Coeno–Storyboard: An Augmented Surface for Storyboard Presentations

Abstract

In this paper, we present Coeno-Storyboard, an around-the-table applications designed for presenting a storyboard using tabletop technology in combination with augmented content. The demonstration is based on the Coeno-framework, a flexible plug-in framework that allows fast development of tabletop applications. The goal of the presented prototype was to present new ways of interaction and communication for the next generation working in spaces by using projection based AR technology.

1 Introduction

Mixed Reality has become a popular buzzword used by many researchers moving from the area of Virtual Reality to Augmented Reality (AR). A lot of time has been invested in improving current tracking systems, finding new ways of interaction, searching for adequate displays, and implementing new exciting applications. Inspired by the ideas of the *Future Office* from Henry Fuchs (Raskar et al. 1998) and the *Augmented Surfaces* presented by Jun Rekimoto (Rekimoto & Saitho 1999), we wanted to develop a multi-user shared tabletop application for story-board presentations.

Tables provide a convenient environment for people to meet, discuss, look over prepared documents, and to present ideas that require face-to-face collaboration. However, digital data is commonly used in single user desktop environments and handheld devices. We want to combine both the usage of a table for a better communication and the usage and integration of mobile devices (e.g. laptops, Tablet PCs etc.) to achieve the best infrastructure for a successful presentation and discussion environment. The main aim of our approach is not to eliminate completely the current hardware devices, because a lot of people are already quite familiar with creating their scribbles by using computer devices. However, we want to offer an infrastructure that allows an easy integration of digital data to allow face-to-face collaboration around a digitally augmented tabletop interface.

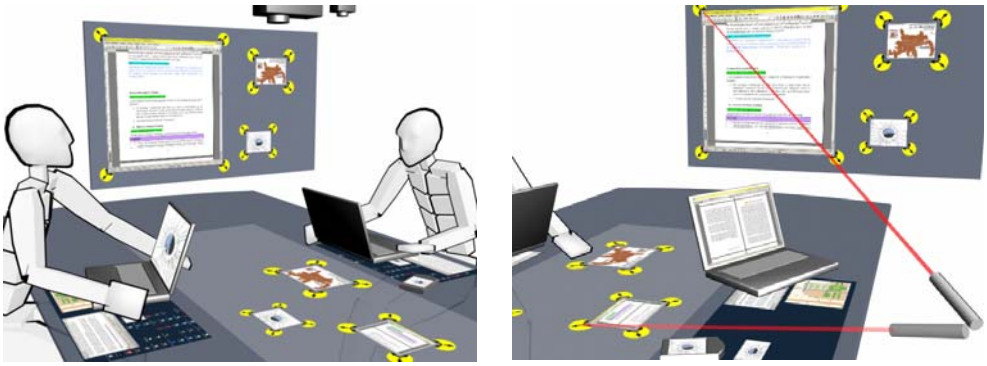

Figure 1: Participants can join the discussion session and move their scribble notes from the laptop to the augmented tabletop projection surface. Intuitive interaction metaphors (e.g. laser pointer metaphor) should support users to have a very intuitive and immersive presence feeling.

Indeed, most of the current around-the-table applications and interaction metaphors are either too isolated, or still proof-of-concept studies; thus there is still missing a framework that is open enough for different input and output devices and for new interaction metaphors. Moreover, it is still too complicated to integrate new hardware devices into existing tabletop frameworks. Our flexible Coeno[1]-framework allows us to further explore, experiment, and design novel tabletop interfaces for a face-to-face collaboration and it provides an infrastructure to quickly integrate new interaction metaphors and to set up new tabletop applications. Our system is based on a plug-in framework written in C++. The presented storyboard application was rapidly prototyped within four days' time.

