KineticCanvas: Synergetic Effort Between Art and Technology

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Figure 1. Kinetic Canvas Installation: (A) Exhibition setup showing the synergetic process between Art and Technology. (B) Final piece that showcase moving fish on the canvas (Only a single fish is visible at run time)

ABSTRACT
Kinetic Canvas is an attempt to synergise art and technology, where artists can animate paintings on their drawing canvas to represent a passage of time. We collaborated with a professional artist who works on "nihonga" artwork (artwork that features traditional Japanese techniques) to create a 5 feet by 3 feet art piece for a public exhibition. This paper presents the development process of the artwork, challenges faced by both the artist and the technologist and reflections on the synergetic effort.

Author Keywords
paper display; peltier; thermochromic; interactive art

ACM Classification Keywords
H.5.2. Information Interfaces and Presentation: User Interfaces

INTRODUCTION
In the recent times creative practices and new technologies have been blurring the boundaries between different disciplines. For example, introduction of toolkits such as LilyPad Arduino (Buechley et. al., 2008) have enabled artists to introduce new dimensions into their masterpieces. In addition, there is an increasing trend of developing toolkits such as Little Bits (Bdeir, 2009) to allow non-expert users such as artists, makers and designers to merge new technologies into their works. Furthermore, research projects such as FreeD (Zoran et. al., 2014) indicate attempts to merge creative practices and technology.

Our previous work on PaperPixels presented the technologies that tried to simplify complex concepts behind animating papers into a simple plug and play toolkit (Peiris et. al., 2014). PaperPixels is a toolkit that allows users to create subtle animations on papers. With this toolkit, the users would be able to create animations on paper by using a simplified three-step process: draw, attach, and animate. The toolkit uses paper, thermochromic inks (inks that change colour based on temperature) and peltier elements (solid state device for active heating and cooling). A workshop conducted at the Singapore Mini Maker Faire indicated that participants from ages 9 to 40 were able to grasp the concept and start using the toolkit immediately.

With Kinetic Canvas, we have been working with a Japanese artist, Tomoyuki Kambe[1], who works on "nihonga" artwork (artwork that features traditional Japanese techniques). His work is generally themed on `chance encounters' with fish, flowers, turtles, water insects that depict a single resonant moment in time.

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[1] http://goo.gl/SMUhOM

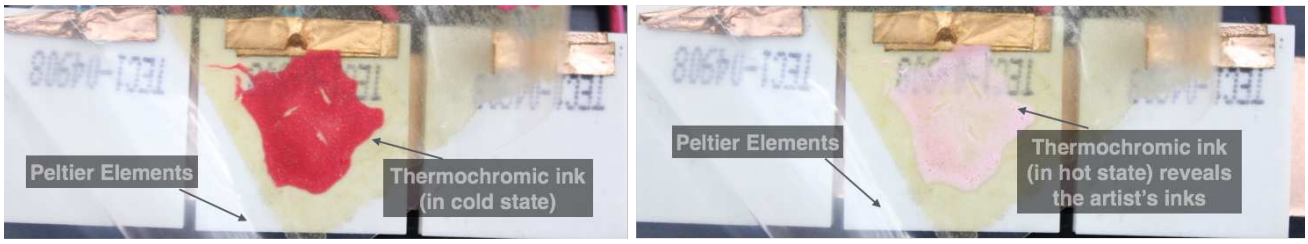

Figure 2. Experimenting the effects of the red color thermochromic inks mixed with inks used by the Artist

We had workshop sessions with the artist to exchange and learn each others' ideas and techniques. We then conducted brainstorming/prototyping sessions to conceptualise the ways of adding time-dependent dynamics (animations) to static moments that are represented in his paintings. Figure 2 represents an instance of these sessions where we explore mixing his regular paints and thermochromic inks and animated with the PaperPixels toolkit (Peiris et. al., 2014).

The Kinetic Canvas is a 5 feet by 3 feet animated painting (Figure 1) which was initially exhibited at the `Making Sense: Intersecting Lines of Investigation in Design and Technology' exhibition[2] in Singapore. This exhibition features works that were collaborative efforts between new technologies and creative practices such as art and design.

