TessalTable:
Tile-based Creation of Patterns and Images

Abel Allison
Stanford University HCI Group
Computer Science Department, Stanford, CA 94305
abel.allison@gmail.com

ABSTRACT
We present the TessalTable, a tangible user interface for children, aged 8-10, to create patterns and pictures using pieces of images and moving video. Children use tiles to"pick up" a piece of an image. The tiles act as containers for visual content which can be arranged and rearranged anywhere on the application surface. The tile-based controls allow for simultaneous multi-user input. A preliminary study found that children understand and engage with the interface. The ability to arrange and rearrange dynamic images invites users to explore geometric patterns and connected motion.

ACM Classification: H5.2 [Information Interfaces]: User Interfaces - Graphical user interfaces.

Keywords: Tangible User Interface, Creativity, Building Blocks, Input Device, Collaboration, Children.

INTRODUCTION

"*I hear and I forget. I see and I remember. I do and I understand.*" -Confucius

Elementary school children engage in exploratory learning exercises as part of their learning activities. These activities provide an opportunity for children to construct knowledge through their own experience [7, 9]. The Constructivist view claims that it is through the construction of *external artifacts* that children construct their own knowledge [8].

In this paper, we present the TessalTable, a novel exploratory interface for constructing dynamic geometric patterns. Using geometric tiles, modeled after Pattern Blocks, children can pick up a piece of an image or video and place it anywhere on the application surface. The tiles act as both input and output devices, at once selecting content and displaying it as well.

RELATED WORK

The Tangicam [4] provides children with a tangible video capture and editing system. The device acts as both a video recorder and editing controller.

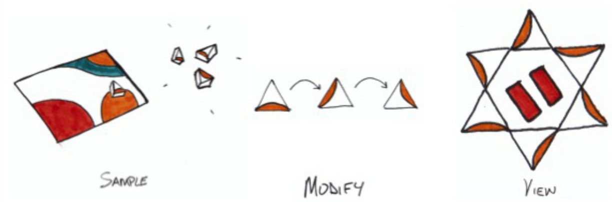

Figure 1: Content is selected by placing the tile on the palette area. The content will then travel with the tile until the tile is reassigned.

TICLE [3] is a tangible application built on top of Pattern Blocks as well as other mathematical concepts. The application is designed to teach math applications, automatically placing constraints on the rules of the application depending on the users actions.

IO Brush [2] lets children explore and create with color using objects from the world around them. IO Brush contains a camera that can capture any color it sees. The brush is also used on a screen to paint pictures using the captured color.

Many current interfaces perform their function through one device, forcing others to wait their turn. The contribution of the TessalTable is to provide a set of embodied controllers for manipulating the world around us. The nature of the interface allows for a truly multi-user experience, encouraging simultaneous collaboration and creativity.

USAGE

The application surface contains a Canvas area and a Palette area. The Palette displays the video or image to be sampled. Videos play in a loop continuously. The Canvas is blank. The user has control over which content they want to display in the Palette at any time. The Palette supports static images, saved videos, and live camera feeds.

To sample a piece of the image, place a tile on the Palette over the area you want to grab. The tile is then moved to the Canvas area, carrying its content with it (see Fig. 1). The content stored in the tile will both move and rotate with the tile. When the tile is removed from the application surface, the content is as well.

In this way, the tiles act as direct representations of the data they contain. The correspondences are all one-to-one, resulting in a highly embodied input device (see Fig. 2).

IMPLEMENTATION

The tiles are laser-cut acrylic. They are tracked using the reacTIVision library. Visual tags are placed on the underside of the tiles and are tracked by a CCD camera placed beneath the application surface. The application surface consists of a sheet of 3/8" acrylic with a thin layer of velum. Velum is a translucent material similar to tracing paper. It allows you to project on the surface of the table while still being able to see the visual tags from below.

To improve tag recognition, the underside of the table is lit using infrared LEDs. Additionally, the IR filter was removed from the CCD camera and replaced with a visual light filter to filter out all but the visual tags. The visual light filter was created out of developed fully-exposed color film.

The application is displayed on the table using a standard LCD projector. The image is projected off of a mirror on to the application surface. The software was written using the Java-based Processing libraries.

