The Interactive Learning Space

A support for project based learning

by

Martin Jonsson (mjonsson@stanford.edu)

INTRODUCTION

The aim of this paper is to examine how the needs of a group of students participating in a project based learning situation can be helped by a room similar to the Interactive Workspace room.

There are many different pedagogical approaches to project driven or project based learning. The basic idea is however that small groups of students are given a real world problem. While working on that problem they have to actively acquire the knowledge they need to solve the problem. Below follows some common components in problem solving learning models.

- Brainstorming. Gather ideas from whole group, without judging them, in an unstructured manner.
- Formalize, categorize, build structures, filtering. Eventually iterate step 1 and 2.
- Define the problems, Set up goals, Make a plan.
- Gather information, perform tasks. (Can be done individually).
- Compile the results, Strive for entirety. Try to answer the questions posed.
- Prepare and perform a presentation.

This paper tries to give a description of a room that supports the activities outlined above. The attempt has been to create a flexible, dynamic environment that can be used in a number of different ways. I have tried to avoid structured applications containing static workflow models, to instead try and work with a toolbox approach with general tools to support e.g. brainstorming.

WHAT LIVES IN THE ROOM?

The room described is one of several identical rooms on a university campus. The rooms are open to all students, anytime.

Physical layout

High resolution screens cover most of the wall-space available in the room. A table with a built in display is situated in the middle of the room. The room is big enough to provide open spaces where people can stand in groups. Except for the chairs that is used with the table, there are a couple of chairs with a built in desk, big enough to host a lap top. These chairs can easily be moved around the room. This layout supports work in one group as well as for persons to break out of the group for a while to perform individual work.

The Media Wall

The Media Wall is the backbone of the system. It provides the basic functionality concerning the users interaction with the walls and the table. The basic idea is to create a huge clipboard for all types of media that can be represented visually. The users should be able to fill a room from floor to roof with visual objects. Most of the objects provide direct visual information (such as text, images, video clips, animations etc.), while others can be links to information (such as web pages or files). This blend of different media is common in normal work spaces where you can see i.e. colored post-it notes and pictures attached to whiteboards : Here's some images that show how normal workspace walls are used.

The Media Wall supports:

- Multiple simultaneous input from pencils as well as from mouse, remote laptops and PDA's.
- Cut and paste of objects from regular programs such as Word or Netscape.
- Clickable URL's.
- Spatial reorganization of media objects over several walls.
- Interoperability with common applications. You should be able to open a Netscape window on top of the Media Wall.
- Saving and recovering the state of the room. After a meeting in the room, you are able to save the current state of the room, so that you can recover the state at another time in another room.

- Data reusability. It is easy to save media as text, images, documents and drawings, so that it can be reached from personal computing environments at a later time. The ability exists to extract atomic objects as images, chunks of text, or drawings, as well as larger chunks like an image of a whole wall. The data is tagged in a number of different ways, examples of such tags are spatial data, time of creation, creator person, connections to categories etc. Sound and video recordings of the meetings are also saved and time-stamped.

On top of the Media Wall you can add tools to support specific activities like brainstorming or tools for presentation. One such tool is the *Formalizer* which allows you to connect objects to different categories. These categories can be seen as layers or dimensions, which you can chose to be visible, grayed out or not visible. This approach allows for parallel work on different tracks. It also allows you to continue to add on objects to the wall without having to delete or reorganize stuff. The main area of usage is within brainstorming sessions where the tool is used to categorize the different ideas. Other tools include:

Timeline tool: To create a plan for project, showing important dates and deadlines.

Magic Merger: To merge ordered data on the wall into a document.

Presentation creator: To create presentations for the room. Supports creation of pages, that can be sequentially and spatially ordered.

Time traveler tool: Makes it possible to view the state of the room at an earlier time. You can play the recorded sound of the meeting and see objects appear on the walls.

Integration of screens and table
On each of the screens (including the screens of laptops) there can be connections to one or several of the other screens. The representation of the screens can take two forms:

1. A resizable rectangle showing the content of the screen it represents. To move an object to that screen you just drag it within the rectangle. In this mode you are able to rearrange the locations of the data on that screen. By using a pencil within the rectangle, you can write and draw on the represented screen.