The contributions of this paper are:

- A case study to explore the synergetic collaboration between art and technology
- Understanding of the advantages and disadvantages of the PaperPixels technology when collaborating with creative professionals
- Presenting an artwork where technology acts as a catalyst in the background

KINETIC CANVAS

Philosophy behind the artwork

The nature around us features an assortment of subtle interactions between various organisms that spark interesting reactions. Whether it is ants crawling on a tree or a mimosa plant folding its leaves when touched, these `animations in nature' have often become a static impression of an artist on his canvas that represent a single resonant moment in time. Kinetic Canvas is an attempt to release the static nature of these artistic representations into a dynamic form. By adding a temporal component to the canvas, the artist can represent several moments of these `animations in nature' as several layers of animation frames on the canvas. That is, the artist can animate his paintings on the canvas itself to represent a passage of time of these nature's animations. This way, the interactions and reactions of the nature can be re-lived and captured on an artistic medium that is the canvas.

In Kinetic Canvas (Figure 1B), the artist attempts to capture the subtle movement of a fish in a pond. The position of the fish at each point in time is painted carefully as different frames by the artist. These frames are animated to appear and disappear with the help of the PaperPixels toolkit that is attached behind the canvas.

Development Process

As a starting point, we conducted a few workshops with few professional artists to understand their techniques.

Figure 3. Results from explorative workshops with professional artist: (A) Experimenting the effect of colour change in the fish (B) Exploring the effects of different types of ink binders on paper (C) An experimental art work created that depicts few animateable `butterfly' frames

Figure 3 highlights some of the explorations of these workshops. Through these workshops, we identified few key steps required for the implementation of the Kinetic canvas. For ease of discussion, we identify the development process of Kinetic Canvas in two tracks (Art and Technology) and discuss the various steps involved. Figure 4 denotes the two track development process.

[2] goo.gl/0AlaV0

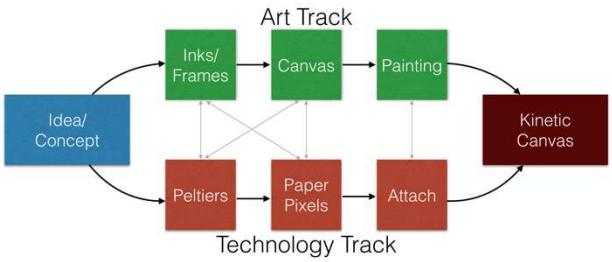

Figure 4. The Art Track and the Technology Track of the Kinetic Canvas Implementation Process

Art Track

This track signifies the artist's development process of the Kinetic Canvas.

- The artist experiments with different kinds of thermochromic inks and their capabilities. In the case of Kinetic Canvas, the artist tried available types of inks, their mixing capabilities, colors, etc. This was important in planning out the composition of the picture. In addition, here the maximum size of each frame (the size of the fish in the Kinetic Canvas) was decided. This was important in selecting the peltier sizes.
- In this step, the artist experimented on different types of canvas for the art work. The types of paper would have a significant effect on heat transfer characteristics from the peltier elements resulting in changes to the synchronization and speed of the animations.
- Working within the agreed specifications, in this step, the artist paints on the canvas using thermochromic inks for the animation frames (fish) and background with standard inks.

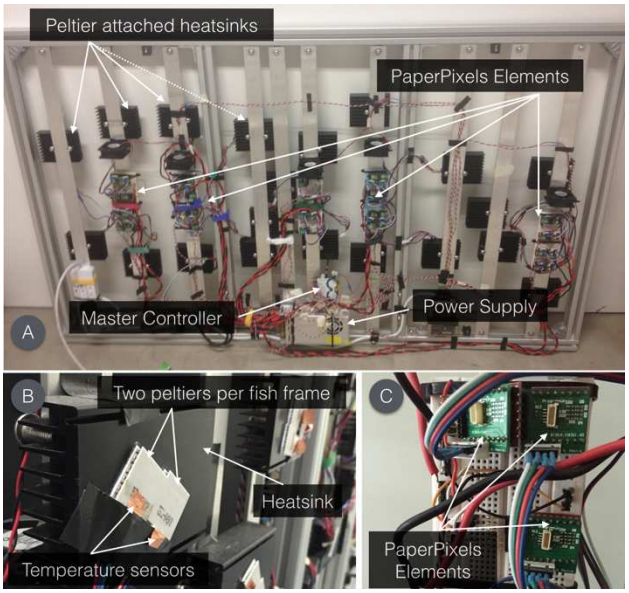

Figure 5. The structure behind the artwork holding PaperPixels components (A) The frame holding 20 actuator pixels for the 20 fish frames (B) A single heatsink module (C) PaperPixels elements

Technology Track

This track signifies the technologist's development process to support the development of Kinetic Canvas.

