Storyboard: An Animation Station for Children to Collaboratively Tell Stories

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Abstract

Storyboard is an interactive, collaborative desk for children to bring their school assignments to life. More specifically, we've implemented an example module. In this module, students can collaborate with one another to animate a scene prepared by the teacher. Our project is designed to be imaginative, collaborative and fun. Whether it's art class or science class, concepts should be presented in more engaging, interactive and tangible ways.

Author Keywords

HCI; color and sound; education; learning techniques; story-telling.

ACM Classification Keywords

H.5.m. Information interfaces and presentation

Concept

Students use the desk just as they would otherwise. The camera is designed to be un-obstructive to the front of the classroom, so the student can clearly see the teacher and the whiteboard/projector at the front of the room. Instead of typing on a laptop, students could write on their desks with styluses or use a regular notebook since there would be no need for a laptop to take up space on their desk.

Students interact with the table by manipulating and designing physical objects. At this point, the output is visual and sound based, but we could imagine 'smart' primitives like Toio or the Transform topography being applied to this setup. More specifically to our application implementation, by using cutout pieces of construction paper, kids can design and assign their own sounds to shapes, can move the pieces around, and don't risk damaging expensive equipment (construction paper is way less expensive than a computer monitor).

Motivation

Many schools are shifting to purchase computers and laptops for the classroom, but those can be distracting because they physically block students' line of sight from the teacher. Children should be allowed to experiment using an interactive and dynamic medium. Additionally, they should be able to share their creations and collaborate with other students real-time. There would be more opportunity for collaboration compared to a traditional laptop as laptops are designed to be personal sized. Children can work on their own desks or partner with each other or the teacher to collaborate on a single work surface.

Affordances

On one hand, the main sensor of the system is the camera which can capture x and y coordinates of a wide spectrum of RGB color values.

On the other hand, the actuators are the **speakers** and the **projector**, both as output devices. The speakers allow the user to hear sound and the projector replicates whether the other platform's camera is capturing. This allows the user to experience i/o coincidence.

There are other important devices or objects to interact with. The user plays with colored construction **paper/watercolor/craft materials**. These analog input devices make the user feel familiar with and they'll be more likely to quickly adopt our platform. Moreover, by choosing a low-cost material, we're encouraging the user to create without worrying about perfection.

By using the physical paradigm of playing through arts and crafts, the user doesn't need to 'pre-learn' how to interact with our device. Instead they can learn about the relationship between color and sound as they naturally explore and create on the platform. Since we're using both visual and audio cues, if the user is hearing or visually impaired, they can still interact with the platform.

Constraints

The brightness, resolution and frame-rate from the camera are their constraints. The same for the projector because their function is to replicate the different animations. However, the projector needs to be precisely placed relative to the platform. The speakers' volume can be adjusted but it has to be enough for creating the right environment. Also, they don't have to be binaural.

As explained in the affordances section, the input devices used (Colored construction paper/ watercolor/ craft materials) are analog. The users are more familiar with them and this kind of materials allows a better manipulation, giving to the user the total freedom to create shapes. Furthermore, they will be more likely to quickly adopt our platform. The overall device doesn't require expertise to be use it. So this main characteristic is definitely a constraint.

Software Implementation

In terms of software, our project was implemented in Max MSP. Emily wanted to learn more about visual programming and Max and took this project as an opportunity to do just that. Max MSP was the perfect platform for the programming requirements of this project. The software is primarily used for video and sound processing and manipulation, which is exactly what Emily was looking to work with. The software is broken into three main components, image processing, image to sound conversion, and image output.

Image Processing

The software grabs frames from the webcam at a down-sampled frame rate (approximately 6 frames/sec) and resolution (24×8 pixels). Then, the saturation and brightness of the image is modified to easily extract and identify colors and to minimize noise from the background. Next, the current frame and previous frame are compared to identify motion. If the pixel value change is great enough, the software registers that position as motion and turns that pixel white. Lastly, the software compares the color image with the motion alpha image and selects the minimum RGB value. That way, if there was no motion detected at a pixel, it will be black, and if there was motion, that white pixel value would be converted to the color in the color detection frame.

The above clip shows the motion alpha channel combined with the ultra-saturated camera input.

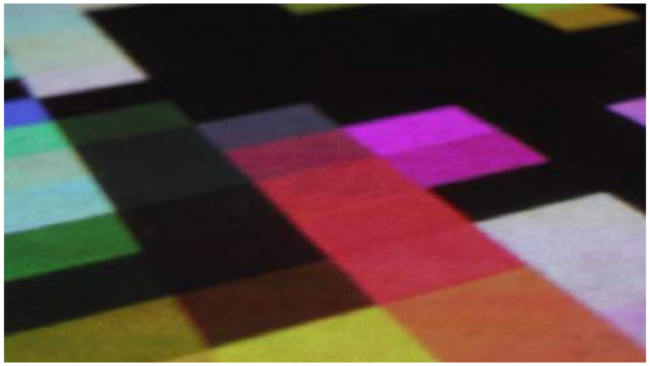
Pixel to Sound Conversion

For the sound processing, Emily started by writing a threshold logic. For example, if the R pixel value was greater than 200, the G pixel value was less than 100 and the B pixel value was less than 100, then my sound processor would register that pixel as RED. There were also threshold values for the colors GREEN, BLUE, and PINK. We avoided using colors that too closely matched skin tone (like yellow, orange, and brown) since we didn't want to pick up hand motion in our sound processor. When the sound converter registers a hit, it increases the volume on that color value. If no hits are registered for that color in the frame, the volume slider fades out.

