Contact Activity Visualization for Seniors

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Abstract. Over the years, people raise their children and watch them as they make their adult lives away from home. Because of that, seniors lose contact and intimacy with their loved ones, as physical presence isn't as possible as desirable. Also, because of physical impairments that may arrive as years pass by, seniors may experience difficulties in communicating and interacting. Thus, a research project called PAELife (Personal Assistant for the Elderly Life) was created with the aim of fighting isolation and exclusion. Our personal contribution to this project is displaying the most active contacts in a visual, powerful way so that they notice which friends are contacting them more and which ones don't contact in a long time. To achieve that, we built a set of prototypes that display contacts' activity from different sources (email, social networks, etc.) and performed two user tests, in order to identify the best alternatives and understand if the senior citizens can correctly perceive the contacts' activity. The tests' feedback allowed us to know what prototypes to choose and the ones to discard. After analyzing the results we implemented a final functional prototype that matched all the requirements collected from the users.

Keywords: social networks; contacts; activity; senior citizens; communication.

1 Introduction

As time goes by, people tend to become and feel lonely, especially if no family members and/or friends are often around [13, 16]. As children grow up and move out, so does most of the communication with them. This happens especially to senior citizens - who are the people with over 60 years old and, also, the ones who need more medical care and are hospitalized more often [15] -, who no longer need to support and take care of anyone. Because of this, they adopt a lifestyle that allows them to stay at home and not going out as much as before [6]. As a result, they tend to have less communication and lose intimacy with their loved ones.

In order to best understand how those limitations can impact the daily basis of the seniors, West et al. studied how function and visual impairment are the most problematic [14] and figured out that those limitations can actually promote dependent living. As a result, seniors tend to abandon social living and interaction. Other studies

adfa, p. 1, 2011.

[2, 12] stated that these kind of limitations are often associated with the decline of quality life and the capability to be with other people.

Nonetheless, technology helps us communicate in many ways, and many people nowadays are already embracing those technologies and making a continuous, effective use of them to narrow the emotional distance between them and their family and friends, that often live apart [10, 11]. As so, technology has proven to be very useful, as it might help in fight isolation and exclusion and can break time-space barriers, which wouldn't be possible without its use. However, senior citizens may have trouble using the technologies described before. When growing up, they hadn't them around, so they aren't used to them. Also, they are commonly resistant to change their lifestyles [6], mainly when it comes to technological aspects, as they appeared late in their lives. We wonder if we can help seniors overcome these time-space barriers, using technology to do so. Even if we could do it, there is a possibility that it wouldn't work, because of the existent gap between seniors and technology; we are going to try to reduce it. Despite that, we believe that these changes would be acceptable to these users, because they might help them become closer to their loved ones.

Taking all this into account, the PAELife project has the goal of preventing and fighting isolation, exclusion and loneliness, promoting new ways of enhancing interaction so that the seniors can experience a more social and fulfilling life. Part of the problems to solve, and the focus of the research described in this paper, is to successfully tackle the remote availability issue, so that users can know how often is a certain person available for online conversation, or has initiated that conversation in a number of different channels. Finding out an effective and efficient way to convey that information led us to study some alternatives, first with low-fidelity prototypes and then, with functional prototypes embodying the lessons from the first study. Our analysis of those studies allowed us to find a suitable solution, as well as a set of design guidelines that could help and guide the creation of similar applications.

2 Related Work

Ozenc and Farnham [9] studied and explored some natural ways of displaying visual representations of groups of people. In the study are represented common lists, pie charts, timelines, geomaps and treemaps. This work compared these ways of organizing and displaying groups of people, giving us an interesting overview of some of the most used representations. The main purpose another study [3] was to display the users' activity so that it would become a way of stimulating users' participation. The authors created IntroText, a new way of displaying the users' activity on a community. This interface is based on multiple actions, as it captures all the interactions that can be performed on a certain online community. Based on those indicators, sentences are formed to let the users know how active a certain contact is. "[Username] is a loyal visitor" and "[Username] eventually shows up" are just a couple of examples of how the activity can be showed.

