Investigation of an Ambient and Pervasive Smart Wall Calendar with Event Suggestions

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ABSTRACT

People have been using calendars for thousands of years to schedule appointments and to keep track of their daily lives. Today, calendars have a variety of form factors, including wall, desk, and digital calendars that all have specific advantages and limitations. In previous work, we envisioned *Caloo* a smart wall calendar. In addition to displaying users' schedule, *Caloo* suggests nearby events. *Caloo* aims to increase the awareness regarding appointments and to support to be active through event suggestions. In this paper, we present the implementation and insights of the developed smart calendar. We deployed *Caloo* for four weeks in participants' homes. Our results show that all participants are eager to use the developed system. Our analysis further indicates that the usage of *Caloo* makes users more open to attending local events. Results also suggest that it is important to provide fine-grained control over event suggestions, enable users to define when events should be suggested as well as to prioritize events.

ACM Classification Keywords

H.5.m Information interfaces and presentation (e.g., HCI): Miscellaneous

Author Keywords

Ambient information system; smart calendar; event recommendation.

INTRODUCTION AND BACKGROUND

People of all ages likely forget upcoming tasks or appointments [6]. While younger people tend to forget more diverse things, older adults fail to remember things more frequently. Therefore, people use calendars to coordinate and schedule tasks and appointments. Previous work investigated tools that support people to avoid forgetting tasks or missing appointments [4, 6]. It was found that people use various reminders including paper-based reminders, technological and specialized reminders, people-based reminders, and location-based reminders [6]. Today, people use physical calendars and digital calendars to organize their daily lives. Especially families use calendars to schedule appointments and be aware of upcoming events and tasks of all family members [3, 8, 9]. Investigating the use of calendars at home, Brush et al. found that wall calendars are the most commonly used physical calendars [1].

A body of work investigated how digital calendar data can be represented in the users' physical environments [2, 5, 7, 10]. Crabtree et al. investigated the design of group-calendar systems and found that digital calendar information should be displayed in frequently visited areas in the home [2]. Neustaedter et al. created an ink tablet-based digital calendar to organize family affairs, and Plaisant et al. developed an shared digital wall calendar using digital paper to support multi-generational families. Matviienko et al. [5] developed a tangible cube to display calendar data and additional information.

Nowadays, social networks such as Facebook allow their users to create shared events. Additionally, social networks inform their users proactively about an upcoming event if their friends will also attend this event. Stein et al. found that an integrated event calendar in a transportation platform for older adults calendar provided a strong incentive to use their application [11].

In our previous work [12, 13], we created a link between current calendar systems and event suggestions. We presented the concept of *Caloo*, a *Calendar of Opportunities* with the aim to support aging in place [14]. *Caloo* is a digital wall calendar that synchronizes with the users' existing digital calendars, displays the users' digital calendar data and proactively suggests local events to the users based on their interests. The initial interviews using a design prototype suggested that *Caloo* has the potential to increase users' awareness regarding their appointments and supports them remaining active. However, it is unclear if and how users would use such a system in their daily lives. Furthermore, we assume that the concept of *Caloo* can also be useful for younger people such as students or families. In this paper, we, therefore, present the implementation as well as gained insights of a four-week deployment of *Caloo*. Participants value the system and are eager to use it. The results also indicate that *Caloo* makes users more open to attending local events. Additionally, our results suggest that it is important to provide fine-grained control over event suggestions, enable users to define when events should be suggested as well as to prioritize events.

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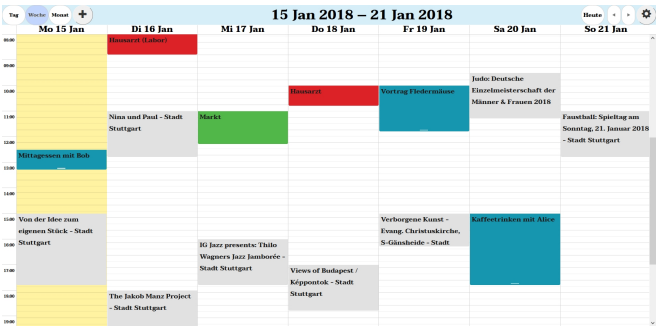
(a) Top view



(b) Bottom view

Figure 1. Implemented views of Caloo.

