first is a surveillance function, i.e., users use Facebook to see what old contacts and friends are 'up to', how they look and how they behave. The second is the social capital building gratification, i.e. users use Facebook to build, invest and maintain connections with distant friends and contacts.

In conclusion, Joinson found out that different demographic groups are motivated to use social networking sites for different purposes, with social connectivity and perpetual contact motivating younger (and female) user's more than older (and male) users.

But what makes Facebook so successful and popular among the several social networks? To answer that question (Hart, et al., 2008) made a study using traditional usability

methods and user experiences. User experiences were taken into account because traditional usability methods don't consider the user's 'felt experience' when interacting with social networking sites. Although, they are something difficult to empirically measure due to the fact that they are personal judgments and opinions. However, it is something that is growing in importance as technology becomes far more ubiquitous and moves out of the office into the wider environment.

The study consisted of a usability evaluation by experts followed by interviews with the participants and the observation of their interactions with Facebook. The usability evaluation revealed that Facebook did poorly on it, adhering to 2 of the 10 Nielsen's' heuristics, with 4 rated as having minor problems and the last four rated as having major problems. The main problems identified were of consistency and standards, error prevention and recognition rather than recall of the elements of the interface.

The user study revealed that users would usually visit Facebook several times a day while doing some other activity, like visiting other websites. Afterwards they would periodically revisit Facebook, 'hanging around' in it instead of the traditional way of web surfing (get in, get it and get out). That fact further raised the question about the relevance of traditional measures of usability such as task completion time when designing and evaluating social web services.

During the study, curiosity and enjoyment were two aspects that were mentioned more often by users when describing their experience. This is due to the fact that Facebook takes advantage of curiosity by enticing users in to find out more about their friends through the numerous options on a profile page. That is done using several mechanisms like feeds, walls and applications, which has the consequence of clustering the user's personal page. Which in return lead to poor usability, but the user is motivated enough to ignore the clustering.

As a conclusion, the study showed that even though Facebook failed in traditional usability evaluation it excels in providing many positive user experiences for its vast community of members. Providing not only a great deal of social pleasure but also features that spur curiosity on its users.

2.3 VISUALIZATION TECHNOLOGIES

The use of visualization technologies to allow a better understanding of information is something that has been growing, which is correlated with the increase of data available today and the complexity of that same data. By using them, we can present information through interactive graphics and with an appealing visual design that transforms a set of data into information the people can effectively use and understand.

Several studies were made in the use of visualization technologies to present digital information, including more recently the use of a 3D visualization like (Wyeld, 2005). Information is usually presented to the user through the technique of representing three-dimensional objects and depth relationships on a two dimensional surface. That is, using

perspective as method for viewing three-dimensional space, something that has been a dominant method on the western visual culture since the Renaissance.

Some theorists claim that our ability to imagine regular three-dimensional objects in the mind's eye is universal regardless of race, gender, or culture. Others counter claim that only through exposure to a normal variety of Western visual media and to the cultural conditioning, can we accept what is otherwise merely an illusion. But that distinction is most pertinent to 3-D information visualization where the images displayed often have no physical-world counterpart other than as abstract metaphors, such as a deformed 3D meshes, globes and so on.

Even though the use of a 3D visualization has the potential to better show information to the users, there are some negative aspects surrounding the use of perspective on the visualization of information. The main "problem" is the fact that it's inherent to it the existence of privileged viewing position in a perspective. What that means is that there is only one "correct" view, which affect what we see and look for in information displays. That remains true even when the user can manipulate the 3D view in real-time, because the user is simply moving through individual views, where each one has its correct center of projection. As a result of that, a main assumption in the use of perspective is that what the user can see may be all that matters. Although as Theodor Wyeld says, "What is not visible matters to some particular users".

2.3.1 Failures

The use of 3D Visualization technologies in the web has already been tried, resulting in high-profile failures. The reasons for those failures include the hardware not being at the right level to allow the move to a 3D space, the software technology produced hasn't in line with the developer community whether by being too difficult to produce content with it or by simply not gathering interest among them. Now will be presented two of those cases, which were hailed as being the beginning of the 3D era on the web but that failed to so.

VRML

"It is almost painful for me to watch some of the VRML initiatives. It just seems so obviously the wrong way to do something."
John Carmack

VRML (pronounced "vermal ") stands for Virtual Reality Modeling Language, and it represented the first real attempt to bring real-time, interactive 3D graphics to the Internet. It all started in 1994 when Dave Raggett, the father of HTML, in a birds-of-a-feather (BOF) [3] session talked about "VR and the Web". It was there that, Dave Ragget, decided to call this new Web-based language of Virtual Reality Markup Language. But it was only when a group of people led by Mark Pesce and Tony Parisi started a mailing list

[3] A meeting between a group of people with some kind of shared interest, to talk about a topic without a pre-planned agenda.

called www.vrml that the VRML technology was created. VRML 1.0 was based on the Inventor File Format from Silicon Graphics, due to the fact that it was developed by them, ensuring that VRML would have a hierarchical structure and pre-defined 'node' names.

VRML files are analogous to HTML (hypertext markup language) files in that they are standard text files which are interpreted by browsers. But due to the fact that VRML specification was not set, anyone could create a VRML browser but each browser would interpret the VRML file differently. And because there was no single source controlling the look, feel, and interpretation of the data file, the VRML content found in the internet wouldn't run in every browser. That was one of the main reasons that lead to the failure of VRML.

Another reason was the fact that it launched in an era where most people didn't have an internet connection, and the connections available where very slow. Due to that, few people could even imagine that interactive 3D websites were possible, far less actually had the capability or the patience to view them. When VRML 97(VRML 2.0) launched and was adopted as an ISO standard, technology had evolved to a point where VRML could be used across the web. But at that time VRML had evolved to a point, where it was far too complicated to the average user. That and the fact that VRML browsers were slow and hard-to-use, led to most sites on the web be made in 2D using HTML.

Nowadays only some non-commercial websites use VRML and a few research institutes and universities use VRML to some of their experimentations.
Even though VRML had the backing of Silicon Graphics, Microsoft, IBM, in the end nobody knew what to do with it or how it was ultimately going to make enough money to justify the millions being spent on developing and promoting it.

X3D

The Web3D Consortium started working on the successor of VRML, the X3D, at 1999 basing it on the VRML97 specification. In 2004 the X3D, which is an ISO standard, specification was completed. It added to VRML Extensible Markup Language (XML) capabilities, which provides parsing, validation, XSLT conversion and granting integration with other World Wide Web technologies. Also X3D has better script integration compared to VRML and it was provided adequate specification on the X3D behavior in such a way that scenes and environments can interoperate between browsers. This is complemented with an X3D conformance program being developed by the Web3D Consortium, which will attest for the reliability of the browsers and players available on the market.

Those last two aspects are really important, because they were some of the reasons why VRML failed. But even though it has corrected the flaws of the VRML, it hasn't really taken the internet by storm. It has a solid presence in some markets such as CAD, geographic mapping, medical, and industrial prototyping but has failed on its main objective. The reasons for this are due to the fact that the developers that work nowadays with 3D doesn't support the X3D structure and the way it works, but also because it

hasn't the appeal, tools and support necessary to allow practically anyone with some basic knowledge to add some 3D functionality to their webpage.

2.3.2 Flash

With the failure of first VRML and then X3D in changing the web from simple html to a 3D experience, or even bringing more interactivity, it was flash that swept through the internet and made its mark. From its introduction in 1996 it has grown in number of features, users and websites achieving, according to Adobe (Fla09), a worldwide market penetration of 99% for the flash player. That market penetration coupled with the fact that it's cross platform has made flash a good option for developers with interest of bringing 3D to the web. Several 3D engines have been created to provide tools for them to make that a reality, including Papervision3D (Pap09), Away3D (Awa09) and Sandy (San09).

With the introduction of those engines, there has been more and more websites that use 3D components made in flash, especially to display photo galleries. The growth in flash components available on the web is showing that flash, which was developed with 2D in mind and that doesn't fully support 3D on their last release (Flash10), is making a significant push for 3D on the web.

But flash still has to overcome the problem of performance, since it still can't render 3D at the level found on other platforms like Unity (UNI09), indirectly imposing limits on the visual quality of 3D components so that they can be usable.

2.4 ANIMATION

Animation has been used for many years in cartoons, to bring to life the characters and the worlds they live in. Whether it's used traditional animation or 3D computer animation they share a set of fundamental principles that are essential for the magic to work. Those principles were defined by the Walt Disney Studio in the first half of 1990s and have remained at the core of the animation process.

Even though animation is mostly used in cartoons, there has been an increase in its implementation on user interfaces. In the last few years developers have fully embrace the idea of using some of the animation principles to make their interfaces more intuitive. With the introduction of 3D interfaces, animation has become an essential part in the creation of interfaces that provide a better interaction for the user than the 2D ones. It's not enough for the interface to give an extra dimension to the user, it must also provide the necessary feedback for him to take advantage of it. And for that, the user must not feel lost in the interface, something that animation can help to overcome.

2.4.1 Principles

The principles of animation used nowadays in user interfaces haven't been defined with that purpose in mind, but have been used over the years with good results. It all started in the Walt Disney Studio, where the principles of traditional animation were defined. But they were adapted by Lasseter (Lasseter, 1987) to be used in 3D animation. The most

important principles of the set will now be described together with an explanation on their use in user interfaces.

The first principle is called Squash and Stretch **(figure 1)**, and states that the rigidity and mass of an object can be defined by the distortion of its shape during an action. In squash position the objects should flatten and in the stretch position the objects should extend. Taking into consideration that the volume of the object has to remain the same, changing its level of stretch and squash makes it look like it's made of different materials.

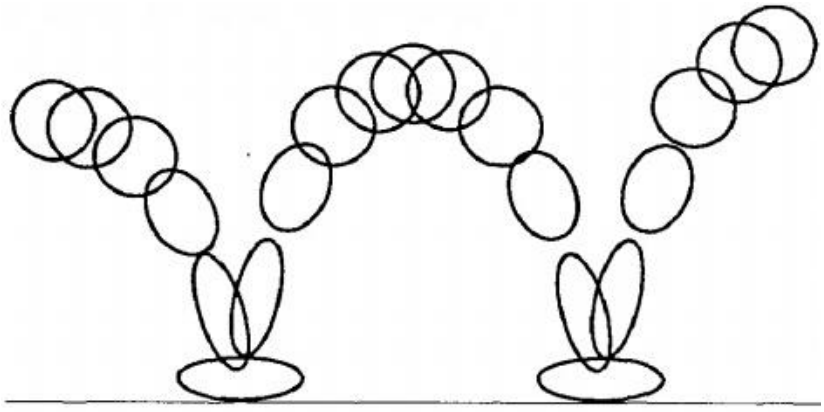

Figure 1: **Principle of Animation - Squash and Stretch**

The second principle is called Timing **(figure 2)** and states that spacing actions can defined the weight and size of objects. It represents the speed of an action, giving meaning to the movement and defining how well the idea behind the action will read to an audience. This is important because it's essential to develop the interface so that the users are capable of reading and understanding the meaning of what's happening at any moment.

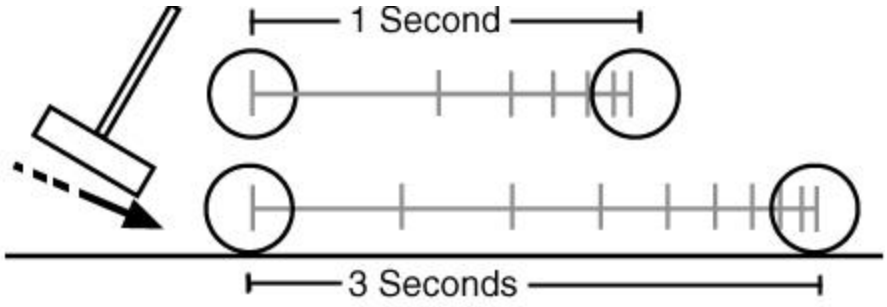

Figure 2: **Principle of Animation - Timing**

The third principle is called Anticipation **(figure 3)** and states the importance of preparing the user for an action **(figure 4)**. Anticipation is used to catch the users' eye and to prepare them for what the next movement will be before it happens. If the users expect something to happen, then it can be much faster without losing them. Also this is used to direct the attention of the user to the right part of the screen and at the right moment, preventing the user from missing some vital action.

Figure 3: **Principle of Animation - Anticipation**

Figure 4: **Principle of Animation - Action**

The fourth principle is Staging **(figure 5)** and helps present ideas so that they are unmistakably clear. To stage an idea clearly, the users' eye must be led to exactly where it needs to be at the right moment, so that they will not miss the idea. One important aspect, when staging an action, is that only one idea should be seen by users at a time. Due to that, the object of interest should contrast from the rest of the scene, preventing the user of overlooking the idea being transmitted when there is a lot of action happening at once.