- Peltiers: In this step, after discussion with the artist, the size of the peltier is determined. This would involve determining the size of the animation frame. For most of the fish depicted in Kinetic Canvas, two side by side peltiers (2.5cm each) were used with two PaperPixels elements in synchronization (Figure 5B). This synchronization results in smooth animation of the full fish frame.
- PaperPixels: This step involved specifying and programming the PaperPixels elements to perform the animation. The PaperPixels elements are the controllers that raise or lower the temperatures of the peltier elements beyond the trigger temperatures of the thermochromic inks. Therefore, the thermochromic ink selection step by the artist was important to specify the triggering temperatures in the PaperPixels elements. As such, the modules were programmed with the triggering temperatures and the animation sequence using the animation software (Peiris et. al., 2014).
- Attach: In this step, we attach the peltier elements and the PaperPixels elements behind each animateable fish frame of the art work. For this purpose, we custom built a frame that could hold the underlying technology components together (Figure 5A).

DISCUSSION

Interactions and Challenges

The steps in Figure 4 are simplified for the purpose of discussion. However, there were plenty of continuous discussions between the artist and the technologist in between the steps. We list some key examples below.

Identifying the inks: In identifying the inks the artist and the technologist had to work together to understand each others requirements. The limitation of colours, using different mixers/binders for the inks were thoroughly experimented. In addition, we agreed to finalise on an ink that turned from one colour to a transparent colour when heated (without turning into another colour).

Number of frames: There were numerous discussions on selecting the number of frames for the animation. To keep the Kinetic Canvas operating for more that eight hours a day and over the course of few weeks, we decided to settle at twenty fish frames for the animation. While more frames would have made the animation smoother, there were concerns of operating long hours considering that peltiers are inherently power hungry devices.

Attachment of pixels: The attachment and painting process also required continuous discussion between the two parties to avoid frames being drawn in areas where the peltier and PaperPixels elements could not be attached. However, the drawing would still need to be up to par with the artist's expectations.

Power requirement: The work required 20 PaperPixels modules in total. This required proper power management to ensure prolonged operation of the artwork as each PaperPixels required approximately 10W of power. This was one of the main challenges of the work.

Feedback

We had the chance to meet and interview some of the attendees at the Making Sense exhibition. Following are few key feedbacks from 6 selected attendees.

Hidden Technology: All the attendees were impressed by the fact that the art was the highlight of the Kinetic Canvas. They were impressed by the subtle animations which was happening on the canvas itself that was not overshadowed by the driving technology.

Proportions: Three attendees mentioned that they would prefer more frames as the final artwork seemed quite empty. They felt that the animation scale was not enough for the size of the artwork.

Speed: Two attendees indicated that the speed of the animation was too slow which could possibly seem as if there was no animation on the canvas. There's possibility of speeding up the animation but we believe the PaperPixels technology is meant to add subtle and ambient dynamics to a static drawing.

Interactivity: Two attendees suggested that we add an interactive component to the Kinetic Canvas. Follow up discussions led to interesting scenario ideas such as fish `swimming away' when there were people around.

Limitations of the current implementation

Our previous PaperPixels workshop with hobbyists at the Singapore Mini Maker Faire indicated that the toolkit was easy to learn and use. However, the experience of Kinetic Canvas can be characterised as a challenging and compromising collaboration between the artist and the technologist. This can be attributed to the following limitations.

Scale of artwork: The Kinetic Canvas is the largest form of artwork that was done with the PaperPixels toolkit. Most of our previous works (including those at the MakerFaire workshop) featured approximately A3 size works. This size could comfortably work within the specifications of the toolkit. However, in scaling up, Kinetic Canvas required careful coordination between the artist and the technologist to ensure a number of factors such as the alignment of the peltiers with the fish on the canvas, ensuring efficient contact between the peltier modules and paper etc. Therefore, in future versions of the toolkit, we intend to look at improving the attachment process. In addition, we are intending to look at rigid frames that allow easy attachment of the pixel elements.

Heatsink modules: All peltiers were mounted on separate heatsinks to ensure proper heat management over longer periods of time. Therefore, we identified that the PaperPixels elements should be further modularised along with the heat sink modules to allow ease of use for large scale projects.

As mentioned above, this synergistic collaboration empowered us to understand the current limitations of the PaperPixels toolkit from a different perspective. We intend to address these issues to develop a PaperPixels toolkit version optimised for larger scale works.

CONCLUSIONS AND FUTURE WORK

Kinetic canvas is an animated art work that features a collaborative exploration between art and technology. With this case-study, we were able to explore the PaperPixels toolkit's advantages and limitations in the context of using in a large-scale art installation. We discussed various challenges and opportunities identified during interactions between technology developer and creative professional. The final piece was presented as a work that intersects art and technology at the `Making Sense exhibition' in Singapore, which was well received by the attendees.

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