Using Horizontal Displays for Distributed & Collocated Agile Planning

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Abstract. Computer-supported environments for agile project planning are often limited by the capability of the hardware to support collaborative work. We present DAP, a tool developed to aid distributed and collocated teams in agile planning meetings. Designed with a multi-client architecture, it works on standard desktop computers and digital tables. Using digital tables, DAP emulates index card based planning without requiring team members to be in the same room.

1 Introduction

Project planning in an agile team is a collaborative process relying on face-to-face communication and shared information to succeed. A common approach to planning involves teams sitting down at a large table and planning iterations using index cards to represent user stories or feature requests. One downside to this involves distributed teams. Using paper-based index cards requires all team members to be collocated during the meeting. Another issue is that the cards' location on the table and their proximity to other cards can contain important information for the iteration. When cards are moved from the table, their arrangement is often lost and with it so is the proximity and location information.

Our goal is to develop a digital environment for distributed agile planning while preserving the benefits of card-based planning. We began our endeavor by observing a team interacting with cards at a table during multiple planning meetings. The cards were organized into sub-projects and again organized so that related cards were grouped together. We rarely observed cards being lifted off of the table; rather, cards were rotated to allow for better viewing by people sitting across the table. These initial observations led us to consider using digital tables as part of a solution. [7] is based on the same idea but the tool does not support distributed settings and its usability is limited due to low screen resolution and issues surrounding the creation of new story cards. A refined approach was needed to overcome these issues.

We analyzed different designs of digital tables to overcome the screen resolution issue. One approach is to design a high-resolution table out of several LCD displays.

This implied that the table would have bezels between the displays. To investigate a bezeled design, we observed the same team conducting a planning meeting, this time using a table with physical bezels. Our observations showed that the containers created by the bezels benefited the teams with the organization of the cards. These observations and findings were part of the motivation behind the work presented here.

Distributed agile teams are a reality in today's world. Index cards cannot be used effectively in a planning meeting when team members are dispersed around the globe. While conducting planning meetings (using speaker phones and paper index cards) with team members at the other location, we noticed that information is often lost when not all team members see the same set of cards. In such a setting, awareness of card layout had to be verbalized for the benefit of distributed members. An approach was needed to support a more natural interaction so that no one is at a disadvantage.

DAP is a planning tool modeled after paper-based planning. It provides an intuitive way for teams working around digital tables to interact with digital story cards. The system supports both mouse- and keyboard-based computers in addition to pen and touch-based systems. This feature allows users to modify the cards as if they were modifying paper cards with a pen. DAP is designed to work with digital table displays as well as with standard vertical displays. Horizontal table displays add the requirement of supporting individuals sitting at different sides of the table. As a result, support for rotating planning artifacts is necessary. This paper reports on the design and implementation of DAP.

The remainder of this paper is structured as follows: Section 2 looks at existing solutions for distributed agile planning and provides an overview of digital table technology. Section 3 shows by example how the DAP environment can be used in a distributed planning meeting. Section 4 provides a description of the DAP digital table environment. In Section 5 we look at the next steps for this research. We summarize our work in Section 6.

2 Related Work

Over the last years, many commercial and open source tools have become available to support the agile planning process. Many of these are web-based[2][15][17]. In general, existing tools provide the ability to create, modify, and delete story cards, and to place them into iterations. However, these tools are usually designed to run on vertical displays that are controlled by a single user. Interaction with these tools is quite different compared to using index cards and handwriting on a table.

CardMeeting [1] attempts to bridge the gap between browser-based systems and physical card-based planning. It displays electronic index cards in a browser on a computer screen. However, it is primarily focused on the visual aspect of card-based planning: only one user per site can interact with the tool at the same time, and it does not provide the iterations and progress tracking that other agile planning tools have. In addition, it gives no support for handwriting-based input, making it unsuitable for digital table environments.

Morgan et al [9] proposed a card-based tool for distributed agile planning that supports a more natural interaction between the participants. This project attempts to

exploit the benefits found in collocated and table-based environments. There is a large body of knowledge in the human computer interaction community on the topic of table-based interaction techniques that has been helpful to our investigation [13].

Several projects have studied how electronic boards support collaboration and group-based interactions. FlatLand [10] presents a way of supporting collaborative activities by using electronic boards, focusing primarily on improving same-site group interaction techniques. In [5], researchers investigated innovative ways of face-to-face collaboration through information sharing between multiple displays.

Recently, [11] investigated the tabletop capabilities in distributed meetings. It concluded that the use of digital tables enhances and encourages collaboration and interaction in a group setting, especially among distributed teams.

Wigdor's [16] investigation presents a solution that improves information sharing for domains in which real-time collaboration is essential. His investigation asserts that recent developments in digital tables can be valuable in supporting face-to-face real time collaborative environments. He reports a series of design requirements for building of an effective table-centered space, and by coupling all these with a real life scenario, he explains how table-based environments are to be utilized when creating collaborative applications.

3 Motivating Example

We present here an example of how DAP is used in a distributed planning meeting.

Suppose Alice, Bob, Charles, and Dan collaborate on a multi-iteration project between two companies. Alice and Bob work in Location X, while Charles and Dan work in Location Y. It is time for their next iteration planning meeting.

