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The Use of Motion Capture and 2D Animation in the Making of "If at First..."

Kyle Formella
formella@siu.edu

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THE USE OF MOTION CAPTURE AND 2D ANIMATION
IN THE MAKING OF "IF AT FIRST..."

by

Kyle Formella

B.A., Southern Illinois University, 2009
B.S., Illinois State University, 2007

A Research Paper
Submitted in Partial Fulfillment of the Requirements for the
Masters of Science Degree.

Department of Professional Media Management and Media Studies
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Approved by:

Cade Bursell, Chair

Graduate School

Southern Illinois University Carbondale

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INTRODUCTION

This paper serves as the written component of my final project completed for my Masters Degree in Professional Media and Media Management Studies. It documents the process of producing my 2D animation titled "If at First…" from start to finish, incorporating cutting edge techniques for motion capture as a supplement to traditional key framing. Since I am seeking a position in a related field, and because I have a passion for technology, I felt that this project would serve as a perfect learning experience and provide a great example of my skills for my portfolio.

With the help of my faculty mentor, Professor Cade Bursell, I learned a great deal about my abilities as a storyteller. Despite the fact that I acquired considerable knowledge regarding production software, I would say that one of the most beneficial lessons learned was regarding the storyboard process. Throughout nearly all of my previous personal work, I almost entirely disregarded the storyboard process. Typically I would jump right into the production phase, which in hindsight lead to wasted time. For this project however, I was pushed to take full advantage of the storyboard step in the production process. Not only was I far less overwhelmed as I began creating the various scenes of the animation, but I was also better able to assess my progress.

In addition to explaining the process that I engaged in and the inspirations that fueled my vision, I will discuss the open-source movement surrounding the use of Microsoft Kinect based motion capture.

MY PROCESS

My process for creating an animation, regardless of whether 2D or 3D, begins with a search for a story. Not having any fantastic ideas of my own, I began surveying the type of material that other comparable independent animators have chosen, searching websites like Vimeo and YouTube. I found many good examples of entertaining or thought provoking animations, which were at least in part written by someone other than the animator. This affirmed my decision to discuss the project with another creative mind to determine a storyline.

Initially I began searching through poetry and short story compilations books. But unfortunately I was not finding any material that either appealed to me or was suitable for the type of animation I was looking to make. I decided to consult a person with a known creative and artistic mind and thus a concept emerged that intrigued me. Her idea was a short story about a T-Rex dinosaur with a desire to be a musician, but a problem with too short of arms to adequately play anything. In the end the dinosaur finds the ukulele, which is perfectly suited for his stubby arms. The story had some obvious appeal since it was very appropriate for the animation medium.

So I had a concept to work with, but I needed to further flesh out how exactly it would look. Since the concept originated from an outside artist, I thought it would be beneficial to tap into her talent for illustration as well. I asked if she wanted to be further involved in the animation, which she was excited about. I saw this as opportunity to diversify my workflow. Additionally, I had not created any illustrations for many years, even perhaps since high school back in 2002.

My plan was to invite this artist named Ashley Brown to collaborate on the project through creating the characters and potentially the scenes, which I would then prepare for animation. We began with the main character initially. I requested a line drawing of the T-Rex, and since Ashley was located 7 hours away, she provided this as a scan of a hand drawn image. I realized that we were not seeing eye to eye on the style I was looking for. More importantly, I began assessing exactly how I would accomplish certain character movements. Her character design had an independent jaw, as opposed to the solid head shape I ended up using. Nevertheless I prepared the character she drew by dissecting it in Adobe Photoshop. In order to accomplish the type of animation that I was planning, using Adobe After Effects, I would need each limb to be a separate object. However, I did not want to bother Ashley wish this. It turned out however that the process of cutting and cleaning up a "flat" drawn character was more work than I wanted to do. Couple that with all of the various character angles I would need, and all of the secondary characters not yet created, and it was adding up to be an excessive amount of work just dissecting drawings.

