Augmenting entry: the possibilities for utilizing geo-referenced information to improve mobile calendar applications

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Abstract
Today's mobile communication devices often offer extensive calendar facilities. However the use of these is often very limited through cumbersome interfaces and inappropriate designs for small devices. Prompted by previous work in mobile calendar usability, this paper discusses how augmentation of calendar entries with mobile spatial information could provide potential advantages and improve the usability of an electronic calendar.

Keywords
Calendars, entry categorization, HCI, personal information management, Mobile Spatial Interaction.

ACM Classification Keywords
H5.m. Information interfaces and presentation H.5.2 [User Interfaces]: Graphical User Interfaces, Screen Design. H5.2. User Interface: Input Devices and Strategies

Introduction
Many of today's mobile devices incorporate a calendar utility, which allows users to carry their daily schedule around and make notes about activities they have to

perform during the day. Calendar facilities are found in all personal digital assistants (PDAs) and in most mobile phones.

Some of the advantages of portable electronic calendars are the provision of reminders for forthcoming entries, the ability to modify or easily erase entries and the integration with the mobile devices' other functions, such as email or telephony. Furthermore, some mobile devices can interface with the user's desktop personal information management (PIM) applications, such as Microsoft's Outlook, in order to synchronize calendar entries, contacts and other data. Despite those advantages, however, mobile calendars are little more than a transfer of a traditional paradigm (the paper calendar) onto a portable electronic device, and thus offer little value over the traditional "filofax".

As part of our research on predicting users' information needs based on calendar entries, we became interested in the categorization of calendar entries and how this categorization could be augmented by contextual knowledge. Our hypothesis was that semantic information could significantly improve the usability and utility of mobile calendars and would in addition support the recollection process. In our pilot study we chose to carry semantic information on the nature of the entry using color; as we regard color as a good medium to convey multiple layers of data. However, the calendar entries could also be categorized not only by nature, but also using spatial information, such as the distance, or the predicted travel time to the scheduled event from the user's current location. However, we wished to start with a small study that would prove or disprove out hypothesis before moving onto more complex information display.

In the next section we describe the current situation with category support in modern mobile communication devices and continue by examining the potential use of categorization. We have found strong indications that the categorization of entries, coupled with the advantages of color representation can significantly improve the usability levels of calendar applications. Our results show that semantic information carried by color-coding calendar entries, offers a significant advantage to the users of calendar applications.

Background

In previous work [11], we showed that the entries in electronic calendars consistently fall under distinct categories, despite the lack of support or incentive to categorise entries.

This result could have somehow been expected, as Bousfield [5], in 1953, concluded that humans tend to form categories to organize the information they receive. The representation of knowledge structured in categories has the effect of optimizing the human ability of recollection and therefore storage and retrieval from long-term memory. Blandford and Green also discovered that in their study of calendar and groupware usage, people relied on their memories for future events and that this memory is used in the formation of intentions and scheduling [6]. Since even the process of transcribing a task helps people remember [3], it becomes apparent that focused organization and information structuring methods that help the recollection process are important and are

Table 1: The test questions

#	Question
1	Can we meet for lunch on Tuesday?
2	Are you meeting any of our friends on Wednesday, if so, could I come along? *
3	If you don't have to wake up early next day, do you want to go clubbing on Thursday?
4	Do you have a couple of hours to go to the shops with me this week?
5	Do you have any days with no classes? *
6	Do you have any classes on Tuesday morning? *
7	What is the best time to meet you this Wednesday?
8	When do you want me to pick you up from uni on Monday?
9	Could I give you a call around 1 o'clock on Friday? *
10	Which day do you have the most classes? *

** Anticipated benefit in colour version*

likely to contribute to the overall usability levels of the calendar.

According to Kelley & Chapanis [1] and as confirmed by Kincaid & Dupont [2], calendar users require daily, weekly and monthly views from their calendars. In [2], it is recommended that the calendar should allow certain keywords within the daily entry to be marked as "event descriptors", which will appear in a weekly or monthly condensed format. Given the screen size limitation in mobile devices, the use of textual entry descriptors for dense views (i.e. weekly and monthly) becomes impractical. Some handhelds and phones overcome this problem by using "boxes" to "block out" the timeframe that an entry requires. However, the representation of these entries carries no actual semantic information, further from the existence of an entry.

The categorization of entries and the association of colors and contextual information with specific categories could improve the at-a-glance feedback levels to the user, therefore requiring less input from them in order to offer meaningful information. In his work, Truckenbrod [7] supports that color visualization techniques increase the amount of information that can be integrated into the visual message, and thus create layers of information.