Alice and Bob gather around their digital table, connect to the server that contains their project data, and launch DAP. They place a phone call via speakerphone to

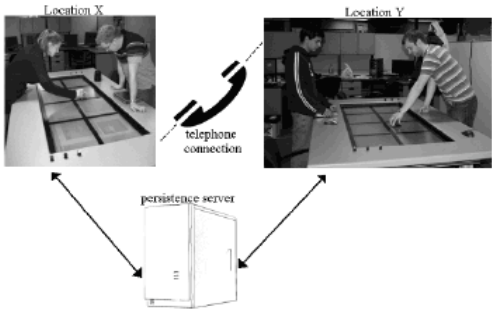

Figure 1: Scenario for a distributed team meeting using DAP

Charles and Dan, who are already waiting around their digital table (Figure 1). Alice opens the previous iteration, and all team members see the story cards from the previous meeting, their arrangement unchanged. Alice now creates a new iteration.

While the team discusses the incomplete cards from the previous iteration, Alice points to a particular card that is assigned to Dan and asks a question. Dan

immediately recognizes which card Alice is referring to because of the mouse pointer hovering over it. He indicates the card is incomplete and uses his finger to drag that card into the container for the new iteration. Charles asks Bob about a story card assigned to him. Bob drags the card to his side of the table and rotates it so that it faces him. The team decides that the card is not needed anymore, and Bob uses a simple hand gesture to delete the card.

After discussing the existing cards, it is time to create new ones. Charles uses his

Figure 2. Handwritten electronic story card

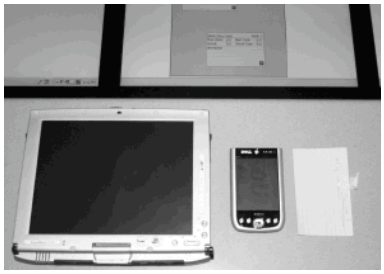

Figure 3. Size comparison of Tablet PC, Pocket PC, paper, and digital story cards

Tablet PC to create a new story, and quickly scribbles a few details about the task (Figure 2). Alice decides that she would like to work on the task as well, so she grabs the card that Charles just created with her Pocket PC. She then edits it to add her name, and places the Pocket PC back onto the iteration in order to save it. The changed card appears on the digital table in the same spot as her Pocket PC.

4 DAP

DAP follows along the same line as work by Liu et. al.[6][7][8]. Their initial investigation looked at the impact of collocated planning on a digital tabletop environment. The investigation highlighted handwriting recognition and artifact organization as important functionality, and that areas which needed improvement included artifact creation, time estimation, and prioritization. The system presented here takes those recommendations into account but extends it in multiple aspects.

The current DAP provides various different methods of interaction to allow for a more flexible use and an increase in usability. We present DAP by highlighting the various methods of interaction to accomplish different tasks.

4.1 Environment Description

DAP is an amalgamation of software and hardware that, when combined, create a digital planning environment where story card based planning can be used by distributed and collocated teams alike. The planning environment makes use of visual representations for each type of planning artifact, with the iteration and backlog artifacts doubling as containers for story cards. To overcome the input resolution

limitation of the digital table, DAP uses handwriting–enabled devices (Tablet PCs and Pocket PCs) to support creating and modifying story cards.

A central component to DAP is its use of digital tables. Our newly designed digital table provides a large, interactive, horizontal display surface. The output resolution of the table is approximately 10 MP. This large resolution allows displaying substantially more electronic index cards than conventional PC projectors. Interaction with digital tables is typically direct, using one's finger or other physical pointing device to control the on-screen mouse. The main advantage of a digital table is that it supports collaborative work environments: it allows many people to view and use a single display screen simultaneously in a face-to-face seating arrangement [13].

4.1.1 Story Card Creation and Modification

DAP supports a number of input mechanisms for creating and editing story cards. This is to allow team members to create and modify the cards in a way that is most comfortable and intuitive for them. Current digital tables do not provide an adequate input mechanism to support handwriting of the size used on paper-based index cards. A work around was found in using handwriting-enabled devices.

These small handwriting-enabled devices are employed to mimic card creation in a paper based planning meeting. Their primary purpose is to allow team members to quickly create and edit card content in a way that is similar to writing on an index card. The devices are well suited for these tasks as they can be easily held in one's hand or placed on the edge around our table. The DAP software for these hand-held devices focuses on creating and editing of card content; project and iteration information is limited to encourage interaction with the digital table DAP software.

DAP for the digital table is a full-featured planning tool. Its approach to creating card follows the idea of taking a card from a pile and placing it at the desired location on the table. This same approach is used for creating all other planning artifacts. The limitation with the digital table DAP is its ability to edit the card content.

4.1.2 Organization and Information Sharing

The digital table DAP focuses on allowing teams to organize planning artifacts. The visual representations of story cards, iterations, and backlog artifacts make it easy for anyone sitting around the table to place their finger on the artifact and drag it to a new location. Once again the interaction approach used tries to mimic the way teams move cards in a paper-based environment.

