Dranimate: Paper Becomes Tablet, Drawing Becomes Animation

Ali Momeni
Carnegie Mellon University
CFA 300 - 5000 Forbes Ave.
Pittsburgh, PA 15213, USA
momeni@cmu.edu

Zachary Rispoli
Carnegie Mellon University
5000 Forbes Ave.
Pittsburgh, PA 15213, USA
zjrispol@andrew.cmu.edu

CHI'16, May 7–May 12, 2016, San Jose, USA.
Copyright © 2016 ACM ISBN/16/04...$15.00.

Abstract

Dranimate is an interactive animation system that allows users to rapidly and intuitively rig and control animations based on a still image or drawing using hand gestures. Dranimate combines two complementary methods of shape manipulation: bone-joint-based physics simulation and the as-rigid-as-possible deformation algorithm. Dranimate also introduces a number of designed interactions created around the metaphor of an image on a tablet screen replacing a physical drawing. The interactions focus the users attention on the animated content, as opposed to computer keyboard, mouse, or tablet surface while enabling natural and intuitive interactions with personalized digital content.

Author Keywords

Animation; gestural control; puppetry; mobile; playful

ACM Classification Keywords

H.5.1 [Multimedia Information Systems]: Animation; H.5.2 [User Interfaces]: Input devices and strategies

Introduction

This paper describes an extension to Dranimate [2], a real-time system that allows users to rapidly rig and gesturally control animations derived from hand drawings or printed imagery. The first version of Dranimate was implemented

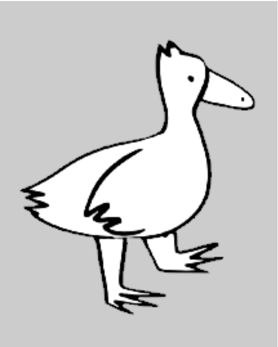

Figure 1: Sample drawing on paper; (bottom) virtual drawing on tablet after processing and contour recognition

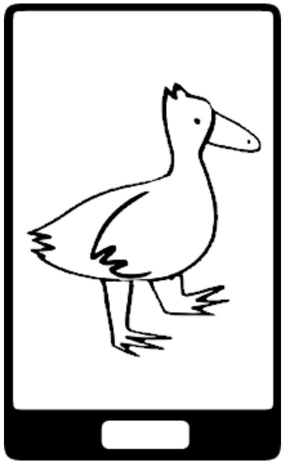

Figure 2: Virtual drawing on tablet after processing and contour recognition

in C++ using openFrameworks[1], an open source toolkit designed for creative coding. This implementation was designed for desktop computers and required a number of hardware accessories, most notably a USB or Firewire camera and Leap Motion controller[2]. While this implementation proved effective for production and performance contexts for expert users, it lacked the accessibility to be used by non-expert and young users. The new version is implemented for a mobile tablet equipped with front and back facing cameras. The back camera is used to capture images of drawings placed on a table top, while the front facing camera is used to track the user's hands and in turn control the animation in real-time, akin to a digital puppet.

Implementation

This version of Dranimate employs openFrameworks for iOS[3], along with the openFrameworks addons listed in [2]. As opposed to the previous version, the external camera is replaced with the back camera of the tablet, while the leap-motion controller is replaced with machine vision applied to the front facing camera.

User Interaction

The interaction design for this version of Dranimate is motivated by the following metaphor: a physical drawing (Figure 1) is transferred to a virtual drawing on a tablet (Figure 2), where it comes to life. Efforts are made to preserve scale between the physical drawing and the image rendered on-screen; similarly, the interaction design symbolically replaces the paper on a table-top with a tablet placed on top of the paper so as to create the impression of the drawing *entering* the tablet screen and coming to life. The sections below describe a step-by-step walk-through of the user interactions for creating an animation from a drawing on paper.