With a clear solution in mind, I went back to Ashley and requested that all drawn characters from then on be separated into body, head and limbs; with minor details like eyes and mouth excluded (Figure 1). This would allow me to color and texturize limbs cleanly, and to then reassemble the character in After Effects. This would serve as the process used for all characters used throughout the animation, but ultimately I would not be collaborating with an outside illustrator. It turned out that Ashley, who is completing her first college degree, was too busy to meet the deadlines I had set. In a panic state I went to the drawing board to see what I could accomplish on my own. The end result

can be seen throughout the animation, since every drawn set, object and character were of my own illustrations (Figure 2).

So now with a rough story in place and the need for an illustrator fulfilled, I began looking forward to the next step in the process. With the guidance of Professor Cade Bursell, I managed a draft version of a storyboard that would serve as the outline for the final product. My focus for the storyboard was less on the story itself, and more about the various sets, shot angles, character models and objects I would need. Since Ashley provided me with a concept, but not a scripted story, I basically made it up as I went along. With the feedback of some classmates, I realized that the story needed some tweaks. The most important change was concerning the reveal at the end. Initially I had given away too early the fact that the T-Rex discovers the ukulele. This was changed to give greater suspense up to the point of the reveal in the scene.

I now had a storyboard with which I could use to illustrate all of the necessary character models and sets. After assembling two or three scenes as planned, I realized that there were gaps in time between different shots in a single scene. Many scenes appeared as though they would benefit from additional shots beyond what was described in the storyboard. I also realized, that some of these gaps would require complex animating and entirely new models just to accomplish three to five seconds of transitional footage. In the end I used still shots or close-ups of objects in the scene to accomplish the transition for most of the gaps. One example is where I cut to the guitar lying on the floor in place of animating the T-Rex hopping into his beanbag chair and picking up the magazine, which would have involved multiple character models for a three second shot (Figure 3). Then to give the transition shot more purpose, I added

the snapping of one of the strings.

As I continued on with the scene assembly and animation process, one goal I tried to maintain was organization. My plan was to make it so easy to understand my workflow that I could potentially use it as a learning tool for others; sharing everything. Ultimately I did accomplish this up until about the last 25% of production. As my end of semester deadline approached, I had to toss organization aside. When I have some free time I plan on cleaning up all of the last minute messy pre-compositions and scattered assets.

There are some defining characteristics of my animation that made it a manageable learning experience. The most significant is that the lack of dialogue to worry about. My initial collaborator, Ashley, suggested some potential dialogue for the story. However I was not very enthusiastic about the material offered. Instead I planned to support the story through the use of visuals and diegetic sound. The objects and posters in the main character's room are meant to help the audience understand his motivations. The sounds that emerge from his attempts at playing multiple instruments clearly show a struggle physically. There was but one instance that I even used a talk-bubble to visually express the verbal abuse the main character received for trying to play the guitar. Ultimately, by not including dialogue I felt that I was challenging myself to work harder on the visuals.

Another characteristic of my animation that made it manageable was the incorporation of photo real objects throughout. I decided early that I wanted a mixed style of animation. I even made plans to incorporate 3D for one or two secondary characters, which had to be put on hold due to time constraints. By using photo real

objects, I not only gave my animation a specific aesthetic, but also saved myself from

illustrating a large quantity of objects; objects that would have demanded a great deal of

attention to coloring and texturing. So rather than spending an hour on hand drawing a

guitar, scanning into the computer and manually coloring using Photoshop, instead I

was able to photograph a guitar and create a clean version with transparency all around

the object. This left less flexibility in the way objects looked, but allowed me to take

advantage of my extensive Photoshop experience.

DRAWING INSPIRATION

My inspiration for this animation began with the show *The Amazing World of Gumball.* This half-hour animated series airs on Cartoon Network. I have only seen but a few episodes, however I was smitten with the style of animation from the moment I stumbled upon the show. The show's creator, Ben Bocquelet (2011), describes the animated series as "a show without graphic unity" (para. 7). He states; "I started looking back at the characters that I created for commercials. It was a big mash-up of 2D, stylized 3D, realistic 3D and even stop motion. I lined them up and the result looked varied and unusual" (Bocquelet, 2011, para. 7). On paper it may sound like a mess to watch, but *The Amazing World of Gumball* is actually very fluid and visually appealing (Figure 4).