Another widget is called 'Babble' [4] and it provides cues about the presence and activity in an online conversation. The 'Babble' is a circumference that contains a circle on the center of it and several other colored, smaller circumferences - dots - (each one of the latter representing a contact). The proximity of the dots to that centered circle is a representation of how recently the contact has spoken to the user, which means that the closest a dot is to the center of the 'Babble', the most recently that contact has talked to the user. This way, each user can see what are the most active contacts, and what are the contacts that haven't been talking much.

Morikawa and Aizawa [7] propose a system to facilitate awareness of peoples' contactability and online presence. The framework proposed by this study tries to display the contacts in an innovative way, including a new way to let the users know that a certain contact is actually available for chatting. In the solution proposed by the authors, the contact's avatar is what the user sees. The pictures are displayed in front of a colored background, which indicates the current status of that contact. On top of that, the avatars have their own opacity, whether its owner is in front of the computer or not. If an avatar is opaque, it means that its owner is sitting in front of the computer. As time passes, and if the user leaves its position, the avatar starts to fade out and becomes more trans parent. This approach the problem of the transparency of the avatars, that may not be very noticeable by the senior users, who tend to see fewer details and lose visual perceptiveness, with the ageing process.

There are a few guidelines that developers should take into consideration when designing for seniors. Sizes should be larger than usual, as seniors have difficulty in perceiving small details. Colors are a key point and should be used in as much contrast as possible [8]. Low saturation levels and transparency are to be avoided, but very bright colors might also fatigue the eyes [5], so balance is required. Background patterns should be avoided as well. Also, there is a need to make distinguished and important elements highlighted and visible, but without animations and distracting constituents [5]. These few guidelines are important concepts that are proven to be helpful when designing for seniors and that should be taken into consideration to help seniors take the best advantage of the interface.

3 Low-Fidelity Prototypes

The contacts' activity visualization development was processed in several steps, in order to correctly identify the users' needs and build the visualization prototypes incrementally. The first set of prototypes was made based on some of the implications described in the previous section.

For the general activity, we proposed two different visualizations, which are presented in Figure 1. Figure 1a shows the activity apart by increasing or decreasing the sizes of the avatars, as the activity is higher or lower, respectively; Figure 1b, instead, changes the transparency of the pictures, in a way that pictures with lower transparency are the ones that have the highest amount of activity.

Regarding the activity from the sources, we designed seven different ways of displaying this information. The first two, represented by Figures 2a and 2b only differ in the shape of the avatars. The first one has a squared representation while the second is rounded, which allows containing more than four sources. The approach on Figure 2c condenses the bars horizontally in only one place, thus making the visualization cleaner. Figure 2d show vertical bars on the middle, making it is simpler to compare the activity from different sources this way. The three remaining options are very similar between them, as they differ only in the shape of the representation of each source, and are represented on Figures 3a, 3b and 3c.

Regarding notifications, representations with glow, saturation change and numbers were used, as shown in Figure 4. The representation of the small dots was created because it could be simpler for seniors to count the dots.

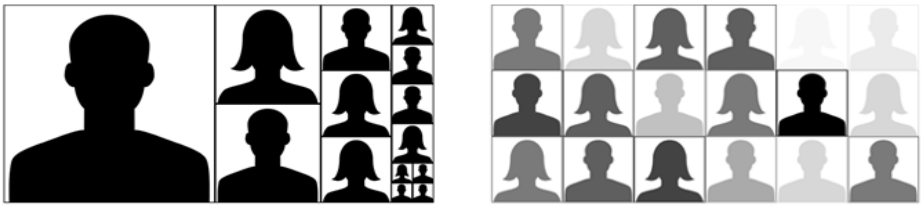

Fig. 1. a) Representation of the activity levels by distinguishing the sizes of the avatars; b) Representation of the activity levels by distinguishing the transparency of the avatars.

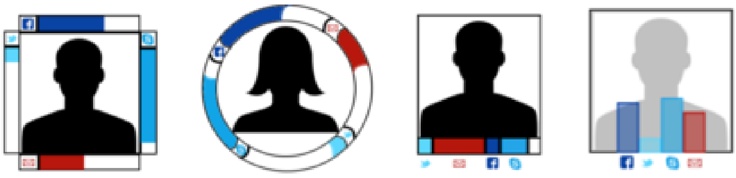

Fig. 2. Squared (a) and rounded (b) representations of the sources' activity; representation of the activity sources only in an horizontal bar (c) and only in vertical bars (d).

