BricoSketch: Replicating and reusing electronic and physical material physical material in professional illustrations

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This is to certify that **Magdalini GRAMMATIKOU** conducted an internship in the LRI lab under the supervision of **Theophanis TSANDILAS and Stéphane HUOT**, in partial fulfillment for the degree of Master of Science.

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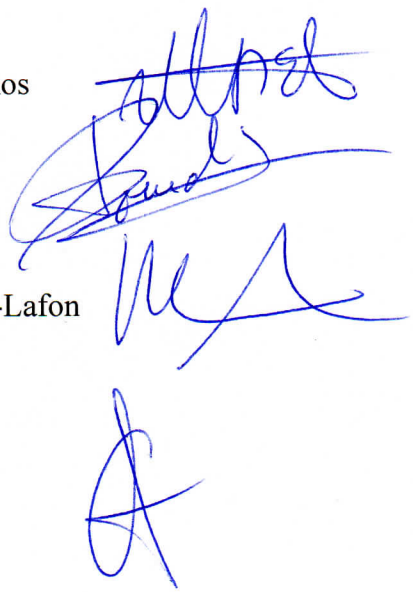

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Abstract

This project investigates how artists use sketches on paper, physical objects in their environment, photos, and online material as models for their illustrations. We are interested in designing a computer tool/software that supports the workflow of illustrators, avoids the use of multiple devices, and simplifies their overall work by grouping together the functionalities of all the tools and means they use. Our overall objective is to enhance the productivity of illustrators by facilitating and simplifying the illustration process, while preserving their creative ways of working.

We interviewed illustrators in their working environment in order to understand their working process and to gather information useful for designing the new tool. We focused on the means they prefer, the devices they use and the steps they undertake in order to proceed with their illustration, as well as the relation among all the above.

When illustrators work they often alternate between different devices (e.g. pens and paper, light table, computer, pictures) until they come up with their final illustration. All the transitions from one means to another and from one device to another add complexity and might act as a disturbance in their workflow.

We present the design of Bricosketch, a new computer tool that integrates a number of features based on our observations and on a detailed analysis of the illustrators' workflows. BricoSketch provides illustrators with an interactive workspace that allows them to work simultaneously on paper and with an image processing program, thus eliminating the need to switch between different devices. Limitations of the actual design and possible extensions of BricoSketch to a wider audience are also discussed.

Περίληψη

Η εργασία αυτή διερευνά πώς οι καλλιτέχνες χρησιμοποιούν σκίτσα σε χαρτί , φυσικά αντικείμενα από το περιβάλλον τους, φωτογραφίες, και ηλεκτρονικό υλικό ως μοντέλα για τις εικονογραφήσεις τους. Μας ενδιαφέρει ο σχεδιασμός ενός εργαλείου/λογισμικού που να υποστηρίζει τη ροή εργασίας των εικονογράφων, να αποφεύγει τη χρήση πολλαπλών συσκευών, και να απλοποιεί τη συνολική δουλειά τους συγκεντρώνοντας τις λειτουργίες όλων των εργαλείων και των μέσων που χρησιμοποιούν. Γενικός στόχος μας είναι να ενισχύσουμε την παραγωγικότητα των εικονογράφων με τη διευκόλυνση και την απλούστευση της διαδικασίας εικονογράφησης, διατηρώντας παράλληλα την δημιουργικότητα τους καθώς εργάζονται.

Προκειμένου να κατανοήσουμε τη διαδικασία που ακλουθούν στην εργασία τους και να συγκεντρώσουμε χρήσιμες πληροφορίες για το σχεδιασμό του νέου εργαλείου πήραμε συνεντεύξεις από εικονογράφους στο εργασιακό τους περιβάλλον. Εστιάσαμε στα μέσα που προτιμούν, τις συσκευές που χρησιμοποιούν και τα βήματα που ακολουθούν προκειμένου να προχωρήσουν στην δουλειά τους, καθώς και τη σχέση μεταξύ όλων των παραπάνω.

Οι εικονογράφοι στην δουλειά τους συχνά εναλλάσσονται μεταξύ διαφορετικών μέσων (π.χ. στυλό και χαρτί, φωτεινό τραπέζι, ηλεκτρονικό υπολογιστή, εικόνες) έως ότου καταλήξουν στην τελική εικόνα τους. Όλες οι μεταβάσεις από το ένα μέσο στο άλλο και από τη μία συσκευή στην άλλη προσθέτουν πολυπλοκότητα που πιθανώς δρα σαν μια διαταραχή στη ροή εργασίας τους.

Στην εργασία αυτή παρουσιάζουμε το σχεδιασμό του Bricosketch, ενός νέου εργαλείου πληροφορικής, που ενσωματώνει μια σειρά από χαρακτηριστικά με βάση τις παρατηρήσεις μας και την λεπτομερή ανάλυση των ροών εργασίας των εικονογράφων. Το BricoSketch παρέχει στους εικονογράφους ένα διαδραστικό χώρο εργασίας που τους επιτρέπει να εργάζονται ταυτόχρονα με χαρτί και με ένα πρόγραμμα επεξεργασίας εικόνας, εξαλείφοντας έτσι την ανάγκη για εναλλαγή μεταξύ των διαφορετικών συσκευών. Η εργασία επίσης παρουσιάζει μια περιγραφή των περιορισμών του σχεδιασμού καθώς και των πιθανών επεκτάσεων του BricoSketch σε ένα ευρύτερο κοινό.

Acknowledgments

I would like to thank my supervisors Stéphane Huot and Theophanis Tsandilas for their valuable advice and support during this project, the four illustrators for sharing patiently their work experiences with me, and my family and friends for their overall support.

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Chapter 1

Introduction

Recently there have been a lot of technological attempts to enhance artistic creativity by providing artists with new tools that facilitate their working process. In this study we are interested in developing such a tool specifically aimed at the illustrating process.

Paper plays an important role in art and specifically in the process of illustrating. Reducing the use of paper has been tried already in different fields. In the domain of illustration various image processing tools have been created in order to replace paper and to provide the users with more options and functionalities that paper cannot provide. These image processing tools, thought, did not succeed in replacing the use of paper. The feel when working on paper and the freedom of expression and lack of constraints available to illustrators through this medium cannot be replaced easily. Therefore, illustrators continue to use paper. However, at the same time, they do not frown upon the possibilities offered by technology. Interestingly, they seem to be profiting from both means by adopting various ways of combining the use of image processing tools and paper and pen. This way they succeed in maintaining the uniqueness of their work provided by the paper and at the same time they take advantage of the functionalities provided by the image processing programs. However, as revealed in the interviews with a sample of illustrators, these advantages come with a cost in the form of added complexity.

In this study we are specifically interested in exploring the means that illustrators prefer to use, i.e. paper and pen or an image processing program, in the different stages of their work. We document that both means are being used but a lot of transitions are observed between them during the illustration process. The order in which they are used is not standard. Every illustrator has developed his personal way of working depending also on the results he wants to attain. Moreover, in order to transmit from one means to another illustrators resort to using a number of external devices. These are necessary in order to digitize a sketch that was drawn on paper or to actually bring on paper a sketch that was drawn in an image processing program. The use of these devices complicates and disturbs the workflow of the illustrating process and fills the illustrators' workspace with devices that take a lot of space. According to the Theory of Flow an artist is at his most creative phase while in the flow, when he is concentrated on his work without being interrupted by exogenous factors (Csikszentmihalyi, 1975). By interrupting the illustrator's workflow in order to transmit from one means to another the state of flow is continuously being interrupted with potentially detrimental effects on his creativity.

In this project we are interested in providing illustrators with a tool that will enhance their creativity by helping them maintain their current state of flow undisturbed by any alterations between the two means they chose to use in their personal work flow. Useful information about the complete illustrating process is obtained by interviewing a sample of illustrators at their working environments. Then we proceed with the design of a tool, BricoSketch, that allows illustrators to use the two means, paper and pen and image processing programs, as they wish. The tool allows for smoothly transitions between them, thus providing the user with the unique advantages offered by both means.

Various improvements to BricoSketch are possible by providing additional hardware. It must be acknowledged, however, that due to the small number of illustrators interviewed BricoSketch may not fully respond to the needs of all illustrators. Nevertheless, it is believed to be an effective first attempt towards creating a tool that combines the basic functionalities of all the devices typically used by illustrators when working. Additional functionalities can

always be added to upgrade the design and to make it appealing to a wider audience of illustrators. Finally, the project opens a number of interesting research questions that future researchers may want to explore. A thorough understanding of the illustrators' motivations in the choice of the working method and the means they use could be useful in the design of a more general tool that would enhance the creativity for a wider audience of users and not only illustrators.

The rest of this study is organized as follows: Section 2 discusses some key recent studies in related fields. The procedure followed in the interviews with a sample of illustrators and the main findings are presented in Section 3. The design and main innovations of BricoSketch are covered in Section 4, while possible improvements, limitations and future research questions are found in Section 5. Section 6 is a conclusion.

Chapter 2

Related Work

This part is divided in two sections. First, we present the work in the field of augmented reality and more specifically we focus on interactive paper and pen based interfaces. Second, we present studies that describe how the augmented reality can affect creativity.

2.1 Augmented reality

The "paper-less" office has proven to be a myth. Though technology exists to convert documents and other papers into digital form, the use of paper has not been greatly reduced. This has resulted in having to deal with documents both on paper and in a digital format. No link is provided between digital information and information in the physical word and this creates a big gap between these two worlds. Augmented Reality reduces this gap by providing people with everyday objects integrated with electronic information making a link between these two worlds (Mackay W. E., 1998).

A number of studies demonstrate how to integrate computer functionality in everyday objects in different fields, thereby allowing users to interact with these objects using only their existing skills, while benefitting from the computer functionality attached to them. *Neurosurgical planning* (Hinckley, Pausch, Goble, & Kassel, 1994) is an application that gives the possibility to surgeons to plan their surgery using real-world objects, props and on-screen graphical representations of their actions. *metaDESK* (Ullmer & Ishii, 1997) is another attempt to bridge the physical and digital world. It provides digital information by manipulating physical objects that play the role of an interface. Augmenting surfaces have also been the subject of study. For example, a hybrid work space has been proposed that allows people to transfer digital information among their computers and various surfaces (Rekimoto & Saitoh, 1999).