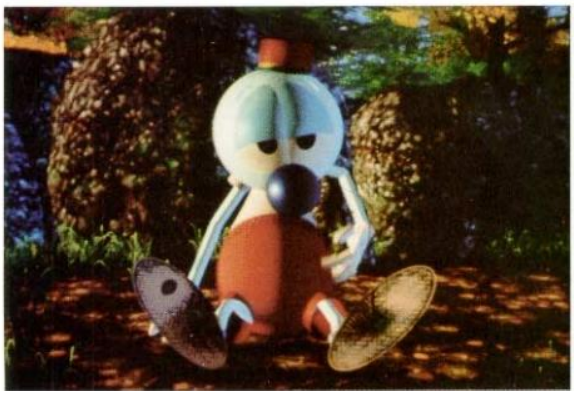

Figure 5: **Staging - The character's scratch was staged to the side, in "silhouette", for clarity**

To sum up, bringing animation to the user interface has both cognitive and affective benefits. By offloading interpretation of changes to the perceptual system, animation allows the user to continue thinking about the task domain, with no need to shift contexts to the interface domain. By eliminating sudden visual changes, animation lessens the chance that the user is surprised, thus reducing his uneasiness. So employing animation not only aids the user in understanding the events in the user interface, but also makes the user's experience of the interface more pleasant and comfortable.

2.4.2 Cartoon animation

The use of cartoons animation instead of a strictly realistic animation, in user interfaces, is due to three essential characteristics: its theatrical basis, the engagement of its illusion and the nature of its artistic medium.

Cartoons are theatrical, so actions and reactions are exaggerated, situations are staged, and all of the energy of movement and depiction is calculated to best convey the animator's point. User interfaces have the same need to communicate clearly and concisely, and theatricality can contribute to that goal. Also cartoons are engaging because they create an illusory world, effectively absorbing the audience into that world. User interfaces can benefit by becoming more engaging and therefore fully absorbing the user into its world, so that his attention may be devoted entirely to the task. To conclude, user interface designers can draw upon the wealth of experience in the field of cartoon animation to achieve similar successes of communication, vibrancy, and illusion.

One implementation of many that can be found in several types of applications, that used cartoon animation is the user interface called Self (Chang, et al., 1993). Self showed how the cartoon animation was widely applicable, and may have additional benefits in certain kinds of interfaces. In particular, collaborative applications stand to benefit greatly from the use of cartoons animation. Anticipation, slow in and slow out, motion blur, and follow through can be used to more fully and more gently inform the user about remotely initiated actions.

2.4.3 Conclusion

In conclusion, despite the differences between user interfaces and cartoons, interactive tools vs. passive entertainment, cartoon animation has characteristics that are very useful in the design of user interfaces. Using some aspects of cartoons animation allows the user to visualize the changes that are occurring in the interface when he executes an action, making it clear what's happening. So by applying the principles of animation, the interface can provide visual clues necessary for the user to understand what is happening before, during and after the action. Those visual clues take off the burden that result from those interfaces that make so that the user has to use his deductive ability to interpret changes, instead of using animation to smoothly change and move the objects present in the interface. So with careful tuning, cartoon animation can turn the user interface into an understandable, engaging, and pleasurable experience.

2.5 SOCIAL NETWORK VISUALIZATION

In the last few years several social network visualization systems were built to let users take full advantage of the information contained on their social network. They fulfill that goal by using visualizations that present the network through the use of graph structures. But those systems are based on the social network theory and so are focused on the analysis of social networks instead of on the users that utilize online social networks to keep in touch with friends. Two of those systems, Vizster and SocialAction, use the prefuse visualization toolkit (Heer, et al., 2005), to create their visualizations. Both

systems will now be briefly presented and then explained why there's the need for a new social network visualization system.

2.5.1 SocialAction

SocialAction (Perer, et al., 2008) is a social network analysis tool that enables users to explore a data set to uncover new information. It makes use of statistics and visualizations, allowing users to derive the benefits of both. Statistics are used to detect important individuals, relationships, and clusters by allowing users to focus on statistically significant nodes and edges. On the other hand, the visualization simplifies the statistical results by providing a visual solution for exploratory data analysis.

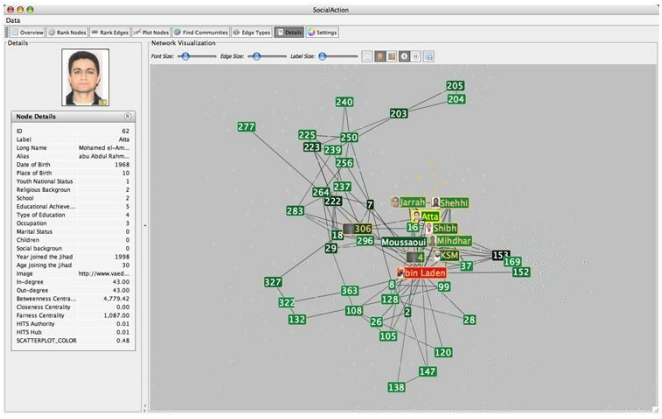

Figure 6: **SocialAction - Social Network Overview**

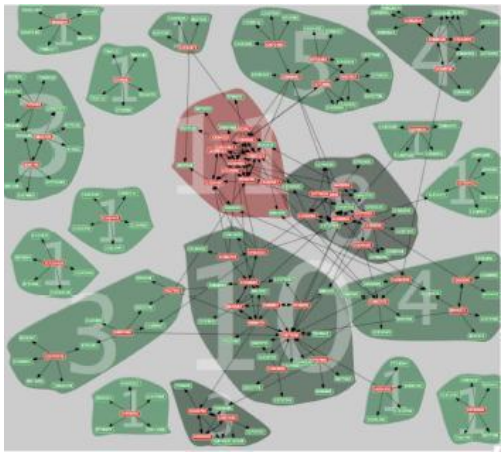

Figure 7: **SocialAction - Communities Overview**

2.5.2 Vizster

Vizster (Heer, et al., 2005) is a visualization system that enables the exploration and navigation of social networks. It uses a node-link network layout, representing the user and his friends in a graph structure. Also it has the ability to automatically identify and visualize the community structures that exist in the user's network. Vizster is based on ethnographic research of online social networking services and previous work in social network.

Figure 8: **Vizster - Egocentric Network view**

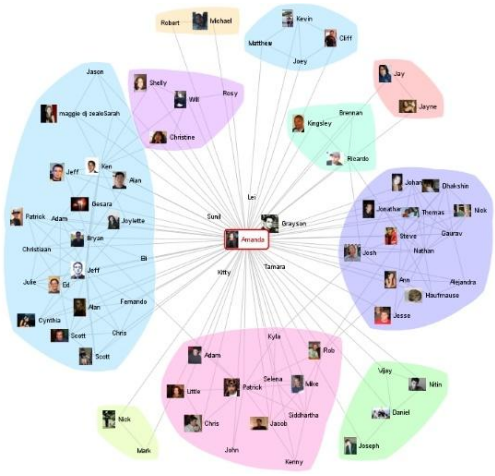

Figure 9: **Vizster - Community Overview**

2.5.3 Comparison

Both of the two previous systems are geared towards sociological research, i.e. are based on social network theory. They allow researchers to analyze the communities that are formed on social networks and the interactions among its users. In SocialAction that is the only focus of the system, while Vizster is also intended for end-users of the online social networks. So it has a visualization that is less comprehensive on the research side but also isn't completely centered on those users.

Taking into consideration the focus of those systems and similar ones, there is the need to build a new visualization system that has the online social network's users at the core. One system that takes in consideration all the users' needs, providing a highly interactive visualization that supports all their activities. For this, the social networks visualization should go beyond the graph structure representation and make use of real world metaphors, since even though those graphs represent lots of data, they can be hard to perceive much of the information they contain. That is due to the fact that social network graphs have a mathematical instead of a visual-perception standpoint.

In line with that facts (Viégas, et al., 2004) state that visualizations of social networks that are aimed at end users ought to go beyond the graph paradigm and should use adaptive zooming and multiple viewing modes to provide useful visual solutions to end users. To back that statement they built two visualizations of email, one using the graph representation and other one using the metaphor of a calendar. The graph visualization showed clusters of email contacts through a spring system algorithm, which pulls contacts that have tight bonds towards one another and repels the ones who do not know each other. The calendar metaphor visualization shows the amount of email exchanged over time between the user and each different contact, revealing large concentrations of interaction during certain periods in contrast to times when almost no email was exchanged.

Those two systems were tested using an ethnographic evaluation, which showed that users would make use of those two visualizations to get a better sense of the structure of their social network. The back and forth between visualizations that users would do is explained by the fact that we understand things better when we have more than one way of looking at them. Therefore graphs structures in social networks visualizations are useful and should not be completely abandoned but for end users they should be use as the basis of more sophisticated social networks visualizations.

2.5.4 Conclusions

In conclusion, the current social network visualizations systems are not the ideal solution to serve as the interface for end-users to explore, interact and navigate in their social network. They are aimed primarily at supporting analysis rather than typical user tasks such as "keeping in touch with friends" (Joinson, 2008). But they can provide the basis for a new visualization that using real world metaphors can better support all the types of interaction present social networking websites but that can give the user full control over it while providing quick access to the information that interest him.

2.6 DIRECT MANIPULATION

The theory of direct manipulation describes interactive systems that, according to (Shneiderman, 1997), depend on visual representations of the objects and actions of interest, physical actions or pointing instead of using complex syntax and by using rapid incremental reversible operations whose effect on the object of interest is immediately visible. As a result, those three principles lead to the creation of user interfaces that are comprehensible, predictable and controllable. So the interface can mask the underlying computational complexity of the system.

Those benefits have an impact on the user experience, whether it's a novice or an expert since novices can learn basic functionality quickly, usually through a demonstration by a more experienced user and experts can work rapidly to carry out a wide range of tasks, even defining new functions and features. Beyond that knowledgeable intermittent users can retain operational concepts and can immediately see if their actions are furthering their goals, or if the actions are counterproductive, they can simply change the direction of their activity. Also users experience less anxiety, because the system is comprehensible and because actions can be reversed so easily. Last but not least, users gain confidence and mastery because they are the initiators of action, they feel in control, and the system responses are predictable.

In conclusion as Shneiderman puts it, most users want comprehensible, predictable and controllable interfaces that allow rapid user controlled animation on task-relevant animations and that give them the feeling of accomplishment and responsibility.

2.7 INTERFACE CONSTRAINTS

A constraint in user interfaces describes a relation between two or more elements that must be maintained. Those elements can be data and the view of the data, multiple views, components of a layout or events. So constraints can provide a good mechanism for the creation of highly interactive interfaces, since it's possible to give the user more freedom in the interaction with the interface's components while guaranteeing that the layout isn't ruined.

The use of constraints in social network visualizations makes sense, since it's composed of sets of interconnected data. So constraints can be used to manage the relationships between graphical objects on the screen and the application data structures that they represent. In (Szekely, et al., 1988) a user interface toolkit, named CORAL, was developed to give some insights on the construction of interfaces in which it's whether recommend or required the use of constraints.

One of the insights that were attained from that was that the use of a hierarchy of graphical objects facilitates the creation of new classes of objects. That is due to the fact that the new graphical objects can inherit the complex mechanisms already implemented or override it to their specific needs. The second idea is that we should define constraints that can be applied to sets of graphical objects. Furthermore we should make them reusable so that different sets of constraints can be applied to different instances of the

same class. Last but not least, we should provide a clean separation between the user interface and the rest of the application. This is a very important aspect in the development of applications, because it allows the application and its interface to evolve without having the burdens that come with the fact that they were tied to each other.

A different type of constraints, non-linear constraints, was used in (Gleicher, 1993) on the development of a graphical toolkit called Bramble by using a differential approach. With that non-linear constraints such as distance and orientation, in addition to simple connections were used. Also Gleicher used constraints and controls on aspects of objects, rather than just directly on their parameters, making the methods for manipulation of graphical objects more flexible. That resulted in graphical objects that provide the positions of points as outputs without knowing what will be connected to it, and interaction techniques that can be defined in terms of point positions, without knowing what types of objects these points come from.

2.8 SUMMARY

In summary there are several aspects that will have to play a part in the design and development of a new social network visualization that can provide a better experience than the one users have with the actual interface of Facebook. The first important aspect is to understand the main activities users perform, like keeping in touch with their friends, so that the visualization supports it but also to facilitate and allow users to create new activities. This is a different approach than the ones taken by current social network visualization systems, like Vizster and SocialAction, which aimed to support the analysis of social networks and not the activities of end-users.