Multi-modal interfaces, immersive workspaces and new input devices improve the current Coeno-framework. The seamless integration of heterogeneous hardware devices and the combination of different input and output metaphors achieve a better user acceptance, which is one of the primary goals of creating a better face-to-face interface. The computer as a device disappears and is almost "invisible", but the functionality is ubiquitously available. This does not necessarily mean that users will not use their laptops or any other hardware devices, but we want to have it "disappear" into the background and make it as much as invisible for the user. Participants should not feel lost in or intimidated by the complicated hardware devices. Instead of fighting with the hardware, they should concentrate more on the content creation process. Therefore, we want to experiment with new interaction media, test it with different interaction metaphors, evaluate them and combine them as much as possible to achieve the best interaction possibilities as possible with respect to usability and flexibility.

[1] Greek: koinos = collective, together

2 The storyboard presentation tool

The design process of a storyboard is a really challenging task and demands high collaboration between all participants. In most cases, people sit together around a table and discuss the different sequences of a new movie or animation.

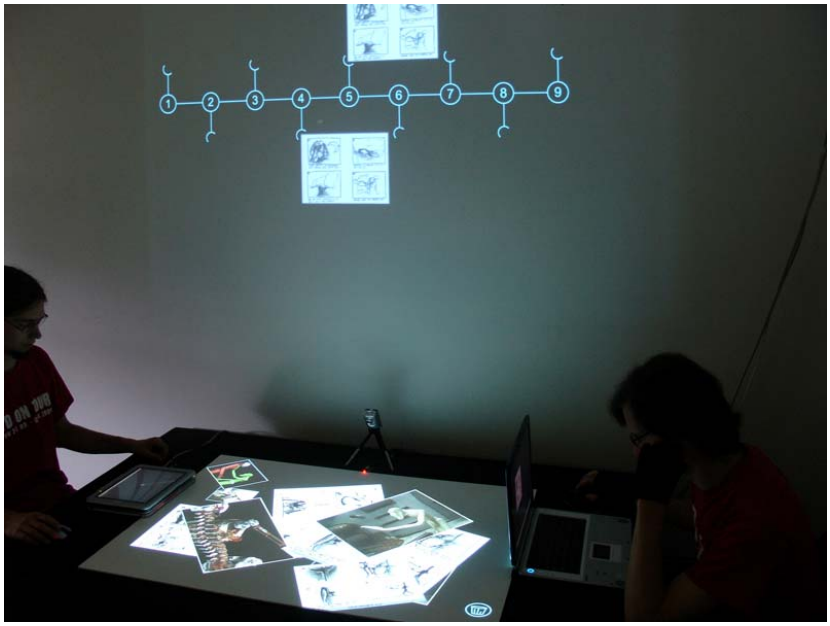

Figure 2: Coeno-Storyboard allows a seamless integration of mobile devices into an augmented tabletop system where people can exchange their ideas by moving digital data to the table. The projected timeline on the wall allows ordering the different shots of the animation.

Coeno-Storyboard is a storyboard presentation tool that offers a cooperative and social experience by allowing multiple participants to interact easily while discussing the same story, in the same space, and at the same time. During the storyboard creation process, multiple authors and designers can create rich stories. Users bring their laptops and Tablet PCs into the environment, connect them to the system, and start exchanging their data by moving them to the table or picking them up from it. Coeno-Storyboard offers a smooth integration of portable computers into a meeting room, where the table and walls are acting as an extended public computer display.

After connecting the laptops to the system, participants can move digital data (e.g. images, videos, digital scribbles) from their portable computer (private space) to the projected surface (public space). Thus, all participants can smoothly

drag their data onto the table. We used the hyperdragging-metaphor proposed by Rekimoto (Rekimoto & Saitho 1999), where the table is an extended workspace and data is projected onto the table respectively. Participants are allowed to create new notes only in their private space and then they can move them accordingly to the public space. While users are with their cursor outside the private space, thus at the border of the laptop, the mouse cursor automatically moves from the laptop to the table and a line is projected from the center of the laptop to the corresponding virtual note on the workspace (cf. Figure 3).