Paper is a powerful medium that provides users with a lot of possibilities. It is a versatile object that provides the freedom to express, to write or illustrate many things without imposing any constrains in the format that the user prefers to work in. It is easy to use since specific skills or training is not required in order for someone to work with it. It supports multiple ways of working that no existing program can realistically provide. The use of paper provides users with a single durable, definitive source that they can always go back to as a reference point. It is a very cheap means that is easy and practical to carry around. Finally, as mentioned before it is a medium that still plays a very important role for many applications (e.g. drawing, music composition, note taking). Since paper documents are still widely used, paper is a good candidate for everyday objects to be augmented with electronic power.

For this reasons a lot of research has been done in order to augment paper with functionalities needed for different fields. *DigitalDesk* (Wellner, 1991) is a physical desk with some extra computer capabilities. It is been augmented with a computer projection and video cameras to merge the electronic world of the workstation with the physical world of the desk, thereby providing a computer augmented environment for paper. The *DigitalDesk Calculator* (Wellner, 1991) is a calculator projected on the DigitalDesk. The user can interact with the calculator the way he would have done with an ordinary calculator but he can also enter numbers that already exist on pieces of paper lying on the desktop. *Ariel* technology (Mackay W. , et al., 1995), a technology influenced by DigitalDesk, was created for engineers. It augments paper by projecting on top of it computer information, thus giving the possibility to the user to both interact with his drawing on paper and with the information projected on top of it. The *a-book* prototype (Mackay, Pothier, Letondal, & Bøegh, 2002) was created for linking experimental laboratory results in notebooks combining the use of a graphics tablet, to

capture the writing on paper, and of a PDA with a 4D mouse sensor attached, to create the link between the physical documents and the electronic ones. *Augment flight strips for Air Traffic Control* (Mackay, Fayard, Frobert, & Médini, 1998) is another interesting application.

The *paper PDA* (Heiner, Hudson, & Tanaka, 1999) is a hybrid paper electronic system for editing text. Functionality is added to the paper by periodically scanning documents, processing and adding their contexts to the digital format of the paper, and by printing the paper again. This way the user can interact with the paper format of the document while the digital format is kept up to date. *XAX* is a system that brings the computer interface on actual paper by adding to paper marks that the computer can read, marks that the user can read and areas where the user can write (Johnson, Rao, Hellinek, Klotz, & Card, 1993).

Digital pens have been widely used to provide input to interactive paper and thus to alleviate the need for scanning annotated paper documents. A lot of text editing systems, based on digital pens, have been built. *Paper Augmented Digital Documents (PADDs)* (Guimbretière, 2003) are documents in a digital format that can be manipulated with a digital pen as long as they were printed with a pen-readable pattern. *Paperproof* (Weibel, Signer, Ponti, & Norrie, 2008) is one of these systems created for editing digital documents and documents on paper. It allows users to edit documents on paper keeping the changes in digital format with the use of *Anoto technology*[1], and gives them the possibility to switch to whatever means they want at any point of time. As strokes are created, digital pens provide information about them in real time and this gives the possibility to implement paper-based command systems. *Papiercraft* (Liao C. , Guimbretière, Hinckley, & Holland, 2008) is a paper-based interface that allows users to manipulate digital documents with an Anoto digital pen by using gesture-based commands on a printed version of the document. Attempts have also been made to augment digital pens with feedback mechanisms, more than their standard inking capability, in order to support interactive paper (Fly Pen) (Liao & Guimbretière, 2006). Digital pens are not only used for document editing. A digital pen is also used in *MoldelCraft* (Song, Guimbretière, & Hu, 2006) to annotate and edit printed 3D models, and to merge changes to the actual CAD models. *ButterflyNet* (Yeh, et al., 2006) is a system developed for biologists that allows data gathered from different media to get merged. It uses Anoto technology to capture handwritten notes and a smart camera in order to take photos. The camera communicates with the Anoto pen in order to link notes with specific pictures.

2.2 Creativity

Art is a diverse range of human activities that result in art products (Art). An interesting question that can be asked is what means does the artist use in order to produce his art? There have been a lot of developments in the past few years that have resulted in the creation of new technological means to create art. Do the artists prefer to express themselves through paper? Or have they replaced the use of paper with the use of computers? Why do they use the means they currently use instead of any other means? Is there a way to combine these means together in order to make the artist's work easier and more effective? Is there a way to make computers enhance creativity?

These questions have been a big inspiration for researchers and resulted in many efforts to bridge the gap between physical pen and paper creations and computer graphics tools so as to

[1] See the Anoto web page: http://www.anoto.com/

enhance creativity. Various interfaces have been designed in order to help the creation of different types of art.

For instance, making videos is a really complicating process. Using various interfaces can simplify this task. *StoryCrate* (Bartindale, Sheikh, Taylor, Wright, & Olivier, 2012) is an interactive table acting as a computer that keeps track of all media recorded during the shooting so that content can be used at any point, providing random access to it for users. It supports creativity in the context of individual's skill within the team. *Video Mosaic* (Mackay & Pagani, 1994) is a prototype that augments video storyboards that are manipulated as normal paper story boards, but allow users to control and edit on-line video as well.

Music is another form of art that researches have been interested in. Interfaces that consist of paper and end-user programming that contribute to the process of music composition have been created. *InkSplorer* (Garcia J. , Tsandilas, Agon, & Mackay, 2011) and *Musink* (Tsandilas, Letondal, & Mackay, 2009) are tools for music composition that provide musicians with the possibility to easily transition from their paper notes to OpenMusic[2]. *Interactive paper substrates* (Garcia J. , Tsandilas, Agon, & Mackay, 2012) reflect and control the structure of computer-based data. The user can print a representation of a musical sequence on paper as an interactive substrate. As he interacts with the data on the paper the online object gets modified accordingly in real time. *PaperTonnetz* (Garcia, Bigo, Spicher, & Mackay, 2013) is a tool that lets musicians compose music by making gestures on interactive paper that has Tonnetz representations printed on it using an Anoto pen[3].

Various interfaces have also been created in order to help the processes of painting and image creating. *ShadowDraw* (Lee, Zitnick, & Cohen, 2011) is an interface created for guiding users in drawing objects with more realistic proportions. Every time the user tries to draw an object the system tries to figure out what the user is trying to draw and projects a shadow image of a matching object. The shadow gets updated every time a stroke is added. Another interactive system for guiding artists to paint is *Projector-Guided Painting* (Flagg & Rehg, 2006). It displays the areas in the layers that the user has to paint in his canvas using a multi-projector. *PapARt* (Laviole & Hachet, 2012) is an interface that projects a 3D scene onto a paper sheet allowing the user to interact with it.

Applications to efficiently create collages by matching user provided color strokes to a database of images, segmenting out regions and interactively blending the retrieved segments also exist. An example is *Sketch-to-Collage* (Gavilan, Saito, & Nakajima, 2007). Work has also been done in simulating painting tools such as brushes. *I/O brush* (Ryokai, Marti, & Ishii, 2004) is a brush that captures colors and patterns from everyday objects and paints with the information captured using it as ink. *IntuPaint* (Vandoren, et al., 2008) provides artists with the ability to draw on an interactive surface using electronic brushes and their fingers. In *FluidPaint* (Vandoren, et al., 2009) users can paint on an interactive canvas using real wet brushes. Collaborative drawing has also been studied. *VideoDraw* (Tang & Minneman, 1991) is a prototype that provides collaborators with a virtual sketchbook that allows users to see each other's drawing moves.

[2] See the OpenMusic webpage: http://repmus.ircam.fr/openmusic/home
[3] For an explanation of Tonnetz see the webpage http://www.tonalsoft.com/enc/t/tonnetz.aspx

Despite all this work, the illustrating process has never been studied and there is no tool that supports this specific task.

Chapter 3

Understanding the Process of Illustration

The first step in the project was to collect via interviews basic user input about the illustration process. The goal was to understand the illustration process and the techniques used in order to arrive to the final illustration on paper or on the computer. More specifically, we were interested in the successive steps used for the realization of the illustration projects, the sources of inspiration, the means used and the difficulties illustrators face during this process.

3.1 Method

The interviews took place on the 15th and 24th of April 2013 in a studio of illustrators in Paris. We interviewed four illustrators: *Participant1*, *Participant2*, *Participant3* and *Participant4*. Their age ranged from 31 to 36 years old (two were males and two females). All of them are professional illustrators and two of them are writing cartoons (bande dessinée) as well. They have been working as illustrators from 4 to 11 years.

We first gave the participants a consent form to sign (see Appendix 1) and a pre-questionnaire to complete about themselves, their gender, age, years of working, specific fields of illustration that they are working on and the devices and means they use while working (see Appendix 2). Ideally we would have liked to observe them while working from the start till the end of a project. Unfortunately, this would have been a very time consuming process and we would have been able to follow only one way of working, the one being used at the time of our interview with each illustrator. Instead, we invited them to speak about the project that they were involved at that time and then we asked them to show us some previous work that they had already completed and to inform us about the process they followed to complete it. This way we were able to gather information about various ways of working that each illustrator was following depending on the project. We prepared a set of guidelines about the specific information we were interested in during the interviews and we tried to keep the discussion focused on them in order to obtain complete answers (see Appendix 3). The interviews were filmed and the videos were analyzed later in the lab in order to extract as much information as possible about their work processes.

3.2 Results

Before they start a project all the illustrators we interviewed search for documentation related to the project. If the project is a book, a cartoon (bande dessinée) or an article they first read the text that is provided by the publisher so as to extract important information about the context of the project. They search images and videos usually on the Internet (Google maps, Google images, Corbis, YouTube, etc.) and buy books that are related to their project so that they can get inspired. They also take pictures or sketch scenery or objects that they then use. They create folders with all the material they gather. *Participant2* even visits places that are related to her drawings. She takes photos or sketches objects and scenery. Illustrators use this material in order to get the atmosphere needed to start their work and to come up with ideas of what they are going to draw. They usually place the background material in front of them while working (see Figure 1 and Figure 2).