The moving of cards is not the only benefit that DAP brings to the table. A major component to DAP is its support of distributed teams. DAP's planning environment is shared with other DAP connected systems. Using existing tools, distributed planning presents some challenges when it comes to ensuring all team members see the same information at the same time. DAP shares the current state of the iteration plan in real time and pushes changes on one site out to all connected clients.

Live information updating is only part of DAP's consideration for distributed teams. Conversations taking place during planning meetings are often augmented by individuals gesturing with their hand to indicate context. This becomes very tricky when others can not see your hands. To overcome this limitation DAP uses telepointers, allowing for mouse gestures to be shared with other connected DAP

tables. If a user moves a mouse on one site, the other sites see a mouse pointer moving too (i.e each display shows multiple mouse pointers).

We mentioned earlier that one advantage of digital tables is that some provide the ability for more then one individual to interact with the surface concurrently. This feature is important, as it is rarely the case that a single individual alone is interacting with the paper-based index cards on a (physical) table. DAP handles this situation by supporting multiple mice on the same site. This multiple mouse feature eliminates the need for any kind of turn taking mechanism and allows for collocated teams to work in a way that they are familiar with. The multiple mouse feature is combined with the telepointers to allow for everyone to see everyone else's interactions.

4.2 State of Implementation.

DAP is heavily dependent on information exchange to provide its users access to the iteration plan in real time. To make everything work together seamlessly, DAP relies on a central persistence server to which all devices (PCs, digital tables, handheld devices) connect (see Figure 2). In order to synchronize clients in real time (as opposed to web-based systems that rely on repeated pull of information), DAP uses a push-based updating mechanism to provide near instantaneous feedback.

The use of digital tables is a central part of DAP and as such requires a digital table display. Our digital table is 8 x 4 feet with a 1-foot border for placing handheld devices and other meeting paraphernalia (e.g. coffee cups). Its display consists of 8 LCD screens. In total, we have an output resolution of approximate 10 megapixels. The placement of these 8 screens creates physical bezels useful for organizing story cards. Figure 2 shows the table in use.

In terms of handheld devices, we make use of Tablet PCs and Pocket PCs. It is important to note that handwriting recognition capability is limited by the state of the device's handwriting recognition technology.

DAP remains under development and features highlighted in our motivating example remain at various stages of completion. Features such as supporting distributed teams creating, editing, deleting and organizing cards are completed and are being used by us for distributed planning with our research partner. Multiple mouse support is in a prototype state and needs minor tweaking and stability enhancements. Card rotation is scheduled to be completed by summer 2007.

5 Discussion

DAP development has made significant strides towards reaching our goal of providing an environment that supports natural interaction for distributed agile planning meetings. DAP provides the benefits of a digital environment and preserves many advantages of paper based planning meetings by combining digital table technology and handheld devices with visual representations of planning artifacts.

Existing agile planning tools bring different aspects of card based planning to a digital environment. Web based tools provide project tracking and information

storage to teams but they lose the spatial information provided by the location of planning artifacts. On the other hand, tools like [1] provide visual representations of cards that can be interacted with, but do not have a tracking aspect. DAP provides both project tracking and visual organization of cards at once, along with a natural way of inputting information and elements of non-verbal communication such as hand gestures (using telepointers). Telepointers, real-time synchronization, multi-use input on a single site, and handwritten index cards for distributed meetings are not available in any other agile planning tool.

Formal evaluation of DAP is scheduled for spring 2007 and we expect that the benefits of these features will result in improved team interactions for distributed agile planning meetings.

We note some limitations of the DAP environment. First, DAP does not provide an audio channel for communicating between teams in different locations. We do not plan to implement this functionality because this can easily be accomplished by a standard telephone conference call. Second, the handwriting recognition accuracy on the handheld devices is limited by the state of the art in that field.

It is important to note that DAP cannot solve all limitations of a distributed planning environment. There will surely be information lost by virtue of the fact that body language and facial expressions are a significant part of human communication, and much of what they convey is difficult to express over large distances. While this aspect may be important, dealing with it is outside the scope of our research.

6 Conclusion

We have presented DAP as a card–based planning tool to support distributed planning for teams sitting around a digital tabletop. Existing research highlights the importance of supporting natural interactions and encouraging face-to-face collaboration.

Existing planning tools provide limited support for interactions between distributed teams. Most tools do not provides support for keeping track of stories proximity to each other. DAP attempts to combine the benefits of digital tabletop environments and agile planning tools with the advantages of paper based story card planning.

DAP is still under development and so has a number of improvements planned. The two most notable are supporting gestures and changing seating arrangements. Gesture support would allow users to trigger actions such as deleting artifacts, cutting and pasting, and selecting groups of objects. Supporting changing seating locations would allow DAP to cater the orientations of cards based on the seating arrangement.

DAP is still work-in-progress and as such no formal evaluation has been completed. Through a formal evaluation, we would like to conclusively determine the benefits and drawbacks of using DAP. We believe that further examinations into the combination of digital tabletop environments and agile planning in both distributed and collocated settings is necessary. It is our sincere hope that tools like DAP will help agile teams in their distributed project planning endeavors.

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