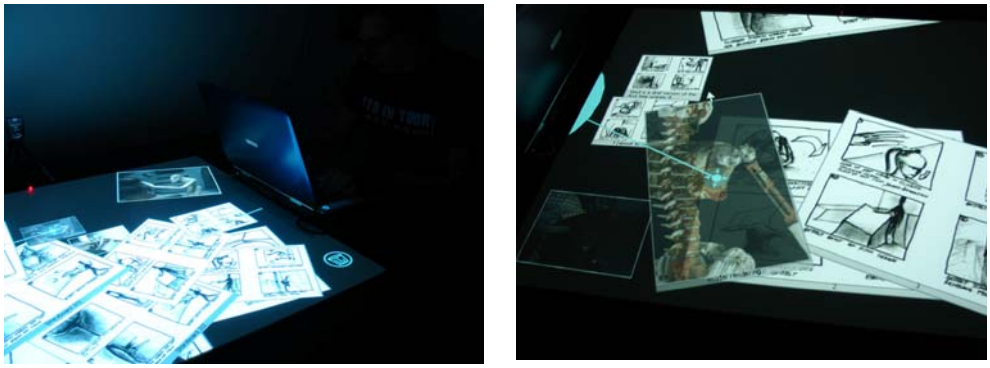

Figure 3: Participants can transfer their scribbles to the workspace and manipulate the data accordingly.

Of course, all users can transfer digital data from their private space to the public space and vice versa. In this application, these notes consisted mainly of storyboard sequences (including images, scanned hand-scribbles, video-clips, and 3D graphics of the characters) that might, for instance, be discussed during a session. On the table, the users can move, rotate, and scale data respectively.

During the discussion meeting, all participants around the table can quickly rearrange the data sources. An intuitive passing of documents around the corresponding surfaces guarantees the location of the scribbles on the timeline that is visualized on a wall-sized projection display. Equipped with a wireless multimedia mouse pointer, a coordinator has the possibility to transfer the unsorted data from the table to the projected timeline. Moreover, the coordinator can reorganize the data on the table as well, move the scribbles, scale them and rotate them accordingly.

3 Interaction Techniques

Participants connect to the system either using their laptops or their Tablet PCs. An integration of mobile handhelds is under progress. There is no limit, how many

clients can connect simultaneously to the Coeno system, thus the amount of participants depends on the space limit around the table.

Coeno-Storyboard supports the following interaction techniques, where we combined the physical interactions with digital data:

- **Seamless data transfer:** Data can be transferred seamless form the laptop / Tablet PC to the public space and vice versa. Currently, we support a data transformation allowing users to combine images and text at arbitrary sizes and orientation by using both the extended mouse cursor (hyperdragging-metaphor) used by the sitting participants and the mouse pointer controlled by the coordinator. By dragging data sources from the laptop to the projection screen, automatically the real document is transferred from the client to the server. In this way, people also can exchange information in a more intuitive way.

