

Who have I been talking to?

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ABSTRACT

In this paper we present "Who have I been talking to?", a tool to answer this very question in a visual way and to analyze the evolution of email use and email relationships. With this tool, users can easily also answer the question "What have I been talking about?", which may be helpful in analyzing electronic relationships, because it provides some context and allows a deeper understanding on why the evolution was like that.

In this paper we present the user's interface and the rationale behind every element of it. After that we present a small study conducted to evaluate the project where users had to perform a set of tasks which were measured in a way to evaluate effectiveness, efficiency, usability and learnability. After those tasks were performed, users were asked to answer a questionnaire so we could evaluate satisfaction.

Keywords

Email, Visualization, Personal Information Management

1. INTRODUCTION

Nowadays, we can say that the computer is used a lot for communication by many people around the globe. From social networks to electronic mail, billions of people use computer to communicate and interact with others. In social networks we got for example Facebook, with more than 600 millions users¹, while email is a technology used even more. Actually, in current times, the use of email is something close to irrational and numbers prove that people consider it an indispensable tool in their lives for either business or pleasure. According to numbers released by Royal Pingdom concerning the 2010 use of email² already excluding the 89% considered spam, there were over 32 billion email messages sent every day. It is estimated that the number of email users is about 1,88 billion around the world. With a few calculations is easy to understand that the average person gets around 17 email messages everyday, which makes about 6000 messages in the whole year. This number is an average, so there are a lot of people that probably get much more than that.

So, how can we keep track of our electronic relationships?

¹Facebook have 600 million users according to http://www.msnbc.msn.com/id/40929239/ns/technology_and_science-tech_and_gadgets/

²Internet in numbers at <http://royal.pingdom.com/2011/01/12/internet-2010-in-numbers/>

In this paper, we try to propose a way to visualize information in order to keep track of it. We chose to use email in this work and the reasons were presented on the previous paragraph. The use of email is much more massive than any other platform and email is much more ubiquitous than any other way of communication possible via computer and internet.

The main objective of our work is to answer the question "who have I been talking to?". In addition to that, we propose a solution that also allows the user to understand the "why" of the answers found for that question as well as understand the evolution of the relationships he or she maintains by email as time goes by.

The structure of this paper consists of basically, after the introduction, a section about related work where a little bit of state-of-the-art in this area is presented, followed by the description of our tool and the results of the usability tests conducted on it.

2. RELATED WORK

Mirroring our live and our relationships with others through our electronic information is a recurring practice that has known very interesting results. Probably, the source most often used for such applications is the email due to the fact that is one of the most used and ubiquitous technologies nowadays. [5], [6] and [2] are three of many works that deal with such source in very different ways. On [5] we have overall information of who have we been exchanging emails with and also the possibility of selecting contacts. However no context is given nor even the actual content of the messages is accessible, making it difficult for the users to answer the "why" of such communications. Besides that, it's also not possible to follow the exchanged messages with another person over time so we don't really have an overall view of who are contacting to over time. The authors of [6] followed a different path as they focused on portraying relationships among individuals rather than on giving an overview of all our email relationships. Although we must admit that this application serves its purpose perfectly, the truth is that we feel the lack of a way to correlate our relationship with the individual X with our relationship with the individual Y and, why not, with the overall landscape of our relations. So, again, it's a context problem. The three visualizations presented in [2] try to cover the problem from different perspectives. However, and again, no context (beyond the temporal one) is given and our relationships to

each one of our contacts is not well explored and the evolution of such relationships is not explored at all. On [4] the authors used chat information to reveal user's communication patterns putting all the information in a 3D structure. Here no context problem exist since we can access the actual conversations' content. On the other hand, the use of such 3D structure made it difficult to compare conversations between contacts not only because of the perspective problem itself but also because of the organization of the each conversation as conversations on the same level for different contact may have occurred in arbitrarily different periods of time.

The main problem of using information sources such as email and even chat logs is the amount of information that we must deal with. The solutions must scale in order for the system to be usable for both the user that receives 10 emails per week and the one that receives 10 emails per hour. Context on several levels should be available for us to fully understand the "why" of the evolution of our email relationships. This will be the aim of our work, since we believe that there is still no solution that focuses on such aspects that we consider so important.

