

Rochester Institute of Technology

## RIT Digital Institutional Repository

---

Theses

---

12-2014

### Reflection

Vijay Chandrasekhar

Follow this and additional works at: <https://repository.rit.edu/theses>

---

#### Recommended Citation

Chandrasekhar, Vijay, "Reflection" (2014). Thesis. Rochester Institute of Technology. Accessed from

This Thesis is brought to you for free and open access by the RIT Libraries. For more information, please contact [repository@rit.edu](mailto:repository@rit.edu).

# REFLECTION

A thesis film by Vijay Chandrasekhar

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF FINE ARTS

IMAGING ARTS/COMPUTER ANIMATION

SCHOOL OF FILM AND ANIMATION

COLLEGE OF IMAGING ARTS AND SCIENCE

ROCHESTER INSTITUTE OF TECHNOLOGY

ROCHESTER, NEW YORK

December 2014

---

Brian Larson, Chair  
Assistant Professor  
School of Film and Animation

Mark J Reisch, Advisor  
Lecturer  
School of Film and Animation

Tom Gasek, Advisor  
Associate Professor  
School of Film and Animation

-----

-----

-----

## Table of Contents

Abstract	Page 03
Acknowledgments	Page 04
Introduction	Page 05
Preproduction	
Story	Page 06
Outline of Story	Page 08
Character Arc	Page 10
Character Design	Page 12
Production	
Set Design	Page 16
Rigging	Page 19
Blendshape rigging workflow	Page 25
Animation	Page 28
Animation workflow and tools	Page 30
Texturing	Page 32
Lighting	Page 36
2D animation and look development	Page 39
Portraits	Page 45
Rendering and Compositing	Page 48
Post Production	
Post processing	Page 53
Music and SoundFX	Page 55
Credits	Page 56
Critique and Reception	Page 57
Conclusion	Page 59

## Abstract

“Reflection” is my animated graduate thesis film. The film is 6 minutes and 30 seconds long. The concept for the story was developed with a focus on character driven animation, acting and performance. I wanted to challenge myself animating a character type that I was not familiar with, something that I could not relate to on a personal level. I chose to animate a mother of 2 kids who is about 40 years old. I wanted her to go through a wide range of emotions throughout the film. I wanted it to be a silent film, so I could bring out all the thoughts and emotions running in her head through acting and really work on my animation skills.

To begin with, the mother realizes through a series of events that she is letting life slip away caught in the act of caring for her family. She is no longer cheerful, beautiful and the heart throb she used to be. As the story developed over time, I realized my character was evolving too. The story simply had to change and become more complex to allow for the exploration of the complex character of the mother.

The film has both 3D and 2D animation elements to it. A majority portion of the 3D production process was done in Autodesk Maya. The 2D parts were hand drawn animations done in TV Paint.

This paper outlines my film, from ideation to a finished product and the wonderful roller coaster ride that is part of the film making process.

## Acknowledgments

I would like to thank a quite a few people who made this film possible. First on the list is my mom. This film is based roughly on her life and how she had to sacrifice a lot to keep the family together. Thanks for being a wonderful mother and a support structure I could always rely on. Contesting close for the top spot is none other than my lovely wife Smitha. She has been instrumental in my life choices and career choices and supported me wholeheartedly with blind faith. I also thank my immediate close family, my dad, my brother Rajah and my sister-in-law Deepa. And sharing the same spotlight is my other set of close family, my wife's mom, dad, sister and brother-in-law. Without your support, I would not have been able to even start my master's program at RIT.

A huge thanks to my chair, Brian Larson. I knew going into my thesis film that I would need the most help in the character development, story and visualization of the 2D animation sequences. I chose Brian as my chair, as I knew he was probably the best at RIT who could help me in all these departments. We went through so many versions of the story and he was a key player who helped me flesh out the strengths and pointed out all the potential problems with my story.

I would also like to thank Tom Gasek and Mark Reisch, who were my committee members. As the story was character acting driven, I knew Tom's acting classes and tips would come in handy. Mark Reisch was a great help in solving all the 3D technical problems and also gave valuable suggestions to improve my story. He also sent me photographs from his own house that influenced my set design. Thanks for agreeing to be my committee members.

I was fortunate to work with some very talented artists who helped me bring this film to fruition. Nola Ennis and Nirja Desai were the two lead 2D artists. They helped add the wow factor in the 2d segments. The music of my film was composed and performed by Yuya Takeda, a genius in his own right. Soheil Khosravinejad chipped in with his help to assist me in my post production towards the end when I was running out of time and needed help to finish the thesis. Piper Hudson and Yekatarina Satanina were my two trusty production assistants. Thanks to Shreyasi Das, for providing me with her model of the bedroom that I modified and used in my film. Special thanks to Carolyn Depp with whom I had weekly critique sessions to re-evaluate my goals and progress.

I would like to thank RIT for helping me financially support my film through a Graduate Student Research and Creativity grant. I would also like to thank Tim Callahan and Martin Rennalls, who funded my project partially through the Callahan Rennall's grant.

Last but not least, I would like to thank all my roommates, classmates, friends and other faculty who were all equally important in helping me realize this dream.

## Introduction

The story and concept development of the film began in September 2011. According to my initial plan, I wanted to finish my film in a year and an additional academic quarter. I worked on this film for much longer for a few reasons. I had a very difficult time coming up with a story that bound all the elements of my film into a cohesive piece. Second, I could not work on the thesis for a year when I got the wonderful opportunity to teach at RIT for a period of one year. Third, after I started working on the thesis, I fell in love with character rigging. I had to explore this option when I had the chance. My experiments and exploration of rigging did take a toll on my timeline for the thesis completion. When I eventually came back to my thesis, I had to redo quite a bit of work as the story no longer felt appealing to me. But through constant revisions and repeated visits to the Brain Chamber (Brian's office), I am happy with the film's reception and its completion.

I had three main objectives in my film. First, I wanted to tell a very powerful story. I wanted a large audience to connect and relate with my film. Second, I wanted to explore character acting and animation. Finally, I wanted to experiment in 3d rendering techniques and come up with a 3d render that looked part 2d.

My story went through a lot of revisions and sometimes changed dramatically. But, the central idea remained the same for the most part. I was limited in the amount of changes I could make to the story through the course of this film, as I was modeling my set and character in parallel. And the story had to stay true to these. But I made it a point to evolve the story constantly to tell a more compelling theme and a better meaningful story.

I also took some time to explore 3D rendering techniques that were based on paint effects in Maya. But I was not happy with the flat shading look that is characteristic to toon shading. I wanted the toon lines to add a different dimension to the 3D world and use these lines as a visual medium to enhance my story.

I also took time to develop the look and style of animation of the 2D world in the film. I wanted to express some strong emotions like energy, youth and freedom and then transition those emotions to a dull, somber 3D world. The transitions between the two worlds needed to be seamless and the two worlds needed to be visually very different, to tell them apart easily.

# Preproduction

## Story

I spent the longest time developing the story of my film. I knew going into my thesis that this step was going to take time. I had taken storyboarding classes with Brian to make sure I can quickly draft out many versions of a story. I wanted to represent two worlds and use two different treatments to represent these two. The 3D world would represent the present, or current world of the mother. This would occupy 70% of the screen time. The 2D world would represent the recollections of the past by the mother and would account for the remaining 30%.

The story went through many drafts and revisions. I started my film with a focus on character animation and acting as the main objective while trying to convey a powerful story. I knew the concept of my film needed to appeal to a wide audience. As I did not want language to become a barrier, I wanted to convey the story without any dialogues and rely only on character acting and performance. Initially, my story was about a mom who catches her reflection while working in the kitchen and realizes that she has aged a lot. She starts to feel insecure and doubts her likeability, using her appearance as a yard stick. When she is reminded of the presence and love that her family has for her, she feels reassured and this helps alleviate her doubts and insecurity.

This story had a basic drawback that I was not developing the character of the mother enough. I was instead relying on her visual appearance, or the lack of it, to tell my story. While this was not a bad thing to do, it left out the opportunity to tap on the mother's emotions and develop that further. Since I was directly establishing bad looks with love in the family, there was a chance that not everyone in the audience might be able to relate to this feeling. I wanted a more universal theme and kept working on the story trying to explore the mental state of the mother. By this time, I had already modeled the set, modeled the mother to look unappealing and was finishing up rigging the character. So, I knew I could not change my story drastically as I did not have enough time to redo all of them again. Also, my rigging skills were very novice at that point and I did not want to risk rigging the character all over again.

A story is driven by many factors. The instigating element is probably one of the most important factors. While there was conflict and resolution in my story, the conflict was just not powerful enough. The conflict was that she was not liked by her family and feels unwanted because of her diminishing attractive looks. We can already see how shallow this conflict is. No matter what I did to this story, it was not going to be a powerful story because of the weak concept. To remedy this, I went through many versions of my story but could never really figure out why the story was just falling apart. This was when Brian Larson pointed out a very valid point. He advised me to go talk to women who have gone past their 40<sup>th</sup> year and have sacrificed something for their family. According to him, I needed to get a woman's perspective on my film and nobody in my committee could help with that, as all of them were men ☺.