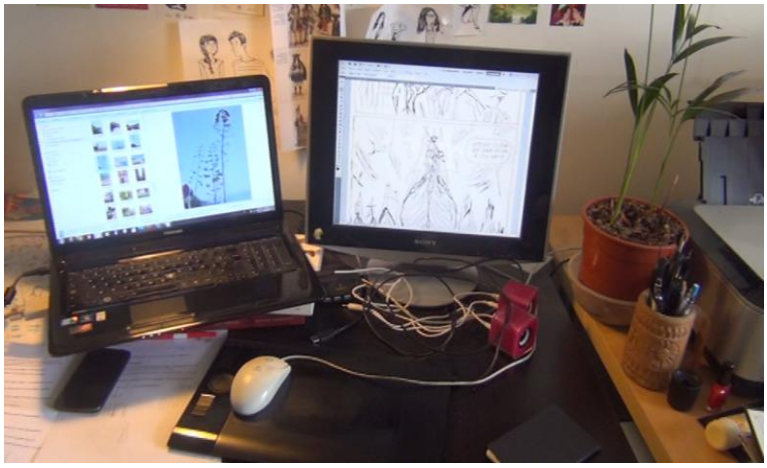

Figure 1: Project inspiring photos on screen

Figure 2: Pining up inspiring items

In order to sketch a complicated item (an item whose characteristics are complicated or not known by the illustrator) they search a lot of images representing this item so that they can understand its exact features in order to be able to sketch it. They then proceed on drawing the object by simply looking at it or by doing a montage of the photo in Photoshop. When needing to draw complicated body movements *Participant3* even tries to make the movements herself in order to understand the positioning of the body while doing the movement. She sometimes captures the movement using her web cam. She searches for videos as well and if she finds the movements that she is interested in she freezes the image in order to capture the movement and to draw it.

We identified different ways of working. In order to present these different ways we found it convenient to divide the overall illustration process in 3 stages: i) the **first sketch** which is the first representation of the illustrator's idea and is usually a rough sketch; ii) the **final sketch** before the coloring and the finishing of the actual illustration, and iii) the **final illustration**. There can be a lot of sketches from the first sketch till the last sketch is obtained. The rest of this section describes the different ways of working followed by the illustrators.

One approach is when the illustrator works with paper and pencil. His first sketch is done on paper with the use of pencil. Then, he uses a light table (see Figure 3), a table made for tracing, whose surface is made out of glass allowing this way the light of a lamb that is situated below it to pass through it. He traces his sketches over and over again till he obtains the results he is looking for. Once the final sketch is done, he scans it and adds colors in Photoshop with a graphical tablet. If corrections are needed on the strokes he draws them on the original sketch on paper. Then he rescans the corrected version of the sketch. The process is more complicated if he wants to make corrections when he has already colored the sketch because he has to fit the coloring to the corrected version and this process takes time. Though this method is time consuming the illustrator can obtain a good correspondence between the original sketch and the final result. Only *Participant1* works this way.

Figure 3: Light table

A different way was observed when the illustrator works entirely with a graphical tablet in Photoshop. The first sketch of his ideas is done directly in Photoshop and refined using the same tools. Once the final sketch is done, the illustrator colors it using the exact same tools in Photoshop. Corrections are made directly in Photoshop. Three out of the four participants work this way but they use different techniques in order to obtain each sketch. One technique involves using the first sketch in a transparent layer in the background so that it will not interfere with the drawing, and then drawing the outlines of the shapes and filling them with color (see Figure 4). Another approach involves simply refining the first sketch in order to get to the final one.

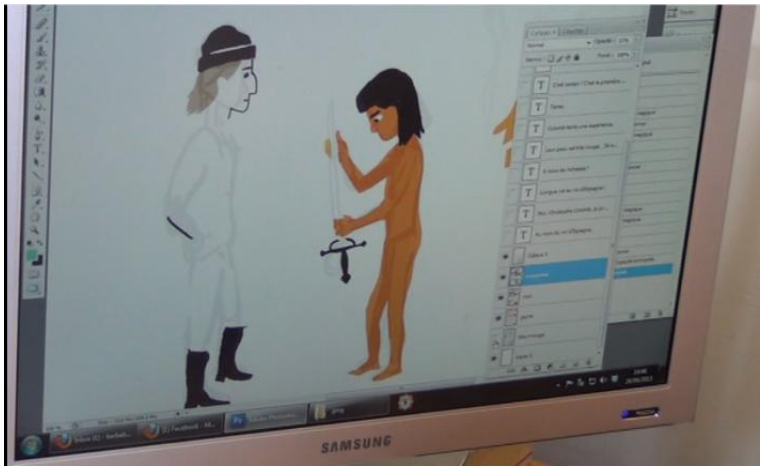

Figure 4: First sketch in a faint background layer

Still, a different working way was observed when the illustrator draws the first sketch in Photoshop. He then prints the sketch and traces it either with a marker or a dip pen. We observed two ways of tracing. The first one involves printing the sketch and using a light table. The illustrator places the printed sketch on top of the light table and on top of the sketch he places a plain piece of paper. The first sketch can be seen through the plain paper and the illustrator sketches it. The other way of tracing involves printing the sketch in light blue ink. The illustrator then simply traces the sketch on top of the first light blue sketch (see Figure 5). Once the last sketch is done on paper it is then scanned and processed in Photoshop. If small corrections are needed the illustrator draws them directly in Photoshop. Conversely, if major corrections are needed, the illustrator draws the corrected item by hand on paper with the help of the light table so that he can preserve the position and the size of the changes using the old sketch in the background. The corrected item is then scanned and placed on the sketch in Photoshop. Coloring is done in Photoshop. Two of the participants work this way.

Figure 5: Print in light blue and trace over

Finally, the illustrator may sketch the first idea on paper. We observed two different techniques in this way of working. In the first technique, the first sketch is done with a pencil on paper and it is then traced over and over again using a light table until obtaining the desired result. The first sketch is in smaller dimensions than the ones needed by the publisher. The illustrator then scans it and resizes it to the dimensions needed. After this is done the sketch is printed with the new dimensions and the illustrator uses the light table in order to

trace it and add the details needed so as to finalize it. The sketch is then scanned again and processed in Photoshop. If small corrections are needed they are made using the graphical tablet. If something larger needs to be corrected, the part of the item that needs corrections is drawn by hand (see Figure 6). The light table is used in order to draw the part in the right shape and position (but on a different piece of paper) and once the new item has been drawn, it is scanned and placed at the correct position on the main sketch using Photoshop. Once all the corrections have been done, colors are added in Photoshop. In the second technique the first sketch is done on paper with a marker. The illustrator scans the first sketch and colors it in Photoshop without making any corrections or alterations to the actual first sketch. Two of the participants work this way.

Figure 6: Draw corrected item by hand

3.3 Analysis

We focus our analysis on the editing tools and the means that are used in the different stages of the illustration process.

3.3.1 Editing tools

In Figure 7 below the different ways of working of each participant can be seen in relation to the editing tools used in each process. The colors of the arrows define the different ways of working as mentioned above.

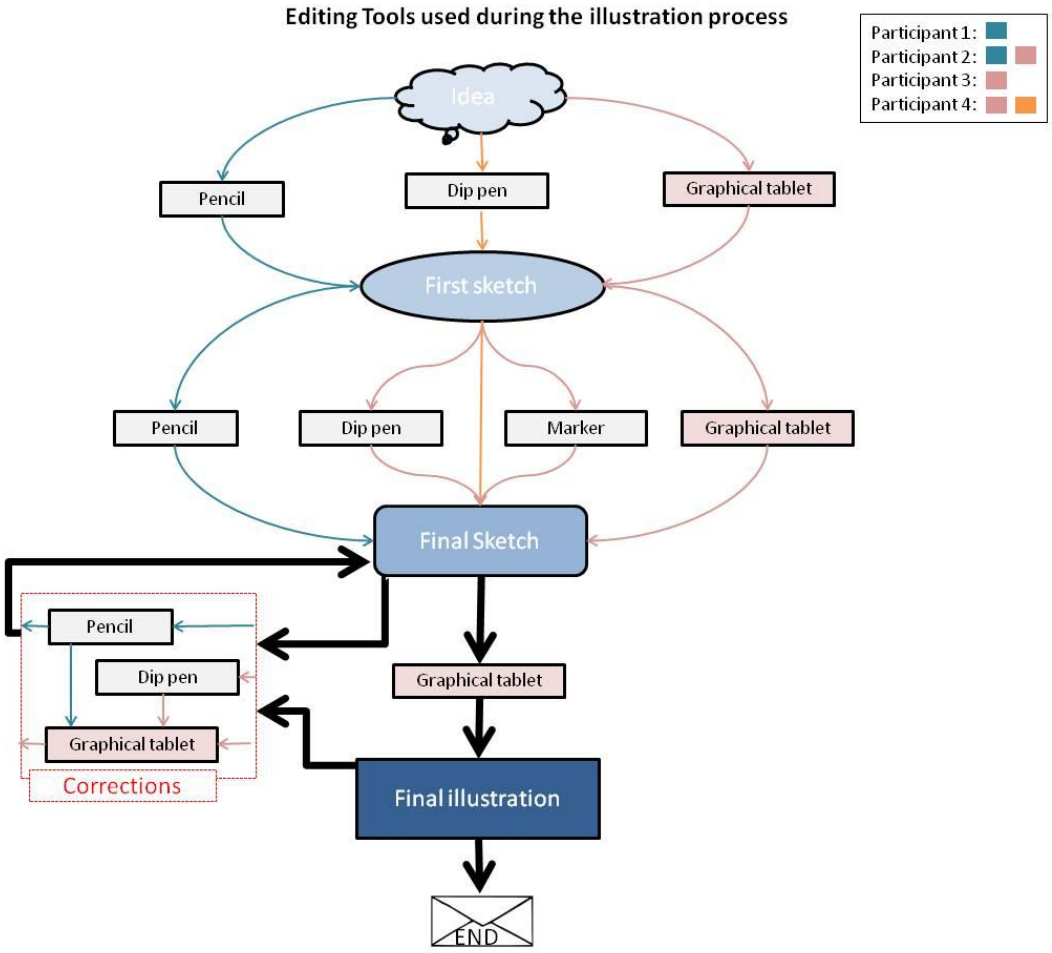

Figure 7: Editing tools used during the illustration process

All of the illustrators interviewed use Photoshop with a graphical tablet in the last stage of their illustration process which involves the coloring of the illustration. When working on paper they draw with a pencil, a dip pen or a maker. Three out of the four illustrators use a light table when they want to trace a sketch on paper. They use a scanner and a printer in order to transition from one tool to another. They use a scanner to go from paper to Photoshop and a printer to go from Photoshop to paper. When working both on paper and in Photoshop there is a lot of back and forth between them.