3. "WHO HAVE I BEEN TALKING TOO?" TOOL

In this section the tool and its underlying concept are presented. In Figure 1 we can see the general look of this application and the several partitions that compose the visualization area. The visualization has three main areas and a few minor on top.

3.1 Three main areas

By paying attention to the general look of the tool in Figure 1, these areas are very easily spotted as the two on the bottom along with the one on top of them. This last one, the biggest one, is what we call the "Main Timeline" and is the main visualization partition of the tool. Below them we have a "Secondary Timeline" on the left and the "Topic Cloud" on the right.

3.1.1 Main Timeline

The "Main Timeline" is the main visualization partition of the tool and it provides information about e-mail relationships on a monthly basis. At a first glance is nothing but a lot of bars, but after understanding how to "read" the information it becomes more interesting.

First, we can see that a horizontal rule divides the partition in two, with bars growing from bottom to top on top of it and the opposite below it. The bars on top represent incoming communication, i. e. received e-mails, whilst the bars below represent outgoing communication, i. e. sent e-mails.

The months are divided by vertical rules identified with labels. Also, the amount of emails is not represented by the visible area of a bar, but more by it's position, i. e. the higher it is, the more e-mails it represents. The rational behind this technique is easily explained.

Imagine in one month a user talks with three different people (like the first three bars of Figure 2), having received a different number of e-mails from each person. With the

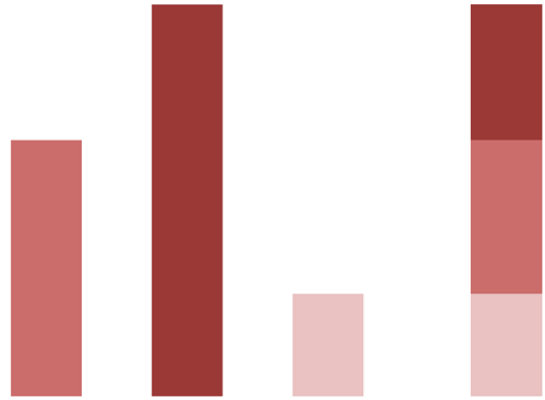


Figure 2: Bar's meaning example. A time unit in the tool is represented with one bar for a number of e-mails, having the several bars sorted and represented in front of each other with the tallest behind.

difference in the number of e-mails comes a difference in the height of the bars and in the luminance component of the color (more e-mails means a taller bar and a darker color). To represent a month we decided to sort the bars by height with the tallest on the back, getting a view of every bar (like the fourth bar of Figure 2). The choice of this strategy is simple to explain. First, quantity is better perceived by users through the use of position, so we believed it was something important to use. Also, we wanted something which could be not very large, considering the number of months a person could have with information. It's true that stacked was a possible solution, but the vertical space could not be enough, and, not only could smaller bars be less than a pixel tall and not be represented, but also this technique allows to spot more easily if the difference between bars is bigger or not. Is also important to refer that the use of luminance allows to extract different information. For example, looking at Figure 3, we can see that in the first bar there is no one and no group of people in particular that stands out, but looking to the second bar allows us to see that there is clearly someone with who the amount of communication that month was higher.

When we see a person that clearly dominated the communication, there is obviously a way to see who that is. We do it by mousing over that bar. On Figure 4 we can see that a bar represents two people that had the same amount of emails.

There is however a drawback of not stacking the bars as we lose the sense of global communication: having the highest bar of month X higher than the highest bar of month Y doesn't necessarily means more communication on month X. The luminance allows to see it a little because it allows to see the number of people represented, but we implemented a clear way of doing this: By mousing over a month, the number of emails sent and received is presented (Figure 5). In general, the application still allows to analyze a user's timeline and spot breaks or big increases in communication.