2. You can "connect" the one side of a screen with a side of another screen. By dragging an object to this edge of the screen it becomes partially visible on both screens. By connecting screens you can also use the mouse to control a pointer over several screens. Just drag it to the edge of your screen and it will appear on the connected screen.
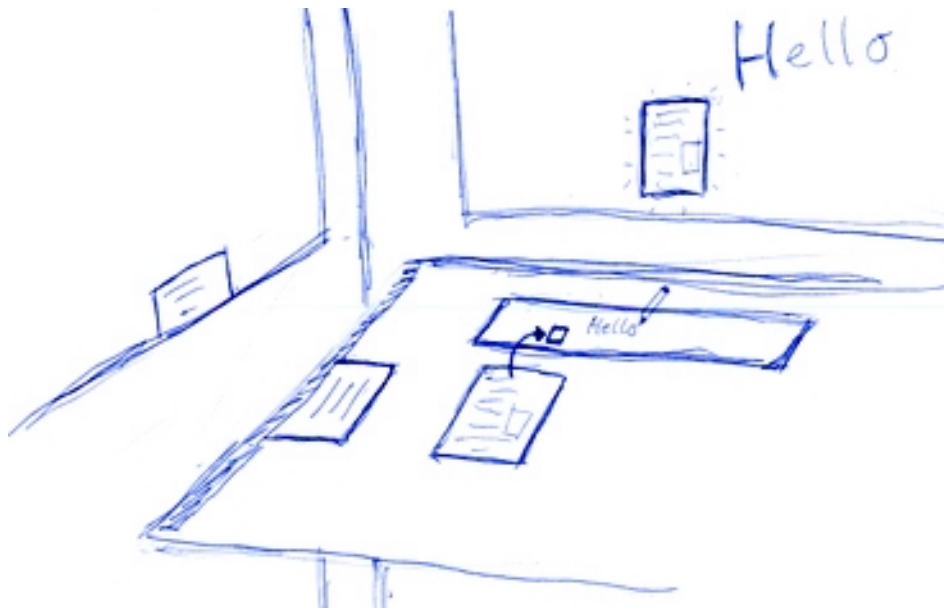
ScopeCam

The ScopeCam is a very small camera mounted on a telescope stick. The stick is mounted on a horizontal bar that runs along the upper edge of the wall-screens. When not used, the stick is in its shortest mode and does not cover any part of the screen. When you use the camera you can pull the camera vertically as well as horizontally to place it anywhere on the wall. Preferably you place the camera in line with your eyes. A videoconference application connected to the camera has access to the camera position. When you launch the videoconference the center of the incoming video image is placed at the current location of the camera. In this way the ScopeCam gives you good eye contact with the remote participants. Another benefit of this system is that some people can participate in a videoconference on one part of the wall while some other people work on another part of the wall.

Bonus option: You can also chose to pull the camera out from the screen, turning the camera towards the screen. This option makes it possible to show material on the wall to the remote party of the videoconference. Or you can record a person writing on or interacting with the wall.
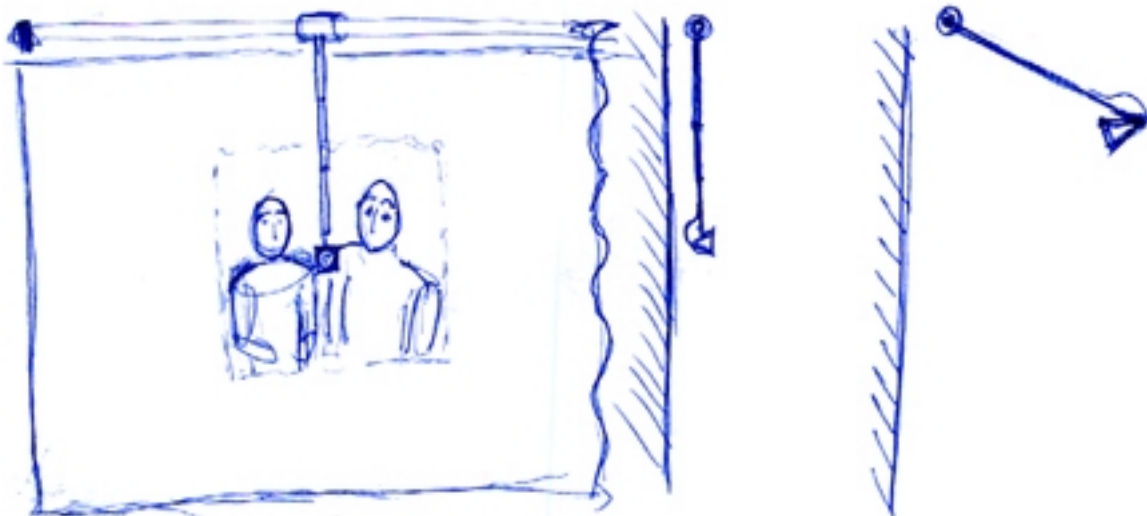
Radio transceiver

In the room there is a radio transceiver with the transmitter/receiver ranges limited to the boundaries of the room. The transceiver has two functions.