I acted on this advice and spoke with Mary Barnard, the ever cheerful and wonderful office assistant at SoFA. She sent my story to her friends who all visited the gym together. They came back and pointed out the main

problem in my story. According to them, what they missed the most was not their physical appearance. It was the little things they had to give up in life, dreams that had to wait a few years to chase after, or in some cases completely give up in order to realize their family's dreams. It finally made sense to me as to why my story was not appealing enough. I had based the main conflict of my character on her looks and age. All my efforts to improve the story by adding more acting choices, better camera angles, set design etc did not help to make the story any better. What I needed was to change this conflict to a more personal and compelling conflict that a larger audience could relate to.

When I came back to work on my thesis after teaching for a year at RIT, I had given enough gap in my film to go back and look at it from a fresh perspective. I realized I had spent too much time in trying to fix a bad story. I needed a fresh start. I needed to develop the character of the mother through the film. This meant redoing a good portion of my sets, set dressing and about a minute and 20 seconds of my animation.

Within a few more visits to *Brain Chamber*, I was well on my way to crafting a much better film. The instigating factor now was no longer her looks. But it was more about the time she had spent with her friends when she was young, her fun filled activities, her dreams and aspirations and how she was missing these in her current role as a home maker. This allows for the audience to empathize with the mother more easily as all of us have at some point in life sacrificed something for our loved ones. The inciting incident was no longer bound by the age limit or appearance but was a more generic theme.

## Outline of the story

The story is divided into 4 sections. My goal was to explore a different character arc in each of these sections. In the first section, the mother is trying to get as much sleep as possible while she is constantly being reminded of how she has to get up very soon and start the day much before anyone else in the household gets up. This section is all about lethargy and tiredness. In contrast to this, in the second section, she goes through her routine with speed, skill and finesse. In these two sections of the film, the focus is more on what the mother does for the family. The third section of the story is the crux of the film and explores the ups and downs in her mental state. She is cast in happiness, self-doubt, sadness and conflict while looking at the photographs on the fridge. The fourth section is the resolution of the conflict.

The movie begins with the mother lying wide awake on the bed trying her best to get some sleep before the dreaded alarm starts her day off. She is having a tough time catching a wink thanks to the loud snores from her husband. In no time, the alarm rings a shrill pitch announcing the start of her day. As she grudgingly snoozes the alarm and decides to get up, we see the bedroom walls breakdown and transform into a kitchen. Metaphorically, I was hinting at how she had no time to settle in after getting up, and had to get to work right away.

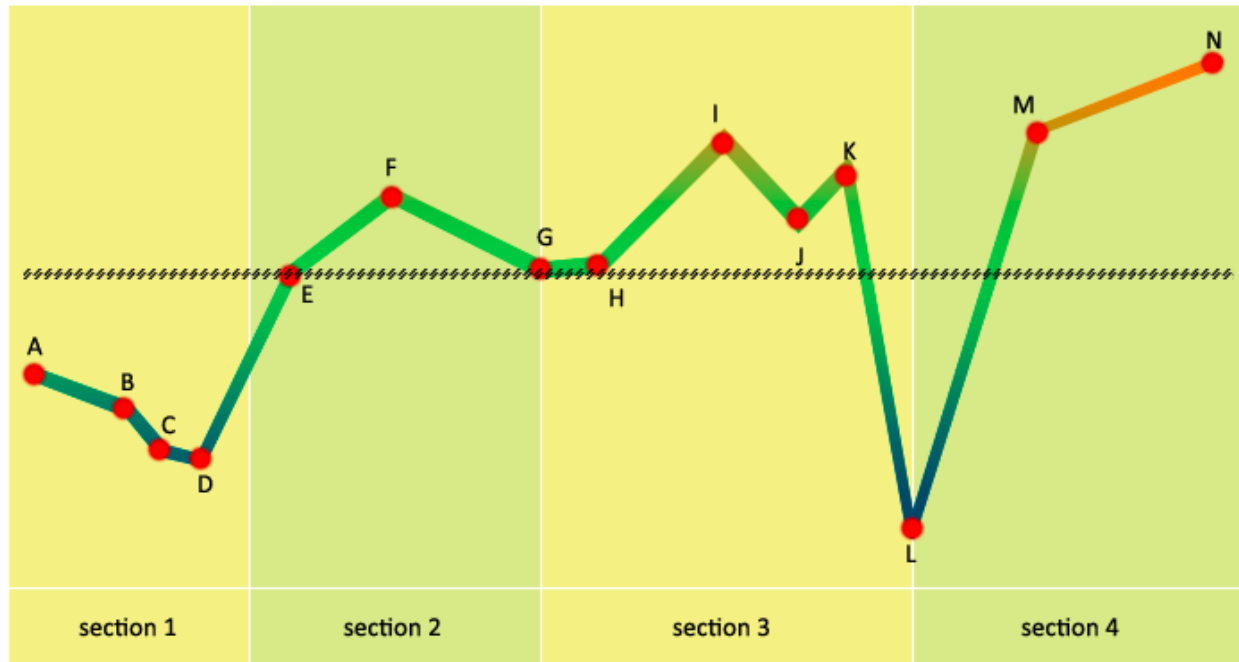
We then see her working briskly in the kitchen, going through her routine with ease. As she finishes her work and settles down to relax, she happens to see a picture of her 2 year old daughter with her pet rubber duckling. Laughing at this, she decides to go add it to her collection of prized photographs on the fridge. As she finds a place for this new photograph among all the other photographs, she sees a set of photographs tucked away underneath some of her children's photos. As she picks these up and starts to go through them, she realizes these are photographs from her past that were dear to her while growing up. She remembers the time she spent with her friends, the swimming competitions that she took part in and each of these memories transition back to a mundane and boring setting of the kitchen. This contrast in her life starts to plant the seeds of doubt in her mind. She starts to wonder if her past life was better than the life she is living right now. She then looks at a picture of her dancing with her husband in their wedding. The figures in the photograph come to life and start dancing gracefully. Then the scene dissolves into her husband leaving for work and she is left behind with a couple of kids to take care of. The transformation from being happily married to a mother of two that has to take care of her family happens so quick that she is unprepared for the change. The whole world seems to have come crashing down to a grinding halt. Her life seems to have now been confined to the 4 walls of the kitchen and keeping her family happy. She starts to miss the good times she had in her younger days, and starts to wonder if her current life is really worth all the sacrifices she has made.

While she is in this confused state, we hear the kids wake up in their rooms in the background. We hear them laughing and talking to their dad and sounds of a dog greeting all of them happily. This bubble of happiness and energy in the neighboring room breaks the mother out of her reverie and pulls her back to the present world. She realizes with happiness that her family does indeed matter to her. Her priorities might have shifted in life, but she is certainly happy to be a homemaker and take care of her family. She leaves the kitchen with this realization and as

she leaves, the camera pans down the fridge to reveal a bunch of photographs. All these photographs show her as a source of happiness for her kids and family. The audience then learns that she has indeed been very happy with her kids and husband. It's a different life that she leads now. But she definitely has no regrets for being what she is.

## Character Arc

If we broadly categorize all emotions as positive and negative, then the character arc of the mother would resemble the graph below. The graph is divided into the 4 sections of the story.



A : Start of film. Mom is tired and sleepy.

B : Loud snores that disturb her sleep.

C : External noises in the street to add to the restlessness.

D : Alarm goes off reminding her that it is time to get up and get to work.

E : Transition to kitchen and a cup of warm coffee in hand. Ah! That wonderful sip of hot coffee!

F : Thanks to caffeine, she goes about her daily chores, busying herself in the kitchen. She seems to enjoy what her skill at cooking too.

G : End of work in kitchen, a little tired.

H : Rest at table and discovery of photo of kid.

I : Discovery of older photographs and recollection of the times with her friends. Recollection of the swimming events.

J : Transition from a wall of trophies in her recollection to a wall of spice jars in the kitchen. Realisation that her life has transformed a lot.

K : Wedding photograph and start of the third and final memory sequence.

L : Realisation that her life is nothing what it used to be.

M : Sounds of family drawing her attention to the present.

N : Realisation that her family is in love with her and she with them.

## Character Design

I was pretty sure about the look of the 3D part of the film from the beginning. I knew I wanted to explore a very stylistic approach to character design and set design. I wanted to contrast hard lines with smooth curves. According to my initial story, I wanted to design the mother as a slightly chubby and dull looking character. I wanted her face to show the signs of aging. I decided to add a lot of blues and greys in her texturing. I wanted a slightly disheveled look to her entire appearance.

The hair was a tricky part for me. I did not want to get into Maya hair dynamics for my character. I did not want the hair to look too realistic either. I wanted a stylised look for the hair going with the idea of smooth curves and simplistic shapes. I studied a variety of hair types for women in their 40s. While the hair styles differed, most of them preferred to tie their hair into a tight bun when they started to work as this kept the hair away from the eyes, face and their busy hands. I knew I would want this look for my character as she started to cook in the kitchen. But also knew this look would not work for the entire film. For, eg. a tight bun is really an uncomfortable style while sleeping. I would have preferred a more loose style of hair for this part of the film. But, as the transition from the bedroom to the kitchen happens in a matter of seconds, I wasn't sure how to make the loose ruffled hair bundle up into a tight bun. So, I decided to go ahead with a small bun for now and then tackle this transformation of hair later.

In line with the initial concept of the film, the proportions of the characters were exaggerated to make her look aged. Small but sagging breasts, an inverse hourglass figure, comfortable house/work wear, an easy to manage hair style, untrimmed and dirty finger nails, were some of the design aspects I paid attention to.