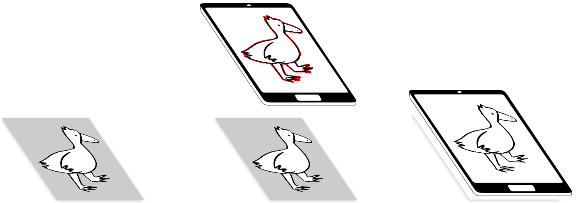

Figure 3: (left) the drawing on a table tope; (middle) user holds tablet above the drawing and captures and image; (right) user places tablet on top of drawing

Image Acquisition

The user begins by capturing a picture of an image they wish to animate. The tablet is held above the image, the image is captured, and the tablet is placed down on top of the paper, supporting the metaphor of the drawing "entering" the tablet (See Figure 3)

Image Processing

The software employs contour detection and thresholding with the OpenCV computer vision library in order to isolate the figure of interest (See Figure 4)

Mesh Generation and User Definition of Expressive Zones

The application generates a triangulated mesh based on the isolated image contour. The user then defines a number of expressive zones that serve as control points for the as-rigid-as-possible [1] shape deformation engine. Once this step is complete, the digital puppet is ready to be animated with hand gestures. See figure 3 for an example of this process. During this step, the user also associates each finger with a specific expressive zone in the meshed contour by

[1] http://openframeworks.cc

[2] https://www.leapmotion.com/

[3] http://openframeworks.cc/setup/iphone/

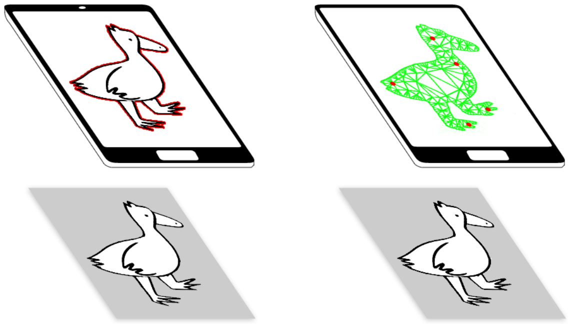

Figure 4: (left) system analyzes the image to find contours and to create a triangular mesh within; system also places five expressive zones on areas in the image suitable for expressive movement; (right) five expressive zones corresponding are placed within the mesh, corresponding with the user's five fingers;

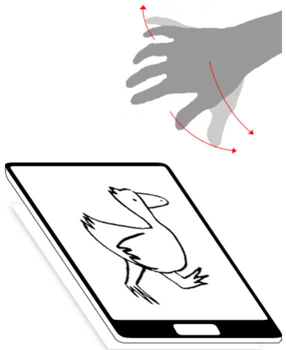

Figure 5: Sample drawing on paper; (bottom) virtual drawing on tablet after processing and contour recognition

sequentially touching desired expressive zone starting with the thumb (finger 0), followed by the index finger (finger 1), middle finger (finger 2), ring finger (finger 3) and pinky (finger 4) (See Figure 6).

Real-Time Animation of Image through User Gesture
Dranimate implements machine vision hand tracking as described by [3] in order to identify the location of each finger, as well as the palm. The system maps the location of each fingertip to displacements in the location of an expressive zone in the meshed contour, thereby allowing for real-time animation of the drawn image.

Conclusion and Future Work

Dranimate exploits a range of software, hardware and interaction designs to facilitate creation and gestural control animated characters. In addition to obvious applications within animation and special effects, we propose that this approach to intuitive real-time animation holds promise within education, storytelling, information visualization and participatory art installations and performance.

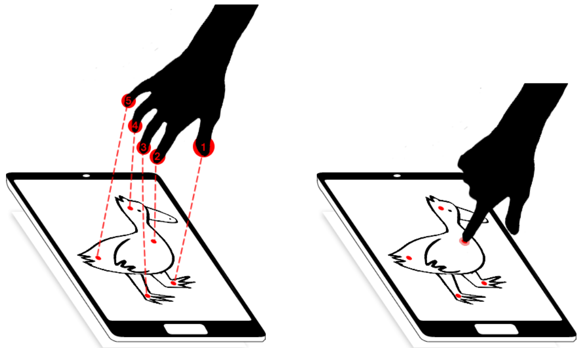

Figure 6: (left) five expressive zones in drawing correspond with five fingers; (right) user sequentially touches ezones with finger tips;

References

[1] Takeo Igarashi, Tomer Moscovich, and John F Hughes. 2005. As-rigid-as-possible shape manipulation. *ACM Transactions on Graphics* 24, 3 (2005), 1134–1141.

[2] A Momeni and Z Rispoli. 2015. Dranimate: Rapid real-time gestural rigging and control of animation. In *Proceedings of the 28th Annual ACM Symposium . . .*.

[3] Yalun Qin. 2015. Color-Based Hand Gesture Recognition on Android - Eaglesky's Blog. (Dec. 2015). http://eaglesky.github.io/2015/12/26/HandGestureRecognition/