We've already covered how to see who represents a bar but the application allows more than that. While using this tool,

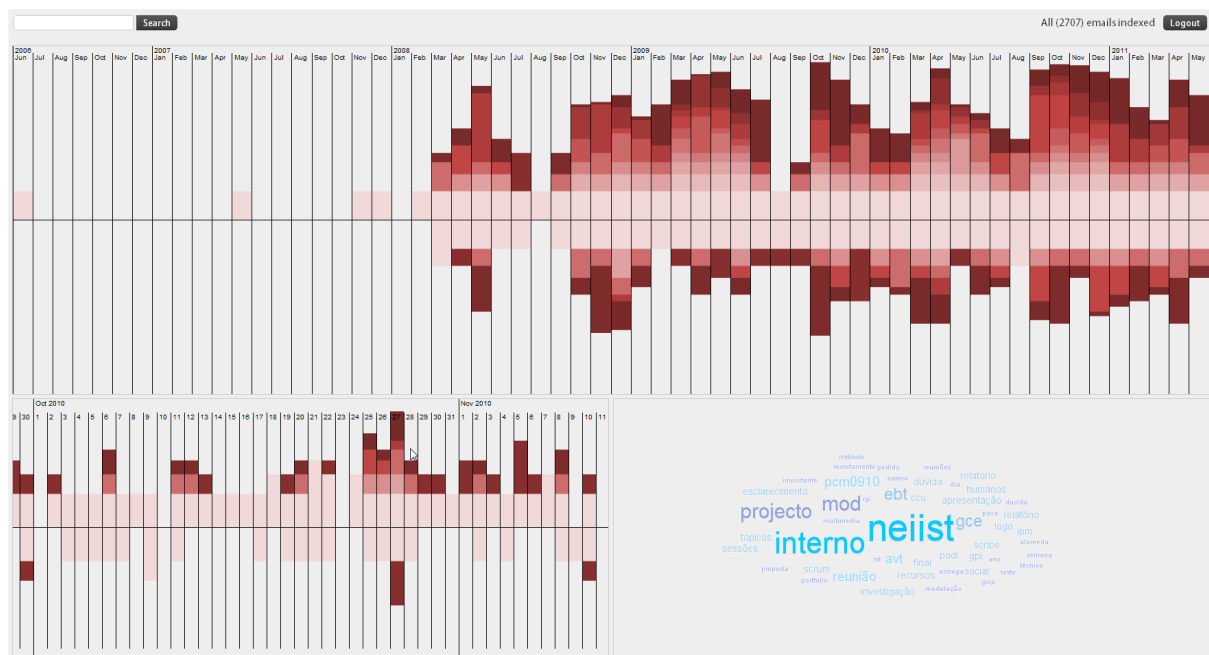


Figure 1: A general view of our tool.



Figure 3: Luminance allows to sometimes identify clusters of people based on the amount of communication. Big gaps stand out a possible boundary in clusters. For example, there are no big gaps on the first bar, but on the second there is one person that stands out.

is also possible to see the evolution in communication. The way that is done visually is depicted on Figure 6. When a bar is clicked, all the bars associated with that contact are assigned the same color and the rest of the bars get represented in grayscale (as they are considered "not interesting at the moment"). On Figure 6 is possible to see that the highlighted person is someone that wasn't the person the user talked to the most when communication first started, but he or she became the top person in communication volume eventually.

When it comes to analysis of electronic relationships, the

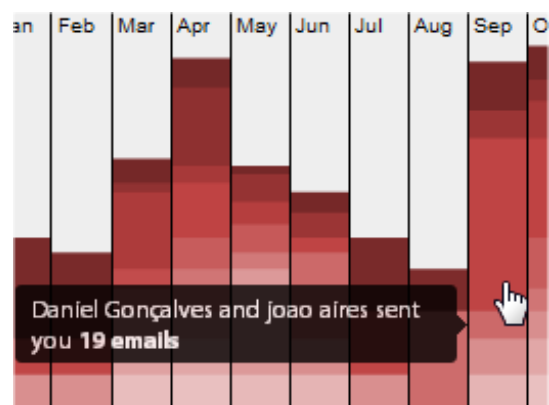


Figure 4: Label that illustrates who is represented by a bar.



Figure 5: Mechanism to see the communication volume.

tool does more than that. It is possible to select more than one person and compare different relationships and sometimes even find correlations between them. Figure 7 depicts the selection of multiple contacts. As we can see, each contact is assigned a color and, like it happen with the selection of one contact, the rest of the bars are represented in grayscale.