3.3.2 Means and input devices

Figure 8 below shows all the transitions between the two means in the different ways of working, and the input devices used in order to transit from one means to the other.

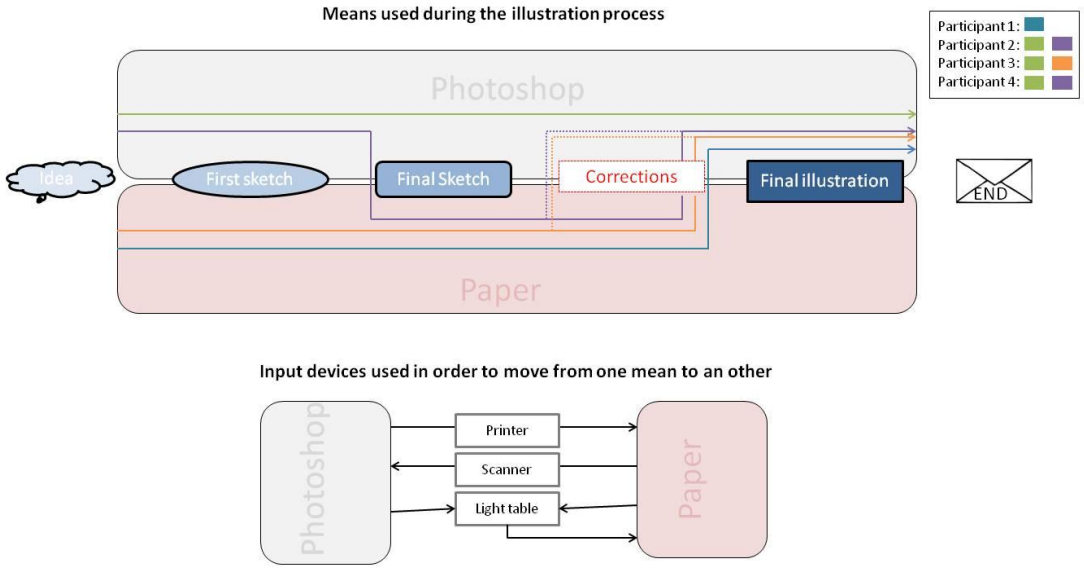

Figure 8: Means and input devices used

Most of the illustrators find it easier to work in Photoshop because it has the option to cut, copy and paste elements from the existing sketch thus making its manipulation easier. Two out of the four participants explained that the use of paper is easier when they want to refine their strokes, while the same task requires a lot of work using the graphical tablet. *Participant3* believes that there is a difference in the results achieved with the two methods. She finds that the resulting illustration is more realistic and more sensible when it is done by hand on paper rather than when it is done using the graphical tablet. She also finds it easier to think with the help of paper. *Participant1* draws everything on paper because he wants to keep his original sketch updated with all the changes. All participants, except *Participant1*, have multiple ways of working and they change their way according to the publisher's demand or to their own desire to try something new. The way they work in each project also depends on the result they want to achieve.

The most interesting observations revealed by the interviews are summarized below: We observed a lot of back and forth between paper and Photoshop when combining these two means. Illustrators use different devices. They use scanners, printers, and graphical tablets as input devices. They also use the light table in order to trace when using paper.

Obviously, tracing play a very important in the entire process. Various ways of tracing are used depending on the means on which the sketch to be traced is drawn. Once the first sketch is obtained illustrators move to the second sketch by tracing. Illustrators trace when they have their sketch on paper or in Photoshop. When the sketch is on paper they use the light table in order to trace it on a new piece of paper. When the sketch is in Photoshop they place it in a transparent layer in the background and they trace it in another layer. They print the sketch and then they trace it using a light table. They print the sketch in light blue ink. They trace it by drawing on top of the light blue ink (they use light blue so that it will not show once scanned).

The way they make corrections in their illustrations is really interesting and depends as well on the means used. When they work entirely in Photoshop illustrators make corrections to

their sketch by erasing, copying and pasting elements. When working in Photoshop in combination with paper they make small corrections directly in Photoshop. When they want to make major corrections illustrators draw the corrected item by hand with the help of the light table so that they preserve its position and size.

Chapter 4

Design

Based on the main observations revealed by the interviews, we next designed a tool that would help illustrators with their complete working process. The main objective was to meet all their needs in a single tool so that they would not need to use different devices to complete their tasks. In this section we present the design of this tool, named "BricoSketch".

4.1 Conceptual Design

In order to get from the digital format to paper and from paper to the digital format a printer and a scanner are needed. When the illustrator works entirely in Photoshop a graphical tablet with a digitizing pen is needed as the input device. When working on physical paper a pen and a light table are needed to trace. Consequently, for an illustrator to work smoothly there is a need to merge the functionalities of all these devices within a tool. BricoSketch provides illustrators with an interactive workspace that supports all the above actions. Moreover, the interviews demonstrated that paper is widely used. Illustrators indicated that the look and feel is different while working on paper. The use of paper also provides them with the possibility of keeping the original sketch. This look and feel is provided in our tool by letting the users work with actual physical drawing tools on paper.

An image processing program is always used at least in the last stage of the illustration process. BrickoSketch combines both an image processing program and paper. It provides the user with a workspace on which an image processing program is projected. The user can directly interact with the image processing program using a graphical pen or he can draw on paper and then interact with a digital representation of his sketch.

As observed from our interviews, illustrators use both paper and pen, and Photoshop as means of working. As explained in our field study analysis, they have to heavily switch between the tools in order to complete their projects. However, a lot of transitions between the two means make the illustrating process much more complicated. In order to simplify the process, BricoSketch brings illustrator's entire working environment on paper by projecting an image processing program on top of the user's workspace. If the user wants to work entirely on an image processing program he just uses a graphical pen. The user interacts with it as he would have interacted with a graphical tablet with a display. The changes he makes to the sketches are projected on his working environment so he can easily keep track of his drawing. Every new stroke is added to the drawing in real time. The user can see the actual result of his strokes in real time projected on his working environment as if he were using a normal pen and paper although now the movement of the pen leaves a digital ink. In a sense, this implementation is similar to a graphical tablet with a screen. As the user sketches the results are projected just in front of him.

The novelty of our approach is to also allow users to work directly on paper while the drawing is being digitalized, avoiding this way the need to use additional devices to transition from one means to another. When the user is done with sketching on paper then he can just process his drawing on an image processing program without needing to scan it. The transition from one means to another is smoothed this way. The use of a scanner is no longer needed because the sketch is being digitalized at the same time the user draws. The use of a printer is no longer needed either as it will be explained in the following section. The benefit is that the user can now work without interrupting his workflow by using external devices.

During the illustrating process the illustrator uses tracing a lot, either to move from the first sketch to the final one or to correct specific items in his illustration. In the process of tracing, the user puts the item that he wants to trace on the background and on top of it he places the surface on which he wants to trace the item. The item that he wants to trace can be a sketch in digital format, in Photoshop or a sketch on paper. The surface can be a physical one, i.e. paper, or a digital one, i.e. another layer in Photoshop. BricoSketch supports tracing from both paper and an image processing tool so that the user can trace from a physical or a digital sketch digitizing in both cases the traced sketch. The use of a printer is no longer needed now because the illustrator can trace directly a digital sketch without needing to print it.

In order to illustrate our design we present bellow three user scenarios based on the processes observed in the interviews.

Scenario a

John works in a traditional way. He likes to work on paper from the start. He finds it more comfortable to think on paper and prefers the result of the illustration when the lines are drawn by hand.

He takes a piece of paper, places it on his workspace and with the use of a pencil he draws his first sketch. While he is sketching, strokes are digitalized. Once the first sketch is finished he removes the paper from his workspace. His sketch is kept in a digital format on his workspace. He places a new sheet of paper on his workspace and traces the first sketch that is now shown on his workspace using a dip pen. Once done with the tracing he removes the paper from the surface. The final sketch is kept in a digital format on his workspace. Using a graphical pen he makes small changes directly on the digital representation of the sketch that is projected by the image processing program on his workspace. He resizes elements, moves and duplicates them using the cut, copy and paste options. He corrects major items by placing a piece of paper on his workspace and tracing the item that needs to be corrected using a dip pen. All his changes are being digitalized in real time and are shown on his workspace. He uses a graphical pen in order to place them in the right position of the illustration on the image processing program. When he is done with the final sketch and is happy with the result he proceeds with the coloring part. He uses a graphical pen in order to color his illustration in the image processing program situated on his workspace.

Scenario b

Maria likes to work on both computer and paper. She finds it easier and quicker to sketch her first ideas on Photoshop.

She starts her sketch directly on the image processing program on her workspace using a graphical pen. Once she is done with the first sketch, she places a sheet of paper on top of her workspace. Using a marker, she starts tracing and refining the sketch on her workspace. Once done with the tracing she removes the paper. The workspace now contains the final sketch digitalized. She makes small changes directly on the sketch that is placed on her workspace with the help of the image processing program functionality using a graphical pen. She resizes elements, moves and duplicates them using the cut, copy and paste options. She corrects major items by placing a piece of paper on her workspace and tracing the item that needs to be corrected using a marker. All changes are digitalized in real time and are shown on the workspace. Using a graphical pen she places them in the right position of the illustration on the image processing program. She uses a graphical pen in order to color her illustration in the image processing program situated on her workspace

Scenario c

George works only in Photoshop. He works as follows.