## References



(<http://cindyyanx.deviantart.com/art/Character-Design-Mom-338757520>)



(Montage of matriarchs blogpost: <http://trippark.blogspot.com/2011/01/montage-of-matriarchs.html>)



(An Interview with Carolina Cuenca : <http://carolina-cuenca-interview.blogspot.com/>)



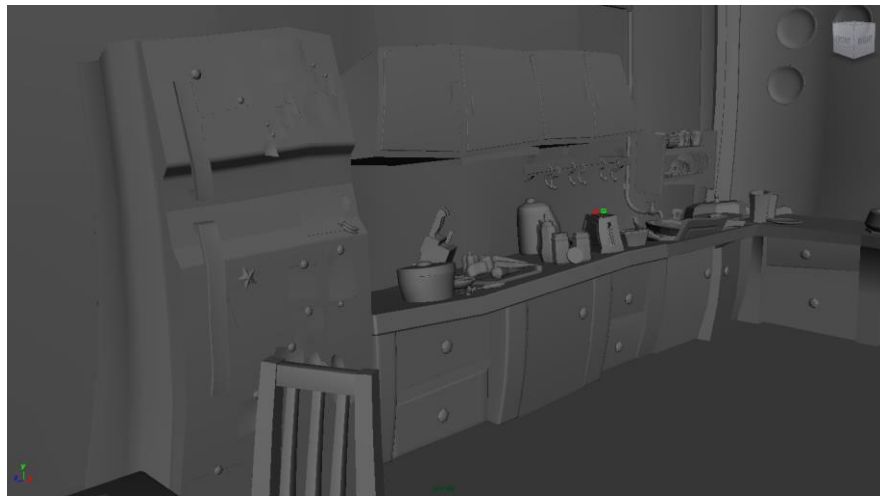
(<http://lorelay-bove-interview.blogspot.com.au/>)

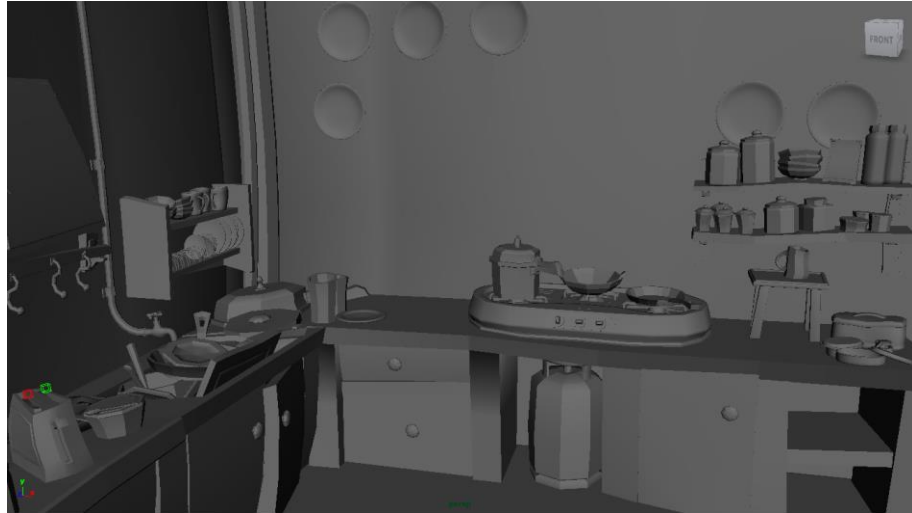
(<http://www.peppermelon.tv/character-design-unilever-pitch/>)

## Set Design

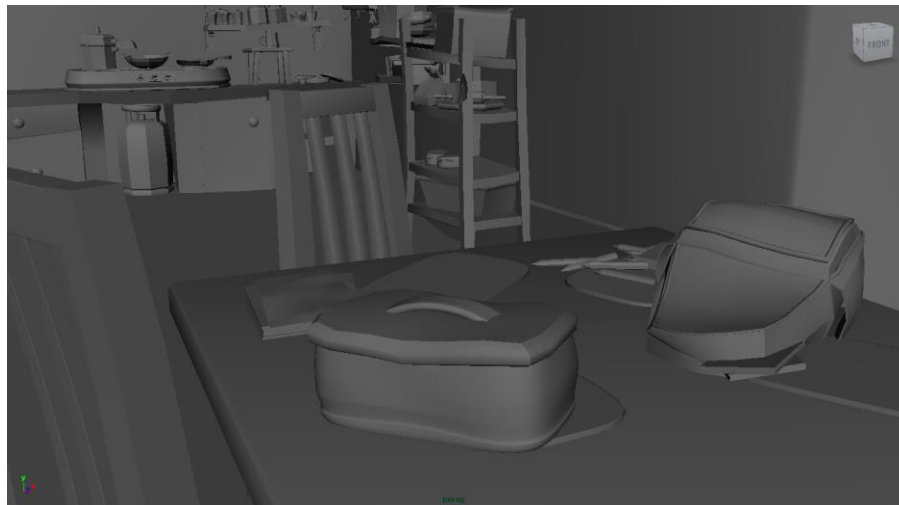
This was a phase of the pipeline that I enjoyed a lot. I was experimenting with a new style of modeling. I had a few challenges to meet in my set design. I wanted to capture the essence of the set with very few edge loops relying on very simple geometric shapes to convey the shape and design.

- 1) The environment needed to reflect the mental state and mood of the mother. I wanted a claustrophobic feel to the entire set with very little space to move around. To achieve this effect, I modeled the kitchen to be very narrow with only one source of light, an open window on the far corner of the wall. I also added a lot of utensils, boxes, spice jars, etc to really sell the idea of a lived in house.





- 2) The house had to show the presence of 3 other people without really showing them on screen. The only way I could do that was by adding props that belonged to the kids and the husband so the viewer was constantly reminded of their presence without actually having to see them.



- 3) I wanted to play a lot with the vertical, horizontal and haphazard lines and use them to represent the unstable nature and the turmoil in the mother's head. So all my sets are modeled to look a little uneven.



- 4) The bedroom was also designed in the same lines of vertical, horizontal and uneven lines. In contrast to these lines are the smooth curves of the bed frame and the bedsheets.



## Rigging

Character Rigging/ TD is the process of adding animation controls to move the character around and pose them to match the director's notes. The rigging part of my thesis is probably my most favorite of all. I remember so clearly my discussions with Brian about the rigging section of my thesis and how much time I really needed to spend on it. This was during the first year of my thesis. I was not at all comfortable rigging and wanted my thesis to be focused on animation instead. Brian even referred me to an ex-student of his who is at Laika right now, Ty Johnson (<http://www.tyjohnson.net>). Ty is a great modeler and could also rig. I was considering paying him for rigging my thesis character.

Two things happened that made me change my mind:

- First, was something I had learned from my experience in the past. When I did my undergrad in engineering, our exams had a format where we would be given 8 questions, of which we needed to answer any 5. Usually, it was possible to predict how the 8 questions would be distributed among the chapters in the text book. That meant, one could either prepare really well for 5 questions, or just prepare for all 8 to be safe. I always took the easier route and studied only the first 5 chapters that would constitute the 5 questions. The remaining chapters in the text book, usually built on the concepts learnt in these first 5 chapters and needed some advanced thinking and implementation to tackle them.

The real problem was when I landed my job in engineering. There was now no option of doing only 5 out of the 8 tasks assigned to me. I also realized that the advanced chapters I had left out studying were more pertinent to the industry. I realized the hard way that the scores/grades you get on assignments or exams was not everything there was to be successful in a job. What really mattered was the ability to understand new problems, to be able to walk away from your comfort zone and then problem solve. I knew I would never make the same mistake again.

So, when I came to RIT to do my masters, I was a clean slate. I knew nothing about animation. I had learnt a lot in the 2 years thanks to some great faculty at RIT. I had also decided to not make the same mistakes in my thesis that I did in my engineering. To me a thesis was that last step where I could still learn from mistakes. It was that crucial phase in my career that allowed me to test and explore uncharted territories. There was no way I could let someone else rig my character. Even if the rig turned out to be a disaster, I knew I would learn something from it.

- The Second reason for choosing to rig on my own was a seminar I attended at RIT from Steve Gressak. He is a facial rigger at Blue Sky studios. His small presentation on facial rigging and the subsequent discussions with Mark Reisch made me feel that I should at least try to rig myself.

With the decision made to rig my character on my own, I was now left with a big question. Where do I begin? I spent a good chunk of my next two quarters learning and experimenting to rig. I knew I had

to learn to rig both the body and the face. I also knew RIT had the license to use an auto rigging tool. RIT was using the TSM(The Setup Machine, for rigging the body) and TFM(The Face Machine, for rigging the face). I saw many students at RIT using Setup machine and Face machine for rigging their characters for their thesis. I saw two main problems while watching them work in the 3D Lab:

- First, the face machine did not do a great job of rigging the face. This can partly be attributed to bad edgeflow. Edgeflow is the wireframe lines we see on a model. For good deformation, we need these edgeflows to mimic the orientation and shape of the muscles in the human body. For eg, circular edgeflows around the eyes and mouth give a good blink and mouth deformations. Edgeloops that originate on the nostril and travel to the outer edge of the lips give good deformations while doing a scrunch.
- Second, the characters rigged with face machine were too heavy. I saw students who had say 3 characters in a scene all rigged through TFM and it took them nearly 5 to 10 minutes to just open the scene file. This, to me was a huge problem.

