Augmenting Mood Boards: Flexible and Intuitive Interaction in the Context of the Design Studio

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Figure 1: Browsing images on a coffee table using hand movements in the design studio.

Abstract

In our studies aimed at understanding design practice we have identified the creation of mood boards as a relevant task for designers. In this paper we introduce an interactive table that supports one part of the mood-board making process (i.e. image browsing) by providing flexible and intuitive interaction for designers in the context of their design studios. We propose an image browser that: 1) merges with the real context allowing designers to work in the comfort of their existing design studio environment, 2) captures the current flexibility of interaction with physical images by allowing designers to work using hand movements, and 3) provides an alternative solution to a cluttered desk and messy design studio by using the space above the table for interaction. Exploratory evaluations show that designers were able to use the system with no prior training, and to see a practical use of the proposed image browser in their design studios.

1. Introduction

The use of mood boards in the early stages of the design process is common practice for designers [6, 11]. Designers use mood boards to explore, communicate, and discuss ideas together with their clients. These boards can be created with different types of media although designers usually use images to say something about the target audience, product, and/or company they are designing for. Designers spend a great deal of time looking for such images in magazines.

Browsing magazines in search for images is one of the first steps of the mood-board making process. Designers prefer going through their large collections of magazines in a comfortable place where they can freely start creating ad-hoc piles of magazines and pictures, making a 'soft' pre-selection of images.

Designers end up with a large number of images taking up all available usable space in their design studios including tables, walls and floor (Figure 2). Space is not only limited to spreading images in the studio but also for storing magazines. Designers must throw away magazines in order to grow their collections with new material.

Desktop and digital systems provide solutions for displaying and storing large amounts of images, however they do not provide the conditions to browse and select images in a flexible way and in comfortable spaces for designers in their design studios.

In this paper we present an image browser (Figure 1) for designers that: 1) merges with the real context allowing designers to work in the comfort of their existing design studio environment, 2) captures the current flexibility of interaction with physical images by allowing designers to work using hand movements, and 3) provides an alternative solution to a cluttered desk and messy design studio by using the space above the table for interaction.

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Figure 2. A designer's studio with images all over the place including the wall behind her.

2. Background

The field of human-computer interaction (HCI) has been investigating how people interact with computer systems at work (and more recently at home), trying to help them achieve their goals. Within HCI, researchers have started to see the potential behind tables as a more natural and familiar setting to design (collaborative) interactions around them. Some notable examples of interactive tables include the DigitalDesk [22], DiamondTouch [4], Sensetable [16], Lumisight [14], and more recently the Entertaible [9], and Microsoft's Surface [21]. Although initially research in this area was mostly driven by technology, we have slowly started to witness a user-perspective approach to tabletop, studying the needs and aspirations of users [2, 13], as well as their limitations [18].

The ID-MIX project [13] tries to assess the relevance and impact of augmented reality systems in work practice. The question the project tries to answer is if professional users (i.e. industrial designers) would change their current work practice favoring the use of an augmented reality system that supports their work.

Figure 3. A designer in her studio browsing images, seating on a couch by a coffee table.

We aimed at understanding design practice by systematically involving designers in user studies using different methods. In the first user study with ten industrial designers we used cultural probes [7] that allowed us to identify a relevant task: making mood boards. Since the probe study, we have conducted two further studies to get a better understanding of why designers use mood boards and how they create them. We did contextual inquiries [10] with Dutch industrial designers (n=4), and 'mood board interviews' with Finnish fashion and textile designers (n=10).

3. Augmenting mood boards

In these studies we identified several opportunities for 'augmenting' mood boards. The process of making mood boards can be divided into these five stages: 1) 'image collecting', 2) 'image browsing', 3) 'image piling', 4) 'building mood boards', and 5) 'expanding mood boards'.

3.1. Image collecting

Designers who use mood boards for their work are constantly collecting images. If they see something interesting, they collect it. They mostly use images from large-sized magazines printed on glossy paper that they find in magazine shops and bookstores, and from the Internet. Occasionally they will also use pictures from their private/personal collection or they will especially make pictures for a mood board at hand.

Adding images from the Internet to a digital table can be solved through different available options (i.e. network drive, USB stick). The same holds for pictures made with a digital camera that can be sent wirelessly to the system. The Cabinet system [11] has addressed the issue of adding images from physical magazines onto a digital table, thus breaking the divide between physical and digital. It photographs objects placed on the workspace and replaces them with a digital footprint in the same place.