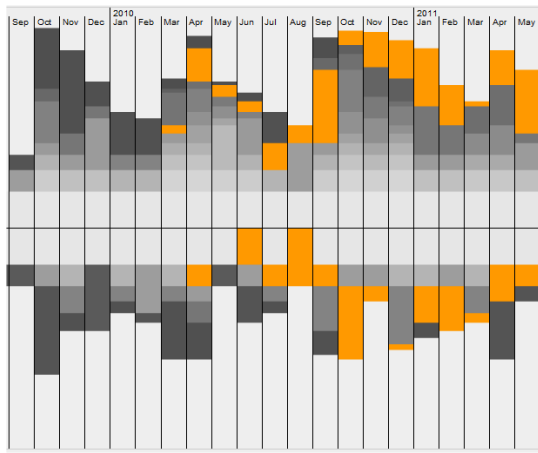


Figure 6: Representation of a selected contact.

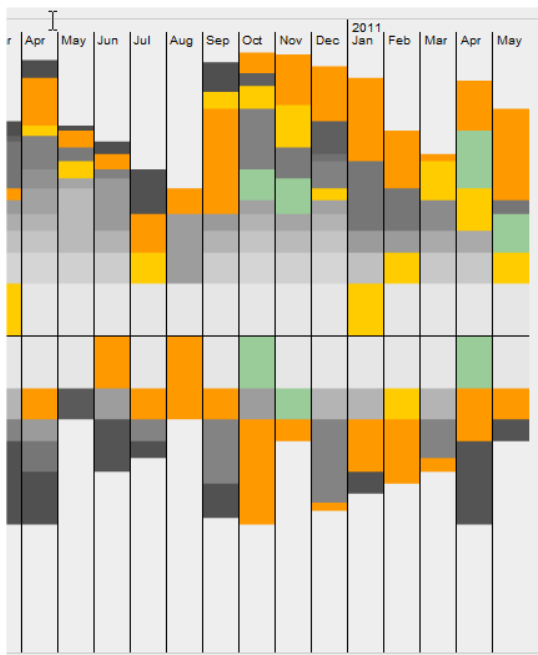


Figure 7: Representation of the selection of multiple contacts.

A few paragraphs ago, we saw that is possible to have a bar represent multiple people when they have the exact same amount of emails in that month. Due to that we had to cover the possibility of clicking a bar that represents more than one person. So, when that happens, the user is presented with a dialog window enumerating those contacts and checkboxes that allows the user to choose which contacts are to be selected and which are to be unselected, as depicted in Figure 8.

We also had to cover the possibility of the user selecting more than one contact that shares a bars. The option we took is to give that bar the original color of reddish with the original luminance. Another possibility (and a better one in our opinion) could be dividing the bar in multiple stripes with the colors of the multiple contacts, but due to

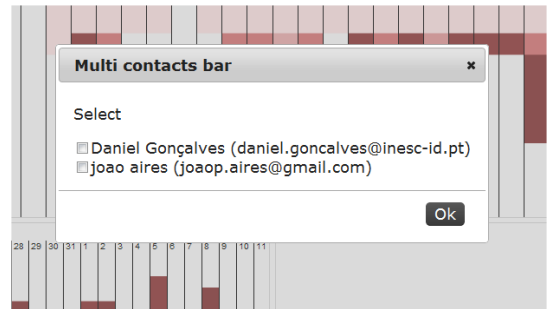


Figure 8: Pop-up alert that allows to choose who to select when a bar that represents multiple contacts is selected.

technological limitations, it was not possible. On Figure 9 we can see that there are three bars that represent the two contacts selected simultaneously.

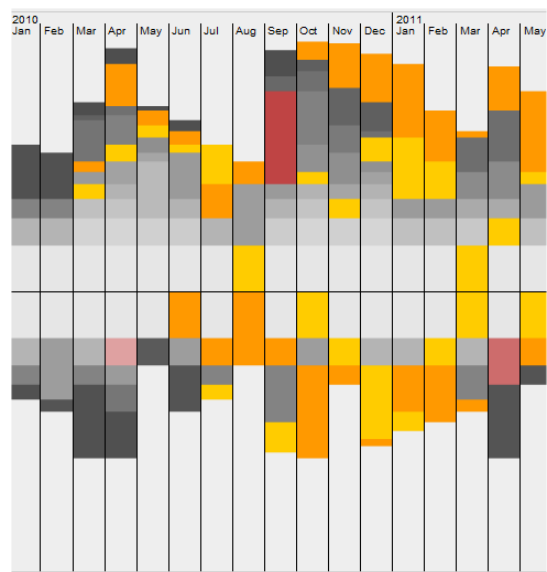


Figure 9: Representation of bars with multiple selected contacts.