Fig. 3. Representation of the activity levels displaying squares (a), circles (b) and semi-circles (c) for each source.

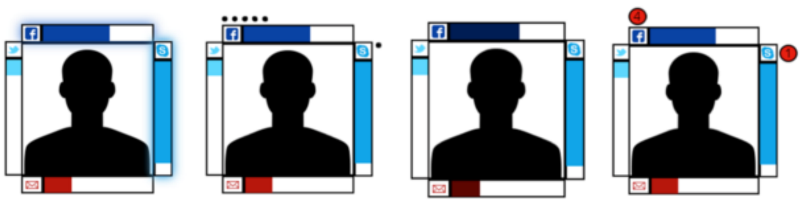

Fig. 4. Representation of the notifications with a glow (a), small dot per notification (b), change in the saturation of the color of the source (c), and with a notification counter (d).

3.1 Results of user feedback

To find out what was the preferred way of displaying the contacts' activity, we performed user tests with seniors and evaluated the results of those tests. This way, we could collect user feedback and engage seniors in the design process. We interviewed 20 older users for our user study. We sequentially showed participants the several alternatives, and then asked which ones they prefer, which they could understand easier, and some other specific questions such as which was the most active contact.

The results showed that, regarding the general level of activity, 60% of the users have a preference for the visualization in Figure 1a. Regarding the visualization of the activity on the different sources, although there was a preference for the representation with inside squares (Figure 3a), we decided to also implement the alternative with outside rectangles as well (Figure 2a), since participants reported it was easier to understand the level of activity of contacts. Considering the notification system, the alternative with badges and numbers was the only one that participants could see and understand correctly, and therefore was preferred by 70% of users (Figure 4d).

4 Functional Prototypes

The first functional prototypes are the result of the feedback collected from the users study with the low fidelity prototypes. In these functional prototypes we maintained the several types of visualization separated, but incorporated the notifications in the sources' visualization, as there was only one preferred option for that element.

Regarding the different sources of activity, we implemented the two alternatives described before (Figures 6a and 6b). We also merged these alternatives with the general activity visualization, as shown in Figures 7a and 7b. Each displayed contact is fictitious and its information represents a few activities a person can perform on each source: number of posts on Facebook, tweets, friend requests, emails received, etc. Each of these elements helps composing the length of each bar and, together, they compose the size of the avatar – in the alternatives where that happens.

Fig. 5. Functional representation of the activity from sources with notifications in bars (a) and in squares (b).

To perceive if the visualization with many contacts was still understandable for users, we created four distinct scenarios: the first one with 20 contacts – a relatively low number of contacts, which is likely the case of most seniors[1] – and just a few contacts that are highly active; a second one with also 20 contacts, but with contacts that have a more uniform level of activity; a third one with 100 contacts, similar in activity as the first one; and a final scenario with 200 contacts, as it is the average number of Facebook friends per user[1]. By creating these different scenarios, we are able to test each alternative with each scenario, making it possible for us to understand if the visualization wasn't reliant to a small number of contacts.

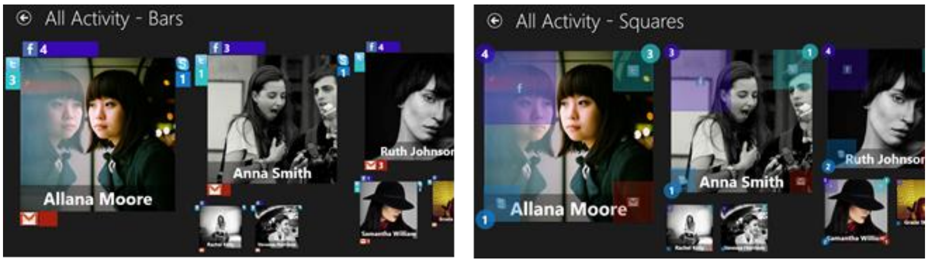

Fig. 6. Functional representation of all the elements in bars (a) and in squares (b).

4.1 Protocol for User Testing

With these intermediate prototypes complete, we also needed to do another session of user testing, in order to understand if these representations made sense and are well perceived by the users, and also, to make a final inquiry on which of the two alternatives for the activity in sources is better, so we are able to choose a final one.