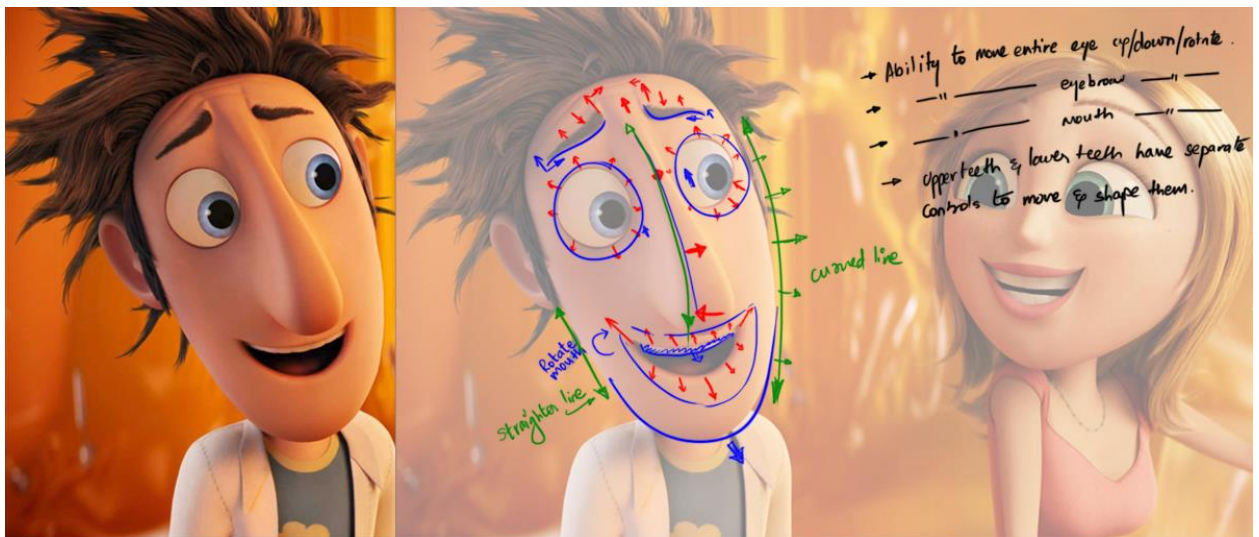
I still tried to rig my character using TFM. I tried it twice and both times, the results were very bad. Maybe it was something to do with my geometry? But, my character might not have had the best edgeflow there was, but it certainly was not a bad edge flow. Having no idea what was going wrong, I sent my scene files to the team at TFM who tried to sort it out. They were very helpful in giving a few suggestions, but none of them worked for me. As the clock was ticking, I realized I could not wait for TFM to work.

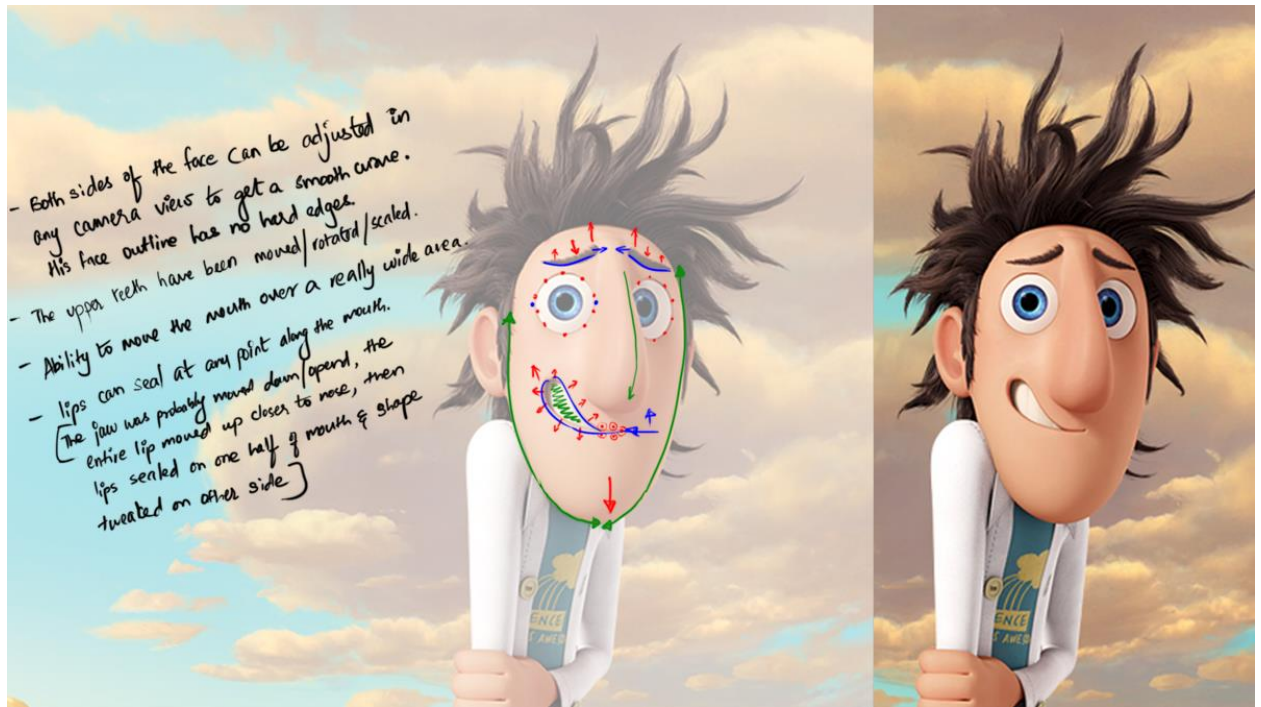
So, the decision was made. I had to rig the face myself, while I could use the TSM to rig the body. I knew that rigging needed quite a bit of programming skills in MEL or Python. Thanks to my engineering background, I was able to pick up on MEL fairly easy. I decided to try and write an auto facial rig for my character using MEL. I did a lot of study and preparation for this. While there were a lot of tutorials for body rigging, there was nothing available for facial rigging. So, I decided to watch the then just released Cloudy with a chance of meatballs, to understand how the face moved, what level of controls the animators had, in order to pose the faces. My second inspiration was a facial rig demo I had seen online.

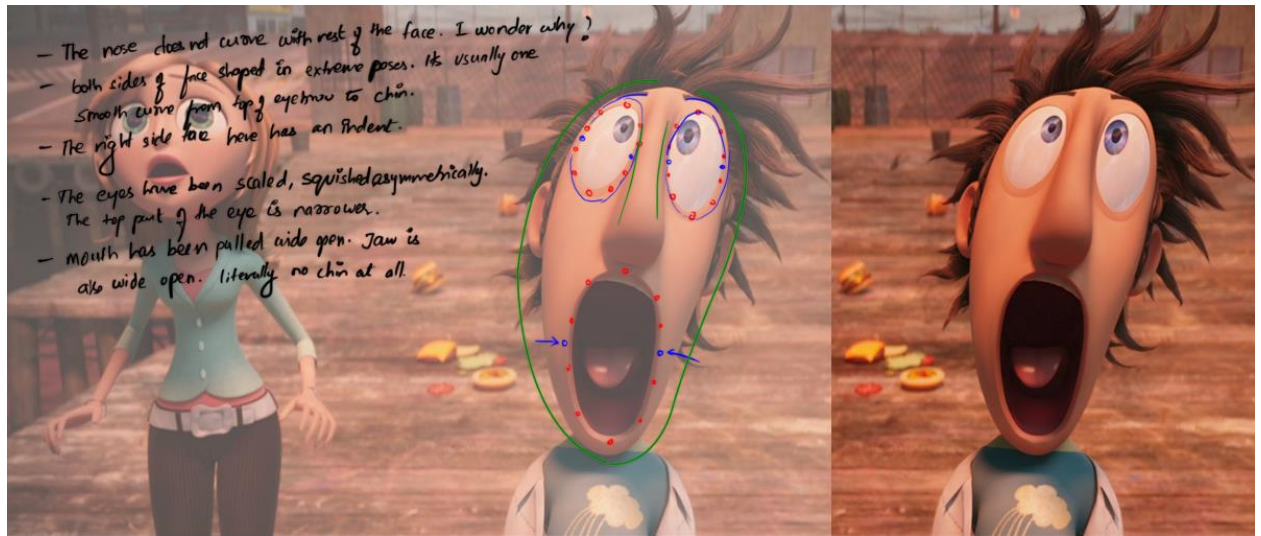
## Inspiration 01: Cloudy with a chance of meatballs

I think I really did spend too much time watching this film. I had always watched it with a focus on animation. But when I started to pose Norman (the free 3D rig) to try and get the same poses of Flint Lockwood, I realized I was not able to do it a 100%. That's when I started watching the film from a rigging perspective. This gave me a completely new insight to facial rigging. I made some notes from studying still frames of the film, which formed my basis for the facial rig.

While I observed many poses throughout the film, a few of these slides are good to understand my thought process behind the study. The absurd complexity of a feature film facial rig will also be evident from this study. In the pictures below, my observations for the expressions of Flint Lockwood are outlined.