Another aspect is the technology in which the visualization will rest and that will power it. Several technologies have tried and failed to support 3D visualizations on the web, so technology also plays an important role. But to aid the presentation of the information and to help the user understand and use the visualization comes the third aspect, animation. Animation, specifically cartoon animation, is extremely important because it will guide the user and provide the needed feedback, so that he doesn't feel lost in it.

But there is one aspect that can help the visualization's interfaces be more comprehensible, predictable and controllable. That is direct manipulation, which empowers the user by putting the components that compose the interface in his hands. Last but not least, are interface constraints that can help in the relations between data and its visual component or between the several visual components, especially if direct manipulation is used.

Two 3D components will now be presented as examples of ways that the use of 3D with animation can provide better results that the ones obtain through current 2D interfaces.

2.9 3D COMPONENTS

The introduction of 3D interfaces brought a new challenge to developers, namely the interaction with content in a 3D space. With that challenge in mind, Patterson (Patterson, 2007) presented two three dimensional interface components. Those components (The Flow and Circulatory system) use the depth provided by 3D computer graphics to present complex information in a natural three dimensional form for user interaction. He also introduces the concept of "active 3D interfaces", a new style of interface that presents its data to the user, through the motion and animation of items, rather than statically waiting for the user to interact with it.

The concept behind the Active Components is to use the natural human understanding of 3D space and the motion of objects in that space. The key principles used in the conception of the components are the use of depth and of motion through depth. The use of depth is to facilitate the presentation of large sets of complex information in an easier to understand and more natural form.

The Flow Component (**figure 10**) represents a new interface (or interaction technique) designed for presenting large sets of unstructured data. An example of this kind of data would be the results obtained from a web search for a particular topic. But rather than treating the result set as a static two dimensional item (in the form of a large textual page) that the user needs to move through, the flow component looks at the result data as a flow of three dimensional items. So the results flow out at the user from the depths of the screen, allowing a larger set of items to be displayed at any one time than would be possible in any 2D arrangement. At the same time, the use of movement through 3D space over time, allows the user to see all the items in detail as they pass by without having to make any interaction.

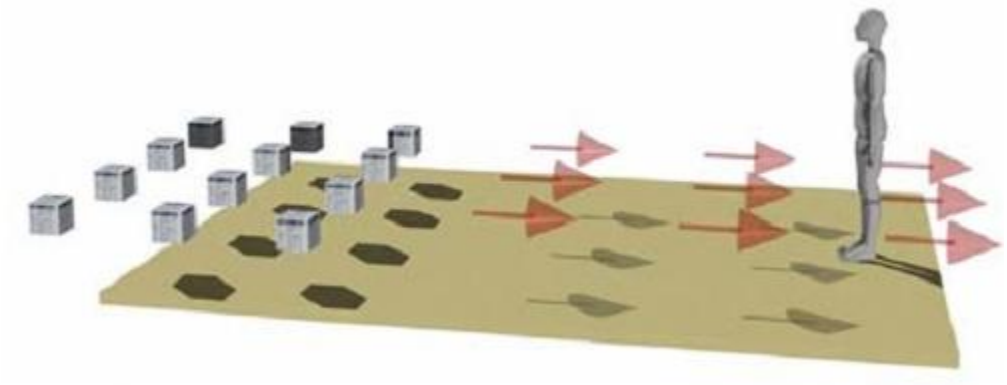

Figure 10: **The Basic 3D Flow System**

The circulatory system interface/component (**figure 11**) represents an extension of the principles established by the Flow component. Unlike the Flow (which presents unstructured data sets) it presents a new method for the presentation of large structured sets of data (e.g. selecting or locating a movie from within a large collection or library of movies). Extending from the basic flow concept, the Circulatory System takes the idea of a flow and creates a flowing loop (much like the human circulatory system). The items would loop past the user showing all options over time, without the user needing to

navigate through the structure. Furthermore, it can create more complex forms of loops and sub loops, allowing the user to have some control in their ability to choose which branches to take.

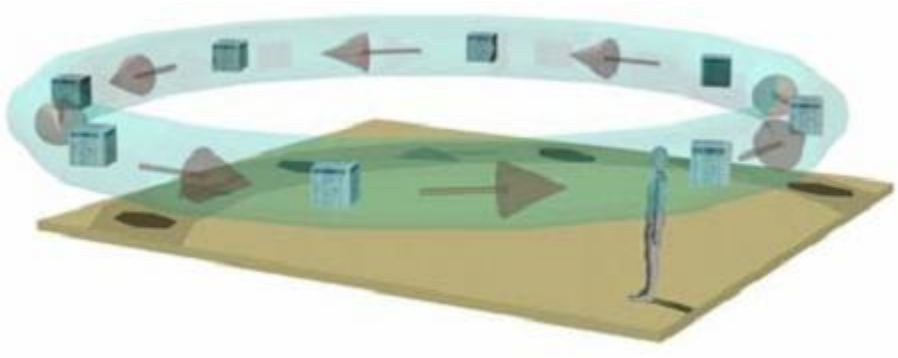

Figure 11: **Basic Circulatory Loop**

To attest the effectiveness of those components in a comparison to their 2D counterparts a series of tests were performed. The tests revealed that 3D computer graphics demonstrated potential in a range of common interaction tasks, being in many cases more effective than current systems. The active interfaces proved particularly effective in tasks such as browsing large structured and unstructured sets. In simple terms the addition of motion (active interfaces) and depth (3D space) has demonstrated potential to be an effective method for improving the human computer interface in these common real world tasks.

As a final point, those two components can provide good solutions for the presentation of information of social networks, whether to show the result of a search in the whole network or as a way of facilitating friend browsing.

CHAPTER III

REQUIREMENTS CAPTURE

3.1 INTRODUCTION

The objective of this thesis is to create a rich visualization for the social network called Facebook. With that in mind 3D, animation and direct manipulation are considered important attributes for this visualization. So first, it was necessary to know the users' opinions on the current Facebook interface and their thoughts on websites with 3D elements. With that objective in mind a survey was created. During its data retrieval phase, several paper prototypes of new interfaces were designed. Those prototypes were then informally tested not only for usability flaws and strengths but also taking into consideration the limitations of the flash platform. Two prototypes were selected and then moved to the development cycle, so they could be implemented.

3.2 *USER SURVEY*

To gain background knowledge regarding social network sites, an online survey on a random group of Facebook users was performed. The survey consisted of 13 questions and had the objective of obtaining the users' opinion on the current Facebook interface and on the use of interfaces with 3D elements. There were rating based questions and open ended questions so the participants could freely describe their experiences. In order to obtain a broad section of Facebook's users, across gender, rage and age, the survey was distributed in English and its link was publicized on the wall of groups with millions of users. When the survey was closed there were 76 valid answers, and is the data contained on those answers that will now be analyzed.

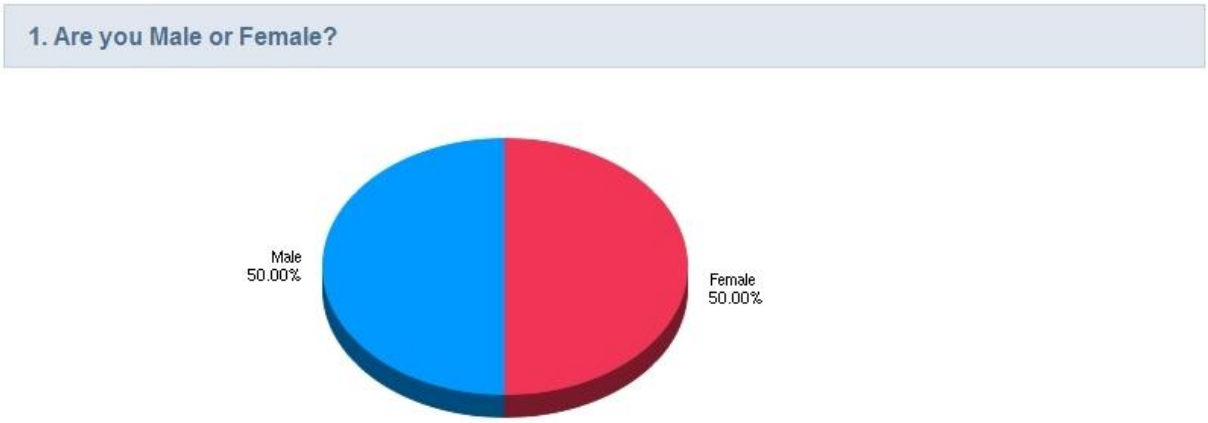

Figure 12: **User Survey - question 1**

- From the group of participants there were an equal number of people of both genders, even though if the number of participants were bigger, it would have resulted in a slightly less percentage for the male gender. Those results suggest that Facebook has broad appeal across society as many social sub groups, in particular professions, have strewed gender demographics.

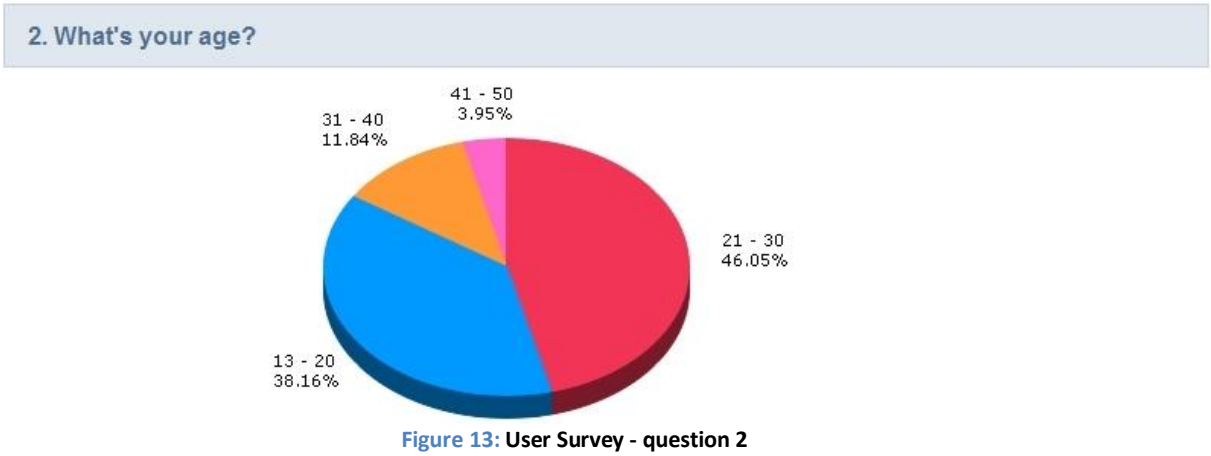

Figure 13: **User Survey - question 2**

- The majority of participants are below 30 years old, being inline with (Joinson, 2008) were the mean age was approximately 26. This is clearly due to the history of Facebook, which in its early ages was only for college students, and the fact that it's still younger people that are more present in social networking websites. Even though there was no one over 50 answering the survey, there are a percentage of people on that range of age that use Facebook but they represent a small percentage. The design implications of this one is complex, since the system could be designed for the existing audience or to enable older users to access content as ease as the young ones does.

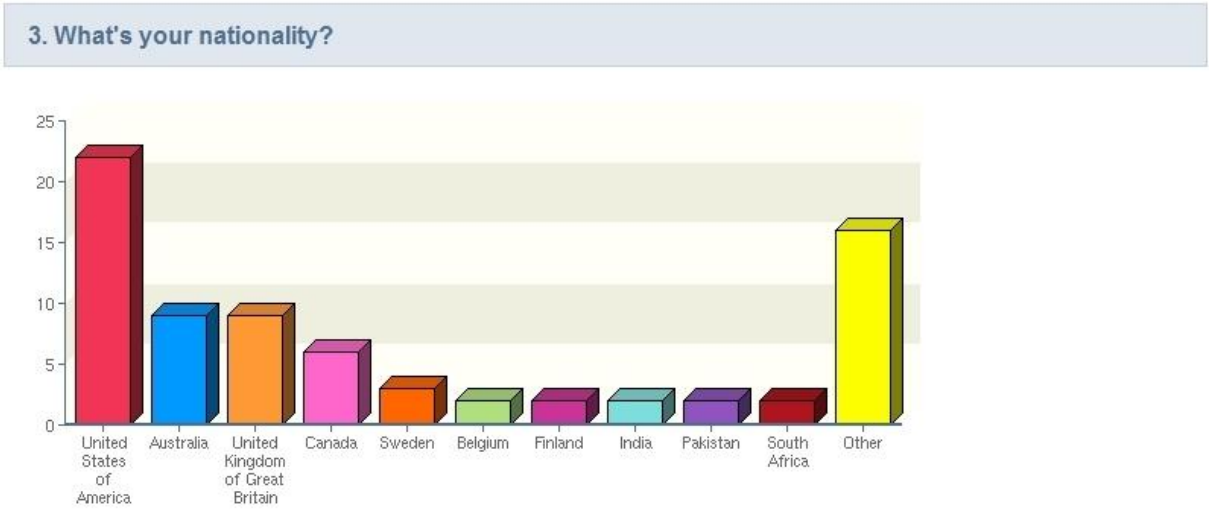

Figure 14: **User Survey - question 3**

- The nationality of the participants are in the majority of the cases the United states of America, something that has to do with the fact that Facebook was for several years only for Americans. Also the fact that the survey was written in English, had some impact on the nationality since we can see that the following nationalities with more users are United Kingdom, Australia and Canada, this last one having also the proximity to the US as a reason.