For the PINK color value, the sound sequencer introduces a looped track. This is to showcase that the user can assign sound loops to trigger when they move a sound loop assigned color. For the RED, GREEN, and BLUE color values, there is an additional mapping of sound over the y-axis. If the user moves one of those colors to the top of the page, the pitch of that instrument is higher, and if they move the color to the bottom of the page, the pitch decreases.

Image Output

Lastly, the composited image is output to the reciprocal device, so the users can share and create animations together. An interesting side effect of this setup, is that in high light situation, the projector output is dim enough to be filtered out in the camera feed (avoiding a feedback loop).



Materials:

Sensors: Webcams

Actuators: Projectors

Other Physical Materials: cardboard, clear acrylic, paint brushes, paper, paint

Electronics: Computers to run Unity/OpenCV/Sound/MaxMSP

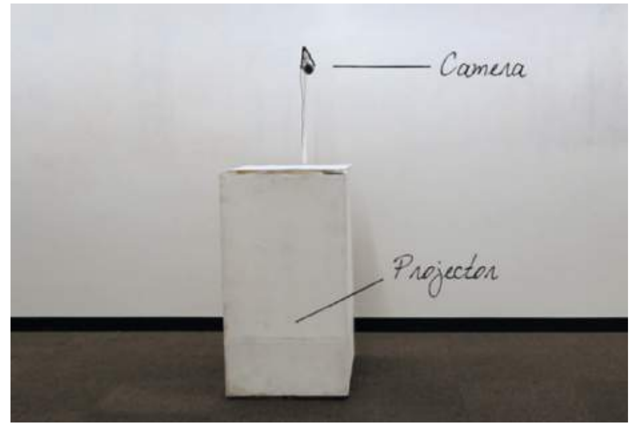
Images:

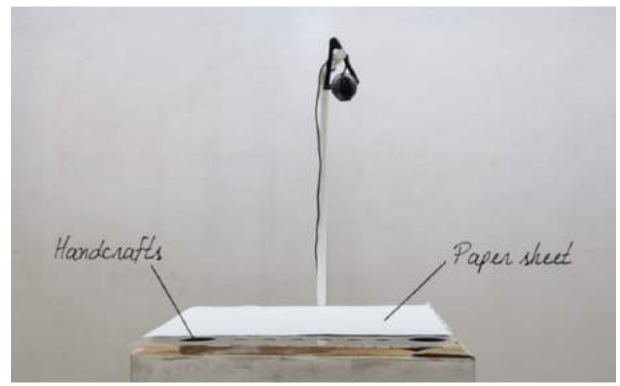
Projection on the sheet of paper of the interaction.

However, in a low light situation (triggered by switching from high light to low light), the camera detect tries to detect color in the darkness, and starts to dream. Those colors are output to the projector and cause new colors to be seen by the camera, generating sound. In this low light situation, the interaction paradigm changes. Now the user can block and add light to the storyboard surface to contribute to the generative composition. For example, if the user blocks all the light on one table, the other table will eventually stop playing music. If the user shines light (from a flashlight or their phone), the feedback loop begins again, radiating out from where the light was applied.

Platform

For the fabrication of the platform, we bought large cardboard boxes (24”x24”x45”) to create a projection surface that matched the size of the canvas. If this were an actual product, we would use a smaller form-factor but we were working with the projectors we already owned (as opposed to buying short throw projectors or monitors to embed under our working surface). We cut PVC pipe to hold up the camera above the canvas and secured the projectors at the base of the table. We painted the boxes white to make it look like we cared about the aesthetic a bit. We cut holes into the clear surface acrylic to create storage pots for the arts and crafts supplies. Lastly, we created demo props using construction paper, pipe cleaners, and popsicle sticks.





Final platform where the different parts are indicated on both pictures.

Imaged captured from two users using the platform and interacting by creating the animations.

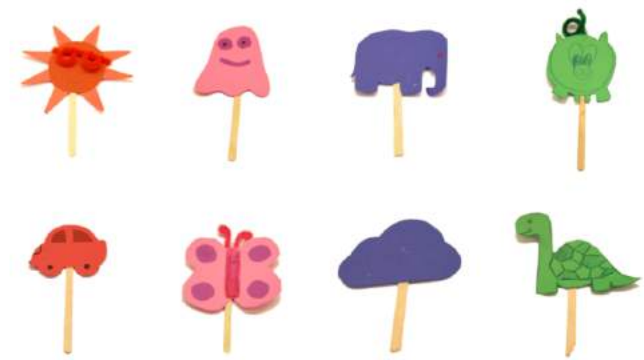
Application

It's very difficult for young children to animate using traditional software like after effects (key framing, rigging, etc.). Even software aimed at children like scratch and logo can be tedious to program and can be difficult to understand and navigate. In the context of imaginative thinking and storytelling, we think this platform could be useful for kids to tell stories with one another. Kids can only use two hands to move pieces, but this system would allow for ~2n pieces to be moved, where n equals the number of platforms. By adding sound effects to the motion, kids can be further inspired to create and think about the story composition holistically.

The teacher could publish backdrops or story prompts from her master device. The student desk devices would receive the prompt. The kids could use prefabricated tokens and sounds or they could design their own tokens and sounds depending on their skill level. When one kid animates an object in their scene, it can be shared with the rest of the class. Additionally, connected desks could create "stop-motion" animations by taking photographs of each frame of motion and playing them back sequentially. Example scenes include "neighborhood" and "ocean reef", but the possibilities are as endless as a child's imagination.

Thus, we're making an animation station for children to collaboratively create storyboards together using cardboard cut-out tokens.

Design



Prefabricated Tokens

Design your handcraft and tell a story with music as a support.

Conclusion

Overall, this was an awesome opportunity to learn more about telepresence, interaction design, image processing and Max MSP.

ACM Copyrights & Permission Policy

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