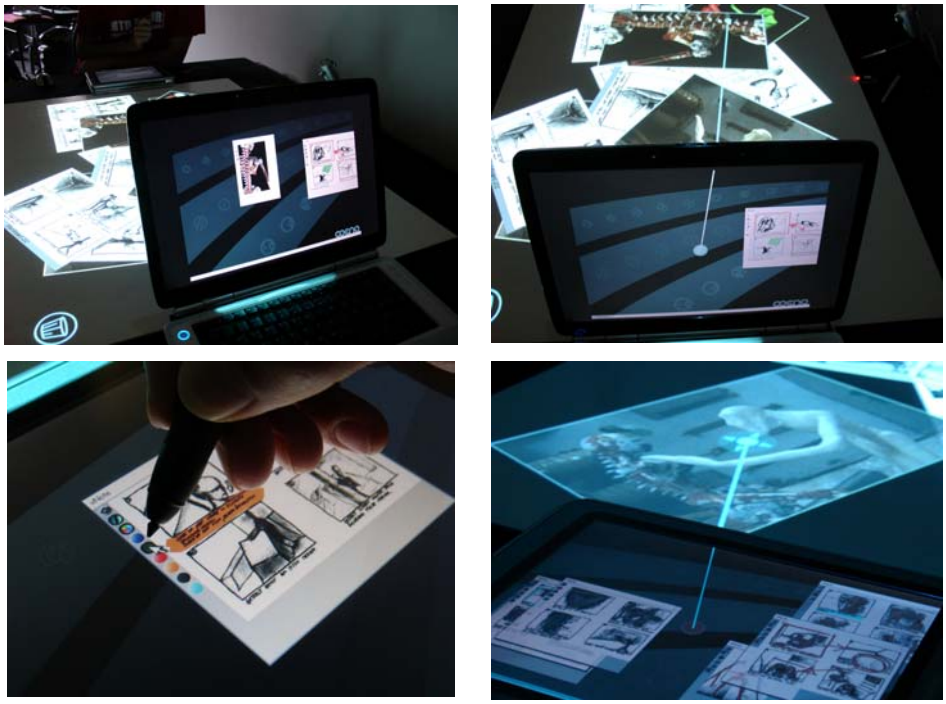

Figure 4: Data notes can easily be created and manipulated on the clients, where the participants add comments onto the images, before sending them to the projection screen.

When participants use their laptops, the table is behind the display-shadow. Thus participants do recognize neither the position nor the status of the cursor

on the projected table. Therefore, the user can see an extension of a projected line that is drawn on the laptop display accordingly (cf. Figure 4).

Data notes can easily be created and manipulated on the clients, thus participants can add comments onto the images, before sending them to the projection screen. Our digital workspace can not substitute traditional paper, which will still be loved by most designers, but we can profit of the digital capabilities we achieve by using our tool. So, for instance, we integrated a clean-up metaphor. Similar to Apple's Expose functionality, where all open windows can be displayed as thumbnails, we implemented a function that allows representing a selected range of documents as thumbnails.

This function is important, because in the normal case, people are moving a lot of different data sources around the table. Moving 20, up to 30, data notes is not a rarity. Moreover, participants can group data sets and move them around the table, or just switch them to the client at once. On the table, people normally locate the unsorted scribbles, whereby on the wall, they bring data only, when they believe that it fits to the right position.

Figure 5: Similar to Apple's Expose functionality, Coeno-Storyboard can sort all data projected on the table.

- **Virtual Keyboard:** There are two ways to bring data to the projected timeline: the first possibility is to click directly on the note data and to drag it manually to the corresponding timeline position. The second possibility is to double-click the scribble data with the wireless mouse pointer. Consequently, a virtual keyboard is projected onto the table and the user can type in the corresponding number of the timeline (cf. Figure 6).

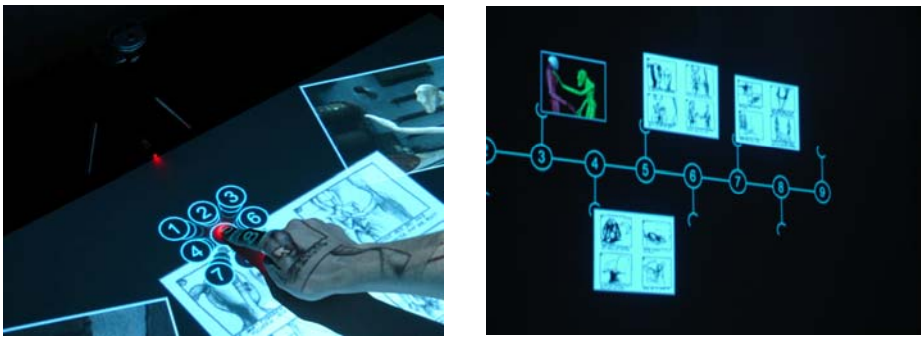

Figure 6: A virtual number block is projected on the surface after a double-click onto data.