Using this cartoon show as a model for my own animation would prove to be a tall task. Combining the various styles meant that I would have to improve my abilities using 3D animation software very quickly. In order to maintain realistic goals, I decided to aim for the inclusion of only one character modeled and animated in 3D.

I was able to determine for the most part exactly what different techniques are used in *The Amazing World of Gumball*. For example, all sets appear to be photograph based. The main character's house is a photograph of a real house. His classroom at school is an actual classroom. Then, where appropriate, there are alterations made and mild stylizations applied. But essentially it remains evident that the sets are photo-real, and not rendered. This was intended to be part of my method as well. Ultimately I scrapped the idea in favor of hand drawn sets, which I colored and furnished in

Photoshop. However I had initially taken a series of photographs meant to be the various sets. Everything worked in theory until I had trouble getting a decent interior bedroom shot, which was planned as the central location for the animation. I was looking for an extremely wide-angle view, allowing me to use the same set from various distances. Every bedroom shot I took using an 11-22mm lens produced undesirable results. Essentially I could not find the right size room to suite my needs. So, I was already derailed from my original aesthetic objectives right from the beginning.

When looking at character design in *The Amazing World of Gumball*, it appears that most of the characters are accomplished using 2D animation methods. The animators do a fantastic job of including very realistic shadows that helps to tie these seemingly flat characters into the "3D" environments. Although there are a number of different ways an animator can accomplish this fluid 2D style, one such method I am familiar with is through the use of Adobe Flash. Again however, I would be treading in new waters looking to use this software. Having no experience nor training in Flash meant that I may waste countless precious hours simply trying to learn the software. Now, in case I haven't made it clear yet, I am the type of person eager to learn new production skills; but based on the scope of my proposed project I opted instead to utilize Adobe After Effects for as much of the animating process as possible. Now, not only was I abandoning the use of photographed sets, but also I would be utilizing an entirely different means of animating then demonstrated in *The Amazing World of Gumball.*

Ultimately I chose to abandon several of the key principles of my original inspiration. What remained was the convergence of drawn characters and photo-real

objects. Interestingly, in making the choices that I did, I inadvertently copied the style of another animated series that I used to watch. In fact, I did not even come to this realization on my own.

With roughly two-thirds of my production work finished I had it called to my attention that my animation bared a striking resemblance to *Aqua Teen Hunger Force*. This animated series, which enjoyed years of popularity through the mid-2000s, utilizes a seemingly "crude" style of animation to match it's often bizarre stories. The animators pay less attention to smooth animation styles and excessive details, and instead focus on the comedic writing. Secondary characters are often very stiff, with perhaps only arms and mouths moving (Figure 5). The show's visual style is a stark contrast from traditional drawn cartoons like *Scooby-Doo* and *The Simpsons*. Upon hearing the comment that my work resembled *Aqua Teen Hunger Force*, I researched and found that sure enough, I was using the exact same software and production process that *Aqua Teen Hunger Force*'s animators use. "The show is created using Adobe Photoshop images, animated using Adobe After Effects and edited using Apple's Final Cut Pro" (IMDB, 2012, para. 1). The only exception being that I did not need to be concerned with dialogue lip-sync.

With this new realization that I had accomplished the visual style of one of my favorite animated shows, I forged ahead to complete the project. I reviewed a couple episodes of *Aqua Teen Hunger Force* to see what could be learned. After doing so I determined that my sets would benefit from details like added wear to the outside of buildings and randomly placed objects. I also paid attention to camera positioning, which is often minimalistic in *Aqua Teen Hunger Force* compared to other animated

series. "*Aqua Teen*'s look deliberately recreates the artifice of a storybook; the "camera" rarely pans or tilts, instead—and, sans opening and closing credits, almost exclusively—utilizing static and carefully placed close-ups, medium and wide shots, the succession of which is often part of the joke" (Humanick, 2008, para. 3).