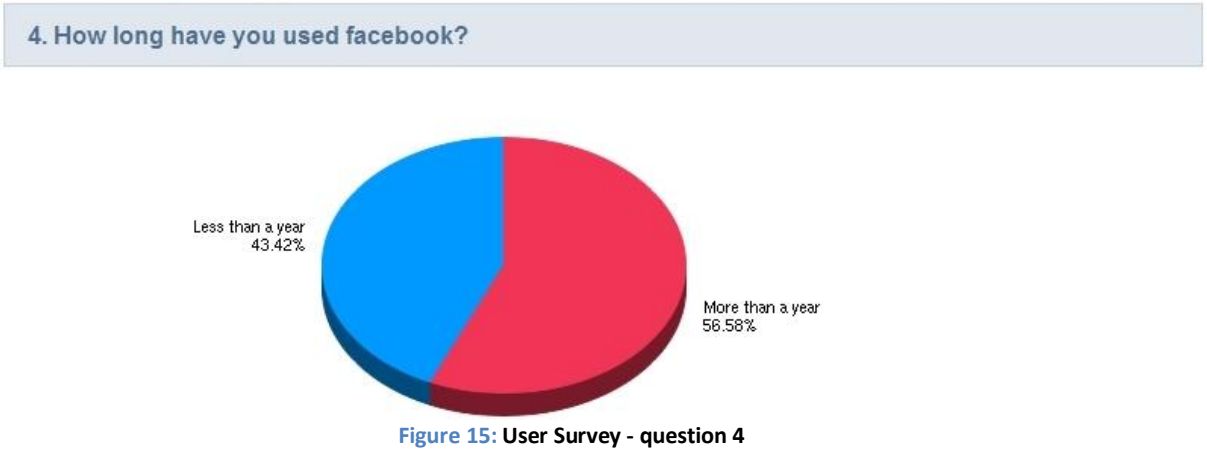

Figure 15: **User Survey - question 4**

- The majority of the participants were using Facebook for more than a year, a fact that would probably remain correct with a bigger survey population, even taking into consideration the its huge growth. That is most likely due to the fact that Facebook has been able to retain a large number of users through its years of operation. This indicates that most Facebook users are long term users.

5. How often do you visit facebook?

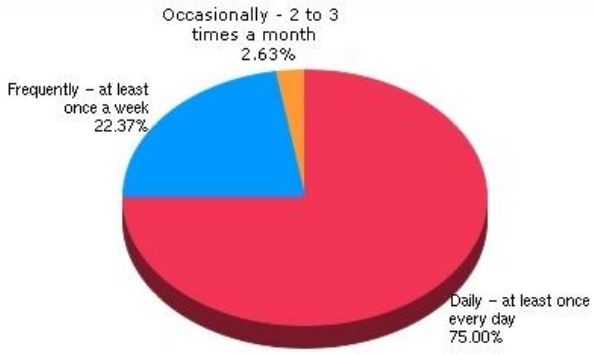

Figure 16: **User Survey - question 5**

- In relation to the frequency of visits to Facebook by the participants, it was inline with other studies that showed that the majority of the users of Facebook use the site every day. Only a small percentage of the participants stated that they used the site only a few times a month, representing those users that don't use Facebook to maintain connections with friends, but due to the fact their friends and or family use.

6. Rate the following activities facebook allow, being "1" the most important for you and "4" the less important.

SUMMARY

VALUE	1	2	3	4	AVERAGE RANK
Maintain contact with your existing friends	66	6	4		**1.2**
Share photos, videos,links	2	44	19	11	**2.5**
Join and interact with a group of people that share your interests	3	14	26	33	**3.2**
Make new friends	5	12	27	32	**3.1**

Total Responses: 76

Figure 17: **User Survey - question 6**

- Almost everyone of the participants of the survey rated "Maintain contact with your existing friends" as the most important activity that they do on Facebook,

being in second “Share photos, videos, links” and as third/fourth place “Join and interact with a group of people that share your interests” and “Make new Friends”. This reveals that Facebook users, and probably other users of social sites like it, use the site mostly to keep in contact with their existing friends and through that share photos, videos and links. The interaction in groups of interest to the users and making new friends seems to be more of a secondary, not very important, activity for the majority of the users.

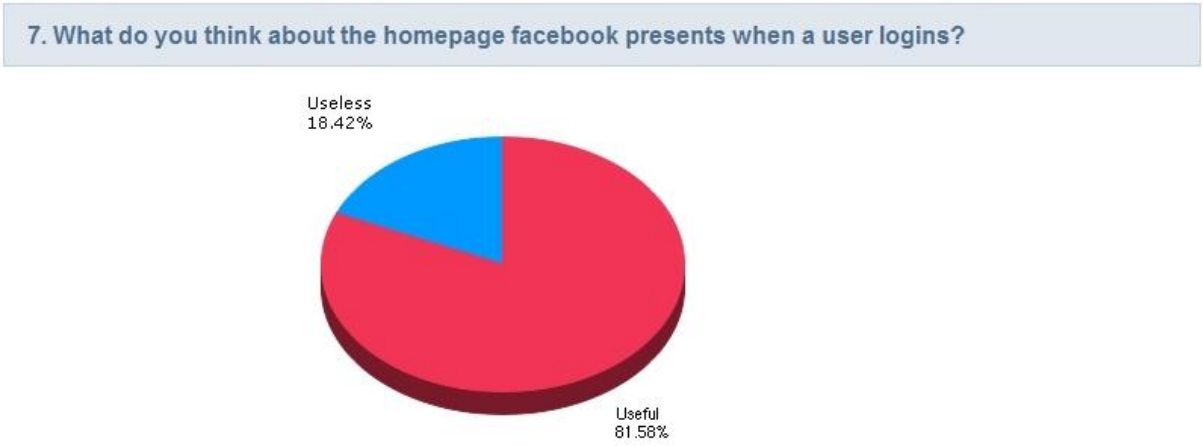

Figure 18: **User Survey - question 7**

- The homepage that each Facebook user has and that is shown every time he logs in the site was considered useful for the majority of the participants. The rest of the participants just pass through it, not giving a great deal of attention to the homepage.

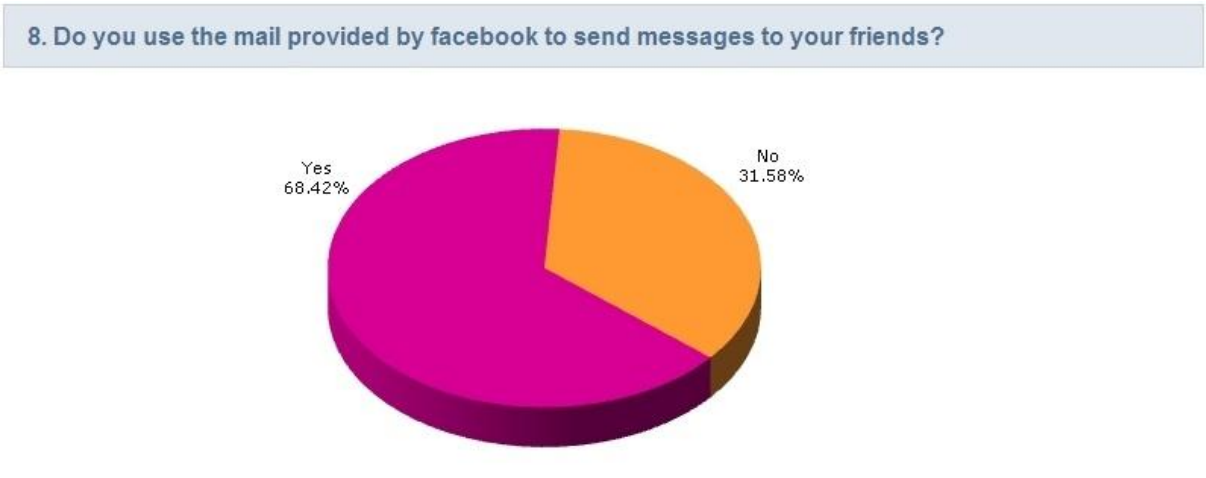

Figure 19: **User Survey - question 8**

- The email provided by Facebook has a great level of usage among the participants, being used by almost three quarters of them. The users of the email service also said that it was easy to use, where the others said that the fact that they already had an e-mail account extra to Facebook was the reason to not using the one Facebook provided.

9. Have you ever used a website with a 3D interface, like www.whitevoid.com/application or the plugin Cooliris for Mozilla Firefox/Internet Explorer on a site like Deviantart?

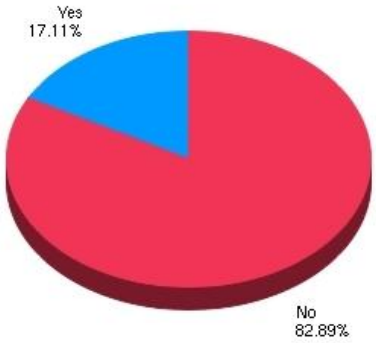

Figure 20: **User Survey - question 9**

- In relation to the use of sites with a 3D interface, the survey showed that most Facebook users haven't used something like that, being only less than 17% the ones who have.

Analyzing the textual answers, of those last set, related to this question with a tag cloud (**figure 21**) is possible to see the main idea transmitted in relation to the use of 3D. The participants think that it would probably be more confusing to most users. Furthermore, they think that would be especially true in websites with a lot of information. Nevertheless, some users think that the use of 3D interfaces in websites would make the interfaces better looking even though maybe they would became slower. This indicates that people that have experimented websites, which are fully 3D or have some 3D component, have seen it as a gimmick and not something that would give them a better experience and better visualization of the information.

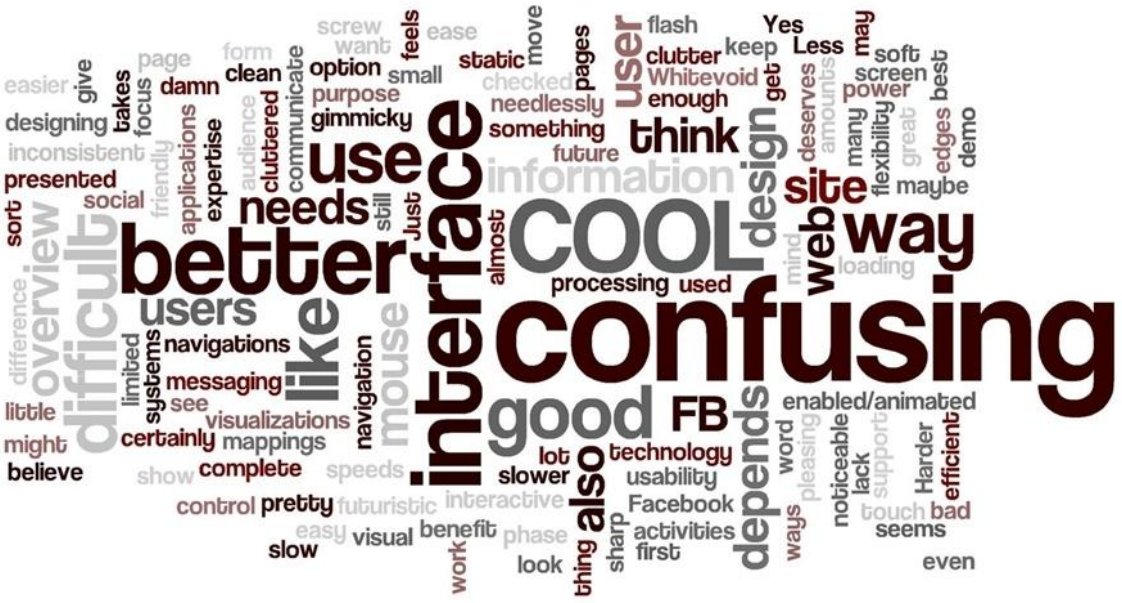

Figure 21: **Tag Cloud - What users think about the use of 3D on the web.**

Even though it was important to see if participants have experienced 3D on the web and if so how was their experience, it's equally or more important to see what participants love and hate about the Facebook' interface. Those answers are important since they indicate the particularities that made users keep using Facebook but also those things that participants feel that don't help them in their activities or just don't provide a good experience.