3.2. Image browsing

Designers start looking for images that will help them build a story or say something about the target audience, product, or company they are designing for. Designers browse magazines, cutting out pictures from them and ending up with a large number of images, in a process that can take a considerable amount of time. Designers prefer going through their large collections of magazines in a comfortable place (Figure 3) where they can freely start creating ad-hoc piles of magazines and pictures, making a 'soft' pre-selection of images.

Figure 4. After making a soft-selection, designers end up with one large pile of images that they carry around with them.

Figure 5. Creating piles of images on a table. Labels are also created at this stage. The final selection of images is created.

Designers end up with a large pile of pre-selected images that they carry with them if they want to share its contents with colleagues for discussion (Figure 4).

3.3. Image piling

Once designers have collected enough images, they will 'categorize' their collections of images. For some of them it is a very structured personal process keeping images in boxes under labels (i.e. human, modern, kitchen, etc.). For others, the categories are looser, keeping the complete magazines arranged in a bookshelf according to brand, topic or theme, ready for later retrieval. In any case, be it a loose or structured categorization, these categories are very personal and make sense most of the time to the designer only.

Designers will start sorting their collection (Figure 5) by throwing images in categories (usually up to 30 images per concept). They will sometimes label the piles with notes. They also like the easiness of piling and arranging images within the pile. Growing piles create smaller piles and sub-piles can be mixed together in a simple way. Retrieving an image that they have seen before is as simple as going to the pile and getting the image. Once the piles are ready, they have an overview where they can see what they have and they can start thinking what they want to do (layout).

The creation as well as the handling of piles on digital tables has already been explored in recent systems such as Cabinet [11] where designers load images into the system and maintain workbooks of related images, with each workbook acting as a digital pile. We have also explored interaction with digital piles [1] identifying three basic tasks that must be supported by a digital pile (navigation, reorganization, and repositioning), and have proposed three interaction techniques that meet these requirements (DragDeck, HoverDeck, and ExpandPile).

3.4. Building mood boards

Once designers have found the right images, they like cutting the images with scissors and dragging the images to try different layouts.

Designers use different techniques to control the overall expression of the mood board. For example, they will add subtle effects such as blurring by adding semi-transparent colored sheets of paper to give a more uniform feel about the color of the mood board. They may also include the logo and name of the company to create a greater sense of identity with the company. Color tablets can also be included on the mood board to show the color schemes that are being used and to make sure that the right Pantone colors are used in the new designs that emerge from the mood boards. Text with keywords can also be part of the mood board. Placing the keywords is the last thing they do.

3.5. Expanding mood boards

In our interviews with designers participants shared with us scenarios for possible future expansions of mood boards. In some companies they already present mood boards as part of PowerPoint presentations, sometimes including music to help create the atmosphere. Other designers encouraged us to explore creating mood boards with moving images.

4. Designing the 'image browser'

In the previous section, we have identified and described the five main parts of the mood-board making process that we aim to provide support for with augmented reality. As was previously mentioned, out of these five parts, we have already conducted some exploratory studies in relation to 'image piling' [1]. Based on the requirements we gathered from designers, we have decided to now focus our work on supporting

the second part of this process, image browsing, by designing an 'image browser' that: 1) merges with the real context allowing designers to work in the comfort of their existing design studio environment, 2) captures the current flexibility and intuitiveness of interaction with physical images, and 3) provides an alternative solution to a cluttered desk and messy design studio by using the space above the table to interact.

4.1. Merging with the real context: coffee table

From our contextual inquiries, we discovered that the context of use is an essential part of supporting the work of designers. We aim to design a space for creativity where designers feel comfortable and keep a good attitude. This space would create a positive effect [15] that facilitates creative thinking in designers.

We envision a space that encourages designers to move around their design studio pretty much as they do now. Designers have their desks with their computers on them but they prefer to look for images away from large desks or computers. They will usually prefer browsing for images while comfortably seated on a couch, in a coffee corner or at the coffee table in a living room (i.e. when working at home). As such, our system should encourage breaking the rhythm and doing activities away from their desks [11].

In this context, we have decided to design the interaction using a coffee table to encourage image search in a more relaxed environment within a design studio. Designers can sit around the coffee table and sit back comfortably on a couch. Designing interaction around a coffee table (120x40x40 cm.) has its own implications and challenges from an ergonomic point of view. Looking at the Dreyfuss charts [5], we realize there are aspects related to appropriate viewing angle, posture, reach, and the time people would be sitting around the table that need to be taken into account when designing interactions around such elements.