Although I did not stay true to the style of animation in my original inspiration, *The Amazing World of Gumball*, I am determined to make my next project do so. My primary interest in doing this is to practice the execution of joining 2D and 3D animation in a seamless way. However, as I have learned through the process on this project, I will pay attention to where the story takes me rather than blindly following aesthetic goals.

INCORPORATING MOTION CAPTURE

Prior to beginning my animation, I had started with a goal to employ motion capture technology. Since the release of the Microsoft Kinect in 2010, there has been an incredible amount of attention devoted to harnessing the abilities of the motion camera. Despite the fact that my animation only contains one character controlled by motion capture, I did research quite heavily on the subject. What I found is that there are many considerations even after you have the necessary hardware. Due to the fact that Kinect based motion capture is an open-source movement, there are some highly technical pieces of software that may need to be used. Furthermore, simply choosing to perform the whole process on a Mac or Linux based machine is arguably much more difficult than using a Windows based PC. In my case, I performed all of my research and testing using a Mac OS system.

Like many open-source software (OSS) projects, development for the use of Kinect for motion capture is largely driven by independent developers. There are various examples of OSS that are backed by large financial contributions like the popular Linux distribution Ubuntu and the office suite OpenOffice.org. But for every one of these well-funded OSS projects, there are seemingly dozens of projects developed by a community of people with little more than time, knowledge and a desire to create. The popular OSS website SourceForge (2012) currently has 3.4 million developers and more than 324,000 projects, all connected directly with over 46 million consumers seeking free and affordable software solutions.

At the core of OSS is the fact that anyone can share and improve each other's programs. As opposed to closed-source software like Microsoft Office, which prevents programmers from gaining full access to code, open-source software is unlocked for anyone to modify. In addition, OSS can be licensed allowing others to make derivative software that can be commercialized. When the Kinect peripheral hit the market, without hesitation people saw potential beyond the commercial purpose of gaming. Others like myself saw the creative value in having access to motion capture for the amazingly low price of $149 (Rosoff, 2011). As code experts worked diligently to unlock the potential of the Kinect within desktop operating systems, others sought to build end-user applications in order to directly integrate the Kinect with industry standard production software like Adobe After Effects. One great example is the application KinectToPin developed by an animator named Nick Fox-Gieg (Nece, 2012).

The use of motion capture in film, sometimes referred to as MoCap or performance animation, is nothing new. Since early examples like *Total Recall* and *Toys*, motion capture techniques have offered an effective and sometimes easier way to puppet animated characters, effects or features in film (Menache, 2000). Motion capture is the process of capturing and harnessing motion. In our modern computer age, this typically involves generating data based on motion, which can then be directly utilized in a software environment. When used in film, it can simplify the process of compositing live action with computer generated (CG) material. In animation, it can allow actors to completely control CG characters, as though they were directly onscreen.

Within the animation and film industry, motion capture has been achieved using a variety of different methods. According to the author of *Understanding Motion Capture for Computer Animation and Video Games,* Alberto Menache (2000), the first notable usage of motion capture was the *rotoscope* created by cartoonist Max Fleischer in 1915. This device allowed cartoonists to "trace" the outlines of filmed actors by stacking filmed imagery beneath animation cells. Thus motion capture began as a means to simplify the animation process through the use of technology. The technique was famously used in the 1937 animated feature *Snow White and the Seven Dwarfs* (Menache, 2000). Fast forward to the mid-1980s when Robert Abel accomplished the first "performance 3D animation" featuring a metallic cyborg woman in an advertisement for canned foods. The advertisement aired during the 1984 Super Bowl and naturally gained much attention for its pioneer usage of motion capture techniques (Menache, 2000). From there came countless more examples of motion capture as creative minds scrambled to find newer and better ways.

Motion capture is now becoming a household staple thanks to the Microsoft Kinect, which was released in November of 2010 and sold more than 10 million units within the first four months at a price of $149 (Rosoff, 2011). It is a pretty impressive price when you consider that the prototype was purchased for $30,000 (Carmody, 2010). The Kinect is not the public's first introduction to motion capture, but the device represents the moment at which the technology has reached the masses.