1. It acts as a radio beacon, that continuously transmits a URL to a local http server. This URL are received by personal mobile devices that enters the room, and are used to localize software services that are available in the room.

2. Receiver: Users can wear active badges with a radio transmitter. These badges transmits a globally accessible URL pointing to a Personal Agent. This agent can provide certain services to applications running in the room. One such service can be access to a persons private file archive. Another service could be to provide speech recognition patterns to a local voice recognition application.

SCENARIO

A group of students in the computer science department are attending a course in computer vision. The major part of this course consists of a project where each group has to solve a real world problem in cooperation with a company. The groups have access to an interactive workspace as described above. One of the groups, consisting of Jerry, George, Elaine, Cosmo and Newman, have chosen following problem submitted by BMW in Germany:

Use computer vision technology, with off the shelf video and computer hardware, to create a system to be used in cars that detects and warns a driver that falls asleep.

The goal of the work is to, in cooperation with a team of engineers at BMW in Germany, create a functional proto-type mounted into a car. The BMW-group will take care of the mounting in the car, and the student group will create the software.

First meeting: Conquer the room.

As the persons enter the room, small icons appear in an ICQ-like interface on one of the big screens. These icons are shortcuts to private files as well as e-mail. Since Newton forgot his radio beacon card at home, he has to log on to the application manually. Cosmo and Elaine brought their laptops to the meeting. When starting their laptops inside the rooms they are immediately prompted with a question if they want to receive software to control the room. When clicking OK, they get access to applications for controlling the physical properties of the room such as lights, as well as controls for the software running in the room.

"So…" Elaine says, "Where do we start?"

"I think we should start with a brainstorming session" George says.

"That's a good idea, but first I think we ought to adjust this room a little bit to better fit our needs. For example we could put all URL's of interest over here" Cosmo says and demonstratively copy a link to the course homepage from his laptop to the middle of one of the walls.

"Yes, and can't we keep the current definition of the problem always visible over here" Elaine says copying the (so far rather vague) problem statement from a browser running on one part of the screen to the media wall.

"I made some drawings at home yesterday that you might want to have a look at" says Jerry. He taps an icon on the wall with a picture of his face on it, and can soon browse a file directory for his image files. The images appear on the wall. Jerry uses his finger to move the images around and to resize them to appropriate sizes.

Newton has some notes written down on a piece of paper. He puts the paper on the table, uses a pencil to draw a frame around the edges of the paper. The document camera over the table zooms in the paper, scans it and runs it trough an OCR program. An exact copy of the document appears on the table screen underneath the paper. Newton pulls this document to a rectangle representing one of the walls, and it immediately appears on that wall.

The members of the group continues to add related material to the wall. After a while they have defined several different areas containing different types of content. One big part of a wall is left blank and declared as a working area.

First meeting: Brainstorming

"So how abut that brainstorming…" George says after a while. Jerry and Elaine immediately takes place at the wall, starting to write their ideas at the wall. Cosmo sits down in one of the chairs with his laptop, typing his ideas at the keyboard. The written sentences appear on the wall. Newton uses his PalmPilot to give input to the wall. George writes his ideas on the meeting table. When he is done writing a sentence, he marks it and drags it into a rectangle representing the actual wall. The text appears on the wall. Sometimes someone posts an image or a drawing on the wall.

When they feel that they are done they bring up the formalizer tool. First they create the different categories, and place them on the wall. Then they connect different objects/ideas to categories by drawing a line between them. They also connect links and other material from the stuff they put up on the wall in the beginning of the meeting. They

then choose to do some further brainstorming around one of the categories. They make all of the other categories invisible and then continues with their brainstorming.

