Data in Everyday Life:

Visualizing Time-Varying Data on a Calendar

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ABSTRACT

Designing visualization for everyday life is challenging, yet design approaches in this field are not well explored. We propose a design approach that implements data as additional media in an existing information ecosystem rather than within a stand-alone application, hoping to enhance on-going awareness and lower the cost of long-term maintenance. This approach was implemented as a web application that integrates time-varying data as an additional visualization layer in a personal digital calendar. We suggest that personal digital calendars can provide personal context to assist with data interpretation and can lower the barriers of accessing data without interfering with daily routines. We deployed our prototype in two pilot field studies, with data streams from household electricity meters and Fitbit devices, respectively. The preliminary results were encouraging. As a different approach towards designing visualizations that can fit into people's routines, we hope our work can inspire future exploration of design approaches that can bring the power of visualization to people's everyday lives.

Keywords: Personal visualization, design approach, time-varying data, digital calendar.

1 INTRODUCTION

Making sense of data with visualization is common practice nowadays. Data are usually accessed through stand-alone visualization applications that facilitate the analysis process. In this project we are exploring design approaches that use data as a media stream rather than within dedicated stand-alone tools; that is, we visualize the data stream as an additional layer in an existing information frame. Particularly, we implemented this concept by adding an additional data stream into a personal digital calendar. We deployed our prototype in two pilot case studies to obtain feedback from the communities.

Visualizations used in everyday life should fit in people's life routines (e.g., to provide on-going awareness) and require minimal effort for long-term maintenance [3]. With these design considerations, we propose a design approach that integrates data as an additional media layer in an existing information ecosystem i.e., a routinely used information tool in everyday life. Specifically, in our case, we integrate data into a personal digital calendar (Figure 1), hoping to tackle two problems: providing better context to help people interpret time-varying personal data, and lowering the barriers involved in accessing personal data, which should lead to better long-term adoption.

People interpret data in context [1, 4, 5], and thus finding the appropriate contextual framing is a critical factor in helping people recognize and understand information patterns; for example, a log of physical activity is useful as context in

reviewing insulin levels. Lacking context for reflection is one of the major barriers for personal information systems [4], e.g., in feedback designs of energy conservation [2]. For instance, "What data range is reasonable?" "What situations trigger anomalies?" Personal calendars provide some relevant context, by indicating what activities were going on in parallel with the data stream. For example, energy consumption may be low when the family is away on vacation or high when they have dinner guests.

Thus a digital calendar can frame the data with relevant contextual data. More importantly, people are familiar with digital calendars and use them as regular time management tools in everyday life, which can reduce the cost of learning and maintenance, possibly making the application easier to be adopted than stand-alone applications.

We are exploring the idea of integrating quantitative time-varying data visualization as additional media into a personal digital calendar, as a way to encourage awareness and improve understanding of everyday data. In this poster we present our early prototype and two pilot field deployments, with data from household electrical meters and Fitbit devices, respectively. Our initial deployment results show promise for this approach. As a new approach towards designing visualizations that can fit into people's daily routines, we hope our work can inspire future designs that bring the power of visualization to everyday non-occupational lives.

2 IMPLEMENTATION

Before we implemented our approach, we first conducted a lab experiment to evaluate its viability and narrow down design choices. The results showed that an additional visualization layer can be added to a digital calendar in a way that does not interfere with regular calendar use, and meanwhile the visualized data can be easily perceived. Following our lab study, we implemented a working prototype as an interactive web application (Figure 1). The web application works as an online digital calendar (with basic functions and features of a digital calendar), synchronizing with calendar events (through Google API) and also fetching live data feeds (e.g., from a household smart meter or Fitbit API) in real time. The visualization layer, showing the data stream, can be displayed either in an overlay or side by side with calendar events (Figure 1 shows a side-by-side example). Users can choose the visual encoding for displaying the data, e.g., line graph or color encoding. To balance the ambience of foreground calendar events and background data stream, users are also allowed to adjust the transparency of the data stream visualization layer. Since digital calendars normally use colors to categorize events, we make the default color of the visualization layer grey to minimize visual interference (see Figure 1); however, users can customize the color and scale of the data stream.