We interviewed 15 people, 9 of those were female and 6 were male, from 68 to 90 years old without cognitive disabilities and with none to low knowledge of computers. These are roughly the same characteristics of the participants of the preliminary user tests. Each test was performed individually and the total amount of time spent with each person didn't exceed 15 minutes.

The survey was divided into six categories: general information about the user, the users' perception about the general level of activity, their perception about the activity from each source, their perception about the notification system, perception about the total amount of activity (general and sources) and a few conceptual questions regarding actual tasks that can be performed using our solution.

4.2 Results

In these tests' results, we used a chi-square test to analyze the preferred options when we asked for comparisons and analyzed the general understanding in each alternative. In the perception about the general level of activity, as we only had one option, we asked the users if they understood the concept correctly. More than 65% of the users were able to understand the concept and make the comparison of the general

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[1] http://www.pewresearch.org/fact-tank/2014/02/03/6-new-facts-about-facebook/

activity between two contacts correctly. Some of them found it confusing but, after a simple explanation, most of them understood it correctly.

Regarding the perception about the sources of activity, more than 90% of the users were able to perceive both approaches. However, the comparison of the activity between two contacts was well perceived in Figure 6a, as 93% of the users were able to compare easily and correctly, while only 33% could identify who was most active on Twitter on Figure 6b. This happened because humans are better in perceiving changes in length than changes in areas. Also, the results from the preference of the users supported the difficulties they had in analyzing the sources' squares. The users showed a statistically significant preference for the option with the bars (p=0,004).

Both alternatives from the notification system (the same approach chosen from the previous user testing, but represented inside the bar and inside a small rounded circle) were well accepted and interpreted by the users, as over 85% of them understood both alternatives. However, the chi-squared test was statistically significant, although with a lower confidence (p=0,071), which showed us a preference by the representation of the notification's number inside the bar (Figure 6a).

Finally, we asked the users about their perception about the total activity (general, from each source and with notifications), which is a representation of what the contacts' visualization will probably look like in the final prototype. In this case, the representation with the bars was preferred to the one with the squares (test showed p=0,004, a preference for Figure 7a) and the understanding was higher in the alternative with the bars – 80% - than the one with the squares – only 40%.

4.3 Conclusions

As we only had one alternative to represent the general level of activity and it was well accepted by the users, we are going to continue to use it. The same goes for the notification system, that was incredibly well perceived; to represent the notifications, we will choose the option that has the number of notification inside the bar, as it was preferred by users and it makes the matching (notification to source) more immediate.

Regarding the activity from each source, it was clear that the users had a preference for the representation with the bars, and it was also clear that this representation made the comparison of the activity of the contacts much easier. Therefore, on the final prototype, we will implement only the representation with squares (Figure 7a).

5 Implementation

We implemented the visualization as a Windows Store App, since it was a requirement of the project. We implemented a module to collect users' contacts activity information, but also kept the fictitious for users who did not have social accounts.

5.1 Displaying Contacts

First of all, and when we started to build the first functional prototypes, we had to think about how to design our contacts' avatar, which is represented on Figure 8a. This element is the base of all the contacts, which all look the same.

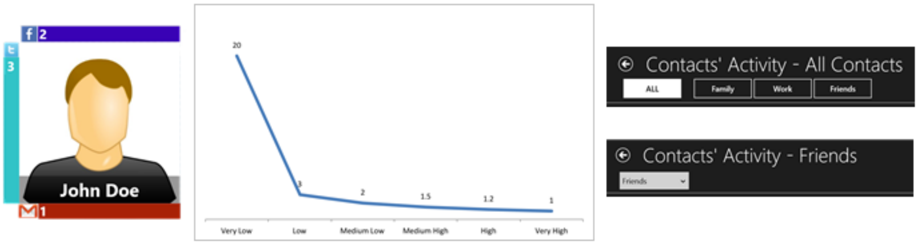

Fig. 7. a) Contact with sources' activity and notifications inside the bars; b) Multiplying factor variation regarding the variation of the activity on the sources; c) Visualization of the groups in an horizontal list and in a dropdown list

5.2 Packing Algorithm

A problem that we had to address was how to pack the contacts' on the canvas. As the size of the avatars isn't always the same (they have different areas correlated with the different level of activity each contact have), we implemented a packing algorithm that packed the squares in the available empty area. We based our implementation in an algorithm that tackles the problem of packing blocks into a fixed rectangle[2]. Our solution was based on setting the maximum height size to the computers' screen resolution. After that, we place an avatar on the first empty space it fits. Then, and instead of horizontally dividing the empty area into two, we do it vertically, so our biggest avatars are placed on the left side on the canvas. Each new avatar is then placed in the leftmost and topmost empty area available where it fits. We do this recursively until we have no more avatars to place on the canvas.