## Inspiration 02 : Joint Based Facial Rig Demo by Suchan Raj

There are so many ways to rig a face. Joint based, blendshape based, deformer based, curve based, etc. With such a wide array of tools at disposal, it really comes down to what the time, production pipeline and rigger experience allows for. I had already done a blendshape based facial rig. I knew the pipeline well enough and it was fairly simple to setup. But, I wanted to use this opportunity and learn something new. I knew that in game engines, only joint based facial rigs were preferred as the game engines cannot process deformer information. So, I decided to experiment with joint based facial rigging techniques.

During my research, I came across a great facial rig demo by Suchan Raj on his vimeo page. The rig was so intuitive and so animator friendly and seemed to be able to get most of the basic shapes needed for animation. A link to the demo: <http://vimeo.com/3077609>

### My results

What started as an emulation of Suchan's technique, took a completely different path altogether. Through my experiments on facial rigging, I came up with my own technique of facial rigging. It was based on a very simple concept of constraints. It was also an auto rig using MEL. Thanks to studying cloudy with a chance of meatballs, I knew that having too many controls on the face could never hurt. At the end of my first year, I had therefore come up with a version of my character that I could finally animate with. Phew!

Link to demo: <http://vimeo.com/mcvijay/autofacerig>

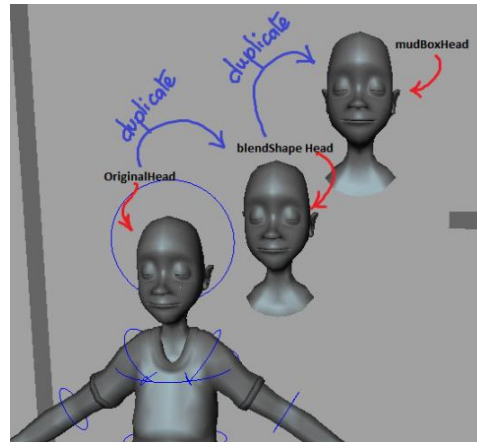
As I developed as a rigger, I did go back and revisit this rig and do some major fixes on it. I faced a lot of problems taking my script through production. But that was the fun part too. I also built a few tools to help me rig faster. Some of the problems I faced are as follows:

- How to transfer weights from a skinned character to an updated character, with slight model changes.
- How to make the eyebrow geometry follow with the skinCluster deformations
- How to make the eyebrow geometry follow blendshapes
- How to mirror blendshapes. I wrote a pretty intricate mirror blendshape tool that could do the following:
  - Mirror the blendshapes from one side to the other and name these
  - Group the shapes and arrange them neatly in the viewport
  - Automatically connect the new blendshapes to the target node, and link the blendshapes to a set of control attributes with limits set to -10 and 10.
  - Set the animation controls on these shapes to post and pre infinity to override the limits on the control attributes.

## Blendshape based rigging workflow

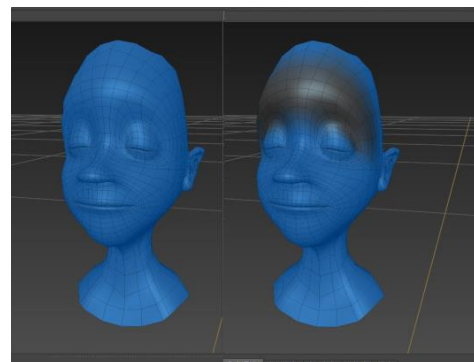
As I started animating the scenes, I soon realized that having the joint based facial rigging was fine, but having that extra layer of controls using blendshapes was very useful. After a few attempts to figure out how to move from Maya to Mudbox and back, I came up with a workflow to assist me in making these blendshapes. When making my blendshapes I prefer working with Mudbox rather than ZBrush. The only reason is the ease of integration with Maya. As Maya and Mudbox both are from Autodesk, and both have their free educational versions available to download and use, I just ended up working with Mudbox. I am sure a similar workflow can be established to work with ZBrush as well.

1. Open the Maya scene file and select the base head geometry. Roll over to the inputs section and set all envelopes including skinCluster to zero. This makes sure that we are forcing this head to go back to its default state. Now duplicate this baseGeo. All blendshapes will be connected to this duplicated head. This way, the joint based head has only the skinCluster node deforming it. There is no reason the blendshapes can't be added to the original head, but I prefer to keep them separate.
2. Select the duplicated head and make another copy of it. Name it mudboxHead. This will be the base shape used to generate all other blendshapes.
3. Set the translate channels on this head to zero. Hide all the other heads.
4. By the end of this step, there should now be 3 heads. The original skinCluster head, the duplicated blendshape target head, and the mudBox head. The Mudbox head should be at origin. This is because sometimes when moving between the programs, the pivot point of the object is reset to origin. This will cause the head to 'fly-away' when activating the blendshape.
5. Select the Mudbox head and send it to Mudbox either through an obj/fbx export or using the send to Mudbox -> send as new scene option.



6. Creating the shape itself:

Use the freeze tool to freeze areas that are not going to be affected by the shape. This tool is good as it gives a clear visual representation of what is being affected and what is not. You can also get a gradient of the affect by freezing the area partially. So, as the first step, paint the region on the face that should not be affected by the shape.

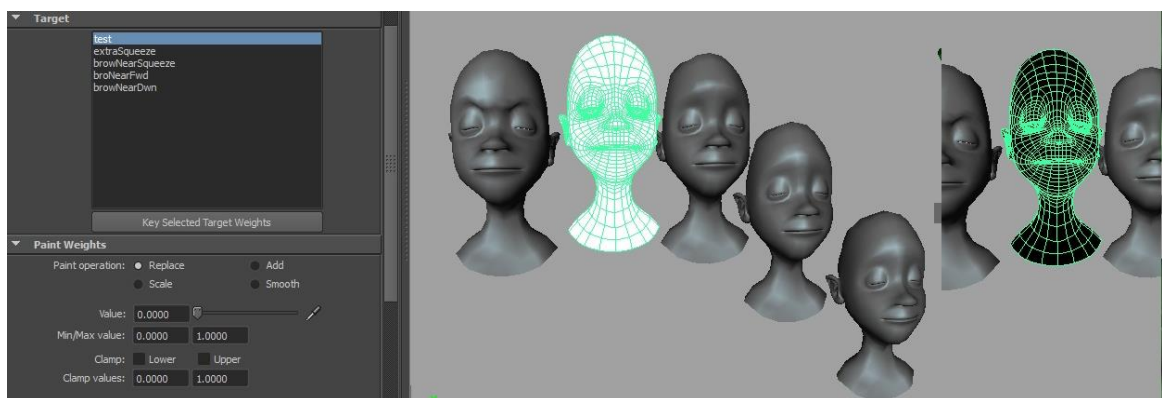


7. Now create a new sculpt layer. Use this layer to build the shape. It is very important to first work on the lowest level of detail possible before going to a higher poly mesh
8. Use any brush types needed to sculpt the shape. You can set the brush to local mirror mode to mirror the action on the other side. Feel free to use the opacity slider from zero to 1 while working on the shape. This allows us to see how the shapes are being transformed and how they look in motion. Create multiple layers to sculpt the shapes in greater detail. The first layer is at lowest division possible and should be used to get the broad movements done. A top level layer, but of same subdivision, could be used for a really exaggerated shape of the same expression. That way this layer can be turned on and off to get a more realistic shape or a more exaggerated shape. A third layer and a much higher subdivision could be used for sculpting all the details such as wrinkles, folds in the skin etc.
9. Once the shapes have been sculpted, get them back into Maya.

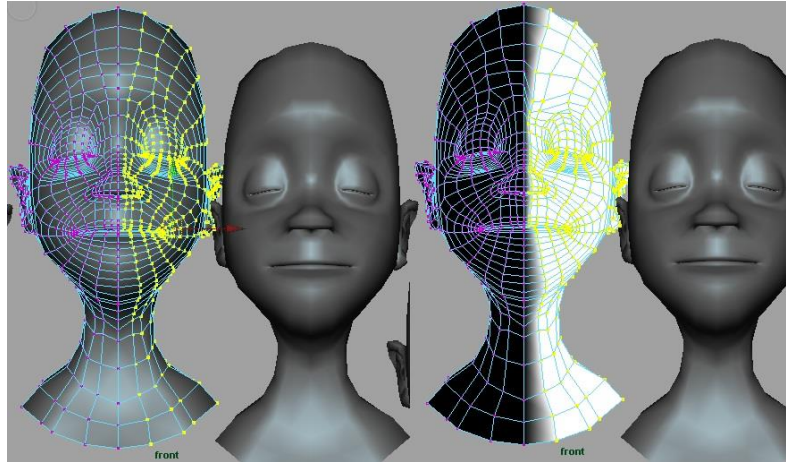
## Extracting the shapes in Maya

Once we have the shapes in Maya, they need to be extracted into left and right shapes. Ideally to speed up the workflow, a script/tool needs to be used to do this. But for the not so code savvy, there is a very simple way to do this in Maya too. I used this method of extraction before I developed my own mirror blendshape tool.

- Select all the sculpted shapes and then the Mudbox head shape and create a blendshape. Test to see if each shape is working correctly before going ahead.
- Select the mudboxHead and then go to paintblendShapeWeights tool. If done correctly, the model will turn white. In the tool settings, you will see the name of the blendshape node and the blendshapes listed. Select the node. In the Value of brush, set to ZERO, and opacity to 100, click on Flood. The face turns black and will look like the default shape. No matter what you do with the slider, it is not going to change shape.