Telemeeting

At a later meeting some questions concerning the installation in the car comes up. Elaine decides to try and set up an ad-hoc videoconference with some members of the BMW group. She grabs the ScopeCam camera from its position above the screen, pulls it downward until it levels with her eyes. By clicking a button on the camera she invokes the videoconferencing tool. A window appears right in front of her eyes. When she has spoken to the BMW guy for a while, she wants to illustrate something by drawing on the wall. She pulls the camera out from the wall, flips it 180° towards the wall, and can then film herself writing on the wall.
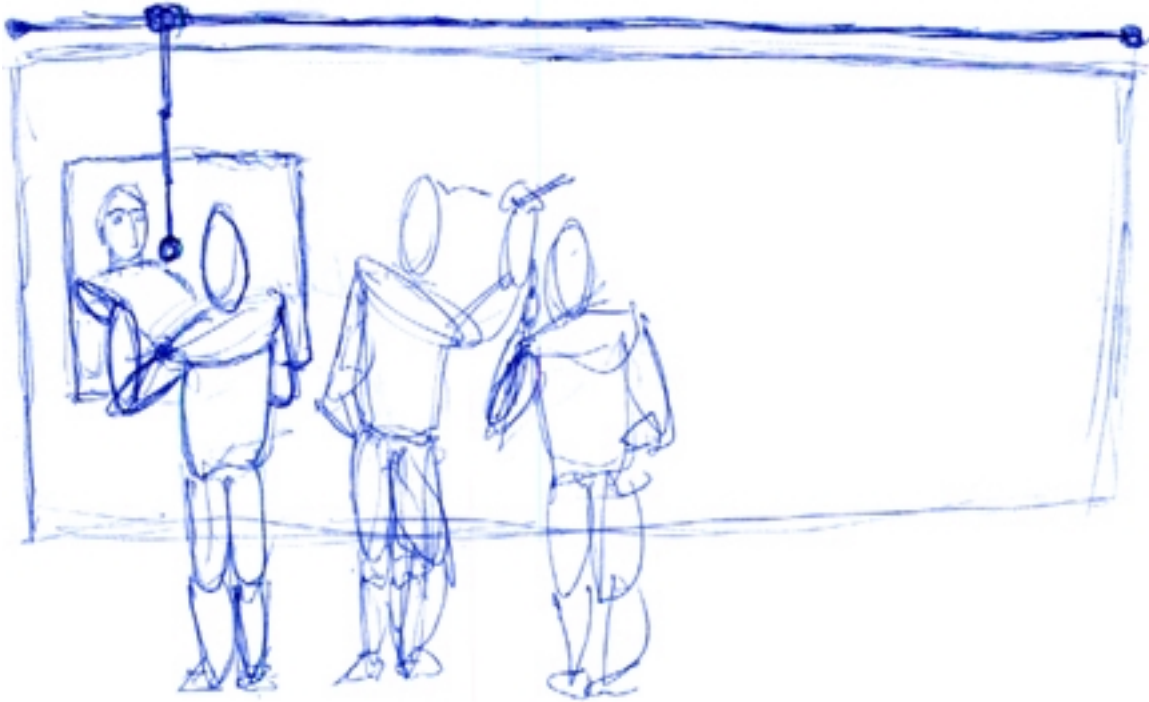
Merging the data

Most of the work is now done. The group has made a prototype and tested it. They have also individually been writing on the report. At this meeting they will try to merge the different data, and create an outline of their final document. The test they made on the prototype has generated a lot of data visualized in different kinds of diagrams.

They start with putting all their data: text, diagrams and pictures on the walls. The text is divided into chunks, represented by icons. They move around the different objects on the walls, trying to form an acceptable sequence. When they feel that they are done, they use the Magic Merger tool to create a single document of the pieces (or they cut and paste in Word).

Creating a presentation

The final part of the project is to create a presentation. The presentation will take place in a room with similar capacities as their project room. During the work process the group has generated a lot of data that could be reused in their presentation. They start the meeting with bringing all relevant data up on the walls. Among the data is some video clips from the final implementation at BMW.

To their help they have a presentation tool that lets them create "pages" containing objects such as video clips, images or text. These pages can then be arranged spatially and sequentially, allowing the pages to appear on any of the walls. A control panel on a Palm Pilot can be used to navigate among the pages during the presentation. The group also chooses to create an interactive presentation, to be explored without their help. In this presentation, you navigate through the information by touching the screens.