The method of motion capture employed by the Kinect is optical based. The Kinect utilizes a depth sensor coupled with an infrared laser projector, combined with an RGB camera to accomplish tracking without the need for any additional tracking

equipment (Carmody, 2010). In other words, the Kinect can track the skeletal outline and motion of a person without anything more than proper lighting. Compare this to many other Optical Systems that require additional hardware, like specialized suites containing markers that must be worn by the performer (Menache, 2000). The Kinect also uses a self-contained micro-processor, effectively taking the burden off of the host computer (Microsoft, 2010). In contrast to industry standard Optical Systems, the Kinect is both affordable and more flexible. According to Menache (2000), traditional Optical Systems involve extensive post-processing work, use hardware costing upwards of $100,000, require strictly controlled environments and suffer from limitations due to visibility of marker points. The Kinect is able to capture motion from a single individual without any of those major problems.

The Kinect does however have some of it's own limitations. Excluding the software involved, the camera has a limited region it can accurately capture from. That is to say, the subject cannot exceed a maximum distance of 20 feet from the unit, and must stay within 57 degrees of the Kinect's perpendicular axis (Wikipedia, 2012). Based on my own testing I have also found that while you do not need perfect lighting, enough for the camera to discern contrast in essential.

Microsoft chose to provide a USB port adapter with the Kinect rather than strictly relying on some proprietary offering. This is most likely due to the fact that all previous generations of the Xbox 360 console, which the Kinect is designed for, included USB ports as the primary means of peripheral connection. Having the standard USB connection was essentially an invitation to the open-source community to get the device working on PCs. Microsoft had put in several hardware and software safeguards to

prevent unintended usage of the device, but with a $2,000 bounty placed on cracking the code and developing a driver, in less than a week after release there were demonstrations of rudimentary Kinect usage within a desktop PC environment (Loftus, 2010). Thanks to a range of developers, within less than a year there is not only a stable framework for running the Kinect hardware from multiple operating systems, but also several pieces of software written to translate Kinect data into existing production software like Maya and After Effects. This means that even the non-developer types are able to use the Kinect for creative purposes.

Using most of the current software solutions for integrating the Kinect into Maya or After Effects is still very messy. By this I mean that there are "apps" or "plugins" written, but they still suffer from interface problems and rely on a complex cocktail of supporting framework. Thus is the nature of primitive open-source software. When I encountered problems in executing the final piece of software, I was left perplexed as to which link in the chain was the cause. Ultimately I managed to succeed, but not without a fair amount of trial and error. Clearly this has implications for professional usage, where artists and designers may be far less interested in troubleshooting unsupported software.

When trying to make sense of all of the open-source software intended for use with the Kinect, you have to keep in mind the multitude of uses that people are devising for the technology.   According to visual effects artist Victoria Nece (20120), the framework recommended to get the Kinect running for Adobe After Effects usage includes the following software: OpenNI, PrimeSense Sensor Module for OpenNI, OSCeleton, Simple OpenNI, and Processing. All of this and we haven't even included a

specific software tool to translate Kinect skeletal data into something that works with the primary software environment like Maya or After Effects. So all together we are looking at seven separate pieces of software to use the Kinect in a primary production application.

As mentioned, I dealt directly specifically with the process of installation and operation of the Kinect from a Macintosh computer running OS X 10.6. Being that the Kinect is a Microsoft product, naturally developers and hackers managed to get the Kinect up and running first in a Windows OS environment. I would strongly suggest that any non-technical type use the Kinect in a Windows environment, as there are developers like Jasper Brekelmans (2012), the creator of Brekel Kinect; a singular application that greatly simplifies the process.

After successfully installing the needed framework, I was ready to begin capturing data for my animation. What began as a plan to puppet a 3D character quickly shifted to a 2D character when I realized the value of learning MoCap in After Effects. Through the use of an application called KinectToPin I was able to puppet the upper body movement of a photograph of myself. I realize that to some it may sound pointless to puppet my own image, which I could seemingly just film and composite in. However, I enjoyed the final aesthetic and learned much more from the process than I would have from compositing.