He starts his sketch directly drawing in the image processing program on his workspace. He sketches using a graphical pen. Once he is done with the first sketch he puts it in a faint background layer and traces it directly in the image processing program. He makes small changes directly on the sketch that is placed on his workspace, with the help of the image processing program functionalities using a graphical pen. He resizes elements, moves and duplicates them using the cut, copy and paste options. When he is done with the final sketch and is happy with the result, he proceeds with the coloring part. He uses a graphical pen in order to color his illustration in the image processing program situated on his workspace.

In general, if the user wants to draw using physical pen and paper he places the paper on top of his workspace and starts sketching. While he is drawing his sketch is being digitalized. If he wants to draw in the image processing program he sketches directly in the image processing program on his workspace in front of him using a graphical pen.

If the user wants to trace a sketch from paper to paper and the sketch was not drawn using our tool, then he places it on top of his workspace, places on top of it a new piece of paper, enables the light table functionality and traces the sketch. If the sketch in paper was drawn using our tool, then there is a digital format of the sketch as well. He places a piece of paper on top of his workspace. The sketch is projected on the paper. He traces the sketch with a physical drawing tool of his choice (pencil, marker, dip pen). The same process is followed if he wants to trace a sketch that was directly drawn in the image processing program. If now the illustrator wants to trace a sketch that was drawn in the image processing program to the image processing program he puts the sketch that he wants to trace on a faint background layer and traces it directly on a different layer using a graphical pen.

If the illustrator wants to make corrections on paper he uses the light table functionality and traces the elements of the sketch that need to be corrected with a physical tool of his choice. The corrected item is being digitalized. Once the element is traced, he places it on the right position on the image processing program. If the illustrator wants to make corrections to the digital representation of a sketch then he corrects his sketch using a graphical pen.

4.2 Setup and Implementation

In this section we present the physical set up of our tool. Figure 9 shows the basic hardware and software elements used in the implementation of BrickoSketch. They include a projector, Anoto paper, a paint application, a touch surface and a light source.

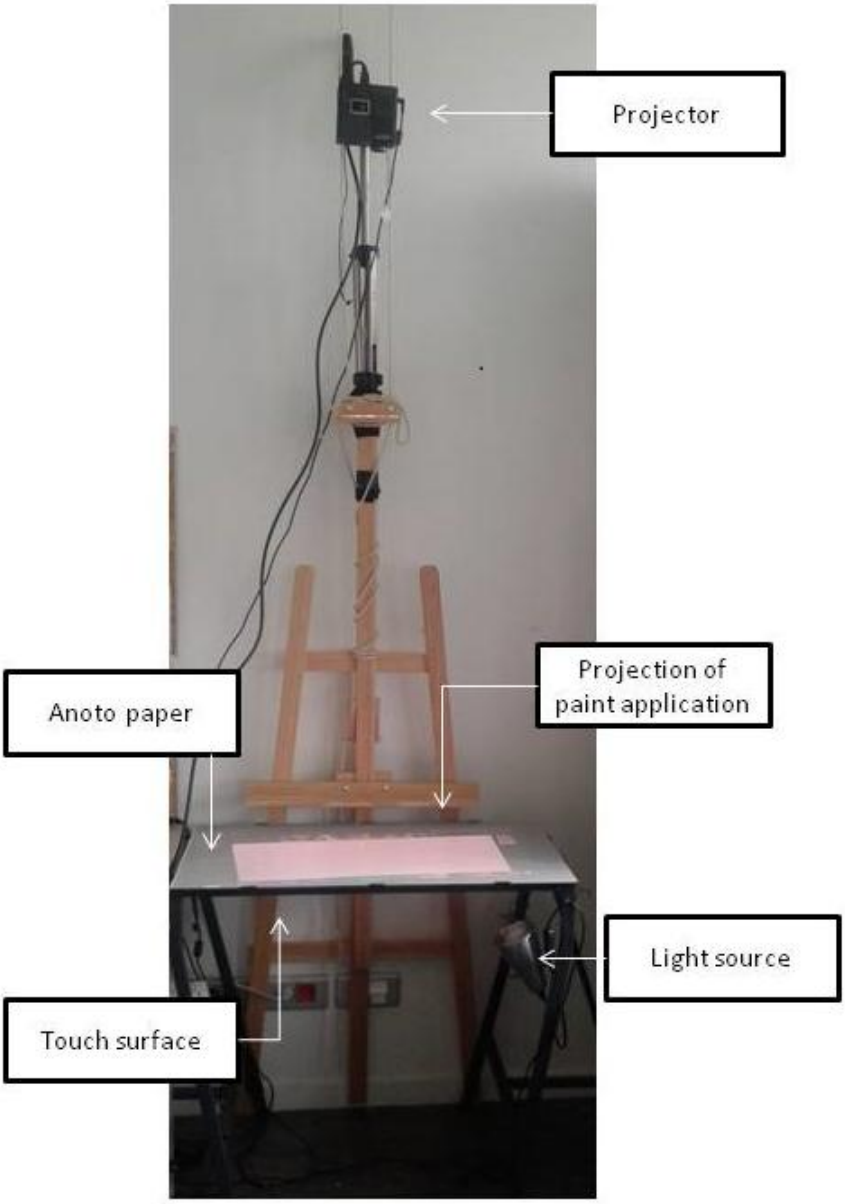

Figure 9: BricoSketch setup

The main objective was that BrickoSketch should allow the user to draw both digitally and physically. To do this we decided to project an image processing application onto the surface on which the user would draw. The original idea was to project the application from below the surface so that the user's hands would not occlude the workspace. This was not possible, however, because the distance was very small and this resulted in the projected area being too small for a user to work on. A bigger projection could have been achieved using a mirror but we did not have the required material at hand. Consequently, for our first test prototype, we made the decision to project from above the surface. We took care in placing the projector so as to achieve a bigger projecting area enabling the user to work on it easily.

The next issue to address was how the user will interact with the projection on top of the surface. As mentioned above we wanted to provide the user with the look and feel of using physical paper. A possibility was to use a camera on top of the surface in order to capture changes on the paper on top of the surface and process them. However, this was rejected because it was too difficult to implement. We finally came up with the solution to use an Anoto pen and paper. The application is projected on a surface covered with Anoto paper, a

paper on which a special dot pattern is printed. Using the Anoto pen, a pen that digitally records everything written with it using a digital camera that captures the strokes in relation to the dot pattern, we provided the input to the application. This way, the user can obtain the feel of paper. The Anoto pen can be used both with and without ink, thanks to a special tip. By using actual ink the user can get his sketch both in digital and in physical format so that he can always keep his original sketch on paper. However, it is not advised to use ink when sketching directly on the main application workspace because changes cannot be made on the paper once it has been drawn on.

We wanted to give illustrators the possibility to select items in their canvas and to edit them. This could not be done only with the Anoto pen. The selection of the item can be done using the pen but some features, for example, resizing and rotation, could not be implemented only with the use of the Anoto pen. We decided, therefore, to provide a bimanual interaction using the pen and a touch surface as proposed already in the literature (Brandtl, Forlines, Wigdor, Haller, & Shen, 2008). We provided a touch surface in order to use finger gestures to support these features but we did not want the placement of the hands, when drawing, to interfere with the drawing. Hence, borrowing an idea from the literature we used the downside of the workspace (Wigdor, et al., 2006) rather than the upside as the touch surface. We thus allow users to interact with their sketches or parts of them using hand gestures below the surface.

Finally, a light source is necessary to support tracing from paper, an important step in the overall illustration process when combining both means. When the item that needs to be traced is on paper illustrators use a light table, a table made of glass that has a light source underneath it. We added a light source underneath the workspace.

4.3 User Interface and Interaction Techniques

In this section we present the user interface and the features that comprise it. The interface itself was implemented in Java using the Anoto and touch input management software libraries developed at in|situ by Theophanis Tsandilas and Jérémie Garcia. We also show how the interactions between the user interface and the illustrators take place. Finally, we demonstrate how BricoSketch supports the scenarios proposed in the conceptual design section.

4.3.1 User Interface

In our attempt to create a tool that would combine both an image processing application and paper, our first idea was to use Photoshop and to project it to the user's workspace. Since Photoshop is a tool that all illustrators use, it would have been very useful if this idea could be implemented. However, this proved to be extremely challenging because we could not find a way to add some additional functionality for interactions with the Anoto pen. To solve this problem, we created a basic paint application in Java with most of the functionalities that illustrators we observed use in Photoshop, and especially the addition and use of multiple layers. Illustrators work a lot with layers. Their whole work in Photoshop is divided in different layers. Consequently, the paint application allows the creation of multiple layers. The user can choose the layer that he wants to work on and he can also choose the layers that he wants to show or not. All illustrators use Photoshop at the end in order to color their illustration. Therefore, the application includes a color panel so that users can change the color they use. We also added the option for the user to choose the width of his stroke. At the center of the graphical interface of the application we placed the drawing canvas. The drawing canvas is the area in which the user sketches. Every time the pen is moved within this space strokes are created, are digitalized and are projected in real time. The movement of the pen in this area leaves digital ink.

Bringing inspiration items to the working environment:
Inspiration plays a major role in the working process of illustrators. Before they start to work on a project they search and gather a lot of images from different sources in order to get inspired and get ideas. In a typical illustrator's working environment one can see pictures pined up everywhere on the walls, but also computer displays with various inspiration items in front of them while drawing. In addition to inspiration images, illustrators also make use of some of their own sketches as well. For example, when having to illustrate a book or a cartoon (bande dessinée), they typically pin sketches of their characters up in front of them so that their drawings are consistent all along the project (which could last for weeks or months).

Our tool was designed to directly include their inspiration images needed for their work into their workspace. This led to two galleries included in our paint application. We created two galleries (see Figure 10) in order for the user to separate the images that he needs into:

- older sketches that provide him with consistency, and
- images from different sources that provide him with inspiration

The gallery of the "inspiration images" is placed at the top of our application. The gallery of his old "consistency sketches" is placed at the left side of our application. This way the user can see a small preview of all his images just in front of him. If he needs the image in a bigger format he can just select the image he wants using the Anoto pen and place it on his canvas. The goal is to provide the user with all the functionalities that he actually has with the images on paper, but also to make available additional possibilities that would help him with managing these images while working.