When asked about what participants loved about the Facebook interface (**figure 22**), they said that it's mostly the fact that it's easy to use, allowing them to easily navigate through the site and see the last updates about their friends. That is complemented with the fact that they feel that Facebook has a clean and well organized interface whether in the information the site presents and in the general layout.

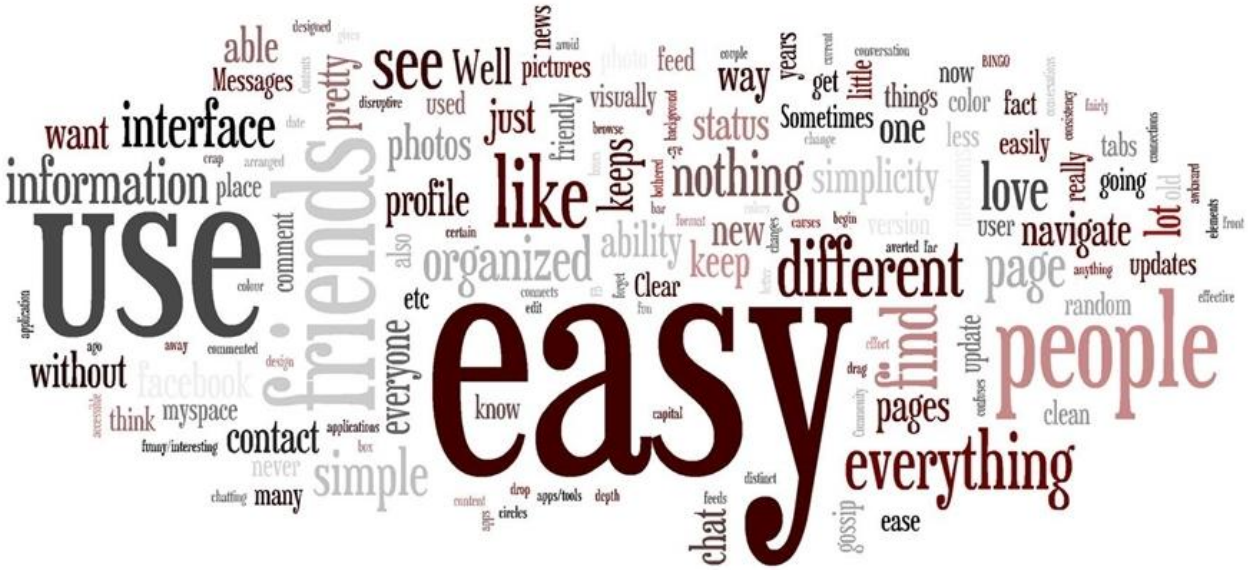

Figure 22: **Tag Cloud - What users love about the Facebook's interface.**

Regarding what the participants hate about the Facebook interface (**figure 23**), the majority is very happy with it saying that they don't hate nothing about the interface. The complaints that were transmitted through the survey are related to the low level of customization Facebook allows and the fact that they can't define their friends on it as casual or close friends. That last fact makes it impossible for them to share some information's only with close friends. Last but not least, there were some criticism about its chat service, the excessive number of applications and the browsing of photo albums.

Figure 23: **Tag Cloud - What users hate about Facebook's interface**

In conclusion, it can be drawn a parallel between (Joinson, 2008) and this survey. The results that relate to the characteristics of the Facebook' users and their motives for using it were the same in both cases. But also one of the main conclusions Joinson determined, was the fact that Facebook's users use the site mainly to keep in touch with friends, being only a small number those who used it to make new friends can also be obtained through this survey. Also from the users response about what they love and hate on Facebook interface, there are attributes that a new visualization has to posses in order to provide a better experience to users. The visualizations have to provide easy access for users to see which of their friends have made an update but also to see that update. Also it has to allow participants to define different levels of friendship, so they can separate close friends from casual friends.

3.3 *PROTOTYPES*

In the modeling phase several prototypes were built with the common goal of giving the user a richer and compelling experience. With that in mind, and taking into account the work of Joinson (Joinson, 2008) and the results of this survey, there were some requisites that each prototype had to obey.

1. The first requirement was the need to have friends at its core design, since the main activity of Facebook' users is to interact with their friends whether checking their status updates, by sharing multimedia content and by commenting on it.
2. The second requirement stipulated that friends should be shown in three different categories, respectively best friends, social friends and acquaintances. That was to

allow the users to quickly glance at the screen and get a clear perspective on their Facebook' friends.

3. The third requirement stated that the user should be able to see that a friend has made an update without having to open their profile. This is due to the fact that user's interaction is driven by updates, like when a user makes a photo upload that leads their friends to see, comment and/or tag it.

From those requirements several prototypes were designed, where some tried to display all the friends at the same time in the screen, while other showed only a set of friends at a time. After the design of each prototype, an informal evaluation test was performed to see if the designed layout showed the essential information in a way that users are able to take advantage of it. The evaluation included the testing of the functionality that was afforded by the prototype, since it's important for the interface not to lead the user in error by affording one thing and behaving in another.
After the individual evaluations on each prototype, they were measure up to with each other. This resulted on the choice of the prototypes that are in the basis of the visualizations present in the application. In the next figures it's both of those prototypes.

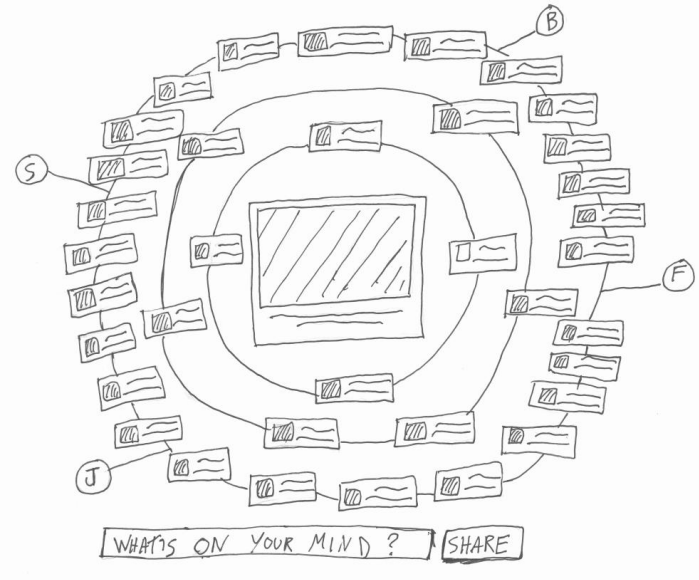

Figure 24: **Prototype A**

The idea behind the visualization A **(figure 24)** is that all friends are accessible to the user at the distance of a click. Also since it's the user social network that he will see, the idea was to put him at the center of the visualization with his friends positioned in three orbits around him. Thus provided three separate sections in which friends depending on the distance to the user are classified as close friends, social friends, acquaintances. Another aspect of this prototype was the fact that users could use the letters connected to the circles to stretch them, to a certain degree, so that they could get a better view of friends that start with that letter. And at the bottom of the visualization was a way for the user to share something with their friends.

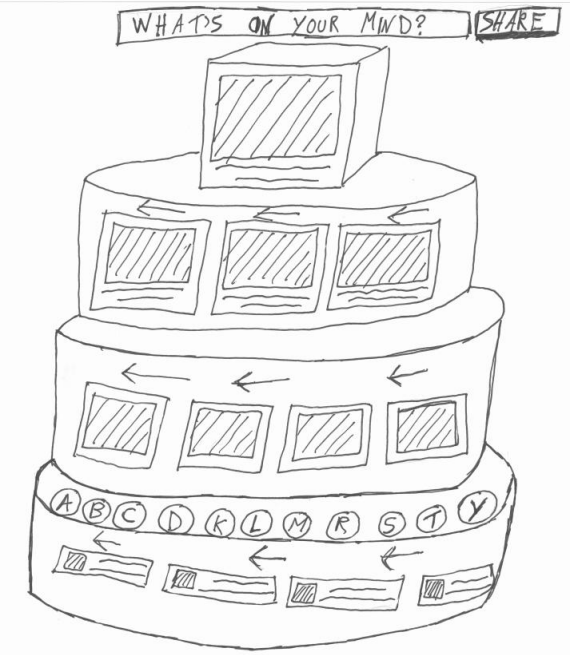

Figure 25: **Prototype B**

The idea behind visualization B **(figure 25)** is to give more information about his friends depending on the level of friendship he had with them. So friends would be in three-layer cake structure, in which as close to the top friends were, more important they were to the user. Also to facilitate the browsing of friends, while giving them more information than the Visualization A, friends would be in motion. That allowed user to browse their social network without any clicks. To allow the user to jump to a specific section of their acquaintances, buttons with letters on it would be positioned on top of that layer, making it easier to accesses a particular user. In this prototype the user had the chance to share something with their friends by using a bar positioned in the top.

3.4 *SUMMARY*

In summary, an online user survey was performed to obtain a demographic overview on the people that use Facebook, what are the main activities they perform on it and what they feel about the interface. Not only that, but also to know if people have ever used websites with a 3D interface and what was their experience. The data that resulted from the survey was then analyzed so that useful information could be generated and used on the definition of the requirements for a new rich visualization for Facebook. Those requirements then materialized in some paper prototypes, which were informally evaluated and two prototypes were chosen to be built.

CHAPTER IV

TECHNICAL WORK

4.1 INTRODUCTION

In this chapter it will be presented all the development process that was performed. The project was developed in Flash, specifically in Actionscript 3, using the flash 3D engine called Papervision in conjunction with the Flex framework and the GreenSock tweeening platform.

Since flash is at the basis of the project it guarantees that everyone can experience with it no matter what platform they are on, just needing the flash plug-in. But flash, at the moment, doesn't fully support 3D, so that is where Papervision comes in. Papervision allowed not only the addition of 3D elements to the interface but also the opportunity to provide the users with 3D interactions.

Finally, the 3D animations are provided by TweenMax and TweenGroup of GreenSock, which provides a basis to make things move and/or transform in a smooth way.

4.2 ARCHITECTURE

The architecture chosen for the SocialCircles application is the Model-View-Controller (MVC), which defines a separation between the data/information contained in the model and the views that are responsible for displaying it and receiving user input. Therefore several views can be developed without the need to change the data structure present in the model. An architectural overview of the SocialCircles application is given by **figure 26**.

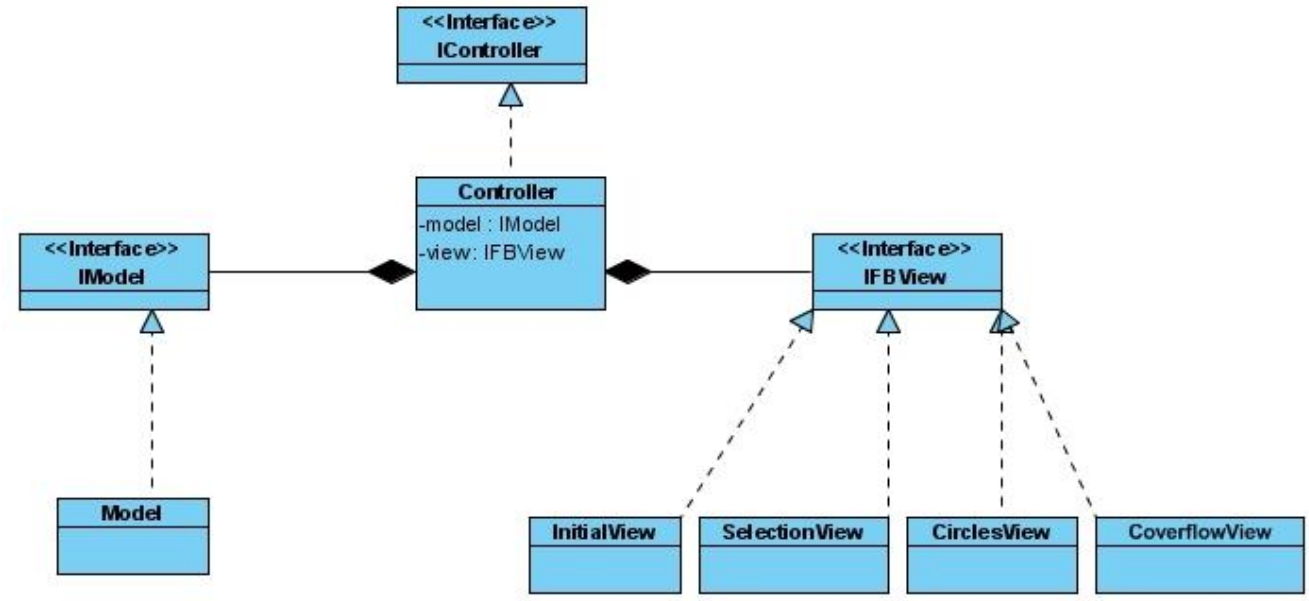

Figure 26: **SocialCircles MVC Architecture**

4.2.1 Model

In the project there is one Model, which is responsible for storing and retrieving all the information concerning the user and its friends in request to the views needs. The Model contains an instance of the FacebookBridge (Fac09) and another of the AMFPHP (AMF09). FacebookBridge is a middleware class created by Zerofractal Studio that enables a flash application to interact with the Facebook API. AMFPHP allows a flash application to communicate directly with PHP class objects on the server, providing one of the fastest client server communication protocols. The PHP class objects can be viewed as services that the server offer and which a flash application can use through AMFPHP.