I will not go into the specifics of how exactly the textual data outputted from KinectToPin was used to breath life into a 2D character in After Effects. The process would easily span several pages. Essentially I followed a guide so thoughtfully shared by Victoria Nece (2012) on her personal website. The most tedious part of the process

for me was cleaning and prepping the character. In order to puppet a 2D character using the KinectToPin method, each joint at the wrists, elbows, shoulders, ankles, knees, hips and neck must be separated. Using a photograph of myself, I proceeded to strip out the entire background and then segment myself into separate layers using Photoshop. Then in order to make the joints more natural, I sculpted a rounded "knob" at the end of each segment for adequate overlap (Figure 6). The result is a character that when properly setup in After Effects, can be used as a puppet for whatever physical motion is captured using the Microsoft Kinect camera. The process is not unlike how children create paper-doll puppets with brads at each joint for rotation.

CONCLUSION

The process of completing my animation, *If at First…*, served as an invaluable experience. If not for the guidance of my faculty mentor and the recommendations of my peers, I would not have completed a piece of work with a story worthy of the time and effort I put into the visuals and audio. I look forward to further developing the strategies I have acquired while completing this project.

Over the course of the M.S. degree program I have grown tremendously as an artist. I am thankful for the guidance and skills provided by many of my professors. When starting this project I had intended to create a work that would embody the direction I have taken as a graduate student, and I feel as though I have succeeded.
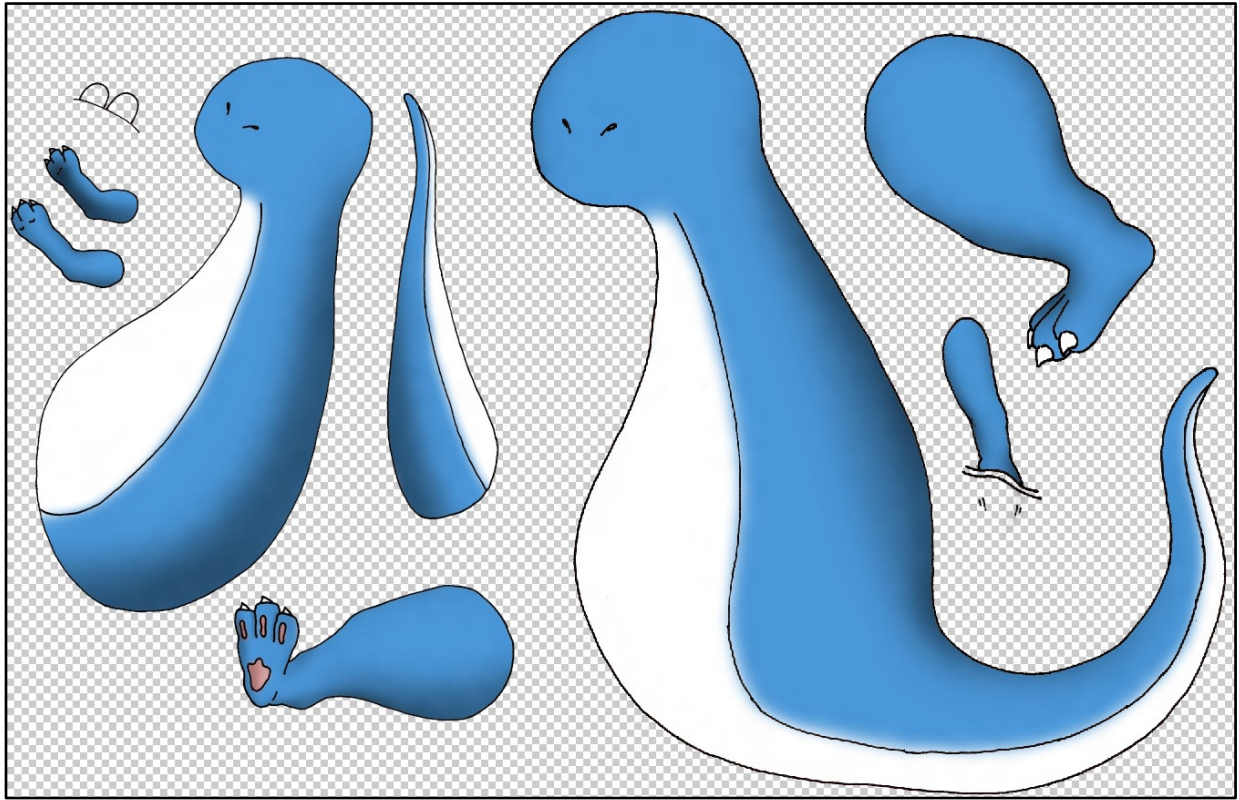
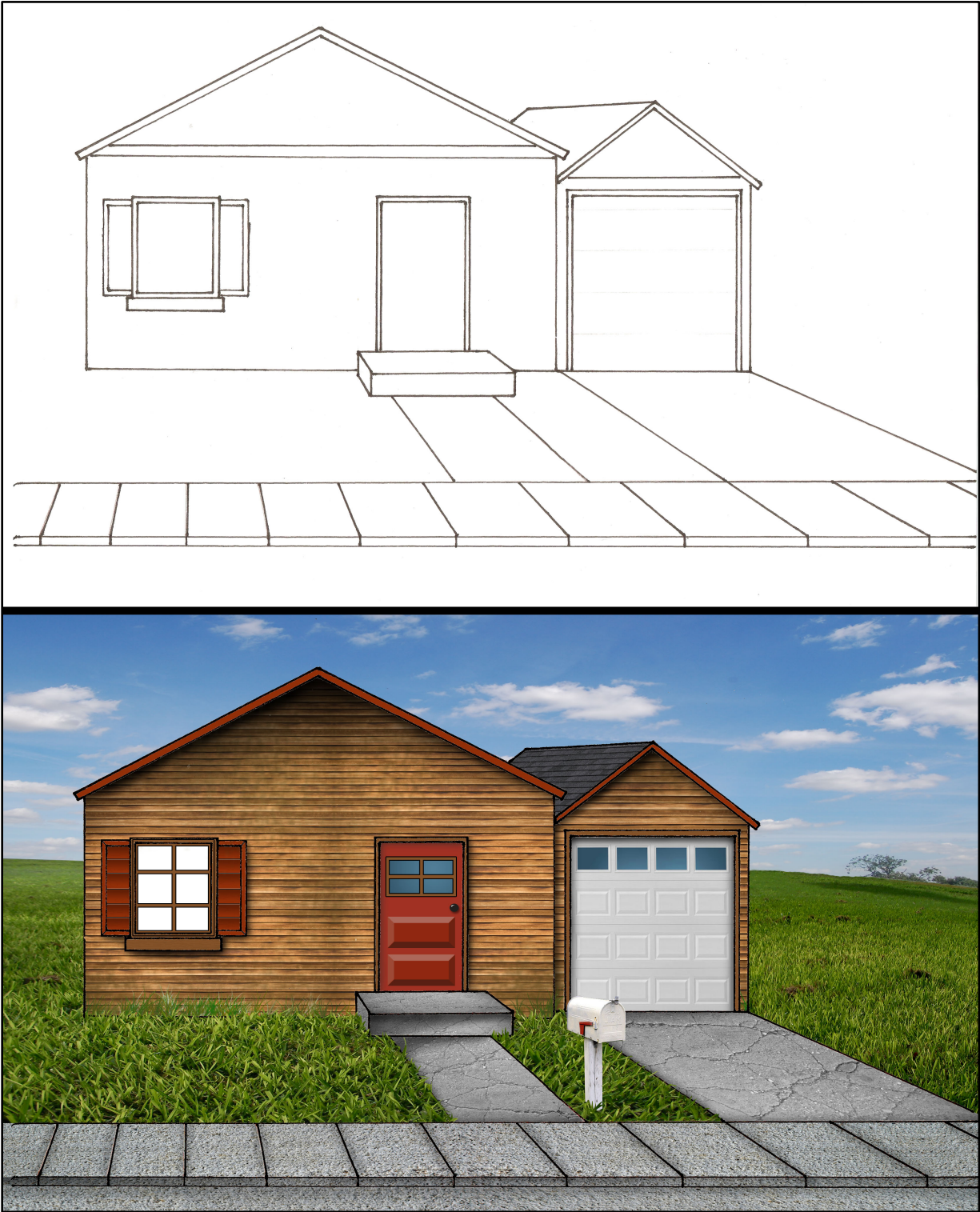Figure 1: Animation character segmented in preparation for animation.