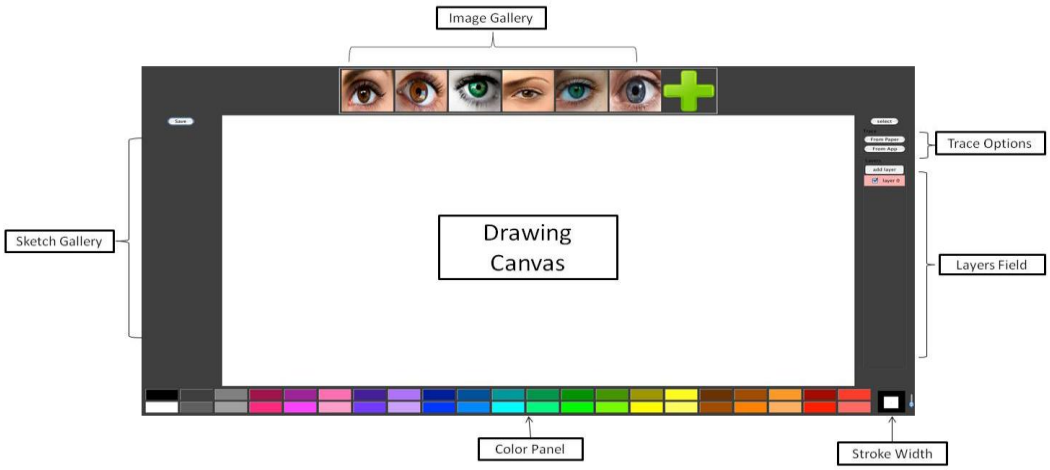

Figure 10: BricoSketch's paint application interface

4.3.2 Interaction Techniques

Using Layers: When the illustrator starts working he begins his work on the first layer, *layer0*. As mentioned before, illustrators work a lot with layers. If the user wants to work on another layer he can press the "add layer" button with the Anoto pen. This will result in the creation of a new layer, layer1, which is displayed above *layer0*. On the right side of the interface, a layer stack displays labels for each layer. In order to make a layer visible or not, a check box exists in front of its label. By default all the layers are visible. By pressing the pen on the check box, the illustrator can make specific layers hidden. When drawing, the layer that is

being edited is the one that is selected, and its label is coloured in pink. Every time a new layer is added, it is automatically selected. If the user wants to edit another layer rather than the last one that has been added, he simply presses on the label of the layer that he wants to edit to select it. Only one layer can be selected and therefore edited at one time.

Processing sketch elements: If the illustrator wants to select a specific item in his illustration, he first selects the layer on which the item is found and then he puts one finger above this item to select it. If now he wants to select the whole layer, he simply places three fingers at any place on the touch surface and the layer is being selected. He can also select a set of items in a sketch by actually drawing a circle around them using the Anoto pen. When an item is selected, its color changes to green. Once the illustrator selects the item that he wants to edit or manipulate, he positions two fingers on the touch surface and by increasing or decreasing the distance between the fingers, the item gets zoomed in or zoomed out. By rotating the fingers the item gets rotated following the angle of the fingers. The movement of the fingers causes the movement of the selected item. These possibilities are demonstrated in Figure 11, Figure 12 and Figure 13 below. The item remains selected as long as both fingers touch the surface. If the fingers are removed the item is unselected.

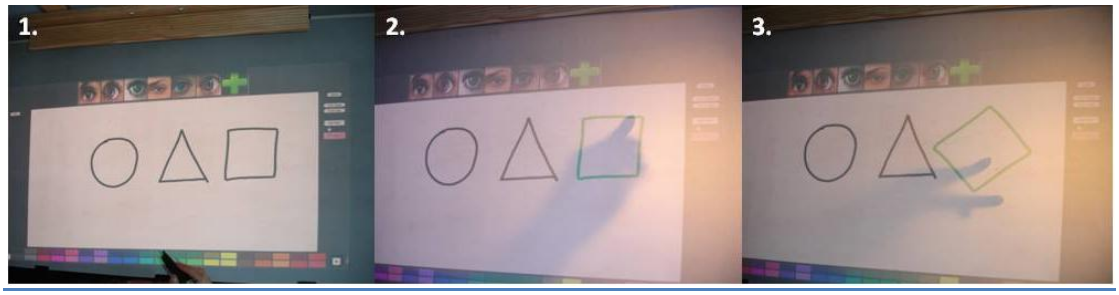

Figure 11: Selecting an element of the sketch with one finger and manipulating it with two fingers

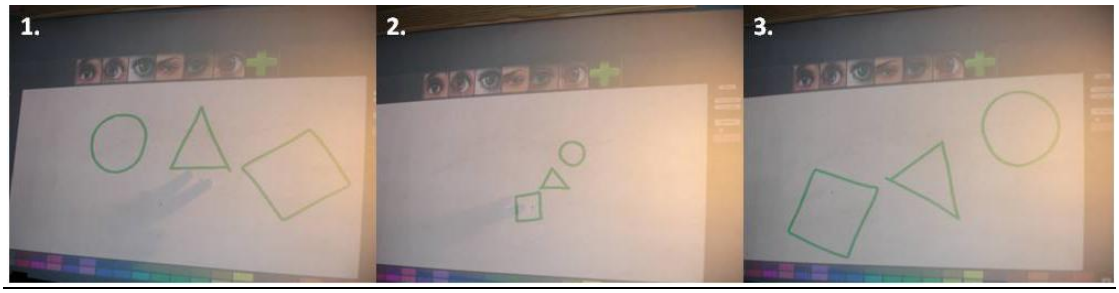

Figure 12: Selecting the entire layer with three fingers and processing it using two fingers

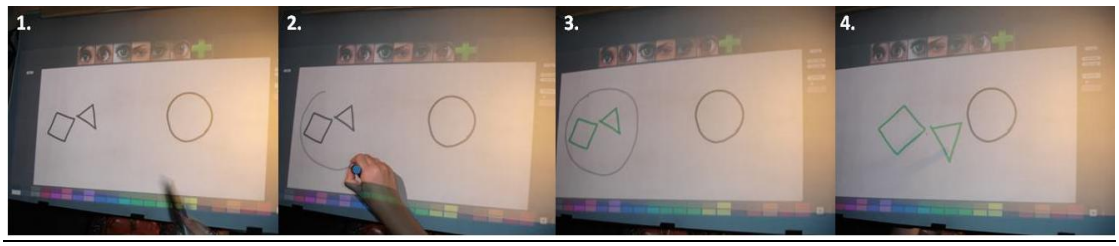

Figure 13: Selecting some elements in a sketch using the pen, and processing them using two fingers

Working with images or old sketches: If the illustrator wants to use an image or an old sketch, he selects it using the Anoto pen. Using the pen again, he selects the position on which he wants to place the image. The image is then placed in the position specified by the illustrator in its normal size. Once the image is placed on the canvas, the user can move it wherever he wants using the hand gestures mentioned above. He can zoom in or out and rotate it depending on what he wants to do. The user can also trace onto the image by adding a layer on top of the existing one. Moreover, while drawing the user can save his sketch by choosing the save option situated on the sketch gallery. The saved sketch then automatically appears on the sketch gallery and he can use it whenever he needs to. He can also open "inspiration images" on the top gallery from his files. This way he can gather all his inspiration material, without printing them, on his workspace and he does not lose time to find what he needs hanging on his walls, nor does he need to have an additional screen to project his inspiration material.

Tracing: Tracing may be done from a physical paper or directly from the paint application.

Tracing from paper:. When an illustrator wants to trace from paper to paper he selects the option "trace from paper". This option actually makes the paint application disappear and enables the light source. By placing a sketch on top of the table and another piece of paper on top of it, the top paper becomes transparent allowing the sketch from the bottom to be visible (see Figure 14). When he is done with tracing, the user removes both papers from the table, turns off the light and touches the touch surface in order to make the paint application visible again. The sketch that the user traced is digitalized and is placed in a new layer on top of the already existing ones.

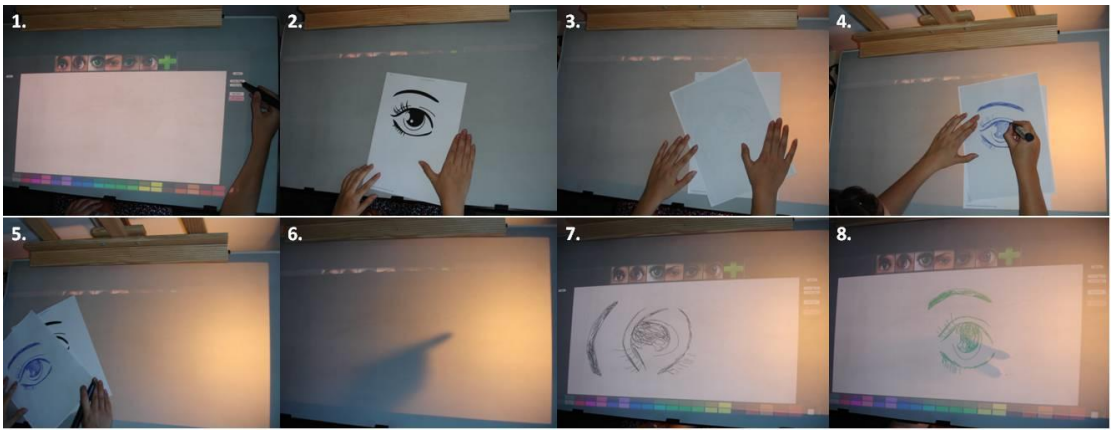

Figure 14: BricoSketch's light table: tracing a sketch from paper

Tracing from the paint application: When illustrators have their sketch in Photoshop, they use two ways of tracing, depending on the means they want to use in the next step. If they want to continue working in Photoshop, they place the item that they want to trace on a faint background layer. Then they trace the sketch on another layer on top of it. If they want to continue working on paper they print the sketch in order to trace it. They print it in normal black ink, and use the light table as explained above or they print it using light blue ink and they trace it on the same paper following the light blue sketch. Once they finish with tracing they scan it and then process it in Photoshop.