Therefore the FacebookBridge instance is used to access the necessary users' data that is located on the Facebook servers and the AMFPHP instance is used to connect with a database, that contains data produced by the application, and to retrieve images to the server. The images are retrieved by AMFPHP instead of using the methods present at flash and more specifically in Papervision due to security restrictions posed by the flash platform. Due to that fact, there was the need of doing an images' cache on the server so that the application could then load the images. The data retrieved from Facebook about

the user and its friends are saved in the model to limit the number of requests the application has to perform.

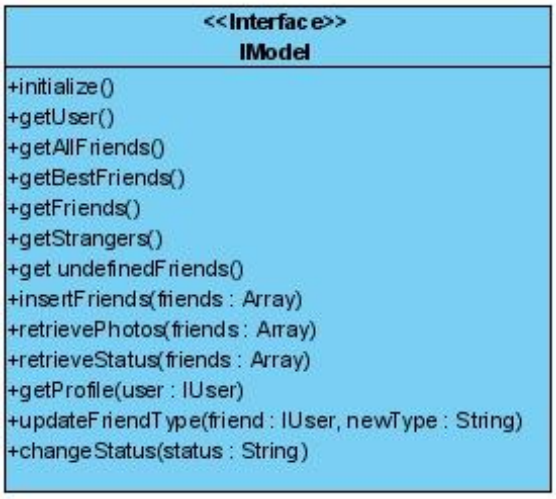

Figure 27: **Model's Interface**

All the communication between the Model and the other two is done through the interface described by a class diagram in **(figure 27)** that defines methods to perform the operations described in the following table.

Table 1: **IModel Methods**

Methods	Responsibilities
initialize	Initializes the model, creating a user instance with all his profile information. At the same it retrieves and separate the user's friends based on the type of friendship already defined by the user.
getUser	Returns the user instance
getAllFriends	Returns all the user friends
getBestFriends	Returns all the friends categorized as Best friends
getFriends	Returns all the friends categorized as Friends
getStrangers	Returns all the friends categorized as Acquaintances
get undefinedFriends	Returns all the friends that haven't been categorized
insertFriends	Insert all the friends that were uncategorized in their proper categorization, chosen by the user
updateFriendType	Update the categorization of a friend in response to a promotion and demotion of a friend
retrievePhotos	Retrieve the photos of a single or group of

	friends
retrieveStatus	Retrieve the status of a single or group of friends
getProfile	Retrieve the profile' information of a friend
changeStatus	Change the user' status, asking the user for permission if he already hasn't given

4.2.2 Views

All the views in the project have an instance of the controller and an instance of the model. The instance of the model is used to request and retrieve the information needed, and the instance of the controller to indicate that the user wants to change view.

Four views were developed: an initial view, a selection view and two main views. The initial view is responsible for "receiving" and giving the user some instructions about the application. The selection view shows the user all his friends that aren't in any category of friendship (Best Friends Social Friends, Acquaintances) and allows the user to put them in a respective category. The two main views are the ones that are responsible for showing the user's information and that allow him to explore his social network.

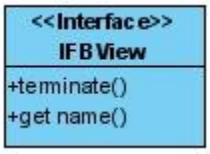

Figure 28: **Views' Interface**

Each view has to implement an interface **(figure 28)** which requests the implementation of a method to return the name of the visualization and to terminate that visualization. That method is used when the user changes from one view to another and is responsible for moving the components out of the screen, clearing the screen for the other view.

4.2.3 Controller

There is only one controller on the structure of the application that is responsible for activating and deactivating the views. So when the application is executed it waits for the default information about the user and its friends to be retrieved. When it's done, the model signals that has completed the retrieval and the controller starts a view. The view that is selected depends if there are friends that aren't associated with a category of friendship. In that case the controller launches the Selection View, which allows the user to categorize its friends. But if that isn't the case, then the controller launches one of the main views. Also when the user selects a switch of the main view the controller is responsible for terminating the current view and then loading the other main view.

As a result, the Controller isn't used in the communication between the user interface and the model, whether to retrieve or store data. Also the controller doesn't contain the logic relative to the view, i.e. it doesn't handle the user interactions with the views, leading to a slimmer controller. The benefit of this approach, instead of putting all the logic to manage the users' interaction on each view in the controller, is the fact that it makes a

change to the logic of a view much more manageable. Also if the logic of each view were to be divided in a number of controllers, which will then communicate with a main controller, it would result in an explosion of controller classes.

4.3 VISUALIZATIONS

As mentioned in the beginning of this chapter, a selection view and two social network visualizations were developed for the application. Each visualization is a class that creates the display objects and takes care of all the interactions with the user, but also is responsible for telling the model's instance to retrieve the needed information.

4.3.1 SelectionView

This visualization **(figure 29)** is composed of three selection buttons that are used to categorize the user's friends that are represented by cards, specifically nametags (**section 4.3**). To facilitate the selection task, each user is categorized by default as an acquaintance, giving the user the possibility to continue to a social network visualization without having to spend time categorizing friends at that moment. The nametags are show in groups of 25 elements, presented in a grid structure that is moved in concordance with the movement of the mouse. The movement of the grid is inverted in relation to the one of the mouse, so that it helps the user get more quickly to any tag.

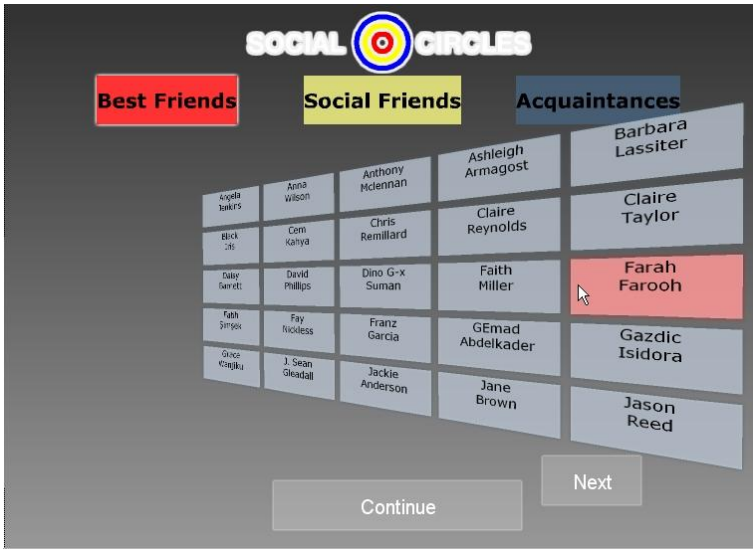

Figure 29: **SelectionView Visualization**

To cut waiting time, the visualization creates nametags for the firsts 25 friends of the user, which the Model has already ordered alphabetically. After that the nametags are only created on demand, as the user moves through his friends using the "next" and "previous" button. Since the Model has already retrieved all the information necessary to create the nametags, on demand proves to be the best way to save resources and to keep the interaction smooth.

4.3.2 CirclesView

This visualization (**figure 30**) is composed by three circles of equal number of colors, a Polaroid (**section 4.3**) with the user's photo and its first name, a set of cards with friends'

photo and a dynamic form for updating the user's status. The circles are centered on the screen, representing different types of friendship, with all the cards mapped on them. The size and the color of the circle are used to show the user the degree of friendship of a circle.

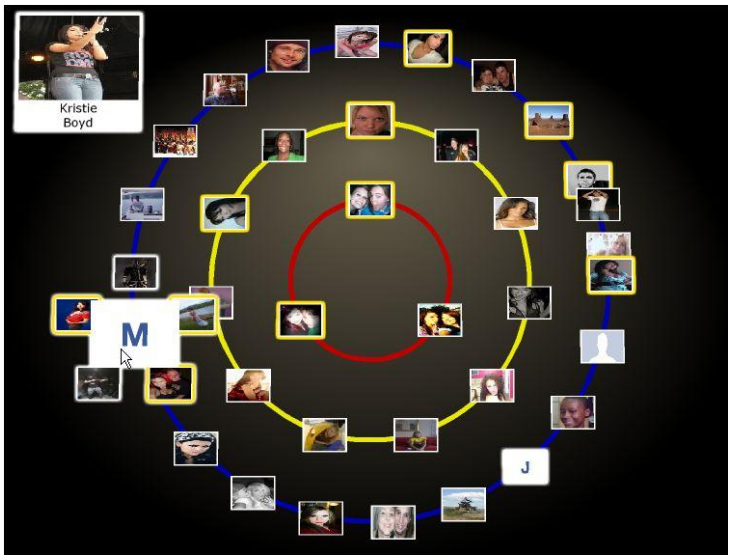

Figure 30: **CirclesView Visualization**

The biggest and of the color blue, is the circle of acquaintances. Blue was the chosen color since it conveys coldness and professionalism, and so represents the relations with coworkers/colleagues and other people in which the user doesn't know well. The middle one and of the color yellow, is the circle of social friends. Yellow conveys happiness and energy, representing the relations with people the user knows well and which is has good relationship. The inner circle, which is the smallest one and that is of the color red, is the circle of best friends. The choice of red is because the color transmits love, desire, excitement and the circle is the smallest because in real life best friends compose the smallest circle of friendship.

The friends' cards are uniformly distributed on the respective circle in an alphabetical order, being possible to cluster them under a letter. The clustering happens when there are more than 4 friends, in a circle, that start with the same letter and has the purpose of providing a better organization to the list of friends present in a circle. Also makes it more manageable to the user to explore his friends as the number of friends in a circle grows. That is improved with the fact that the clustering shows its elements when the user hovers over it, allowing the user to see which friends are contained on the cluster.

Another way the visualization has to make it more manageable and easier to explore, is the gravity functionality that is activated when the user hovers a friend card. When he hovers over a card the visualization calculates the distance to the closest cards and if the distance is smaller than 250px then the all the cards are moved away until they are at the stipulated distance.

Beyond the hover functionality, the visualization allows the drag and drop of cards into a circle. This is taken care by the visualization that detects when a click or a press and drag is detected and then deals with it accordingly, whether transforming the card in a Polaroid or by activating the drag and drop functionality. Since the cards are 3D objects the dragging is not done using the drag methods present in the flash platform, but by using a static method created to this effect. What it does is shoot a ray from the camera, through where the mouse is, into 3D space. Then it founds out where the ray hits the card that is going to be dragged. The static method then returns the intersection between the card and the ray. Then the visualization moves the respective card to the position returned by the static method.

When a user drops a friend card in a circle, whether coming from a cluster or not, the visualization automatically reorganizes the circle of origin assuring that the cards are uniformly disposed in it. The visualization also verifies if there is already a cluster formed with the initial letter of the friend card or if there is the need to create a cluster for it. The card is then introduced on the new circle and the cards are reorganized.

4.3.3 CoverflowView

This visualization (**figure 31**) divides the screen in three sections, where the top section is reserved for the Social friends the middle section for the Best Friends and the bottom one to the Acquaintances. The middle section is also where the user's card is placed, appearing in the middle of the screen when the user enters the visualization. The friends of each section display an amount of information that is proportional to the level of friendship. This lead to best friends being represented by a Polaroid with their status written in it, the social friends represented by a photo with a frame and then acquaintances represented by a card with a small picture and their names.

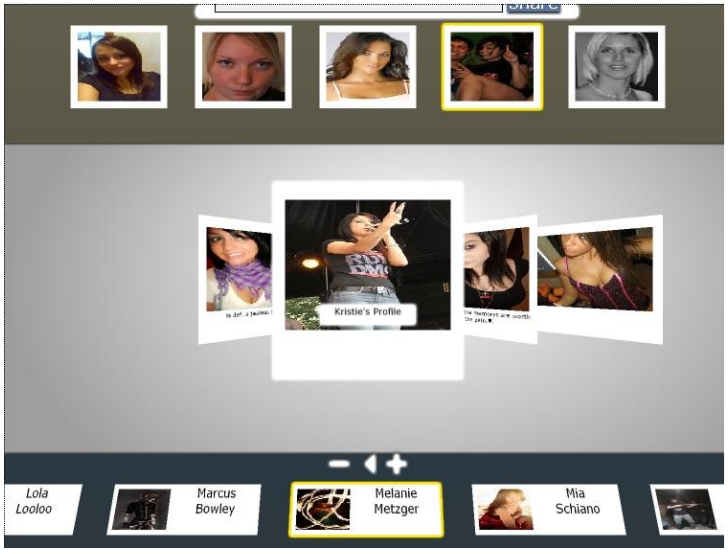

Figure 31: **CoverflowView Visualization**

Cover flow

The best friends' cards and user's card are positioned in a cover flow scheme, allowing the user to get a sense of several cards at the same time and to rapidly access anyone of them.

