Tangible Tiles - Vision-based fluid interactions

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Abstract

We will be continuing the **Tangible Tiles** project with the same group members.

1 Current State of the Project

We have a proof-of-concept prototype developed with an overhead camera for vision-based touch recognition and two physical prototypes. Our system acts robustly to both single and multitouch interactions and detects even the lightest touches [using our underside projection prototype].

When we were testing our **Tangible Tiles** prototype, we noted the following properties:

- *playfulness* - input has a waterbed effect, making interacting with the tile a playful experience.
- *input-agnostic* - most touch input devices require an instrumented or calibrated input device [pen, hand, other object]; our tile can operate under any pressure-based input.
- *input ecosystem* - multiple inputs interact with each other (e.g. the type of shape that emerges from two fingers moving away from each other is unique)
- *scalability* - the board currently costs $15 (materials) + $40 (webcam) to make. We believe we can scale the board to 12 x 24 for about $30, initially limited by the effective area of our laser cutter.

2 Future directions

Now that we have some initial prototypes developed, we are most excited to explore 1) expressive input, 2) large-body interactions, 3) coarse output, and 4) tangible vision-system components. In software, we will build an API for several easy-to-use vision outputs. In hardware, we will build several tile sizes for both small, button-like and large, foot-based interactions. Additionally, we will explore embedding output into the tile for an overall fluid interaction.

2.1 Expressive input

We see these properties as lending themselves to expressive input applications such as a musical instruments, drawing/painting applications, or as a performative floor. In order for the tangible tile to be portable to multiple media, we will be developing an input API that encodes several features from vision blobs: position (centroids), area, eccentricity, optical flow, polygon wrapper, and coarse pressure.

Using this input API, we will develop both visual and audio (MIDI) applications which either use the raw API values or train classifiers for desired interactions (e.g. swipe, chord).

One visual application is to make silicon-mold brushes, such as those used in heavy-body painting, to simulate the full look-and-feel in a digital painting context.

Another interesting application would be to utilize the computer vision system and allow for analog mixing of paint. By overlaying the top of the screen with a transparency, we can make it a palette. We can then sample the color from any item that is placed in a predefined region using the webcam.

Figure 1: Silicon brushes used for heavy-body painting

2.2 Large-body interactions

Our first two prototypes explored hand-based touches; in the first, the user touches from above, and in the second, from below. However, in our midterm presentation we proposed the ability for any other limb or object to create a touch-event. We term this Large Body Interactions. As described in the scalability section, our current construction methods limit the prototype to 12 x 24, which is large enough to demonstrate foot-based detection. Practically we envision a tile the size of a floor mat or several scalable tiles for a larger floor.

2.3 Coarse output

Our prototype already provides input-output coincidence whereby the user sees a colored circle around his or her finger when then press on the screen. This establishes a feedback loop between the camera and the user to recognize commands. We can improve this feedback loop using coarse output from a thermochromic display. A heat-sensitive liquid can easily be substituted inside the Tangible Tile. A sparse grid of resistors can then act as a heat source to create a visual output.

We envision an application where the user is led through a space by phantom footsteps that precede several feet in front of the user. These phantom steps can direct a user to their destination or present alternate routes..

2.4 Tangible vision-system components

We see several vision-based components (e.g. buttons, sliders, etc) that can be developed using liquids as a mediator. These buttons can be scaled for large-body interactions in order to obtain higher fidelity readings.

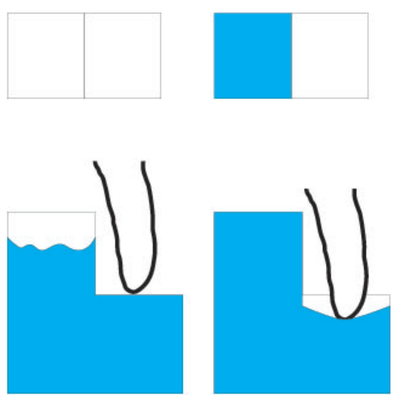

Figure 2: Example of an optical momentary button. The top row depicts what the cameras view. The bottom row depicts a membrane that deforms, displaces a liquid inside the structure, and creates an optical momentary button.

3 Questions for Kimiko and Laura

Is there a larger laser cutter that we have access to (and is functional)?