Key elements of these observations were combined together into one functionality of BrickoSketch. If the illustrator wants to trace a sketch that he already has drawn on the application, he selects the option "trace from application". With this option the sketch turns light blue, a layer is added and the user can sketch following the light blue background sketch (see Figure 15). The illustrator can also place a piece of paper on top of the table and trace using a projected sketch. This is more challenging though, because if he wants the sketch to be digitalized at the same time the user has to calibrate the piece of paper that he uses, and if the user moves the paper then the projection needs to be moved accordingly. We did not implement something like this, however, because we did not have access to the hardware needed in order to detect the movement of the paper so as to move the projection following the paper's movement. Nevertheless, the tool as it stands can still be used effectively. The user can always trace on paper using the projection but he should take care in keeping the paper stable so that the projection stays at the same place during tracing.

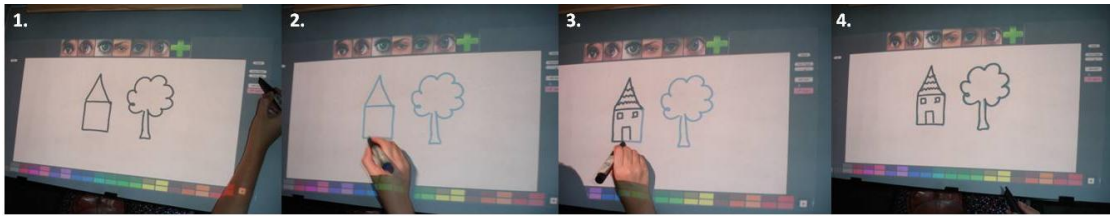

Figure 15: Tracing a sketch from the paint application

Going back to the scenarios of use that we initially proposed for BricoSketch, illustrators can only draw using the anoto pen and not any other physical drawing tools. They can use the pen without ink when working directly on the Anoto surface and follow the digital ink that is being projected. When sketching on additional paper they use it with ink. Below, we describe how these scenarios are realised using the actual prototype of BricoSketch.

Scenario a

John selects the option trace from paper without enabling the light source. This makes the application disappear. He places a new piece of Anoto paper on top of the surface and he sketches on it using the Anoto pen with ink. Once done with his first sketch, he removes the paper from the surface and touches the surface from above. The application appears and the sketch that he drew is digitalized and placed on an additional layer. He uses the projection of the sketch in order to trace it on paper by carefully drawing on a new piece of paper that he places on the surface without moving it. Once finished with the tracing, he removes the piece of paper and touches the touch surface. The touch results in the digitized version of the traced sketch to be added in one additional layer. He adds elements and corrects his sketch using the pen, and repositions items of the sketch by moving them with his fingers from below the surface. Finally once done with the second sketch he adds one more layer and colors his illustration using the pen and saves it so that she can have a reference point for his future work.

If he has his first sketch done in non-Anoto paper, he selects the option trace from paper, thus enabling the light source. He places the sketch on the surface and on top of it he puts a piece of Anoto paper. He traces the sketch using the pen with ink. Once finished with the tracing he then touches the surface to switch to the paint application on which a digitized version of the sketch is shown. He then makes small corrections using the pen without ink and moving and placing his hand above the surface on the touch area. If he wants to make major correction,

he follows the steps he did at first by actually making the corrections in a new piece of Anoto paper. Then he processes the corrections and places them in the right position by selecting them with one finger and moving them with two. Once the second sketch is done he proceeds with his work as above.

Scenario b

Maria starts sketching on the Anoto surface using the pen without ink by moving the pen on top of the Anoto surface. Once finished with the first sketch, she places a piece of paper on top of the surface to trace the sketch from its projection. She carefully traces it taking care not to move the paper. She follows steps similar to John's method to finish her work.

Scenario c

George starts sketching on the Anoto surface using the pen without ink and by moving the pen on top of the Anoto surface. After his first sketch is done, he saves it. Using hand gestures he reposition and resizes the sketch. He chooses the option trace form application. The sketch turns light blue and another layer is added. Using the pen he follows the sketch in light blue and traces it. He adds elements and corrects his sketch using the pen, and repositions items of the sketch by moving them with his fingers from below the surface. When he is happy with the second sketch he proceed with the coloring the way John proceeds.

4.4 The overall illustration process in BricoSketch

The steps of the complete illustration process using BricoSketch are illustrated in Figure 16 below.

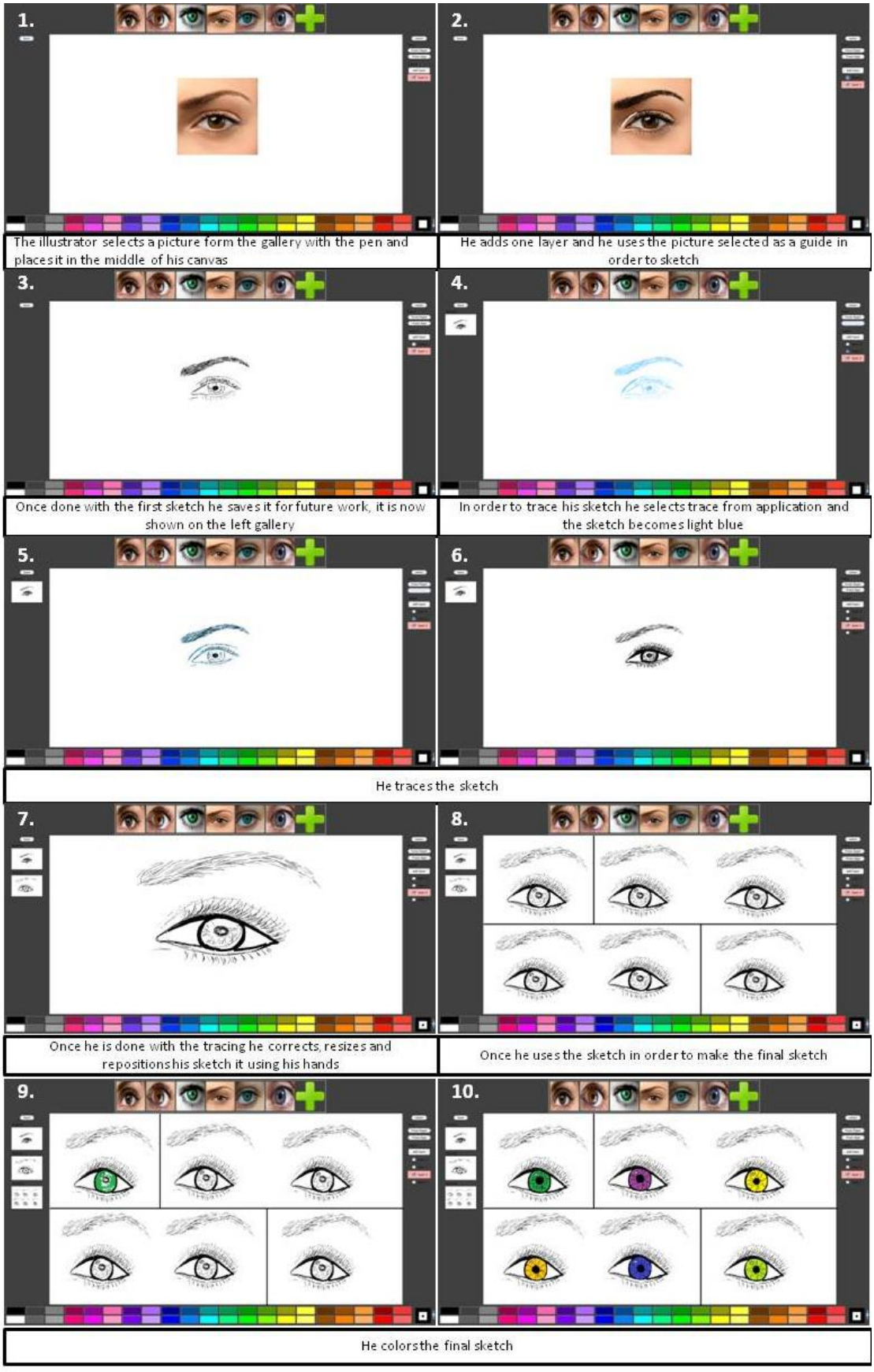

Figure 16: The illustration process in BricoSketch

Chapter 5

Limitations and future directions

This section covers two subjects: the improvements and limitations to the current version of BricoSketch and future directions that can be foreseen in this research area.

5.1 Improvements and limitations

BricoSketch is a first attempt towards an integrated tool to facilitate the illustration process and a number of possible improvements have been identified. As mentioned before in the design section, the tool as it stands does not support completely tracing to paper from the projection of the application. For the user to trace from the application to paper, he has to be really careful not to move the paper on which he traces. Otherwise, if the paper is moved, the projection is not consistent anymore with the traced sketch. A camera can be used in order to capture the movements of paper and to move the projector accordingly, as it was implemented in *PapARt* (Laviole & Hachet, 2012). This way the sketch will always be consistent with the projected version. This would not only help with tracing to paper, but it would also give the opportunity to the user to move the Anoto paper that covers his workspace, as he would have done while working on paper. Moreover, the camera could also capture sketches drawn on non-Anoto paper, which actually require the BricoSketch user to trace them on Anoto paper or to scan them.

When the user wants to trace a sketch from paper as mentioned before, he places his sketch on top of the surface he is working on, he places the paper on which he wants to sketch on top of it, and he enables the light source below the surface. However, because the surface itself is covered with Anoto paper, the light has to pass from one additional layer. As a result, the light is not strong enough to project the sketch that needs to be traced clearly on the top paper. A bigger working surface could be used, so that we have some additional space not covered with Anoto paper for easier tracing when using a sketch on paper.

Finally, illustrators often use various drawing tools (e.g. pencils, markers, dip pen). Each tool has a different stroke and feel. With BricoSketch, the user does not have this opportunity since he is constrained to use only the Anoto pen. A very useful improvement would be to provide the user with a tool other that the Anoto pen or to enhance the pen or the paint application in order to mimic the stroke of different physical tools, thus bringing the result closer to the result obtained with these specific tools.