3.1.2 Secondary Timeline

The "Secondary Timeline" is the bottom-left partition of the visualization area, as we can see in Figure 1. It has the same properties and interactions as the "Main Timeline", but while the other one shows monthly information, this one shows daily information (Figure 10). We decided to keep the two timelines separate in to different visualization (instead of letting the user zoom in and zoom out on the same visualization) because we considered important to keep the monthly context as a whole while watching the daily context and vice versa.

When the user clicks on the label of a given month on the "Main Timeline", three months are represented on this timeline. The clicked month (centered), the previous month and the following month. At first the whole timeline was represented and we wanted just to slide to the correct month by clicking it's label on the "Main Timeline". The problem

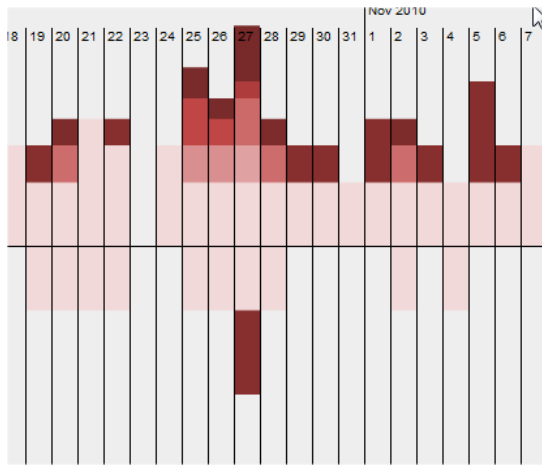


Figure 10: Example of "Secondary Timeline".

was that a daily timeline of every communication since the creation of the account was too heavy in terms of processing time and simple activities like sliding the timeline were impossible from an usability point of view. So this option was taken having in mind that usually the daily view is used to analyse a smaller part of the timeline and we included the two adjacent months because the analysis may be wanted in the transition between them.

Is also important to refer that the two timelines are very much coupled, and selecting someone in one of these timelines also select that contact in the other, as depicted in Figure 11

3.1.3 Topic Cloud

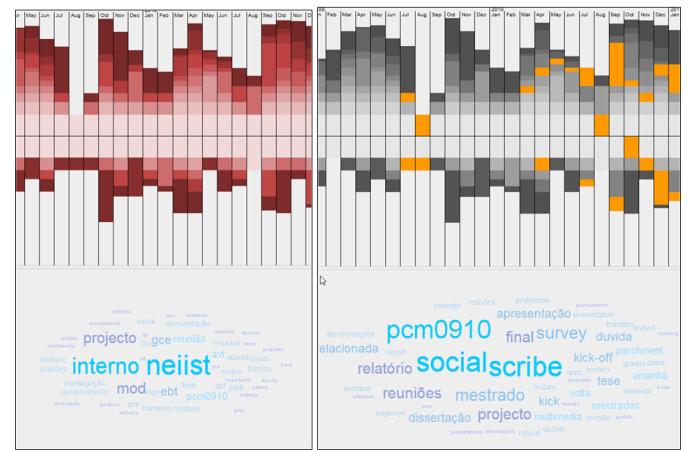
The topic cloud is the bottom-right partition of the visualization area as we can see in Figure 1. Like a typical tag-cloud, this visualization has the purpose to show the most discussed/distinctive topics, in this case, based on tf-idf[3] weight of values present in e-mail subjects. When no person is selected, this cloud shows the most discussed topics from every message since the creation of the account. However, when a contact is selected the cloud shows the topics most used when in communication with that person.

To allow the best analysis possible of a user's electronic communication using the topic cloud, it was made very interactive. When a word is selected, it gets black and bold, and every bar that represents a time and person where the topic was mentioned stays the same, while the rest of the bars get blended with the background color.

This allows to extract a lot of information, like "Who mentioned what, and when?"