Figure 2: Before and after of hand drawn set.

Figure 3: Accomplishing real-time flow through the use of cutaway shots.

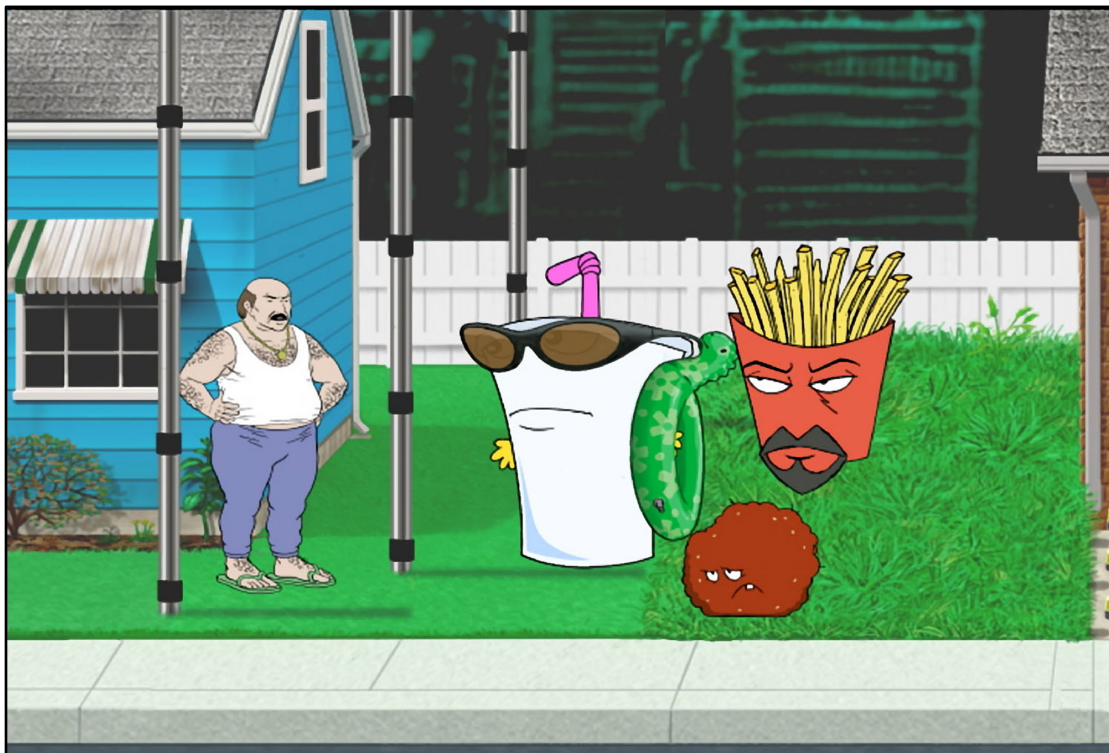*Figure 4: Various creative styles shown in "The Amazing World of Gumball" cartoon series.*

Figure 5: The animation style of "Aqua Teen Hunger Force."

Figure 6: Photograph prepared for KinectToPin by segmentation and re-creation.

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VITA

Graduate School
Southern Illinois University

Kyle T. Formella

formella@siu.edu

Illinois State University
Bachelor of Science in Education, Social Sciences, May 2007

Southern Illinois University Carbondale
Bachelor of Arts, Radio-Television Production, May 2009

Research Paper Title:
        The Use of Motion Capture and 2D Animation in the Making if "If at First…"

Major Professor: Cade Bursell