3 PILOT FIELD DEPLOYMENT

We deployed the prototype in two pilot case studies, with data streams from household electricity meters and Fitbit devices, respectively. In the first case study, we deployed the web
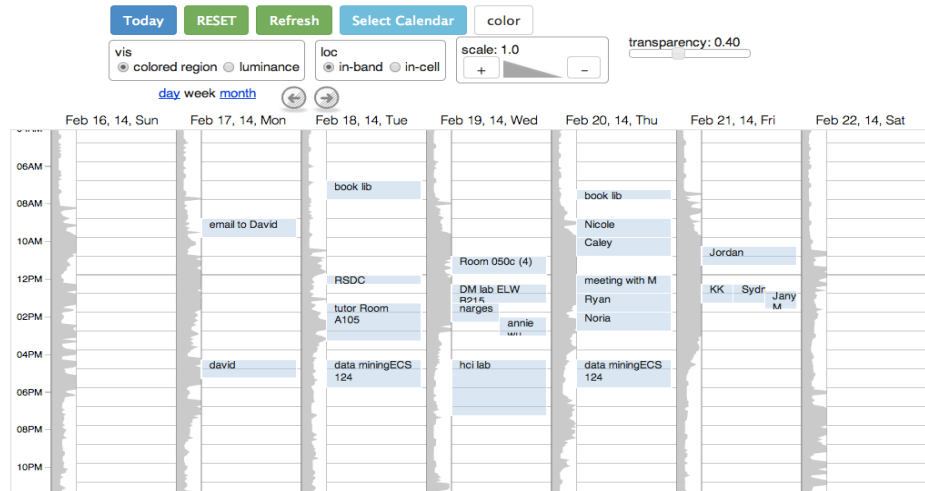
Fig. 1. Our web application uses the Google calendar API and displays household smart meter data.

application to people living in an eco-friendly smart home with the data source connected to their electricity meter. During the four-month deployment (with the calendar application available for two months), we conducted two interviews with respect to participants' awareness, behaviors and feelings about energy consumption at home. In the second case study, we deployed our calendar application to 10 undergraduate students as part of a Psychology seminar course. Students were asked to track their daily physical activities with Fitbit devices. In addition, they also filled in a daily survey to evaluate their emotional wellbeing with respect to their physical activity level. Two interviews were conducted after the first two weeks and four weeks, respectively.

With these two case studies, we aimed to collect feedback on the design approach and identify usability issues with our prototype. The results were encouraging. Overall, the participants liked the concept of integrating a data stream within a personal digital calendar. They believed it was an easy way to access and keep track of relevant data. They also found that the context provided by their calendars was helpful for interpreting patterns and abnormalities in the data. More interestingly, we found that people could easily see their life routines reflected in the on-calendar visualization, even though many of the relevant routine activities were not recorded in the calendar (e.g., cooking, laundry, showers, etc.). This suggests that the context from personal calendars can provide high-level information to help people understand personal data patterns without requiring extra effort for people to record their daily routine activities.

Meanwhile, the studies also revealed a few usability issues with our prototype. Our calendar had some inconsistencies in functionality and look & feel as compared to the commercial calendars that participants regularly used (e.g., iCal or Google Calendar). These inconsistencies presented a barrier for participants and prevented them from routinely using the web application instead of the one they currently use. This meant that our tool was used more as a dedicated visualization tool for accessing the data stream rather than the way we intended, where the data would be viewed in a secondary background stream. However, participants hoped the additional visualization layer could be added into their own calendar application, showing merit for our intended design. These results suggest that our prototype needs to be revised before larger scale deployment, to make the features consistent with digital calendars that people use regularly.

4 FUTURE WORK AND CONCLUSION

Designing visualization tools for everyday use is challenging. However, we believe that a good first step is to make technology accessible to everyone. With this goal in mind, we proposed the design approach that integrates time-varying quantitative data within an existing personal information ecosystem, specifically, a digital calendar. With this approach, data become an additional media stream rather than stand-alone application, which can easily fit in people's everyday life routines, providing on-going awareness and context for reflection. We implemented this idea and explored it with two pilot case studies. The results are encouraging, and we plan to revise the prototype based on feedback so far, and deploy it in a larger scale longitudinal field study. This will enable us to assess the value of the design concept with a broader population and wider range of circumstances.

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