3.2 Minor areas

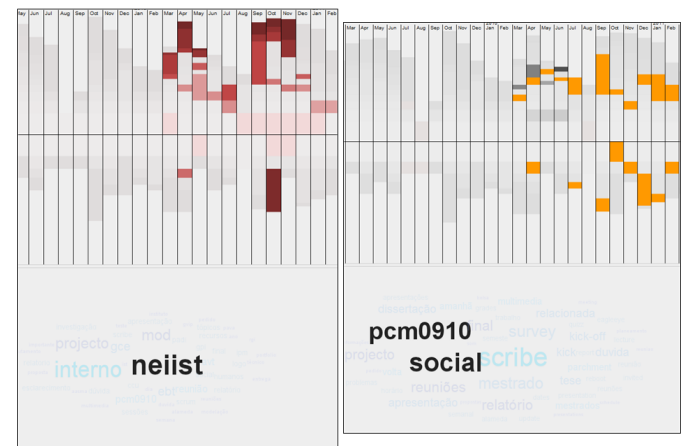
On top of the "Main Timeline" there is an area that serves several purposes composed by a few partitions. Aligned to the right, from right to left we can see the logout button used to close the visualizations and the amount information that tells us how many emails were processed and if it was all of them. Finally, aligned to the left we can see two areas



a)

b)

Figure 12: a) Regular topic cloud with no selected contacts. b) Topic cloud of the same user as in a) but with a selected contact.



a)

b)

Figure 13: a) Regular topic cloud with a selected word. b) Topic cloud of the same user as in a) but with selected words of a selected contact.

that, even if considered minor, are very helpful in terms of interaction. From left to right, we have first the search box and the selected contacts view.

The search box allows us to enter an e-mail or contact name and select them. A contact can contain several e-mail addresses, and if a contact name is chosen, every e-mail of that contact will be selected with the same color. It also provides an auto-complete feature.

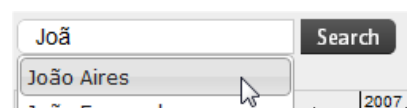


Figure 14: Example of the use of the search box.