- In component mode, select the verts on any one side of the face. Do not select the center line of vertices. Go back to PaintBlendShapeWeights tool and change value to 1 and Flood again.



- Now select the center line of vertices and flood them to a value of 0.5. At this point one side of the face should be affected by the blendshape sliders. But the problem is the change in shape is too sharp from one side of the face to the other.
- To get a smooth transition, select the center vertices in component mode. Grow the selection a couple of times to include about 3 columns of vertices on either side of the face. Keep this selection consistent for all the shapes to get the exact same amount of overlap. Go back to PaintBlendShapeWeights tool and set the brush mode to smooth. Flood exactly 5 times. You can flood more too, but just remember that count and use that exact same count of floods for all shapes.

That's pretty much it. Repeat the same steps for the other side of the face. You can also export the blendshape weight map and take it into an application like photoshop and invert the colors to flip the white and black map. Import it back and connect it to a face to get a mirrored version.

## Animation

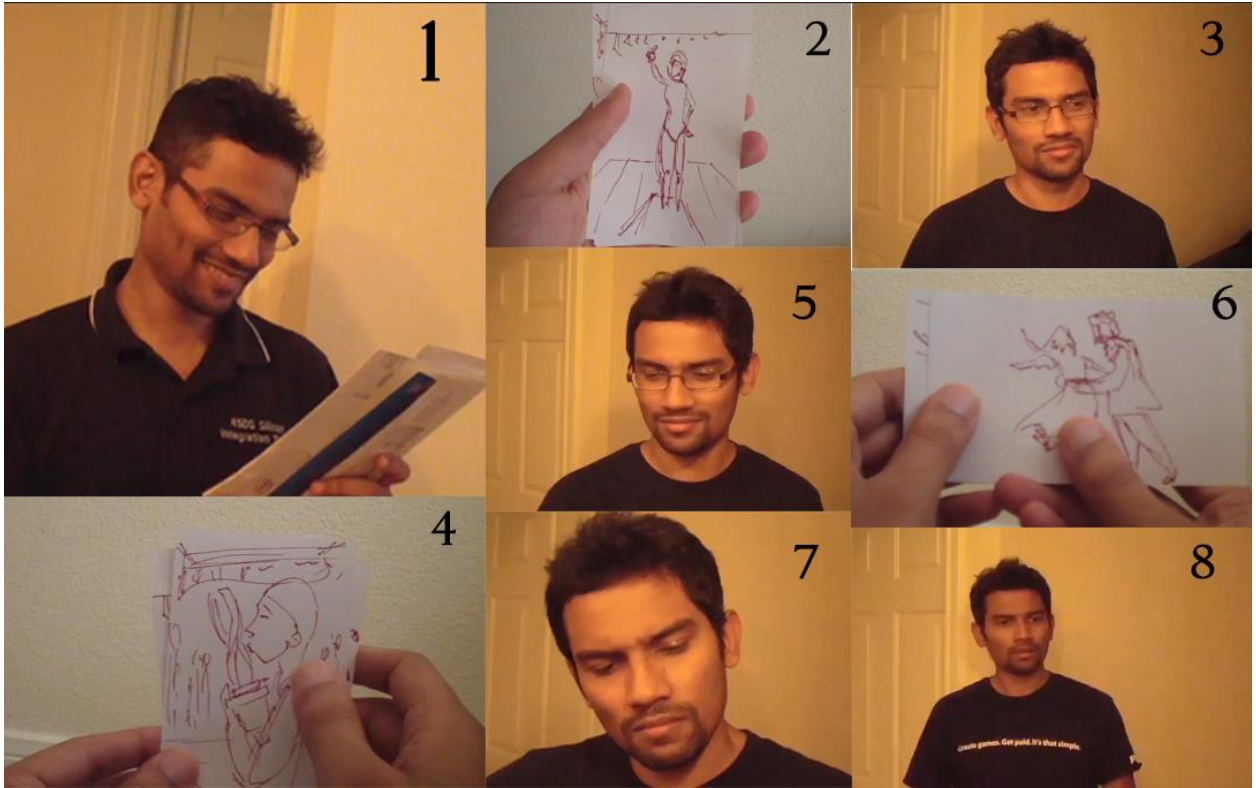
*“Animation can explain whatever the mind of man can conceive. This facility makes it the most versatile and explicit means of communication yet devised for quick mass appreciation.”*

- Walt Disney

It was great to come back to animation after a real long gap. I had spent a lot of time during my break from thesis researching on rigging. When I picked up the animation phase, I had to re learn a few things. I spent quite some time redoing animations as I wasn't happy with the timing or the actions or both. Mark's words echoed in my head: 'Do you have a good reference to work from?' And I did not. Some animators are truly talented and gifted to be able to animate without any references. But, I realized the hard way, that I wasn't one among them. I needed a reference.

I looked for someone who could portray the mother in my film. I was ideally looking for someone who could relate to the story and act while I could direct. But, finding a camera confident mom proved to be more difficult than I thought. So, I decided to do the next best thing. I realized, no one could act my story out better than myself. So, I decided to step into the role of the mom and act it out myself. Again, Mark's words of wisdom made sense here: 'I want to see YOU acting in your reference videos'.

And so I did. I acted out the entire film getting multiple takes for each scene so I had options to choose from while animating. This allowed me to put them all together and create a rough animatic that gave me a sense of timing for each scene. Some stills from my acting exercise.



I think Tom mentioned after watching this animatic that the acting choices could have been pushed a little more. I tried to do that in my animation. But for the most part, I stuck to my reference in the interest of time.



## Animation Workflow and Tools

When animating, I like to spend a lot of time blocking my animation. I spend about 90% of my time blocking in stepped mode. I then spline and refine as needed depending on the time available. When I started work on this film, I intended to do a two pass refinement on animation. But, as I developed into a rigger and realized that was going to be my specialization, I decided to focus on story telling instead of perfect animation. I knew I could animate well if given the time. But, telling a convincing story was still a major hurdle that I wanted to overcome with this thesis.

To help speed up my animation workflow, I also used a few tools. These tools were specific to my animation workflow and might not be agreeable to everyone. But, to each his own way, I guess!

### Pose saver tool

This is one of the best tools out there. I was thinking of writing a tool in Maya that would help me save out a character's pose and then retrieve that pose with a simple click of a button. It's a really simple tool to implement, that reads all the controls, stores their values and recalls them when needed. I found a tool online that did exactly this and used this extensively through my animation phase.

We ideally want all animation scenes to start from a timeline of 1. This allows us to get a good estimate of timing. Also helps in dynamics calculations. Often a scene is broken up into many camera angles. I have seen many of my friends animate a scene and when the camera angle changes, instead of starting a fresh scene and posing the character in a similar pose again, they just create a new camera and continue animating. So this new scene now begins at say frame 1356 and makes it very difficult to keep track of the timing of the shots.

A cleaner method would be, to be able to store the character's pose at the end of each scene, then start a new Maya scene and just pose the character in the exact same pose by using some tool/button.

This is exactly what the Pose Saver Tool achieves. I think every student should be using this tool to help them breakdown their scenes. This tool is available for download in creative crash.

<http://www.creativecrash.com/maya/script/pose-2-shelf>

### EasyEase Tool

I wrote this tool to mainly speed up my process of animation. I realized I was experimenting a lot on trying to find the correct poses and kept going back to tweak my key frames. Each time I did that I had to go back and fix all the eases again. So, I wrote this simple tool that could automatically add a given number of keyframes between any two keyframes maintaining a desired curve. User can easily modify the rate of the ease-Ins and ease-Outs separately. User can also store a specific arc they liked for eases and reuse them as needed to insert the inbetween keys.

To use this tool, I typically set the keys on two extreme poses. Then decide how many keys I want between these two extremes. Then set the sliders that control the speed of the ease-in and ease-out. That is it. Using this tool allowed me to test out very quickly how two poses would transition and allowed me to go back and make edits more freely.

## Texturing

I had seen a lot of films with pristine 3D renders. While that was an approach I could have taken, I felt a more grainy, hand painted textures on the characters and props would add to the quality of the film. I wanted to be able to replicate the brush strokes on canvas. My idea was to add more randomness to these brush strokes to suggest confusion and turmoil. I wanted a technique where I could control the direction and size of the brush strokes too. This way I could go with vertical broad strokes to depict an unsteady state of mind and transition that gradually to horizontal strokes and more subtle strokes to depict calmness of the mind. I felt being able to do this would really enhance my story visually.

As an added bonus, I wanted to be able to add toon outlines on every prop and character and be able to control the thickness, density of lines, color of lines, opacity and also add a small amount of vibration to these strokes, all of which I wanted to control procedurally. I could use these lines to then reflect the emotion in the scene.

I wanted to do all of this in 3D while still keeping it unique from the 2D world. And I had no idea how.

### Oil Paint Replication Tests

I had to understand how oil paints worked. I did not have the time to paint myself, which would have been the ideal way to go. Instead, I relied on the internet and studied lots of paintings. I then made some observations.

Consider the following two paintings:



In order to reproduce this effect procedurally in 3D, we need to understand some common artifacts that make it unique to oil painting.

