Using Animated Vectors to Generate 3D Models from 2D Shapes

Jennifer Weiler

School of Arts, Media, and Engineering, Arizona State University
Tempe, Arizona USA
jjweiler@asu.edu

Abstract

The focus of this research is to explore an alternative means of computer animation by allowing two dimensional vector models to be viewed with directional variations. By doing this, the animated model is composed of 2D shapes but can be viewed from multiple angles like a 3D object without having the structural limitations and complex rendering of a 3D mesh.

Keywords

Animation, vector graphics, 3D modeling, Processing

Introduction

Computers have created options for vastly different types of animation by allowing for control and complexity that is virtually impossible to create using only hand drawing. However, despite the diversity of animation that is being created, most of this can be traced back to using series of 2D images or animating 3D models. This project is centered on creating models based on 2D vectors that, despite being composed of flat shapes, can be viewed and animated in three dimensions. To do this, algorithms are used to manipulate the shape of the 2D vectors based on what direction they are viewed from.

3D Animation and Rigging Systems

3D animation is composed by creating a character model with a poseable rigging system. The 3D model is most often constructed from several 2D source images, and have a rigging system to allow the model to be move [5]. For example, a human model would have tools to move or rotate all major joints, so that the model could be animated in a way that mimics how humans actually move [1]. After the rig is created, the actual animation is done by moving the joints of the rig to different positions within the timeline of the animation [4].

2D Computer Animation

While 2D animation still largely focuses on drawing individual frames to depict continuous movement, there is currently an additional focus on using computers to combine and manipulate raster images into smooth animation [2, 3]. In some cases, 2D animation movement is accomplished by deforming raster images in order to make them appear that they are moving [7]. In contrast, it is also possible to create 2D animation based on manipulating vector shapes, which can change shape without distorting or loosing details the way a raster image will [6].

Development

This demo was created using Processing, a programming platform that is focused on having visual output and includes many tools to allow for user interaction. During development, several different versions of the program were created to test different parts of the system, including the means of animating the models using pins, the mechanics of 3D rotation and viewing, creating models that are flexible while still holding a recognizable shape, and a version that combines all of these features into a functional prototype (fig. 1).

Animating with Vector Shapes

In this demo, each part of the model is based on simplistic vector shapes. Each point in the vector has a corresponding xy coordinate that can be algorithmically changed based on the angle the model is being viewed from (fig. 1, fig. 2). Because the models are composed of these individually animate-able points, they can have flexibility based on the direction they are viewed that is not present in 3D meshes (fig. 2). In addition to being able to rotate the model, I developed a rig structure composed of pins that could be used to separately animate specific points on the model in a sim-

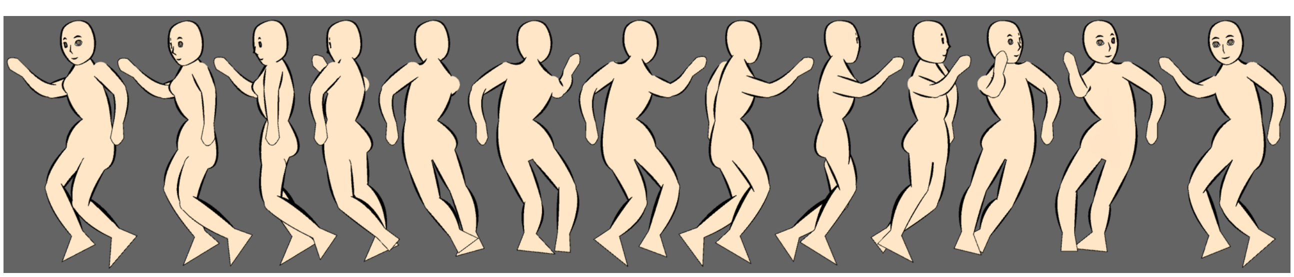

Figure 1. Example of posed 2D rig when rotated to be viewed from different angles.

ilar matter to current 3D animation techniques (fig. 3). When these capabilities are combined, they result in a complete model of the figure that can be posed using the rigging system and be viewed from multiple angles (fig. 1).