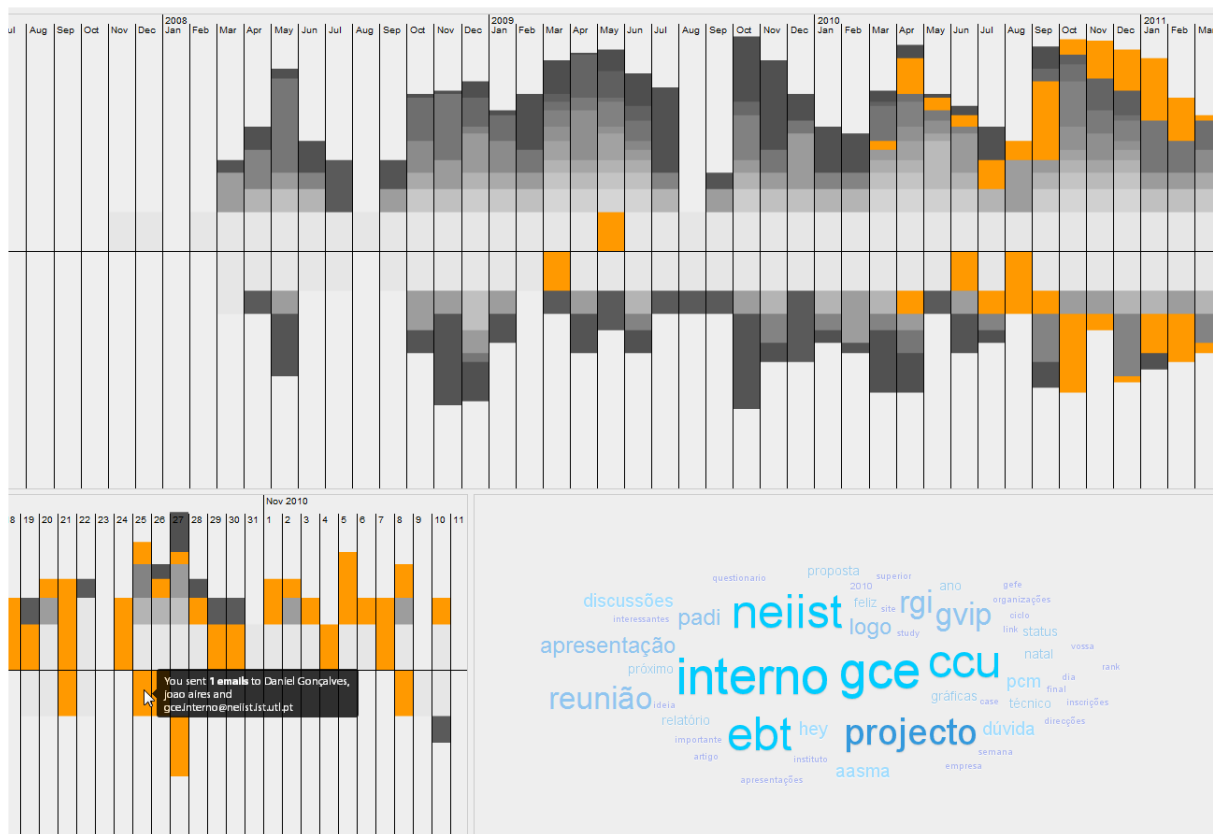


Figure 11: Example of selection on both timelines.

Finally, the selected contacts view provides the information of what contacts are selected and what color is assigned to them, as depicted in Figure 15. Next to each name there is an 'X' that, when pressed, eliminates the selection of the contact.



Figure 15: Example of selected contacts with their respective colors.

4. EVALUATION

In this section we will present the evaluation methodology used to evaluate our "Who have I been talking to?" prototype and the obtained results along with some interpretation of them.

4.1 Evaluation Methodology

To evaluate the prototype, we gathered 10 users and had them perform a set of 6 tasks followed by a satisfaction questionnaire. The requirements we stipulated for the selection of the user's were two. They should have a Gmail account, since our prototype relies on the Gmail's API to retrieve users' contacts, and, for more than an year, they should average an exchange of over 5 emails per week, to obtain more reliable test results.

Before performing the tasks, users had 5-10 minutes to freely use the prototype and ask some questions. While users performed the tasks, we checked if they could complete the task (effectiveness) and how fast they did it (efficiency). Also, we observed if many mistakes were made during the process and if there was an evolution in using the prototype (usability and learnability). In the end, we measured satisfaction using, as said before, a satisfaction questionnaire. The set of tasks we had the users perform is very much coupled with a set of tasks we established as a basis of the project when we started working on it and were the following:

1. Users were asked to find who have they been talking too the most, recently?
2. Users were asked to select a person they communicate with and analyze that electronic relationship. Did the rate of conversation grow or decrease? Could the user tell why?
3. Users were asked to select two people and verify if they could detect some correlation between those two electronic relationships.
4. Users were asked to look at their "Main Timeline" and describe it. Where did they see clear increase and decrease of communication volume and could they tell why?
5. Users were asked if they could tell, by looking at their

Task	Time (s)		Errors	
	Avg	SD	Avg	SD
Task 1	12,9	9,4	0	0
Task 2	35	21,1	0,1	0,3
Task 3	20,6	11,6	0	0
Task 4	19,6	12,1	0	0
Task 5	18,1	10,4	0,1	0,3
Task 6	8,4	4,6	0	0

Table 1: Table showing each tasks’ average (Avg) and standard deviation (SD) time and errors.

“Main Timeline”, if they talk with a lot of people or more with a restrict group?

6. Users were asked to describe the topics most discussed across the time since they’ve had the email account?

While users were performing the tasks we were logging the time spent and errors made as well as any relevant detail or comment from or about the user.

As said before, after performing the tasks, the users were asked to answer a satisfaction questionnaire. This questionnaire could be divided in two parts. The first one was the System Usability Scale (SUS)[1], which is a standard usability set of questions that is associated with a method that assigns the system a grade according to a user’s answers. The second part consisted in three essay questions where an user could express his or her opinion: a question to enumerate the main advantages, another to enumerate the main disadvantages and a final one to write some comments that the user felt could help improve the prototype.

4.2 Results

The current section exposes the results we got from our user tests. As expected, the results were divided into three different sub-sections: the results from the tasks performed by the users, the results from the SUS set of questions and the results from the open answer questions of the second part of the questionnaire.

4.2.1 Tasks’ Results

As stated before, during the user tests we recorded the time and number of errors each user took to complete each one of the tasks. After all the test were done we used those value to calculate the average (Avg) and standard deviation (SD) of such measures (shown on Table 1) in order to better understand the overall results of the tasks performance.