4.2. Flexibility of interaction: hand movements

From our studies we have learned that for activities involving creation designers prefer working with their hands with tools that allow flexibility and intuitive interaction (i.e. pencil and paper). Their current way to browse, select (cut out), and create soft-piles of images is a good example of flexible and intuitive interaction. Inspired by this example, we decided to encourage interaction through hand movements, allowing designers to work with both hands towards achieving the goal of pre-selecting images. Designers use their hands collaboratively; each hand with a different function, as when one is using a knife and fork.

4.3. Avoiding the mess: space above the table

When designers are looking for images in magazines, they start cutting out pictures from them and end up with a large number of images. Designers will create soft-piles of images and thus create a great amount of mess around their design studios. Piles of images and magazines will create cluttered desks and take up all available usable space in their design studios including tables, walls and floor.

To provide a solution for this problem, we have decided to extend the available space for interacting and displaying information by using the space above the table [20]. The active area above the work-surface is divided into multiple layers extending the design space. In our case, this space can be used to interact with soft-piles of images.

5. Interaction techniques

We now describe how the 'image browser' provides support for navigating images and interacting with soft-piles.

5.1. Browsing by flipping pages

We propose two ways to browse images. The first one is similar to flipping pages of a magazine in the sense that users must mimic with their dominant hand the movement anywhere above the table to switch to the next page (Figure 6). Three large-sized images are displayed simultaneously to allow designers to be captured by the atmosphere and contents of the image, hence the 1:3 ratio of the chosen table. The next or previous three images will be displayed depending on the direction of the movement. The change of pages is accompanied with a page-flipping sound.

5.2. Browsing by flicking

Augmenting the process of making mood boards implies extending the current practices by providing relevant support using the advantages of new technologies. As such we extend image browsing by introducing techniques that pertain to the digital world.
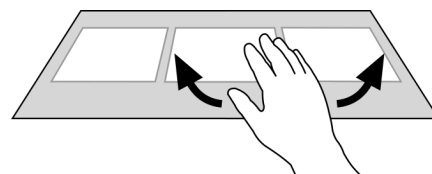

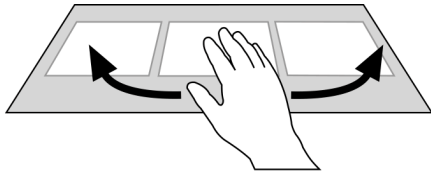**Figure 6. Browsing by mimicking a 'flipping-page' movement anywhere above the table.**

Figure 7. Browsing by doing a 'flicking' movement on the table.

We use a flicking movement to initiate continuous scrolling. The flicking movement is similar to the flipping movement only that it is longer (Figure 7) and triggers a distinctive longer flipping-page sound. We map the direction of flicking to the scrolling direction, and the flicking speed to the rate at which the pictures scroll. The approach is similar to the one used for scrolling on the iPhone and on the 'Cover Flow' view of iTunes (with a difference that we do not use inertia or friction, so once scrolling starts it continues with constant speed until the stop movement is performed). Users can stop the scrolling by tapping on the table.

5.3. Soft piling

We propose the use of layers above the digital table in order to create more space to store images and create soft-piles. Once designers find an image that captures their attention, they can place the image in a soft-pile. Placing their dominant hand over an image at the table-level, and then quickly moving the hand upwards orthogonally with respect to the horizontal table surface achieve piling (Figure 8). The image will be placed into one of two locations at 30-50 cm. (soft-pile 'A') and 50-70 cm. (soft-pile 'B') above the table surface, depending on the highest point reached by the hand movement before it starts going down again to a resting position. Based on our observations of designers working with images at this stage of the mood-board making process, we have deliberately limited the number of soft-piles supported by the 'image browser' (n=2) to meet the needs of designers.

5.4. Reviewing and arranging soft piles

Placing the non-dominant hand above the table surface and changing height accordingly allows navigating within layers of soft-piles. Placing the non-dominant hand at the location of the previous placement (Figure 9a), and then placing the dominant hand at the desired new location (Figure 9b) achieve removal of an image from a soft-pile or positioning an image to another soft-pile. In this way, we are making the interaction simpler by having designers use both hands collaboratively where one hand has a different function from the other.
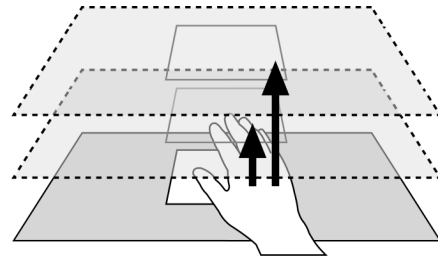