TESSAL TABLE STUDY

A preliminary study was conducted with 4 elementary school students, aged 9-10 (3 male, 1 female). The study consisted of 15 minutes of instruction, followed by 30 minutes of free play, and a 15 minute group post-interview. The results of the study showed that the children understood and were engaged by the interface.

A number of the students were curious if I would return to the school when improvements were made, serving as a loose indicator that they were engaged by the experience. The only observed argument occurred over use of the video camera for the live feed. The fact that each tile is its own controller allows multiple children to work in the same space at the same time with little arbitrating. Responses about collaboration were varied among the group. Some preferred to work alone, while others preferred collaborative work.

At first, students were confused about the purpose of the interface. They began the study by manipulating one static image. When they realized that pieces of different images/videos could be mixed together in one composition, they understood it much better.

Students expressed a desire for more tiles as well as the ability to record and use their own videos using the video camera.

FUTURE WORK

In the future, I hope to explore more interaction possibilities of the device. Tiles do not need to be assigned content on a one-to-one basis. All shapes could contain the same content. As explained earlier, inserting your own content needs to be made easier. The ideal input method for recording would be I/O Brush-like, allowing children to point and record anything around them. Another interesting direction of research is modifiers of content. For example, perhaps mirror tiles could introduce symmetry in an image, etc.

CONCLUSION

This paper presents TessalTable, a tangible user interface for arranging pieces of images and dynamic video. The system uses a vision-based approach for tracking tiles, which act as containers for image content. The interface allows multi-user input without requiring the controls to be shared among the group.

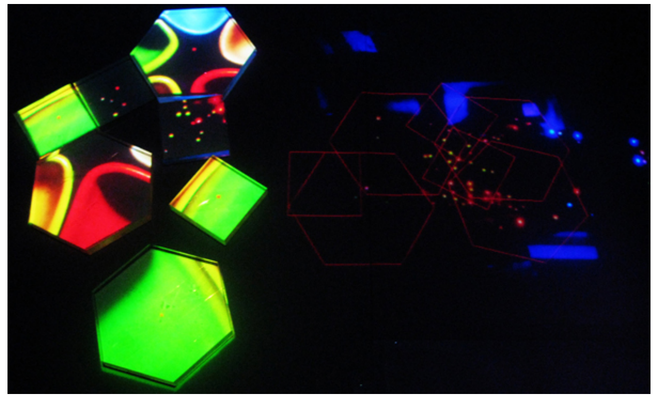

Figure 2: Overhead view of table surface. Content is selected on the right. Pieces are arranged on the left.

REFERENCES

1. Ishii, H., and Ullmer, B. Tangible Bits: Towards Seamless Interfaces between People, Bits and Atoms. *Proceedings of CHI 1997* (Atlanta, March 1997), ACM, 234-241.

2. Ryokai, K, Marti, S and Ishii, H (2004). I/O brush: drawing with everyday objects as ink. *Proceedings of the ACM SIGCHI Conference on Human factors in Computing Systems (CHI04)*, Vienna, Austria, ACM, 303-310

3. A. Mbogho , L. Scarlatos, M. Jaworska (2006). Teaching with Tangibles: A Tool for Defining Dichotomous Sorting Activities. *Proceedings of ACM CHI-SA 2006*, January 2006, 59-64.

4. Labrune, J. and Mackay, W. 2005. Tangicam: exploring observation tools for children. In *Proceedings of the 2005 Conference on interaction Design and Children*. IDC '05. ACM, New York, NY, 95-102.

5. Barnes, C., Jacobs, D. E., Sanders, J., Goldman, D. B., Rusinkiewicz, S., Finkelstein, A., and Agrawala, M. 2008. Video puppetry. In *ACM SIGGRAPH Asia 2008 Papers* SIGGRAPH Asia '08. New York, NY, 1-9.

6. OMalley, C., Fraser, D. 2004. Learning with tangible technologies. *FutureLab*. http://www.futurelab.org.uk/resources/documents/ lit_reviews/Tangible_Review.pdf

7. Piaget, J.; Memory and intelligence: New York: BasicBooks.

8. Papert, S.: The Childrens Machine. Rethinking School in the Age of the Computer. Basic Books, 1993, New York.

9. Ivan Kalas, D. Lehotska: Exploratory Learning. INFOS 2007: 33-44.