A red laser diode emits a thin laser line to the user's fingers. Thus, the reflection of the red laser line on the fingertips can be tracked by a camera that is mounted on the back of the table. The usage of a red laser line guarantees that the tracking system works also under bad lighting conditions. In contrast to the commercially available virtual keyboards, we can change the projected layout relatively quickly by simply configuring a corresponding XML-file. Due to the fact that we track reflected light sources, we also can use a simple red laser pointer targeting to the surface instead of typing with the fingers.

- **Data manipulation:** notes can easily be manipulated on the clients (e.g. laptops, tablet PCs), where users can either add notes at the bottom of the scribble images or paint directly on the scribbles (e.g. with the stylus of the Tablet PC).

  In our testing environments, users had the possibility to make notes onto slides and onto images. Thus, data can just be manipulated on the private workspaces, but not on the table. Participants can also use sketching tools as Alias Sketchbook[2] or ArtRage[3] to generate new scribbles that can be integrated into the system smoothly (cf. Figure 7).

[2] http://www.alias.com/eng/products-services/sketchbook_pro/index.shtml

[3] http://www.ambientdesign.com/artrage.html

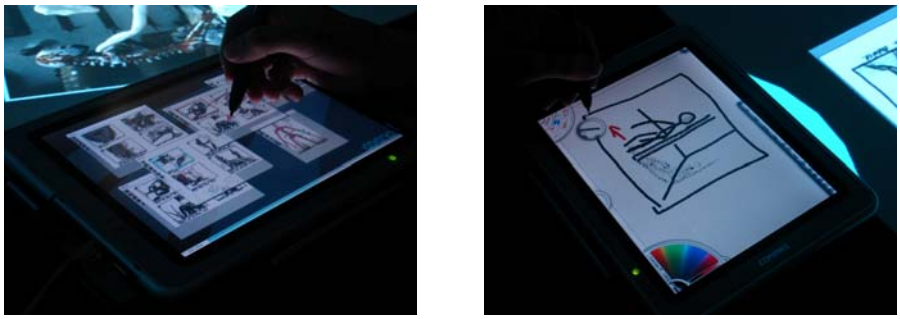

Figure 7: On-the-fly scribbles can either be created within our system or by using external tools (e.g. ArtRage).

- **Store the scenario**: The whole scenario state can be stored on demand, thus each note and its properties can be archived accordingly. This feature was often requested by customers to guarantee to capture the history of discussion and participants can switch smoothly from one stored session point to the next.
- **Moving objects to real objects**: Finally, users love the combination of both virtual and real objects. In our test scenario users had the possibility to move data notes to a real trash to remove objects from the virtual workspace. By dragging objects to different peripheral devices (e.g. printer), users would get the corresponding expected results (e.g. getting a hardcopy of the scribble).

Figure 8: Participants can drag the virtual scribbles to the printer to get a hard-copy.

4 System architecture & Implementation

One of the primary goals of this scenario was to develop a cheap and effective prototype based on the first version of the Coeno-framework. The system consists of a projector above the table and a projector for the wall-display. Both projection images are rendered by the server. The amount of connected clients is limited by the size of the table. We tested our environment with three people simultaneously. For rendering the content, our framework is based on OpenGL (for rendering 3D content) and ClanLib[4] (for rendering GUI elements); the seamless integration of ClanLib on top of OpenGL allows a nice combination of both libraries. Moreover, we used the component model of ClanLib for the inter-component communication and the network extension for the communication between the clients and the server.

The integration of the virtual keyboard included also the integration of OpenCV in the Coeno-framework. The fingertips are tracked by the usage of a Philips webcam and a red line laser module that projects a thin line onto the surface.