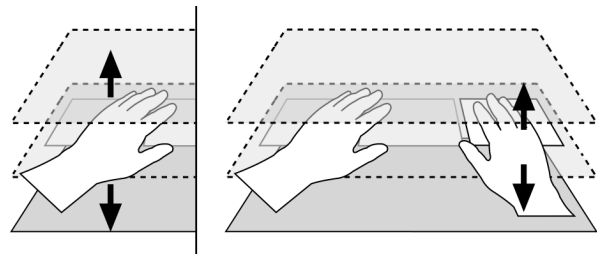**Figure 8. Creating soft piles by orthogonally moving a selected image.**

**Figure 9. (a) Reviewing piles (left);
(b) Placing an image on another layer (right).**

6. Evaluation

The usability and usefulness of the Image Browser prototype was tested in a short exploratory user study. One of the main questions that we wanted to answer was: will practicing designers see the prototype as a relevant tool for creating mood boards? Moreover we wanted to test the interaction techniques (hand movements) in terms of naturalness, ease of learning and use. The evaluation was conducted with 5 practicing designers with at least 8 years of experience. The participants varied in gender (2 female, 3 male), age (between 30 and 40), and hand choice (4 right, 1 left). The evaluations were conducted individually.

Figure 10. Experiment setup with the coffee table, gloves and couch.

6.1. Implementation

A tabletop system was set up using a desktop PC, which controlled a top-down projector projecting an image of size 120x40 cm (1272x424 pixels) on a white IKEA table (120x40x40cm) (Figure 10), as well as an ultrasonic tracking system – InterSense IS-600 used to track hands. During the sessions participants wore custom-designed interactive gloves that contained the sensors. The gloves were made in Lycra to allow a comfortable fit for different sizes of hands and were hand sewn. Participants sat on a couch next to the table. The application was written in C# and OpenGL was used for visualization purposes.

6.2. Setup

Users were asked to focus on both the relevance of the application for the creation of mood boards, and on the interaction techniques. Following a description of the interaction (approx. 5 minutes), participants were allowed to freely explore the functionality and get acquainted with the application (approx. 5 minutes).

Participants were later asked to perform simple tasks (i.e. change pages, start and stop scrolling, create piles, re-arrange a pile), starting with 30 different images at the table-level. Finally, a short post interview was conducted. All sessions were recorded in video. The average time per participant was 25 minutes.

6.3. Findings

In the first part of our exploratory evaluations, designers started trying out the interaction techniques and as a general observation we can say that they were all able to use the system with little or no prior training. They especially liked the naturalness and simplicity of the interaction and of the overall system as can be observed from the following reactions:

- *"I think the movements that you have to make in order to browse are very natural. It really looks like you are actually browsing a magazine."* [P1]

- *"It's beautiful! It's very nice; it's a very nice interaction. (It is) what I intuitively do when I am just organizing stuff, I have piles around me, I put some things here and some things there."* [P2]

- *"It's so nice, I love it! (Reviewing layer contents with your non-dominant hand) is so nice!"* [P4]

- *"I like the flipping movement a lot, it is very quick and clear in combination with the sound."* [P5]

Regarding the interaction techniques, we observed that flicking initially caused most difficulty to our participants, followed by piling. It took two tries to get flicking going for three participants while one

participant needed three tries to get piling working. In the first case, the attempt to do a flicking movement would result instead in flipping a page due to the fact that only the length of the movement differentiates both movements. After these initial difficulties participants were able to continue with the interaction.

There was one conceptual interaction problem for three participants who were trying to rearrange a pile by moving an image from the middle layer to another layer. All three participants were able to access the middle layer with their non-dominant hand but upon displaying the layer on the table, they tried to interact with the elements using their dominant hand at a table-level instead of at a middle layer-level. They all overcame the problem upon further exploration indicating it works fine once you know what to do.

Two participants expressed concern on fatigue:

- *"I am a bit concerned about how much time I have to hold my [left] hand in the air, however, the principle behind it is quite logical…"* [P1]

- *"(Doing the flicking movement repetitively) can be quite tiring for me…"* [P5]

Regarding the relevance of the proposed application, all participants saw a practical use of the image browser in their design studios. They liked the fact that they could dynamically browse images (flicking) to make connections with images:

- *"This kind of browsing gives you more opportunities to select images."* [P1]

Regarding future applications of this table, some participants speculated over possible uses of the table:

- *"It looks very promising. You could create an application in combination with the Microsoft table (Surface)."* [P1]

- *"I think that for the household, you have a digital camera with photographs from your family, children and then you can select the pictures to print out."* [P3]

7. Related work

A considerable amount of related work has influenced the design of this system. Most of this work is connected to image browsing, tabletop systems, and hand gesture/movement based interaction.