We examined several mobile device models (SonyEricsson: K750i, P910, K800i, K600i, P990; Nokia: N80, N90, 5500; Samsung D600, D900; LG: K800; Motorola V3x, PEBL V6, E1000, KRZR K1) in an effort to verify the level of support they offer for calendars. It became apparent that the level of support for the categorization is either virtually non-existent, or, where it exists, the categories provided are very far apart from those that previous research has indicated tend to exist naturally [2],[11]. Apart from this, on the basis of the order in which categories appear for selection in menus, where implemented, it can be assumed that the confusion extends to what the importance of these categories actually is. It would be desirable to allow the users full control over the structure of the calendar and the categories they are allowed to choose, in order to facilitate customization. However, given the user tendency to accept and adapt to default settings [3],[4], these default categories should reflect the real world as much as possible. It is noteworthy however that the Samsung and some Motorola devices in our survey offer different colorization for categories in dense displays.

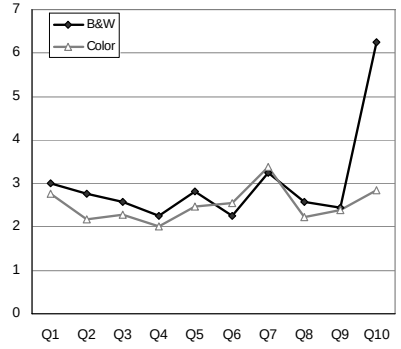
To test in the first instance categorization augmentation we used color to represent a richer view, particularly for dense calendar views on small screens (e.g. weekly). More specifically, we investigated the hypothesis that this augmentation has a positive effect on the speed and accuracy with which a calendar user can obtain information about their daily tasks.

A group of 20 persons was given two printouts of weekly calendar views, which contained the same entries, although arranged at different times/days. The first printout was colorized according to the nature of the entry categories, while the second was a plain representation without category coding. This was done in an attempt to simulate the familiarity of users with their calendar entries (e.g. it is easy for a student to remember that they have a class on Thursday morning) and therefore create a scenario where the color representation did not start with a clear advantage.

The group was asked the same 10 questions for calendar week, with half the group starting with color versions and the others with plain. The questions were simple in nature, such as “Do you have any classes today?” or “Can I meet you for lunch at 1 on Wednesday?” (table 1). Out of the 10 questions, we expected that the users should return a similar performance level for 5 of them (anticipated non-advantage) and that the other 5 would show a benefit for color (anticipated advantage). We measured the time taken to reply to each question from the end of each question till the subject began to speak. Also we wrote down the subject’s replies to the questions in order to measure the accuracy with which they replied. Our results found little difference in error rates between the two versions: 38 errors in 400 total replies for the plain representation and 40/400 for color.

The results show fairly consistent and noticeable difference between the average response times (figure 1). In particular question 10, which asked for summary information over a whole week, showed a very distinct difference in response time. A careful analysis of this result shows that 8 out of the 20 subjects took a considerably longer time to reply to it (response times between 5 and 27 seconds) – therefore we cannot consider this to be a isolated experimental error and must be related to the nature of the question looking over a long period. These results also show that even for those questions where an advantage of color was not anticipated, the performance was slightly better than that of the plain representation. The disparity between these two becomes even greater for the questions where a difference was indeed expected.

Figure 1: Average response times (seconds)



Overall, the averages for plain and color representation response times are 3.02s and 2.51s respectively, showing an overall advantage for the color representation of approximately 0.5 seconds (with an almost equal error rate) – a one-sided t-test confirmed this as significant (P=0.009). In terms of our original hypothesis, this should mean that color-coded calendars provide quicker access to the user’s information by about half a second on average.

Conclusions

In this paper, we showed that semantic information carried by color-coding calendar entries, offers a significant advantage to the users of calendar applications, by supporting the recollection process. We chose to carry semantic information on the nature of the entry using color; however, we regard color as a good medium to convey multiple layers of data. In future experiments, calendar entries can be categorized not only by nature, but also using spatial information, such as the distance, or the predicted travel time to the scheduled event from the user’s current location.

The advantages might be multiple to the user, in such a scenario: Firstly, the user would be able to quickly see how far ahead before the event she would need to depart from her location. Continuing on this theme, calendars might use the same information to issue automatic reminders for events. Sharing travel and spatial information with other users or systems pervasive to the user’s environment (e.g. “the lift is broken”), may allow calendars to dynamically re-schedule reminders or transmit information to other parties (e.g. “user X is likely to be 10 minutes late”).

Furthermore, the spatial information can be used by external agents to help pre-fetch information that is relevant to the event (e.g. train timetables, traffic information) or pre-plan routes that will allow the user to follow the quickest path to their destination.

In the future, we would like to work on investigating some of this advanced functionality. However, as calendars and PIM is an increasingly important function in today's devices, perhaps more time should be dedicated in the augmentation and enhancement of this service, for the benefit of the end user.

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