SYSTEM

We developed *Caloo*, a system that aims to support users in their daily lives by increasing the awareness regarding appointments and by supporting them to be active through local event suggestions. In the following, we describe *Caloo*'s hard- and software implementation.

Digital Wall Calendar

The hardware of the wall calendar consists of two 13.3" Android tablets. Both tablets have a resolution of 1920x1080 pixels and display a full-screen web browser, hiding all other user interface elements. Using a laser cutter, we created a wooden box to stack both tablets vertically. The tablets are powered by USB but can also be temporarily driven by the tablet's internal batteries. No data is stored on the tablets themselves. Both tablets display the web-based top and bottom halves of *Caloo* (cf. Figure 1).

Architecture

Caloo integrates with a user's existing Google Calendar. When first singing in, the system uses OAuth to authenticate the user's Google account and to request read and write authorization for the user's Google Calendar and Google Drive cloud storage. The user is also asked to select interest tags, ranging from music, movies, sports, to literature and art.

The top half of *Caloo* displays an image and the current month. The images are taken from a particular folder in the user's Google Drive cloud storage. Users can place images in the folder, and *Caloo* automatically generates a slide show that periodically changes the displayed image.

On the bottom half, the user's calendar appointments are shown. We implemented day, week and month views. The calendar appointments are periodically synchronized with the user's Google Calendar, enabling seamless integration with the user's other devices. Users can tap on an appointment to open a detail view in the top display. In the detail view, users can edit and delete appointments.

Event Suggestions

Caloo retrieves event suggestions from local event websites, and RSS feeds. We implemented an event crawler to periodically access these resources that often publish events in chronological order. Because the formatting differs from resource to resource, we implemented simple parsers on a per-resource basis. Our event crawler extracts the title, description, date, location, and interest tags of events. The data is then transferred in a uniform event presentation and forwarded to an event scheduler. Based on the user's interests, the event scheduler attempts to fit the crawled events in the user's calendar. Existing appointments in the user's Google Calendar are taken into account to avoid overlaps and to make sure the user has enough time to go to the event. Scheduled events are then automatically inserted into the user's Google Calendar using a "suggestion" layer.

Event suggestions in the "suggestion" layer are synchronized exactly like other appointments in the user's calendar. They are accessible on the user's other devices, and the layer's visibility can be toggled. In *Caloo*, events in the "suggestion" layer are displayed grayed out. Tapping on an event suggestion opens the detail view similar to regular appointments. Here, users can accept or decline suggestions. Declining a suggestion will delete it from the "suggestion" layer. Accepting the suggestion will copy it from the "suggestion" layer into the main calendar and then delete it from the "suggestion" layer. This causes the event to be displayed normally instead of grayed out and appear on the user's other devices. Users can manually request new event suggestions by tapping on a button.

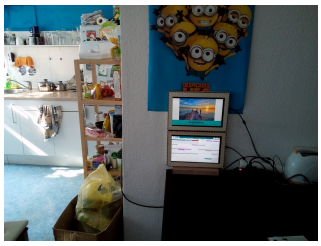
A logging component takes note of accepted and declined events. Using these logs, the event scheduling can be improved over time by learning the user's habits and adjusting the interest matching.

STUDY

We conducted a four-week long in-situ study to observe user behavior to gain insights and to further improve the design of *Caloo*. During the study, four participants used *Caloo* in their homes.

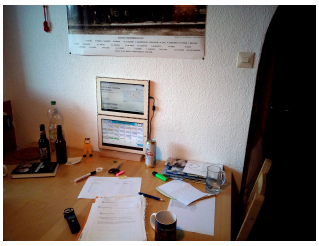
Design

We deployed *Caloo* for four weeks in the participants' homes. For the deployment, we visited the participants in their homes to set up the system. We let the participants decide to place *Caloo* in a sufficient location in their homes (see Figure 2). The study started the day after we deployed *Caloo* in the domestic environments of the participants. The active use of

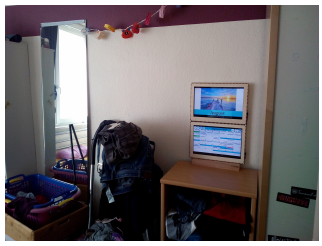


(a) Placed on the eating table close to the kitchen

(b) Placed in the living room



(c) Placed on the eating table



(d) Placed on a highboy in the private room

Figure 2. Placements the participants chose to place Caloo in their homes during the study.