Some limitations of BricoSketch must also be recognized. Due to time constraints, the number of illustrators that participated in our interviews is rather limited. Hence, this sample may not be representative of the overall population of illustrators. More specifically, we may have missed some functionalities that would be useful for other illustrators. For example, we did not observe illustrators who use a screen-tablet (i.e., a display augmented with a digitizing tablet), although such devices are now widely used. Moreover, all of the interviewed illustrators work in the same studio. It is, therefore, likely that the illustrators we interviewed where influenced somehow by each other in the way they are working. Finally, one thing that was noticed during the interviews is that illustrators tend to personalize and to continuously improve the way they work. Having in mind the above facts we cannot claim that our findings are objective for all illustrators. However, our study revealed a number of useful observations on the illustrating process, as a first step toward a more complete analysis.

Despite these shortcomings, BricoSketch is a first solution to some important issues and needs that illustrators face in their work. To improve our design, a larger number of illustrators, from different working environments, should be interviewed and observed while

working. Additional functionality according to the new observations should be added. Once the design is updated according to the new findings, it should be evaluated with real users. Specific tasks should be given to illustrators to accomplish using the tool and interactions with the tool should be observed and analyzed. When real life observations are gathered they should be processed in order to extract further changes and improvements that should be made to the design.

In summary, we believe that BricoSketch already integrates a number of different functionalities in one tool, which can improve illustrators workflow, helping them to stay focused on their creative task instead of constantly switching from one tool to another. On a more exploratory and technological point of view, BricoSketch is also a basic platform to which additional functionalities can be added and tested.

5.2 Future directions

Future work in this area can address a number of interesting research questions. During this study, we observed illustrators working both on paper using a physical drawing tool and on an image processing program, using a graphical tablet and a graphical pen as an input. What criteria do illustrators have when choosing the tool they use at each stage of their work? Why and when do they prefer to use one tool instead of the other? What tool is more helpful to illustrators with their thinking process regarding what their illustration is going to be? The features that make these two means more suitable for specific tasks in the illustration process should be explored. Finally, illustrators are professionals in the field of sketching. By exploring their preferences and the way that they proceed in their work, future research can extract important information that can later be used in the design of a tool that would enhance the creativity for a wider audience of users and not specifically illustrators.

Chapter 6

Conclusions

A number of recent studies have aimed at enhancing creativity, and more particularly drawing. In this project we also focused in drawing and more specifically illustrating. We were interested in designing a tool that would support the workflow of illustrators, while avoiding the use of multiple devices, in order to simplify their overall work.

In order to design this tool, we first needed to find out their needs and their problems while working. To gather all the information needed, we observed and interviewed four illustrators in their working environments. We observed different ways of working and we extracted elements that we identified to be important in their working process. Conceptually we divided their working process into three stages that were found to be common among all four illustrators studied: the creation of the first sketch; the creation of the last sketch; and the creation of the final illustration. This classification focuses on the means, Photoshop or paper, used in order to achieve each of the above phase. An interesting observation is that illustrators always use Photoshop in the last stage in order to color their illustration, no matter what means was used in the previous stages. Another important observation was that their workflow is interrupted by the use of a lot of devices in order to transition from paper to Photoshop, and vice versa. Finally, an important part in the illustrating process is tracing. Various ways of tracing were observed depending on the means used to draw the sketch that needed to be traced.

These observations resulted into the guiding principles for designing a tool, BricoSketch, which incorporates the functionalities of all the devices used in a consistent environment, in order to allow a smooth transition between all the stages of the illustration process. Users have the possibility of working both on paper and with an image processing software. BricoSketch combines key functionalities of a scanner, a printer and a light table, so that users do not have to use separate devices. Instead, they can maintain their workflow on a unique workspace. In fact, the tool provides the choice to use either physical or digital ink while drawing, combining this way the direct drawing in an image processing program and the one on physical paper.

In order to accomplish all these, BricoSketch uses a touch surface covered with an Anoto paper. On this surface, we project a paint application with which the user interacts using an Anoto pen. The user can also interact with his sketch with hand gestures from the bottom side of the surface. A light source is provided from underneath the surface to allow tracing from physical paper.

Various improvements are possible by providing additional hardware to enhance the functionalities of BricoSketch. Due to the small number of illustrators interviewed, BricoSketch may not address all the needs of all illustrators. However, we believe it to be an effective first attempt towards creating a tool that combines the basic functionalities of all the devices typically used by illustrators when working. Additional functionalities can always be added to upgrade the design, and to make it useful for a wider audience of illustrators. Future work can expand our understanding by focusing on the criteria and motivation of illustrators in using different means and working methods. This knowledge could be used for the design of a creativity enhancing tool addressed to a wider audience.

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Appendix 1: Consent Form

FORMULAIRE D'INFORMATION ET DE CONSENTEMENT

IDENTIFICATION

Responsables du projet : Stéphane Huot, Theophanis Tsandilas

Département, centre ou institut : LRI

Adresse postale : PCRI, bâtiment 650, Université Paris Sud, Rue Noetzlin, 91190 Gif-sur-Yvette

Adresse courriel : **Stephane.Huot@lri.fr**, **Theophanis.Tsandilas@lri.fr**, **magdalini.grammatikou@lri.fr**

OBJECTIF GÉNÉRAL DU PROJET

Vous êtes invités à prendre part à ce projet visant à mieux comprendre le processus d'illustration graphique, les techniques concrètes utilisées pour arriver à un résultat final sur papier ou sur ordinateur, en nous montrant les étapes successives conduisant à la réalisation d'un ou de plusieurs de vos projets ainsi que les sources d'inspirations, les outils utilisés et les difficultés rencontrées durant ce processus.

PROCÉDURE

Votre participation consiste à participer à une entrevue individuelle au cours de laquelle il vous sera demandé de décrire, entre autres choses, certains de vos processus d'illustration et

votre utilisation du papier et des logiciels pour la réalisation d'un projet que vous avez déjà réalisé. Cette entrevue est filmée avec votre permission et prendra environ une heure de votre temps. Des photos des documents que vous avez utilisés ou produits seront également réalisées pendant l'entrevue. Vous pouvez signaler les documents que vous souhaitez garder confidentiel à l'expérimentateur. La transcription sur support informatique qui en suivra ne permettra pas de vous identifier.

CONFIDENTIALITÉ

Il est entendu que les renseignements recueillis lors de l'entrevue sont confidentiels et que seuls les membres de l'équipe de recherche auront accès à votre enregistrement et au contenu de sa transcription. Le matériel de recherche (vidéo, photos et transcription) ainsi que votre formulaire de consentement seront conservés séparément sous clé au laboratoire du chercheur responsable pour la durée totale du projet.

PARTICIPATION VOLONTAIRE

Votre participation à ce projet est volontaire. Cela signifie que vous acceptez de participer au projet sans aucune contrainte ou pression extérieure, et que par ailleurs vous être libre de mettre fin à votre participation à n'importe quel moment au cours de cette recherche. Dans ce cas les renseignements vous concernant seront détruits. Votre accord pour participer implique également que vous acceptez que l'équipe de recherche puisse utiliser les renseignements recueillis aux fins de la présente recherche (articles, conférences et communications scientifiques).

DES QUESTIONS SUR LE PROJET OU SUR VOS DROITS?

Vous pouvez contacter le responsable du projet au numéro 01 69 15 68 34 pour des questions additionnelles sur le projet ou sur vos droits en tant que participant à ces travaux de recherche.

REMERCIEMENTS

Votre collaboration est essentielle à la réalisation de notre projet et l'équipe de recherche tient à vous en remercier. Si vous souhaitez obtenir un résumé écrit des principaux résultats de cette recherche, veuillez ajouter vos coordonnées ci-dessous.

SIGNATURES :

Je soussigné(e), _____ reconnais avoir lu le présent formulaire de consentement et consens volontairement à participer à ce projet de recherche. Je reconnais aussi que l'interviewer a répondu à mes questions de manière claire et précise. Je comprends que ma participation à cette recherche est totalement volontaire et que je peux y mettre fin à tout moment, sans pénalité d'aucune forme, ni justification à donner. Il me suffit d'en informer le responsable du projet.

Signature du participant : Date :

Nom (lettres capitales) et coordonnées :

Signature de l'interviewer : Date :

Appendix 2: Pre-questionnaire

Pré Questionnaire

Ce questionnaire d'informations générales à pour but de catégoriser les participants pour l'étude qui suivra, et d'obtenir des informations concernant votre pratique en tant que illustrateur. Toutes ces informations resteront confidentielles.

Age:

Genre:

Homme [ ] Femme [ ]

Activité(s) professionnelle(s):

Années de travail en tant qu'illustrateur :

Outils utilisés (software, périphéri

Veuillez conserver le premier exemplaire de ce formulaire de consentement pour communication éventuelle avec l'équipe de recherche et remettre le second à l'interviewer.

Appendix 3: Interview Guide

INTERVIEW GUIDE

Notes de l'interview et de l'évaluation du …/04/2013.

Participant n° : …

TOOLS USED:

Which tools do they prefer to use in their work?

_____
_____

_____

What problems do they face with the existing tools.

_____
_____

_____
_____

_____
_____

_____
_____

Which factors do they consider in order to choose a tool?

_____
_____

_____
_____

WORK PROCESS :

STAGE	TOOL USED	WHAT IS BEING DONE	DIFFICULTIES FACED

INSPIRATION :

Where do they seek inspiration from?

_____
_____

_____
_____

_____

What kind of inspiration do they seek for?

_____
_____

_____
_____

_____

Where do they need to have the object of their inspiration while working?

_____
_____

_____
_____

_____

COMPLEX OBJECTS :

When they need to draw complex objects where do they search in order to find its features?

_____
_____

_____
_____

_____
_____

How do they proceed in order to extract the features of complex objects?

_____
_____

_____
_____

_____

CONSTRAINS/GUIDELINES:

What are the constrains/guidelines given by the publisher?

_____
_____

_____
_____

_____