5.3 Information Collection

When we had access to the Social Networks API, in which we could retrieve the actual information that we would be able to use in our work, we found we only had access to the following information: Facebook Private Messages, Public Messages, Unread Messages and Likes; Twitter Private Messages and Public Messages; Emails Sent. This information, stored in a text file, represented the same information that we collected from the API, which allowed us to have two similar alternatives.

5.4 Activity's Assessment

As the contacts may have very low activity levels, it might become tricky to analyze the activity levels on those types of contacts. As so, we decided to calculate the activity level multiplying the original activity by a factor that would change accordingly to the contacts' level of activity. Regarding each source of activity (that is displayed in the bars around the contacts' avatar) we used the factor in a way that is represented in Figure 8b. The X-axis represents the amount of activity that a contact might have in each source. These values were determined empirically, accordingly to the total length of the bars, and are here translated from "Very Low" to "Very High". The multiplying factor was, as well, determined empirically. This solution allows us to prevent the problem described previously, in which we might have contacts that

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2 http://codeincomplete.com/posts/2011/5/7/bin_packing/

appeared to have no activity at all. A similar approach was used to the calculation of the general activity, which is translated by the total area of the avatar, even though the factors were quite different – also determined empirically.

5.5 Group Visualization

We decided to represent the groups in two different ways, and evaluate these alternatives in a later user test session. A first approach was to display the groups in an horizontal line and the second one with a dropdown, right above the contacts, just as presented on Figures 8c.

The first approach seemed the best to us because it only takes one tap to change the group. However, in this alternative we had to confine the number of groups to be created. The second approach might allow a larger number of groups, but it requires two taps to change to the view of another group. As so, we decided to maintain both alternatives and let the users choose what best fit them.

5.6 Managing Groups and Contacts

Regarding the contacts and groups management, the users can perform several actions: create, rename and delete groups. These actions allowed the users to manage all the groups in the application. So that the users could add contacts to the groups, they could also work on that: move contact to group and remove contact from group. This way, the users could segment their contacts into several groups, easily finding them and analyzing their activity.

6 Evaluation

In this section we explain all the procedures that we followed during the last user test session.

6.1 Protocol

We interviewed 15 people, 6 of whom were male and 9 were female, from 70 to 91 years old without cognitive disabilities. Participants had low or no knowledge of computers or social networks. Each test was performed individually, in a room were the users could sit and interact with the device, and we explained to the users that their participation was anonymous and cost-free. The total time spent with each person didn't exceed 20 minutes. This survey focused on two main aspects: perception of the users about the contacts' activity using fictitious data and their perception of the contacts' activity regarding their own contacts; thus, with real data. Apart from that, we included some tasks for the users to perform, that tested all the interactions in the application and debriefing questions, for qualitative study.

6.2 Results

The first two questions regarding the perception of activity when comparing two contacts had a task completion of 9/15. It is important to state that the users that couldn't answer those questions were some of the ones who never had any contact with technology. We measured the time that the users took in answering the question. For the first question, the average time to answer was 28 seconds, and the second one (very similar to first) took only 18 seconds, in average, as the users already knew what to search for. So, for the first question we estimated a standard deviation of 30.76 seconds and for the second one, 22.03. Thus, for a level of confidence of 95%, the confidence interval is [7.904, 48.096] for the first comparison and [3.6, 32.4] for the second. The same applied to the next two questions, in which we asked the users about the contact with higher and lower level of activity. Both the tasks had 6 answers and the average times of response was within a reasonable limit.