One first interesting aspect is the very low number of errors that took place during the tests. By inspecting Table 1 we can see that only two of our 6 tasks registered any errors, and even then, only one error occurred for each one of this tasks. Such measure tends to indicate that our system is easy to use and to understand (suspicion confirmed by the user’s feedback described on Section 4.2.3). We also noticed that on the pre-test phase (the phase were the user was free to explore the system for some minutes), the users spent more time that we were expecting exploring the system: they were really enjoying it. Such fact can also help

SUS Score	
Average	84,5
Standard Deviation	6,2

Table 2: Table showing the SUS average and standard deviation score.

justify the low number of errors during the tests as users had already some knowledge about the system. The average time spent for each task and the correspondent standard deviation is more or less within our expectations. There’s however some interesting situations. Task 2 registered the biggest average and standard deviation. Such fact can be explained by the task itself as the task required the user not only to select some contact but also to analyze the patterns of email exchange with that person and the why of such patterns. As expected, such task is not only long but also very subjective and dependent of each persons’ email archive: some users have very long relations with their contact while others have relations of no more than a couple of months. Lastly, some users were also more thorough than others on the analysis required for this task. This last fact is also applicable for most of the tasks with relatively big standard deviation (tasks like 4 and 5 that required the user to analyze and describe something)

4.2.2 SUS’ Results

Following the scoring method described in [1] we were able to calculate the SUS score for each user and then obtain the average SUS score and it’s standard deviation. The results are displayed on Table 2. The average SUS score of 84,3 indicates a very good usability degree perceived by the users during the tests and the small (6,1) standard deviation indicates that each user’s SUS’s scores are clustered closely around the mean meaning that there’s no big discrepancy between user’s scores.

4.2.3 User’s Feedback

From the three essay questions of the second part of the questionnaire we were able to extract some useful comments from the users which included not only the advantages and disadvantages of the prototype but also some ideas to improve it.

The most cited positive aspect of our prototype was the usability as users found the system quite easy to use and understand. The interface was considered clean and attractive and the overall subject of the project considered very interesting. The presence of a daily timeline was also considered a very positive aspect. Last but not least, people were pleased with the amount of information the prototype was able to present in an interesting graphical way.

As for negative aspects, most of the users claimed the need to actually see the content of the emails as the topic cloud was considered not enough for some cases. Another mentioned negative aspect was the fact that it’s only possible to search by contact as users really wanted the ability to also search by word and see all the emails containing those words. The ability to perform a keywords interception instead of a union (which is the default behavior for when two or more words

are selected) was also lacking for some users. Privacy issues were also mentioned by one of the users.

The suggestion users gave were pretty much based on the resolution of the problems mentioned on the last paragraph. However completely new suggestions arised. One user mentioned the possibility of having some kind of contact's ranking to ease the process of discovering 'who have I been contacting the most since the first day'. Another user also proposed a way of selecting a specific period of time to analyze. In general we see most of these commented aspects as very good ideas of what to do next in order to improve the prototype. Some of them are, in fact, quite easy to implement concerning what we already have: for instance, the by-word search would take only a few lines of code, it's just something we didn't thought about before the users mentioned it. Others may require some extra work or, at least, the weighting of various factors and alternatives (for instance the ability to see content of each email as it may require some compromise with regard to how the user gets to it).

5. CONCLUSIONS

Nowadays many of our relationships with others are email-based and we believe that this trend tends to grow even more over the next years. As for it, it becomes hard to keep track of all those relationships and, most of the times, we lost the sense of the evolution of such relationships. Who am I talking to via email on the last couple of days? Are those the same people I was talk to one year ago? Have I lost touch with someone? Those are just some of the pertinent questions that it comes hard to answer to when we got a inbox full of several thousands of emails.

The objective of our work is try to help people answer those and other questions. By using our system the user can see the evolution of his/her relationships as an whole or focus on a particular relationship or even set of relationships for comparison. In order to help users understand the 'why' we provide two context indicators: the time and topics for those relationships.

Our user tests and satisfaction questionnaire revealed that the users considered the system easy and interesting to use. The users suggested that the ability to search deeper on the information (until the level of the email) would be very welcome. Although we must agree with that, we also believe that we still have much to ponder on how we could introduce this functionality without affecting the current usability as it may imply some changes.

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