Google Calendar was a requirement for the participants. All participants used *Caloo* with their existing Google Calendars that they also used on their smartphones. During the study, we logged all interactions with *Caloo* as well as all event-suggestions the participants received. Finally, we conducted semi-structured interviews with all participants after the end of the study. We audio-recorded all interviews.

Participants and Procedure

We recruited the participants via university mailing lists. The participants were compensated for their participation with 20 EUR. In total, four participants (1 female, 3 male) took part in the study. The participants were aged between 25 and 27 years ($M = 26.00$, $SD = 0.82$). All participants were students, had a technological background and lived in shared apartments. All participants used the Google Calendar before they participated in our study. Three participants also used a physical wall calendar in their homes.

After the participants gave informed consent, we asked them to fill in a demographic questionnaire. Further, we asked them to place *Caloo* in a suitable location in their domestic environment. Then, we supported our participants setting up *Caloo*. After *Caloo* was connected to the participants' Google Calendar and Google Drive, we added the standard background images in the participants' Google Drive folder. Then, we asked our participants to set interests and requested initial event-suggestions to explain the functionalities of *Caloo*. After four weeks of using *Caloo*, we revisited our participants in their homes and conducted the semi-structured interviews.

RESULTS

On average, participants interacted with *Caloo* 17.62 times per day ($SD = 10.82$) and switched 3.02 times ($SD = 2.47$) between the different views per day. They opened the detail view for regular appointments on average 4.75 times per day ($SD = 8.85$), added new regular appointments using *Caloo* 1.75 times per day ($SD = 3.50$), and edited 0.5 new appointments per day ($SD = 1.00$) using *Caloo*. Our participants chose from 10 to 20 interests ($M = 15.25$, $SD = 4.99$) of the offered categories. In total *Caloo* suggested 206 events ($M = 51.50$, $SD = 28.80$) to the participants according to their selected interests. From the received event suggestions our participants accepted 20 events ($M = 5.00$, $SD = 3.74$) and declined 44 events ($M = 11.00$, $SD = 12.19$). On average participants opened the detail view for event suggestions 2.75 times per day ($SD = 1.85$).

Interviews

We audio-recorded all interviews and transcribed their content verbatim. We used thematic analysis with open coding to gain an understanding of the interviews. One researcher coded all interviews. Also, we translated all quotes from German to English. We identified in the qualitative data the following four themes *Experience with a digital calendar*, *Interests*, *Experience with local event suggestions* and *Suggestions to improve event suggestions*.

Experience with a digital calendar

This theme describes how our participants experienced the calendar feature of an ambient smart wall calendar. All participants stated that they would use an ambient smart wall calendar such as *Caloo* in the future. Our participants explained that a digital wall calendar erases the limitations of traditional physical wall calendars. *"The space in the physical wall calendar will eventually run out. Therefore, variable views are good." (P3)* Further, they appreciated the awareness *Caloo* creates regarding their schedules as well as the opportunity to adapt the view according to their current needs. *"If you are planning something, the weekly view is good to go through [all appointments]." (P1) "I liked the monthly view to get overview [about all appointments and events]." (P3)* To further improve the awareness of the daily schedules, one participant suggested that a smart wall calendar could also support multiple users by displaying information such as shared responsibilities or tasks in addition to appointments and events. *"I can imagine that [a smart wall calendar] is good for families - [one] large digital calendar for all appointments [or a] cleaning schedule." (P1)*

Interests

This theme captures aspects to further improve the event suggestions based on the defined interests. We observed that users prefer more fine-grained options for interests. Our participants mentioned that the suggested events based on defined interests fitted quite well for them. However, some of the suggested events were inappropriate because the offered categories were too generic and not specific enough. *"I added education [as interest], that also contained suggestions such as homework help. [That] belongs to education, but [it is] not interesting for [me as] a student." (P1)* Furthermore, an event recommendation system such as *Caloo* should also consider preferred

music bands or sports teams of the users. *"A fan of [the soccer team FC] Schalke [04] is not interested in matches of [another team such as BVB] Dortmund." (P4)*