A number of tabletop systems have been designed to support image browsing and sharing. The Personal Digital Historian [19] is a tabletop, pen-based system that helps people construct, organize, navigate and share digital collections in an interactive multi-person conversational setting.

Another example of a tabletop-based system for picture sharing and browsing is SharePic [3], which was specifically developed for the elderly population. The main distinctive property of the system is that it is

strongly influenced by the way physical photographs are handled and placed on physical tables.

Cabinet [11] was developed to support image collection in the context of a design studio. It has specifically addressed the issue of adding images from physical magazines onto a digital table, thus breaking the divide between physical and digital.

There is also a considerable amount of work that addresses gesture-based interaction on tables, in open spaces, or in 3D virtual environments. Tabletop systems like Diamond Touch [4], Lumisight [14], and Entertaible [9] use different hand gestures and movements to interact on the table. [17, 12, 23] have studied the general application of hand gestures and movements to support human-computer interaction.

The use of layers above the table for pen-based systems was first explored in [8] using a single layer, and later in [20] using multiple layers of interaction.

8. Discussion

8.1. Appropriateness of the (coffee) table

We believe that the choice of the IKEA table (and couch) has affected how designers perceived the prototype in a positive way. Designers realized that this was not a "standard" coffee table, but a modern and sleek one that they could perfectly see in their own design studios. As such, the chosen coffee table helped greatly in addressing the context of use issue.

Regarding how the interaction is affected by the seating position around the coffee table, the system currently allows browsing and piling images while designers are sitting comfortably and resting their back. However, for re-arranging piles, designers must lean forward to view the images (due to their smaller size), and to interact with them. We predict that designers will spend a considerably larger amount of time browsing images than re-arranging them so our main concern at this point is what would happen with the perception of the system over prolonged use.

8.2. Interaction based on hand movements

In our prototype we have used one-point ultrasonic tracking (ISense). Alternative solutions such as vision-based tracking can potentially support a richer set of movements and can also add hand gestures, however, as was pointed out above, the main motivation for choosing hand movements to interact was to keep interaction as light and simple as possible. In this respect the tracking capabilities of the ISense were enough for recognizing a small set of movements implemented in the prototype. In relation to a design-

studio context, video-based recognition will probably be more appropriate due to smaller size and price.

Designers favored not having additional interaction devices (i.e. holding tangible objects). The gloves were comfortable and unobtrusive and were perceived as a mean to track hands and not as an interaction device.

8.3. Virtual space above vs. around the table

Some participants suggested a few gestures that could be implemented in the prototype to also support interaction around the table (i.e. at a table-height level, adjacent to the table). We initially considered this option for our prototype especially because it fits the selection process (*"I choose this image, so I bring it towards me"*), however we believe this type of interaction mimics what happens on a normal desk but does not support the ergonomics of seating on a couch. On a normal desk, people sit (or stand) at a different height with respect to the table, and can rest their elbows on the table. Their reaching possibilities are fundamentally different than when seated on a couch. Reaching the vertical space above the table becomes then easier to reach than the space around it.

8.4. Interaction on vs. above the table

During the evaluation we observed that users had no problems with staying in one layer or moving between layers, however they all had some difficulties with arranging piles. While the movement itself was well understood most users needed a few tries to perform it.

All hand movements including page flipping could be performed in midair (it was not necessary to touch the table surface), however all participants used the table surface to start a hand movement and generally had less errors performing this hand movement than when performed in the air. This indicates that interaction in mid air should be kept for simple actions while interaction on the surface can be more complex (this also is inline with findings reported in [20]).

8.5. Number of piles

We defined the number of piles (n=2) for two reasons. First, our studies showed that when designers start searching images for mood boards, they create a few soft-piles (1-3) containing around 20 images each. Second, to keep the interaction above the table comfortable, we set the distance between the first layer (table surface) and the second layer at 30 cm, and the distance between the second and the third at 20 cm. Adding more layers would imply either placing layers on top in an area that is difficult to reach while sitting

on a couch, or reducing the distance between layers, adding extra restrictions to the set of hand movements.

9. Conclusions

In this paper we present an interactive tabletop system that supports image browsing as one part of the process of making mood boards. The system provides flexible and intuitive interaction around a coffee table for designers in the context of their design studios. Through a user study we explored the limitations of the system in terms of placing the interaction above the table, the proposed hand movements, and the image browser itself. The evaluations showed that designers were able to use the system with little or no prior training, and to see a practical use of the proposed image browser in their design studios. We have additionally identified a number of issues related to our system such as the importance of addressing the context of use, reach, and using hand movements for interaction, which could have an effect on future interactive tabletop systems set around coffee tables.

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