Rigging with Two Dimensional Models

Using two dimensional perspectives to animate the model does limit how much the animator can do without rotating the model. For example, if the figure is facing the animator, the animator would be able to move points on the model along the x axis (side to side) or the y axis (up and down) but not the z axis (depth). Similarly, if the animator were to rotate the model to its side, they could move points on the z axis but not the x axis. This is because the current system's user interface is moving the pins based on how they appear to the user, and not their actual position in space. To combat this, it may be preferable to add distinct controls that move the pins along the x, y, and z axis without regard to what perspective the viewer is observing the model from.

Conclusion

This project was able to develop a simplified way of animating models using the rigging approach common for 3D animation, but without requiring the data storage and structural meshes required for 3D models. While this model is still an early prototype, the results of this research have proven that this is an avenue in animation that is worth exploring. In the future, I am interested in exploring the possibility of testing this approach with animators as well as developing more complex animations using this technique.

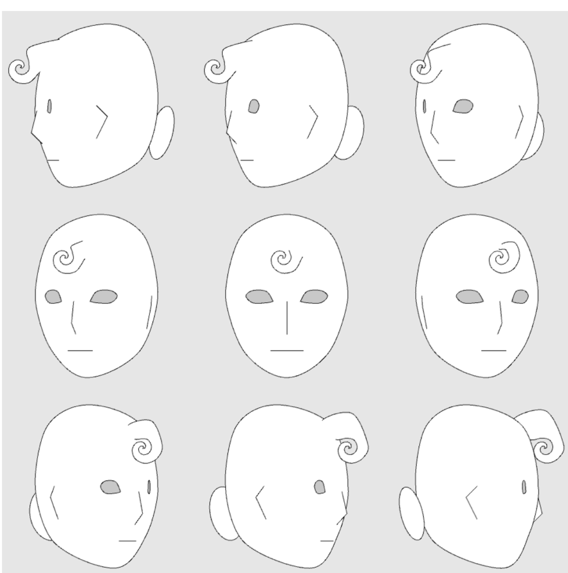

Figure 2. Example of head model being rotated to different angles. Because the model is not based on 3D geometry, it is possible to have parts of it (in this case, the hair) deform depending on the direction it is viewed from.

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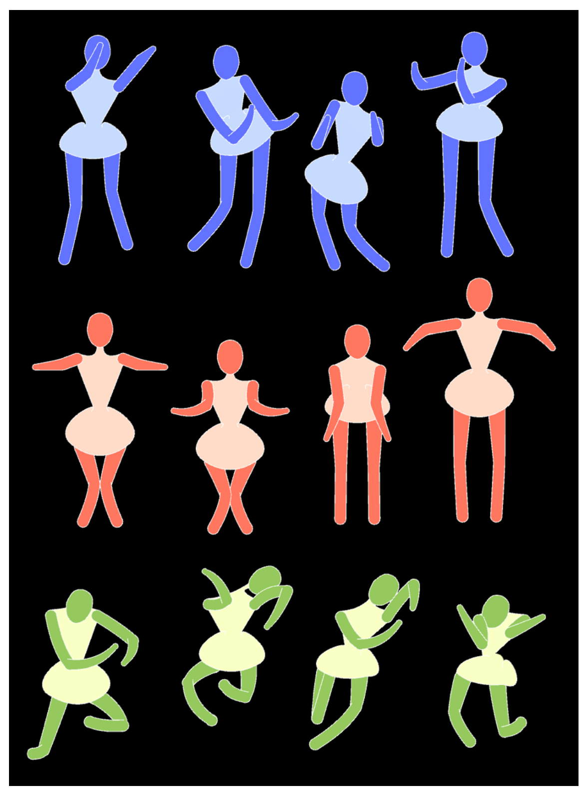

Figure 3. Example frames from some of the earlier animation tests. In order to test the robustness of the character rigs, we attempted a variety of animations, including randomized movements in order to insure that the model would still maintain a recognizable shape.