Carrousels

There are two carrousels on this visualization, one on the top and another on the bottom, which function in different ways. Another difference is the fact that the top carrousel uses the State pattern.

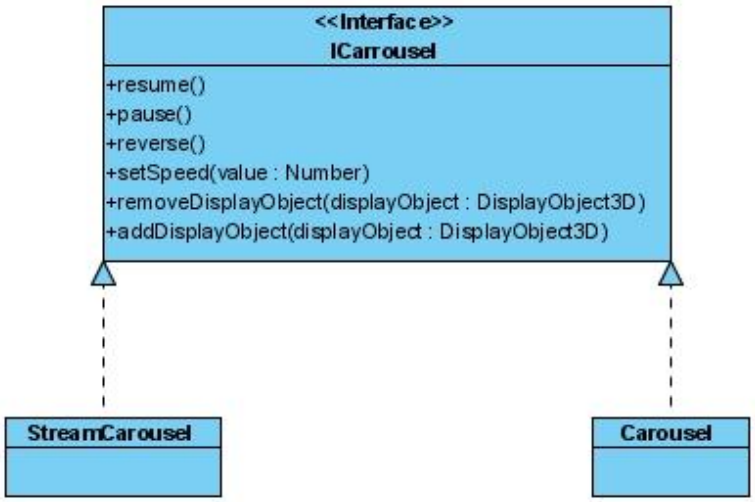

Figure 32: **Class Diagram – Carousel**

Each carrousel implements an interface (**figure 32**) that contains the methods described by table 2:

Table 2: **ICarousel Methods**

Methods	Responsibilities
resume	Resumes the movement of the carrousel
pause	Pauses the movement of the carousel
reverse	Reverses the movement of the carrousel.
setSpeed	Changes the speed of the carrousel.
addDisplayObject	Adds a new card to the carrousel
removeDisplayObject	Removes a card from a carrousel

Top Carrousel

The top carrousel moves in response to the position and movement of the mouse on the top section. The direction of the carrousel is given by the side of the screen the mouse is, so if the mouse is in the right side the carrousel moves to the left and vice versa. The speed of the carrousel is given by the position of the mouse, so as the mouse moves from the center to the left or right border of the screen the faster the carrousel goes. The tracking of the mouse is done through the visualization which then calls the respective method defined on the interface of the carrousel.

Bottom Carrousel

The bottom carrousel moves automatically, functioning like a TV news ticker, but giving the user controls to slowdown/accelerate and to change the direction of the carrousel. The controls component is composed of resume/reverse/pause button that changes in consequence of action of the user and a "-" and "+" to decrease and increase speed.

4.4 CARDS COMPONENTS

Cards are the visual representation of the user and friends on the visualizations, allowing the user to manipulate it directly. Each of those are created by passing as argument its counterpart on the model side, which has the basic information (name, photo, status) and the structure to contain all the profile information. The interface and the concrete classes for the user and friends can be seen in the next class diagram (**figure 33**).

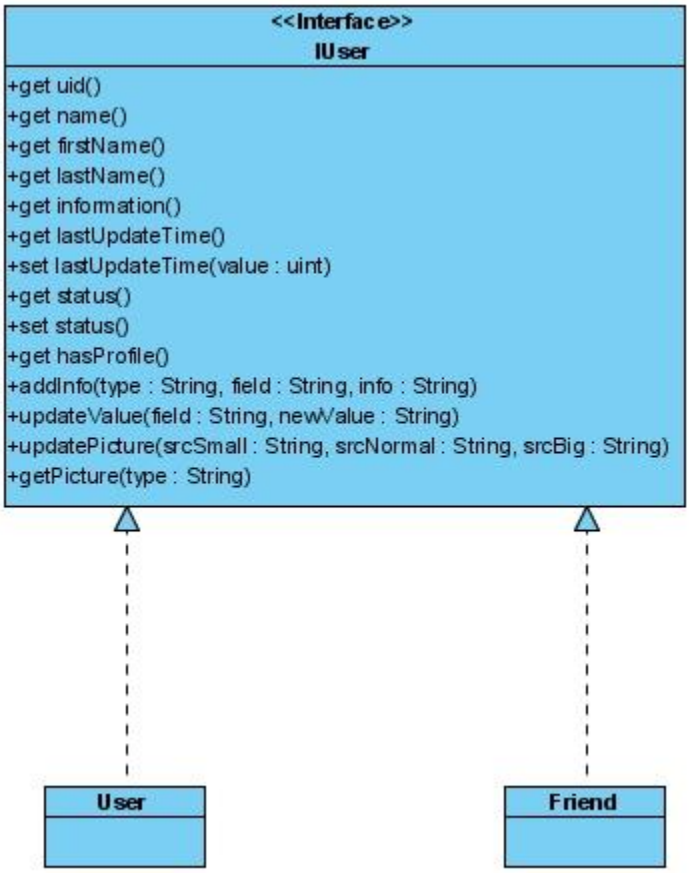

Figure 33: **Class diagram – Users' model**

Whenever information's update on the data related to a card is made, he is immediately informed. This allows the model to only update a specific data recipient without having to worry about the visual component that uses it. The visualization class also gains from that since it doesn't have to be responsible for managing the updates of data with the notification of the right component. However the card instances don't have access to the model instance, whenever the user indirectly request some information by manipulating a

card, the respective visualization instance has to tell the model to retrieve it from Facebook.

Each of the main visualizations, CirclesView and CoverflowView, use a different implementation, i.e., they don't share the same interface or the same concrete class. Next each one of the implementations is presented with a class diagram and a description. The first one, IFacebookCard, is used in the CoverflowView and the second one, ICard, is used in CirclesView.

4.4.1 IFacebookCard

This cards are implemented using the State Pattern, and can be interact with through an interface created to that effect (**figure 34**). So the visualization creates instances of the concrete base card by passing the user's model instance and a string indicating the initial state.

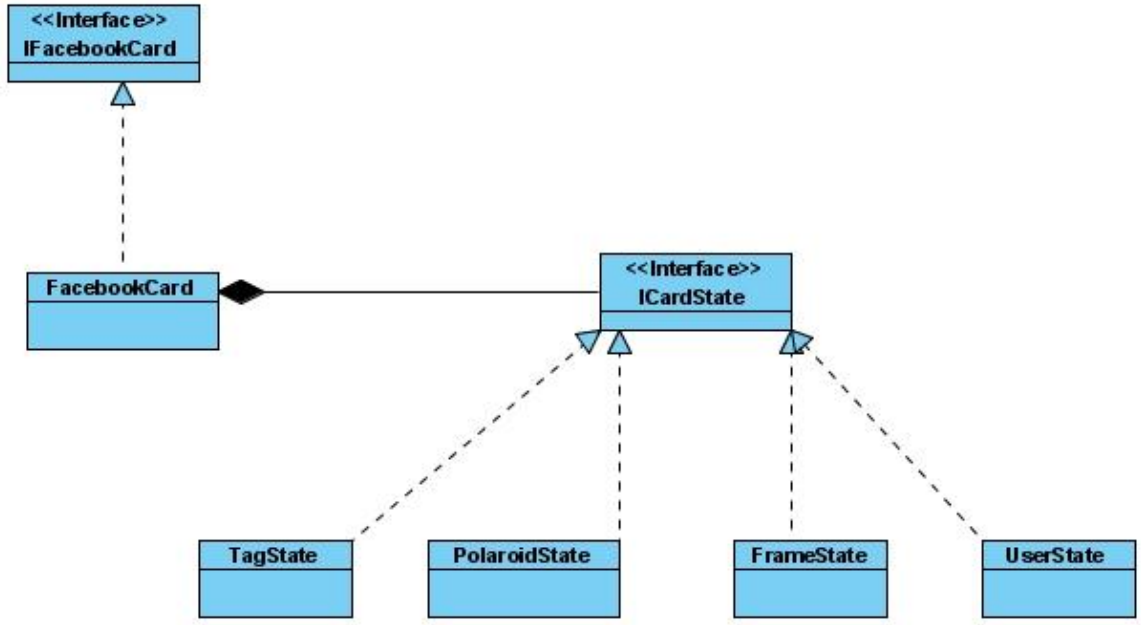

Figure 34: **Class Diagram - IFacebookCard**

The base class instantiates all the states and then according to the string passed it defines the initial state. To define the initial state the base class indicates the card state instance to instantiate the visual elements contained on the base class. This makes it so that each card state class has in its constructor capacity to create the visual elements, instead of being on the constructor of the base class. The reason for this comes from the fact that each state has a different visual form, which requires different instantiations.

4.4.2 ICard

In this implementation there are two concrete classes, DefaultCard and DefaultUser, which implements the ICard interface (**figure 35**). The first concrete class is used to create a visual representation of the application's user and the second one is used to create a visual representation of the friends. While an instance of DefaultUser only has

one visual form, Polaroid, the DefaultCard can take two different forms stamp and Polaroid.

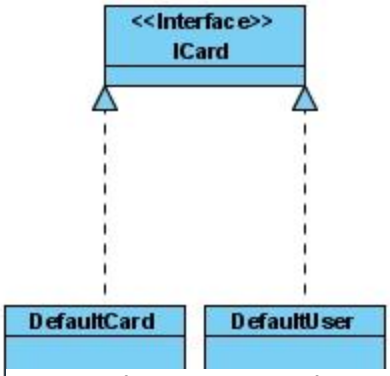

Figure 35: **Class Diagram - ICard**

Types of Cards

Nametag

The nametag card is used to present all the uncategorized friends, and is only present on the selection view. It is composed of a plane that serves as a background and the first and last name of the friend (**figure 36**). The design is based on name tags used in real life to identify people in several situations, providing an understandable way of displaying friends without having to retrieve a lot of data.

Figure 36: **Card - Nametag**

Polaroid

The Polaroid (**figure 37**) card is used to visually represent the user but also its best friends in the CoverflowView visualization. This representation was chosen since it something users are familiar with and has a connection with friendship, special moments and special places. Also it helps to demonstrate that is possible, as in real life, to interact with it and provides a way to incorporate a person's status on the card. The profile's information is showed in the back of the Polaroid, not changing the focus of the user to a side panel and so making each card a complete representation.

Figure 37: **Card - Polaroid**

Frame

This card is used to visually represent social friends on the CoverflowView, being composed by a photo with a white border (**figure 38**) that shows the friend's first name when the user moves the mouse over the card (**figure 39**).

Figure 38: **Card - Frame**

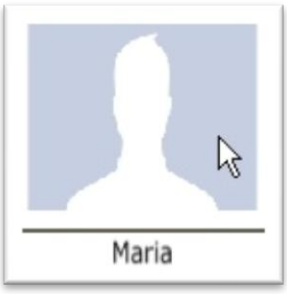

Figure 39: **Card - Frame on mouse over**

Tag

This card is used to visually represent acquaintances on the CoverflowView and is an extension of the nametag card, with the addition of a small photo (**figure 40**). That helps the user to identify a particular acquaintance, especially in those cases where the name is not enough for the user to remember him, avoiding a trip to the acquaintance's profile.

Figure 40: **Card - Tag**

Stamp

This card is only used in the CirclesView visualization to represents ant type of friend. Since in that visualization all the friends are show in the same screen, there was the need for a representation that allowed the user to identify a particular friend while also taking the less amount of space. The result was a card that has a small photo with a white border (**figure 41**) and that on mouse over expands and slides down the first name of the friend (**figure 42**)

Figure 41: **Card - Stamp**

Figure 42: **Card - Stamp on mouse over**

4.5 FINAL POINTS

Even though the application uses the MVC pattern, there was the possibility of using a Model-View-Controller Framework like PureMVC (Pur09) or Cairngorm (Cai09), which would definitely provide more robustness. But that had the disadvantage of bringing extra complexity for the project, when it needed a more basic and flexible solution.

As a final point, flash at the moment it's the best way to bring 3D to the web in a way that most people can experiment, since the flash player has a worldwide market penetration of 99%. But during the development of SocialCircles it was possible to see that it's not the perfect platform when the objective it's to bring the best 3D experience to users. That is related with the fact that flash doesn't take advantage of the GPU, so it can't compete performance-wise with other platforms that can produce more and better 3D content. That fact limited the number of polygons and textures the SocialCircles application could use and the level of quality defined on the stage, in order to maintain the interaction smooth and fluid.