Experience with local event suggestions

This theme describes the experience of our participants with receiving local event suggestions based on their interests. Our participants mentioned that *Caloo's* event suggestions generated an awareness regarding local events and opportunities. *"There are few opportunities to get informed about all local events - if you are not online on Facebook all the time and have not joined all groups." (P3) "It [is] interesting to see what happens pretty close. [...] Many events took place in a small coffee [shop], there are so much options [for attending events]." (P2)* Furthermore, *Caloo's* event-suggestions made our participants curious about many local events. However, only 2 participants explained in the interview that they attended suggested events by *Caloo*. One participant explained: *"I become more open to events. Unfortunately, I could not attend an event because I had exams." (P3)*

Suggestions to improve event suggestions

This theme captures aspects to improve the event suggestions of a smart wall calendar system. An event recommendation system should improve the event suggestions using machine-learning approaches based on the user's former attended events. *"Two weeks after I accepted an event suggestion about a soccer match of the [local team] VfB Stuttgart] there was again a home match. [This time,* Caloo*] did not suggest the match to me. Instead, it suggested another soccer match for the [local team] Stuttgarter Kickers which [...] collided [with the other match]. That was a pity." (P4)* In addition to former visited events, such a system should also consider the importance of an event to the user. *"If you like a [...] certain musician, [concerts from the musician] should be suggested immediately." (P4)* Also, our participants mentioned that they are also interested in being informed about events occur on a regular basis as well as that some permanent exhibitions which do not have specific appointments. *"[Regarding the planetarium], these events occur every Thursday and Friday. [*Caloo *should] display all appointments or highlight them in gray. Thus, I can deliberate when to attend." (P1)*

To be able to plan attending local events together with other people, our participants suggested to deliver event suggestions from one to four weeks in advance and to connect the system with social networks such as Facebook. *"I want to be informed early [about events] to be able to plan with friends." (P2) "For important events such as city festivals [...] I want to be informed earlier." (P3)* In general, our participants preferred receiving multiple events per day (from two up to five events per day) and being able to decide which event is the most interesting for them. *"[I prefer] if [*Caloo*] displays multiple event suggestions, also overlapping suggestions. Thus, I can have a look at them and choose one." (P4)* In addition to recommending events in available time slots, such a system should also offer the opportunity to suggest events only in time slots where users are open to attend such events. *"Maybe you can define a time slot [to receive event suggestions]." (P1)*

DISCUSSION AND LIMITATIONS

We conducted a four-week in-situ study to gain insights into how users experience an ambient smart wall calendar supporting event-suggestions. Our results show that all participants are eager to use the developed system. The analysis further suggests that the usage of *Caloo* makes users more open to attending local events.

We identified several design implications for our further development of *Caloo*. Smart calendars should provide fine-grained control over event suggestions, e.g., by generating multiple event suggestions for the same day as well as considering appropriate time slots in addition to available time slots. More fine-grained control for event suggestions also includes more fine-grained options for interests. To avoid overwhelming the users with too many options to configure, *Caloo* should also consider interest suggestions, e.g., based on the users' place of residence.

Finally, we observed that some local events have higher importance for the users. Thus, *Caloo* should be able to assess the importance of events for the user according to the users' interests, their favorites for certain event types as well as their former attendance at events. Therefore, *Caloo* could access data sets from other services. For example, to assess the importance of an upcoming event such as a local music concert, *Caloo* could access music applications, e.g., Spotify, and check if the user listens frequently to similar kind of music or if the user is a fan of the band giving the concert.

A limitation of our study is that only four participants took part in our study. For future evaluation of a such a system, we need a more diverse set of participants. However, we assume that four participants are enough to gain first insights about how users experience such an ambient smart wall calendar with integrated event suggestions and we identified several design implications to improve our further development of *Caloo*.

In contrast to our previous study where we discussed the concept of *Caloo* with older adults [13], we observed in this work that younger users are more open to local event suggestions integrated into a smart calendar. Furthermore, younger users wish to share events with their friends using social networks in contrast to older users who did not want to share event suggestions with other persons.

CONCLUSION

In this paper, we presented our implementation and deployment of *Caloo* an ambient smart wall calendar. *Caloo* aims to support users in their daily lives by increasing the awareness regarding the users' calendar data. Also, *Caloo* suggests local events proactively to support them to be active in their lives. We conducted an initial in-situ study where we deployed *Caloo* in participants' homes for four weeks to understand how the system is used and to improve its design. We found that participants value an ambient smart wall calendar system and are eager to use it. The results also suggest that event suggestions make users more open to attending local events. Furthermore, we found that it is important to provide fine-grained control over event suggestions, enable users to define when events should be suggested as well as to prioritize events.

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