The first task that asked the users to create a new group had a completion of 7/15. Typing times were not considered. The average time to perform the task was 62 seconds, with a standard deviation of 39.48. As so, for a level of confidence of 95%, the confidence interval for this task is [32.76, 91.24]. The next tasks (all of them had a task completion of 6/15) were performed without major difficulties and were all quite similar. The tasks that required group management were performed with lower average times than the ones that involved contacts management. The tasks about renaming and deleting groups had an average time of 54 and 51 seconds, respectively. Using the standard deviation of those results (33.1 and 38.2), we calculated the confidence intervals of [27.52, 80.48] and [20.5, 81.5]. The average number of errors for these two tasks was also very low: 1.2 for the renaming of a group and 0.8 for its deleting. Finally, the results for the tasks to move and remove contacts from a group revealed higher average times. These results are also explainable: the users sometimes clicked the wrong contact when they had to choose it, which made them deselect the contact and select the right one. Also, when managing contacts, more taps are required, which undoubtedly increases the completion times.

The final task involved switching the activity visualization time to another period. All the users performed the task with 0 errors and the average completion time was 23.67 seconds, which translates to a 95% confidence interval of [13.17, 34.17].

After this, we could analyze the information that we collected from the debriefing questions and from informal conversations with the users. For the two alternatives of visualizing groups, we applied a non-parametric chi-square test. Even though the result of the test wasn't statistically significant ($p=0.205$), there was a preference for the alternative with the list, even it was by a small margin. Regarding the debriefing questions, which asked about the easiness of performing the tasks, results were satisfying: only around 12% of the users found any of the tasks difficult or very difficult.

6.3 Conclusions

This final user test sessions allowed us to choose which of the two ways of visualizing the groups we should use. Of course that we opted to eliminate the dropdown, maintaining the very first approach we implemented: the horizontal list, as the results from the user tests showed a preference for the horizontal list.

Also, although the amount of users that were able to complete the tasks were roughly the same amount as the ones that could answer the first questions about the perceiving of activity, the response times were significantly high. The users struggled in opening the bottom bar, and many times they closed the application in the process of pulling the bar up. Also, they felt confused by doing operations whose context isn't familiar to them, as groups creation isn't a very common action. Even though the results weren't very good, we were not extremely concerned: the main focus of the application is to visually show the activity of the contacts, in which many users succeeded in analyzing. The group management was an extra feature that we included in the application due to the addition of the requirements to the project and it can be used separately regarding the contacts' visualization.

However, we could not evaluate with the real data from the users since none of the participants had accounts in which they could login and test the application. This shows us that, probably, only a very small amount of seniors will use the application due to the fact of not having accounts on Gmail, Twitter or Facebook. However, and as many of the users from our session performed surprisingly well in the tasks they were asked to execute, they might have seen the benefits that the application could offer them, and as they didn't struggle much, they wouldn't feel scared to use it.

7 Conclusions and Future Work

The PAELife research was created with the main objective of fighting isolation and loneliness among seniors, promoting new ways of interaction. To achieve that, and focusing on our own contribution, we developed an application that displays the contacts' activity, in order to allow the users to identify their active contacts easily. This way, the users will know with whom they can readily interact with, by the means of the activity analysis. We produced a first set of prototypes that map all the features we needed to include in our system. Those features were tested with users, and the results collected showed us what were the options we clearly needed to discard and what others were good for the seniors to use.

Then, and taking into account the prototypes previously produced, we chose the alternatives that were most understandable and preferred by the users and built the first functional prototypes. This time we made a similar session of user testing, not only to choose a final representation of each element, but also to perceive if the representations chosen before were still accurate and understandable.

In the final work of this project we only had one alternative for each component. Finally, a final session of user testing was required. Apart from questioning the users about the perceptibility of the activity on the three components of the application, we asked the users some qualitative questions, and performed a debriefing questionnaire, in order to perceive and collect feedback in a way that no answer to a task could. The results of the final user test session showed us that the users could interact with the system with relative easiness.

If we could continue with the work, we would have wanted to explore more ways of visualizing the activity, regarding each source and the general activity. This would allow us to determine if there were still better solutions to display the contacts' activity to the users. Also, it would be interesting to develop new ways of display the management groups and contacts. The most difficult action for the users was to pull up the bottom bar that displayed the available actions regarding groups and visualization of activity on other periods of time.

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