4.6 SUMMARY

This chapter presented the technical work that was developed and that resulted on the SocialCircles application. First the MVC architecture used on the application was illustrated by a class diagram and then each of the three components of the MVC was described. After that, the ideas behind the visualizations and their operation were presented as well the visual components that compose them.

CHAPTER V

USER STUDY

5.1 INTRODUCTION

This chapter will describe the process followed to perform the usability testing on the SocialCircles application. The results from the test will then be presented together with a qualitative analysis.

Usability testing is used to obtain feedback during the development process, to ensure that the application will actually be usable and effective. A Think Aloud (Lewis, et al., 1993) qualitative method was chosen as the objective of the testing was to see if the new visualizations could provide a better view over the users' social network and if it was usable and manageable. Think Aloud involves asking users to perform a test task, but also to simultaneously verbalize what they are thinking, what they are trying to do, while they work on it. During the test, all the comments and reactions of the users should be noted by an observer, so that later they can be analyzed.

5.2 THINK ALOUD

Through the use of Think Aloud it's possible to not only understand the elements of the interface that are not clear to the users but also to see what are the sequence of steps that make sense to the users to achieve a particular task. This is useful to perform alterations to the interface so that it supports the way users perform the tasks.

The user study was performed with 5 Facebook users, using their social network. They were briefed about the Think Aloud procedure and then asked some demographics questions, which can be consulted on appendices.

After the test' participants understood the procedure and were at ease with it, they would go through the process of installing the application on their account. Once the installation process was performed, the procedure would start with the experimenter informing the participant about the first task. During the process they were encouraged to keep saying what they were thinking. The defined set of tasks for the test was:

1. Divide some of your contacts in Best Friends, Social Friends and Acquaintances.
2. Change one of the contacts that is categorized as Social Friend or Best Friend to Acquaintance.
3. Name a friend, from each of the categorizations and navigate to their profile pages.
4. Name a friend, from each of the categorizations and re-categorize them.
5. Update its status
6. Find a contact that has made a status update.

The first two tasks are performed only once, but the other tasks are performed two times, i.e. once for each social network visualization of the application. Another aspect of notice is the fact that the first social network visualization participants saw reversed from test to test. So the first participant interacts first with the CirclesView while the second participant interacts first with the CoverflowView. The reason for this is to get a more reliable set of opinions because the second visualization receives the user with some experience gained from the interaction with the first visualization. This is more relevant since both visualizations use direct manipulation.

When the user has tested the two visualizations some follow-up questions about specific aspects of the visualizations that separate them from Facebook. The follow-up questions can be consulted on the appendices.

5.3 RESULTS

The group of participants was under 25 years old, Portuguese, with only one of them being female. Two of the participants were Facebook' users less than a year, but all of them visited the site daily. In relation to the number of Facebook' friends, there were three participants that had 50 or less friends, with the other two participants having 51-100 and 101-500 friends, respectively.

5.3.1 SelectionView

The participants' reaction to the selection screen was mostly positive, understanding what they had to do and how to do it. Although there were some participants that had a problem with undoing a categorization made on a friend, were they would give another click on the categorized friend to try undoing it. One minor complaint made by one of the participants was on the movement of the grid of friends in relation to the mouse position, which he felt it shouldn't move so much. Also one participant expressed some concerns on the fact that the tags only showed the friend's name, being a problem if he had friends with the same name. When asked if he would like to see a little photo in the tag and if he thought that would be a good solution he answered that it would be better if a photo was shown on the tag, resolving the problem with friends with the same name.

5.3.2 CoverflowView

The reaction to this visualization was mixed based on the three sections that compose the visualization. Almost all participants understood the functioning of the cover flow, present at the center section of the screen, navigating through their friends in an innate way. Furthermore they liked the way their best friends were displayed, since it showed the friend's photo in a size that allowed them to appreciate it, without having to go to the friend' profile. Also they liked the fact that the status of their best friends was easily accessible.

The participants had some problems with the carrousel of friends, present at the top of the screen. Primarily, it was not obvious to them how it worked in the initial interaction with it, which caused confusion. After that some participants were able to navigate through their friends without problems, while the rest kept having some problem with it. The main complaint about it was the fact it wasn't clear to them why it was moving the way it did.

In relation to the lower section where it's the carrousel of the acquaintances, the interaction with the carrousel was obvious to the majority of the participants, whether to change the direction of the carrousel or to increase/decrease its speed. However, some complains were expressed by participants with more than 50 friends and some concerns by participants with less than 50 friends about the navigation to a particular acquaintance through the controls available to them. They felt that reaching an acquaintance by increasing speed and/or changing direction did not allowed them to quickly reach it, wanting a way to jump directly to it or near it.

The promotion and demotion of contacts from friend/acquaintance proved to be natural to the participants, with them being completely at ease with it. But with best friends there were some complaints with the fact that best friends can only be dragged when its card is selected (at the center of the cover flow). Three of the participants automatically selected the best friend they wanted to demote/promote before dragging them, while the rest didn't selected first, become confused and tried again. From those, one asked if it was possible to drag best friends while the other selected the best friend and then did the drag, understanding how it works.

5.3.3 CirclesView

The reaction to this visualization was good with participants understanding the functioning of the visualization. The majority of the participants navigated between friends without any problem, while the ones with more than 50 contacts had a complaint with the clusters of friends. They wanted to see a friend that was in a cluster so they put their mouse over the cluster, which would make all the friends appear from underneath, and click a specific friend. Since that did not result in the card moving to the center of the screen, they became confused and tried again to make sure it wasn't their fault. That then led them to click on the cluster, which would go in the direction of their objective.

The promotion and demotion of contacts was natural to all the participants, with them using the drag and drop functionality without any help. The only problem was when moving a friend of a cluster to another circle, in which they had doubts about if the friend really was moved since it disappeared from the screen. That resulted in them looking around the screen to see where it is, then returning the cluster to its position to find the friend on the circle they moved it to. This is a problem of mode, a classical problem in human-computer interface design (Raskin, 2000), in which the same operation results in different results depending on the current mode. In this case is the dragging a friend operation and the two modes are when there is no friend selected and the other when a cluster is selected.

5.3.4 CirclesView and CoverflowView

The task of accessing profile, changing status and finding an updated status obviously resulted on more pertinent results in the first main view the user interact with, since both views present the profile and the updated condition in the same way, and use the status bar to change status. So the following represents the reactions collected from participants on their first visualization.

The access to friends' profiles from any category of friendship was done with no problems, with participants knowing how to do it without any help. Even though users closed profiles without a problem, they said that they would like a close button or a close indication.

On the task of changing status, participants saw the status bar present in the top center of the screen but it was not completely clear to them that it was there that they could change the status. The participants on the CoverflowView tried to change the status on their Polaroid, while the others looked through the interface then put the mouse over the status bar. After founding the status bar participants knew what to do, i.e. write and then press the share button. That indicates that the status bar should have more affordance so that users can instinctively perceive that they can change their status there.

When told to find an updated profile among their friends, only one participant associated the yellow glow around a friend to a change/update. From the rest of the participants, some noticed the glow but didn't make the association, asking if that represented an update and the others didn't notice the glow. That indicates that an update should be represented in a more significant way.

5.3.5 Follow-up

After users had completed the planned tasks they were asked some follow-up questions, those answers will now be presented.

1. On the representation of their contacts in a three levels of friendship, participants said that it was better than the way Facebook shows, since it's easier to find the contacts that are more important to them and see if they have made some recent update.
2. On the presentation of all the friends at the same time (CirclesView) or only a portion of them but with more information (CoverflowView), the majority preferred the former since they have a quick access to any friend. The rest were undecided, saying that the two visualizations complemented each other, since in the CirclesView they are able to quickly see updates but with CoverflowView they can see the status of their best friends on the spot and have a larger photo.
3. On the use of direct manipulation, especially the use of drag and drop functionality, participants said they felt they had more control since they can move friend around and organize on levels of friendship with a move of a mouse. One of the participants also said that it was like a real life photo album, where you drag photos of friends/family from one place to another.
4. Criticism about the visualizations included that the status bar that was not perfectly visible, the friends' carrousel that was confusing and the fact that there is no control on the acquaintances carrousel to jump to a specific acquaintance.
5. Regarding what they liked about the visualizations, participants answered the cover flow with the best friends, the fact that they could see their friends all in same screen and in separated in levels of friendship and the fact they could simply drag a friend to promote/demote him.

5.4 SUMMARY

In summary, this chapter described the user study performed on the SocialCircles application, presenting the Think Aloud method and all the steps of the process. The results obtained from the usability testing were then presented and analyzed.

CHAPTER VI

CONCLUSION

The use of visualizations to display the information contained on social networking websites is not new, since it's possible to find several systems that were created in the past with that intent. Nonetheless their focus was on providing tools to help analyze social networks so that researchers can have a clearer idea on the relations and interactions between users. That fact makes regular social network users indifferent to those tools even though it's possible to uncover a lot of information with them, information that is not available or not perceptible through the current interface of social networking websites. Furthermore, since those systems are focused on the analysis and not on the users, it doesn't support the everyday activities performed on social networks, like keeping in contact with friends, sharing media or making new connections.

This thesis identifies a need for better visualizations that give everyday users a view on the relevant information that spurs from their interaction with the social network while supporting their current social activities. That is, it demands visualizations that have their focus on users.

SocialCircles is designed from this perspective, focusing on the user and on their activities with the aim of giving more control over the visualization and a clearer picture of their social network. It provides a view on the user's friends by separating them in three "circles" of friendship, something people instinctively understand. This then allows the user to easily and quickly keep in touch with their most important friends and see what's going on with them, without having to search among all of their contacts. Also by representing each friend by a card, it allows the user to reach through the visualization and interact directly with it. So he can reorder its contacts like he would do in real life on a photo album, with a simple and natural drag and drop.

Through the user evaluation of the visualizations it was possible to see that they give the user an engaging and understandable representation on their friends, with users liking the fact they have their friends at the core of the visualization and separated by the level of friendship. Also the use of a drag and drop functionality resonates with users since they feel more in control. And even though there some aspects that attracted criticism, needing some more tuning, the visualizations proved that they can give a useful view over the users' social networks.

However the visualizations present at SocialCircles doesn't support all the main activities a user can perform on social networking websites. Activities like the interactions that happen on the user's and friends' wall, with the sharing of media and the writing of comments. And also the browsing and organizing of photo albums, but also the insertion of tags and comments.

Those activities can be easily supported by the application on future work, as a result of its architecture in MVC. That fact allows the addition of new visualizations to it without the need to change the other visualizations and taking advantage of the model already built to retrieve the necessary data.

Another future functionality that would be an improvement to what social networking websites now offer is users having the possibility to share a link, photo, video, by just dragging a representation of that type of media to a certain friend or circle of friends. With that users would have direct control over who gets that piece of media, without having to go to their account definitions and make changes to the privacy, which some users don't know they can change. So this would allow users to decide, for each piece of media, with whom they want share it.

To conclude, in recent years, online social networks have expanded exponentially both in the number of users and in the type of content available in it. This has led to an increase on information coming from friends and groups, which can be of several types like text, links, photos, videos. So the complexity has also increased, leading to users having more difficulty in getting the information they want through the current interface paradigms dominant in social networking websites. Therefore there is a need for visualizations that take that web of information and present it visually to the user. SocialCircles addresses this issue and tries to give back to the users the control of their social networks by presenting the most salient information in a way that they can immediately understand, and directly and fluidly control. We hope this thesis ushers in a new generation of rich, expressive, dynamic visualizations of this increasingly important media format.

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APPENDICES

Demographic Questions

1. What is your age?
    a. 25 or under
    b. -26-40
    c. - 41-55
    d. - 56 or older
2. What is your gender?
    a. female
    b. male
3. What's your nationality?
4. What is your primary language?
5. How long have you been a Facebook user?
    a. Less than a year
    b. More Than a year
6. How many times a week do you visit Facebook?
    a. Daily
    b. Weekly
    c. Monthly
    d. Less than once a month
7. How many friends do you have on Facebook?
    a. 50 or less
    b. 51 – 100
    c. 101 – 500
    d. 501 or more

Follow-up Questions

1. Do you think the representation of your friends in 3 separate categories provides a better view/visualization on them, allowing you to better see what's going on with the friends you are more connected?

2. Do you prefer having all of your friends in screen at the same time (like Circles View) or to show only a portion on your friends but with more visible information (like CoverflowView). Why?

3. Do you feel that the direct manipulation of dragging friends from one circle to another gives you more control over the dispositions of your friends?

4. What did you most disliked in the interface? (CirclesView and CoverflowView)What did you most liked in the interface? (CirclesView and CoverflowView)