5 Results and Discussions

We implemented two demonstrators for human-to-human interaction on top of the Coeno framework. Our system was firstly presented at the HIT Lab NZ consortium meeting, where about 80 people had the possibility to test the application and to make their comments. No formal evaluation had been started at the time this paper was written. We believe that the Coeno-Storyboard supports a stronger relationship to create a storyboard than it is supported by a traditional graphical user interface, where all participants sit in front of one PC. Thus, users feel a stronger sense of identification with the story, because they can simply concentrate on the story alone instead of being distracted by the hardware. A lot of the users were surprised at the performance of the application and at how intuitively the metaphors were implemented, when moving data notes from one client to the table and vice versa - even with a huge amount of scribbles that have been placed on the table. Once the scribbles were moved to the table, some of the participants started to interact using their hands with the expectation that they could move and transform the notes accordingly. We observed that users liked the hyperdragging-metaphor; moreover, they loved the combination of both virtual and real objects (e.g. putting the document to the real printer to achieve a hardcopy). However, the movement from one private to the public workspace and vice versa can become tiresome after people get more familiar with the system.

[4] http://www.clanlib.org/

When several people gather around the table there is no single directional viewing angle that is ideal for every participant. Therefore, the system should guarantee a flexible and fast movement of data sources around the table. One idea is to support a snip-metaphor, where participants just snip their documents to the others by using their hands.

In our first demo scenario, we integrated a virtual keyboard that was projected onto the table surface. To our surprise, people thought that special sensors had been integrated into the table to track their fingers. The missing haptical-feedback of a normal keyboard was never objected during the demonstration. However, participants had to do mental thinking where they had to transfer the digits on the num block to the corresponding timeline position. Even though we used just nine numbers, some of the participants had problems to understand this correlation. Nevertheless, the combination of a keyboard (or of other control elements) with the working material on the public workspace seems to be a good solution and people do not feel lost – provided that the amount of the projected control elements is kept within a limit.

6 Conclusions and Future Work

In this paper, we have presented the implementation of Coeno-Storyboard, a face-to-face presentation program for storyboards using tabletop technology in combination with augmented, digital information. The goal of this project was to present new ways of interaction and communication for the next generation working in spaces by using projection based AR technology based on a flexible plug-in framework. However, we want to find novel interfaces, that are easy to understand and accepted by people.

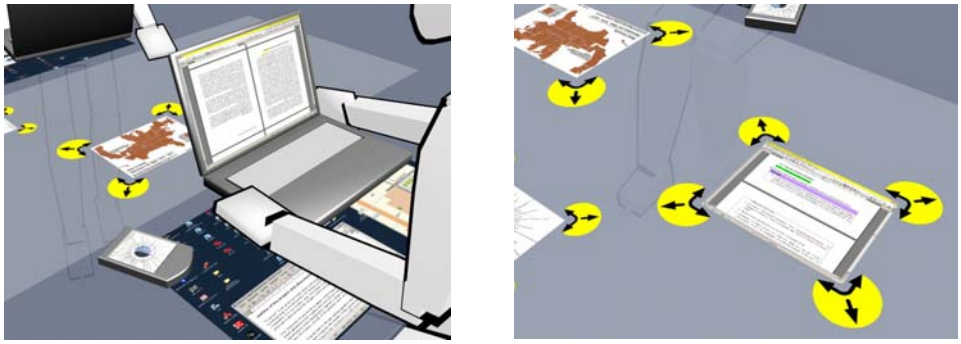

Figure 9: The private space can be implemented as embedded windows on the table. Another improvement would be that multiple people can interact and manipulate the data sources directly on the table.

Instead of using a scrollbar or a ride-wheel for transforming (rotate/scale/translate) data on the table, we want to find more intuitive interaction methods (cf. Figure 9), e.g. using hand/finger tracking system etc. (cf. Wu and Balakrishnan, 2003).

One of the main goals for the next steps is a formal evaluation of the system. Thus, we want to find out, into which of the in- and output techniques we have to put more effort. Apart from new input and output techniques, we want to invest more effort in different application domains (e.g. novel interfaces for team collaboration, tabletop games etc.).

References

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