- A slight noise could add the grain texture to the entire render.
- Brush strokes needed to be visible in some places which would add to the rich texture.

- In any of these objects, the base color is pretty much the same. Over the surface area of that object, the value, V of the color (HSV) changes and becomes darker in the area of shadows
- There is also a slight shift in hue/saturation values in nearby areas.
- To keep things simple, I ignored specular changes for now.

I came up with an algorithm to reproduce this technique:

- Apply a plain solid color to the object.
- Overlay a noise layer to add the grains.
- Create a bump map file of a brush stroke in photoshop. Then import that into Maya and use it as a displacement map.
- Query the color of the shader (HSV and RGB values). Store the current values in 2 variables. Now, depending on a user input that determines how much shadow the object has, reduce the V value of HSV. Store new color information in var2. Now create a shader with these 2 values of HSV and create a ramp from this and apply on the object.
- Now from the sampled RGB value, shift slightly within a range to generate 3 to 4 samples.
- Create three shaders with the three samples generated above.
- Create a granite texture and use that as a mask(transparency map) layer in first of these layers to have the hue/saturation shift in just a few blotches. now use the same granite texture, rotate the 3d placement node and translate, repeat etc to modify the pattern and create another hue/sat layer. Do the same for as many hue/sat layers.
- Combine all these Hue/Saturation layers into one image file. in this file, I need to do a facing ratio(or something similar) and keep the hue/sat shifts in only camera view and fading away in a circular pattern. (basically, I do not want the hue/sat layer to mask out the base color layer. it should be seen in only certain areas. I could even apply another granite layer on this combined layer)

By doing this, it is theoretically possible to generate color variations, value variations, noise and a brush texture. Practically it was much more difficult to implement this. I was also never able to devote a lot of time to follow this idea further. I am sure it can be done with enough time put into it.

As implementing the above concept was taking too long, I decided to alternatively try to reproduce a water color texture. I soon realized that there were many photoshop brushes available to buy that could reproduce water color textures very well. I downloaded one such brush as a test and started to paint the props. This is where I met my next roadblock.

Coming from a technical background, I was one of those who did not understand color theory so well. I have never painted seriously in any medium. I have seen and heard people talk about colors and associate

emotions to them. I have never been able to do that. I really wish this was one class I could have taken at RIT. We are currently in a world where we cannot separate art from technology anymore. The two rely on each other so heavily. RIT accepts a wide range of students with diverse backgrounds. If the expectation is to make visually stunning films from students that do not have an art background, then there really should be a series of color theory classes and visual story telling classes that they could enroll into. Likewise the students with a background in art need to take programming classes. This, I feel will go a long way in improving the quality of films at RIT.

Since I could not take these classes at RIT, I spoke to a few texturing and lighting artists and decided to invest on the book 'Color and Light' by James Gurney. This book was great. I did learn quite a lot about colors and their interplay. I took the concepts I had learnt from here and started to paint all the props and characters in my film to give them a water color texture. I also chose the colors to reflect the mood. For eg, I knew the mood I wanted to convey when she was cooking. As this was a daily routine for her, I wanted the mood to be somber, dull, uninviting and mundane. To emphasize this, I used slightly desaturated colors and tried to vary the colors of the props very little in this area of the kitchen. I wanted even the props to look repetitive, reflecting the mood I was trying to convey. So, most of the models of the spice jars are just duplicated versions of the same model with very slight variations in color. I tried to keep the colors a little darker and wanted to add an aged and used look to this section of the kitchen. I also added some visible cracks in the wall.

I knew that the spice jar setup was crucial as it would also serve as a great transition scene from the colorful, vibrant world of 2D to the mundane world of 3D. But it was also important to make the audience look at each shelf and draw their attention to these shelves during the quick transition. So, I did add a few bright props in each shelf to help direct the audience eyes during the transition.

In contrast, I wanted the scenes next to the dining table and fridge to be associated with happy memories. I painted these sections with a broader color spectrum to bring out the difference in mood. A big open window with lots of light helped add to this contrast.



# Lighting

I kept the lighting fairly simple for the majority of the film. I knew I was going to separate the character and background into different passes so I could individually color correct them. So, I split the lighting into two parts: Set Lighting and Character Lighting

## Set Lighting

For each scene I determined the key light direction and intensity. I lit the scene with just this light. I then added a basic three point lighting to get the majority of the scene lit. I saved these lights into the main set reference file. That way, when I created a new scene and brought this file in, the basic light setup came along with the set file.

I also did a shot specific lighting. For each scene file, I added as many lights as were needed to get the desired effect in lighting. This lighting setup is typical to my first set, the bedroom.

I took a different approach for my second set, the kitchen. This set was different from the bedroom for these reasons:

- The kitchen was a much more narrower set and longer set.
- There was one source of natural light and a few other artificial light sources near the kitchen counters.
- The kitchen needed mood lighting, while the bedroom needed a time of the day lighting. The light intensity and color never changed in the bedroom, while the kitchen had to deal with these constantly to mimic the emotions of the mother.
- The kitchen was also tricky as there was a hero prop, the fridge, that needed to be lit both by natural lighting, the artificial lighting and needed a lot of mood lighting.

## Kitchen Lighting Approach

I had a very unconventional approach for lighting the kitchen. I split the entire kitchen into 3 sections. The area next to the dining table and fridge was the brightest and needed a lot of play in mood lighting. Lights in this section changed in color, temperature and intensity.

The next area was the far end of the kitchen that had the gas stove and the spice jars. This area was to be lit brighter when I was showing her working in the kitchen. But in the later scenes when she is seen sitting at the dining table and reminiscing about her past, I wanted to dial down the intensity of these lights to make them look darker and gloomier in contrast to the bright areas around the dining table.

The last section was the area in the center of the kitchen. There was never a change of light intensity or color in this section. It was also not much in focus and did not have a lot of camera time. So this area had fewer lights.

I also wanted to create a pool of lights between all these three sections that just blended with each other to create a natural fall off in lighting.

In order to achieve this lighting setup, I added all the lights I needed in the main set file and setup a light rig such that I could individually change the intensity, color etc of all lights in each section. I basically linked all the light attributes in each section to custom attributes with which I could easily control the lighting in the kitchen to be anything I wanted. The fall off on the lights in each section were set to affect objects only in those sections.

In order to get the natural fall off for the lighting, I created a new mental ray light and used it as a portal Light. A portal light is a wonderful feature in Maya that allows us to light the insides of a room based on environmental lighting outside the room. All we need is some form of opening, such as a window or a door. Maya will automatically find out what the color and light information is on the outside environment and use that information to simulate a single point of light source at the doorway/window. It will then attempt to light the insides of the room using that one source of light, giving a very realistic fall off in the lights.

To simulate the environment lighting, I used a large sphere enclosing the entire set, and textured this sphere with a ramp shader. A ramp shader is basically a node in Maya that blends between two or more colors. User can add any number of gradient points to blend more colors gradually into one another. I used this ramp shader to set my mood colors. I then set the portal light to look at the ramp shader and treat it as the environment lighting. By overlaying this light on top of the individual section lights, I was able to get a smooth fall off between all these lights.

### Lighting during set transitions

This was the most complicated part of the lighting setup. I have a very quick transition from the bedroom to the kitchen where all the lights in the bedroom need to be dialed down while the lights in the kitchen turn on and the set comes into view. This was a very complicated shot in terms of lighting. The bedroom was lit using the lights that were placed inside the 4 walls of the bedroom. In my transition, the walls of the bedroom collapse and fold away to reveal the kitchen behind it. Now, I could have done this in after effects through compositing. But the lights in the bedroom and kitchen are so different in their temperatures that revealing the kitchen as soon as the bedroom walls collapsed would have been a very severe change in lighting and color. The effect I wanted was to literally turn off the lights in the bedroom and turn on the lights in the kitchen, having a good overlap between them so that the change in color, temperature, shadow directions were all gradual.

In order to achieve this, I had to fold the walls of the bedroom away and let the kitchen be lit by the lighting conditions of the bedroom first. Then the kitchen lights needed replace the bedroom lighting with some overlap between the two. Now as the bedroom walls folded away, they were moving away from their

light source that was illuminating them. So, I had to add extra lights on all the parts of the bedroom that were folding away and control their attributes for every frame of the transition to keep the lighting changes gradual. There was also a portal light in the bedroom and another in the kitchen which needed to interact with each other during the transition phase. Luckily the transition was for only about 20 frames and I could spend time on each frame, controlling the attributes of each light to make sure the transition happened smoothly.

## 2D Animation and look development

Although I have primarily been a 3D animator, I really love 2d animation. I feel 2D animation is the best medium to express some really complicated thoughts. It feels great to get away from all the technical nonsense of Maya and other 3D packages, and just take a pencil to paper, and animate. Pure bliss!

Right from the start, I knew I wanted to incorporate 2D animation into my thesis. Initially, it was just to practice 2D animation more. But, soon as the story developed, I came to rely on 2D animation and the power of transformation it provided to convey some really complex ideas. It would have been supremely difficult to convey these same thoughts through 3D animation techniques.

I wanted to relate the 2D animation medium with the reminiscence that the mother has while looking at the photographs. I wanted this section to express a very wide range of emotions as the memories keep changing in her head. There are three sections in the film where the mother starts to reminisce about her past. I wanted to maintain a similar style in all these sections so the audience could associate the 2D animation with the recollections. I knew very clearly what style of animation I wanted in these sections. I was going to animate them using a gesture style of animation. I chose this style as I wanted to associate her past with freedom, energy and a care free attitude. I felt the loose and carefree nature of the gesture drawing fit very well with this theme. Also, I tend to get caught up in the details of form when I try and start adding details to my 2d animation. All I wanted to convey through the 2d animation was the idea of the emotions and relate the audience to the mood of her recollections. So, gesture drawings fit the bill very well for this.

What I found challenging however was the treatment. Should I be adding colors? Should the colors be popping in and out to add vibrancy? Should I fill the gesture lines with color? Etc. I had a second problem which was also quite challenging to solve. Her recollections were not consistent in the length of time. By length of time, I do not mean the screen time, but instead how many days, weeks or years is each memory associated with.

In the first recollection, we see the mother and her friends posing for a series of fun photographs. This is an individual, isolated event and the fun she had with her friends that I was conveying with the 2d medium. In the second recollection, she is seen thinking about the times she swam and won competitions and accolades. Now, the animation needed to cover an event, which was swimming, but then this event spread across a few months or years. So there was a small passage of time that I needed to show here. And the third sequence was the most complicated of all. I had to show the concept of marriage, a busy husband who leaves for work, a weakening of the support structure in the family as she finds herself all alone, then her two kids being born and the husband still busy at work while she is left alone to take care of the entire family. All of this needed to be shown in about 10 seconds.

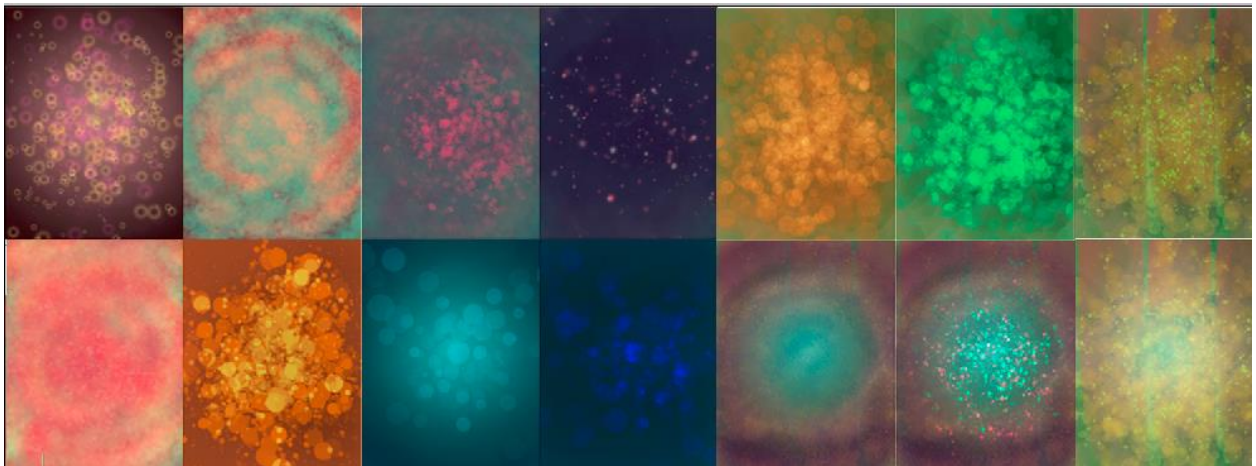
So, the same medium of 2D animation needed to show an event spread over say 5 minutes in the first case, a few months or years in the next and about 5-10 years in the third sequence. While there would be no transitions and

metamorphosis in the first section, the last section was all about transitions and quick metamorphosis. The visual style I chose needed to account for all these.

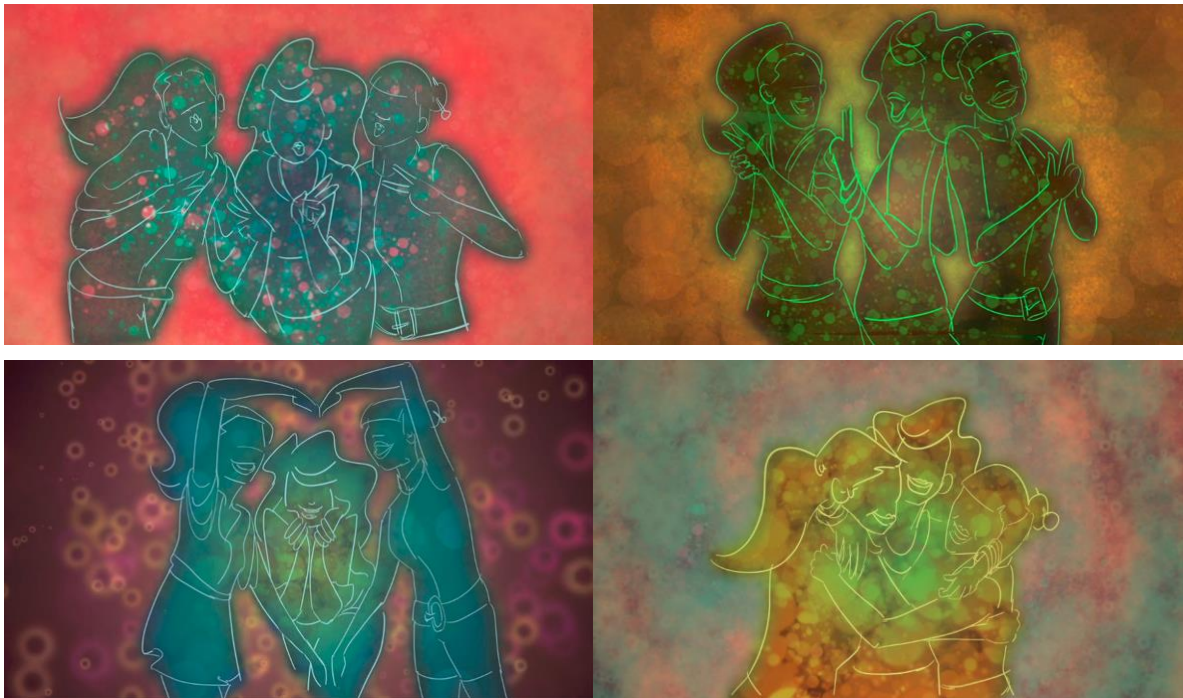
After experimenting with a few styles, I decided to go with simple strokes for the animation. All the energy I wanted to convey would be done with colorful backgrounds and the animation style itself. As this section needed to be visually very entertaining, I decided to entrust the coloring of the backgrounds with a more accomplished 2d artist. I had seen the work of Nirja Desai, a medical animation graduate student. She was very good with colors and her paintings conveyed the moods I was trying to go for. So, while I animated the motion, she painted some exquisite backgrounds. I then used all these backgrounds and animated the transitions in After Effects.

### Dream Sequence 01

In the first section, we see her looking at photographs with her friends. I wanted a party mood, a very happy, young, hippy look to this section. Backgrounds designed for this mood.



I mixed many of these BGs using alpha masks for the characters. I used one painting for the background color. The characters were masked and filled with another painting. There is also a faint inner mask centered on the main character to attract the viewer's attention. A third painting was used on this mask. Some final AE composites are as below:



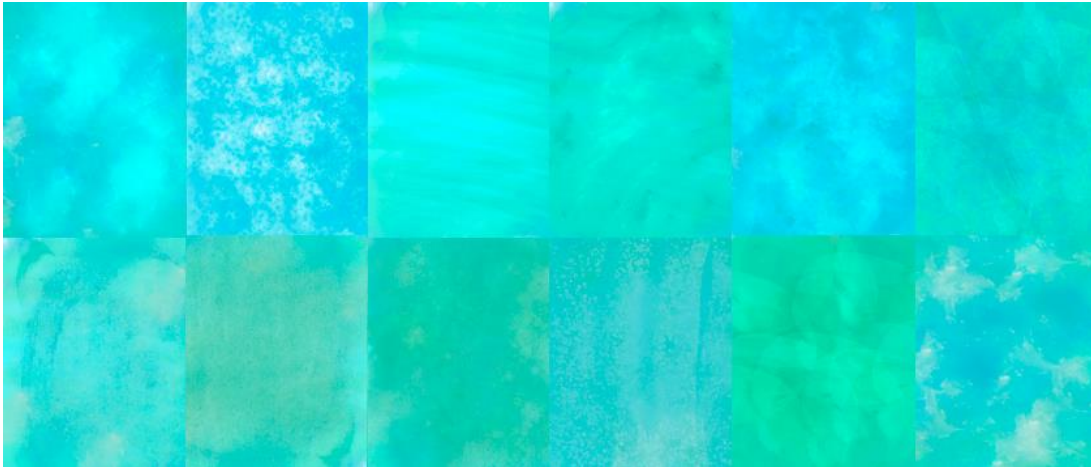
## Dream Sequence 02

The second dream sequence is about something very dear and personal to the mom. It is about her swim competitions and her thinking about how successful she was at her passion. This section is very important in the film in many ways. It forms a bridge to both visual storytelling and the mood in the story. This sequence ends with a wall of bright trophies and medals that fade out to reveal the shelf of spice jars in the kitchen. This plants the seeds of doubt in her mind as she realizes for the first time, that she is no longer the person she used to be.

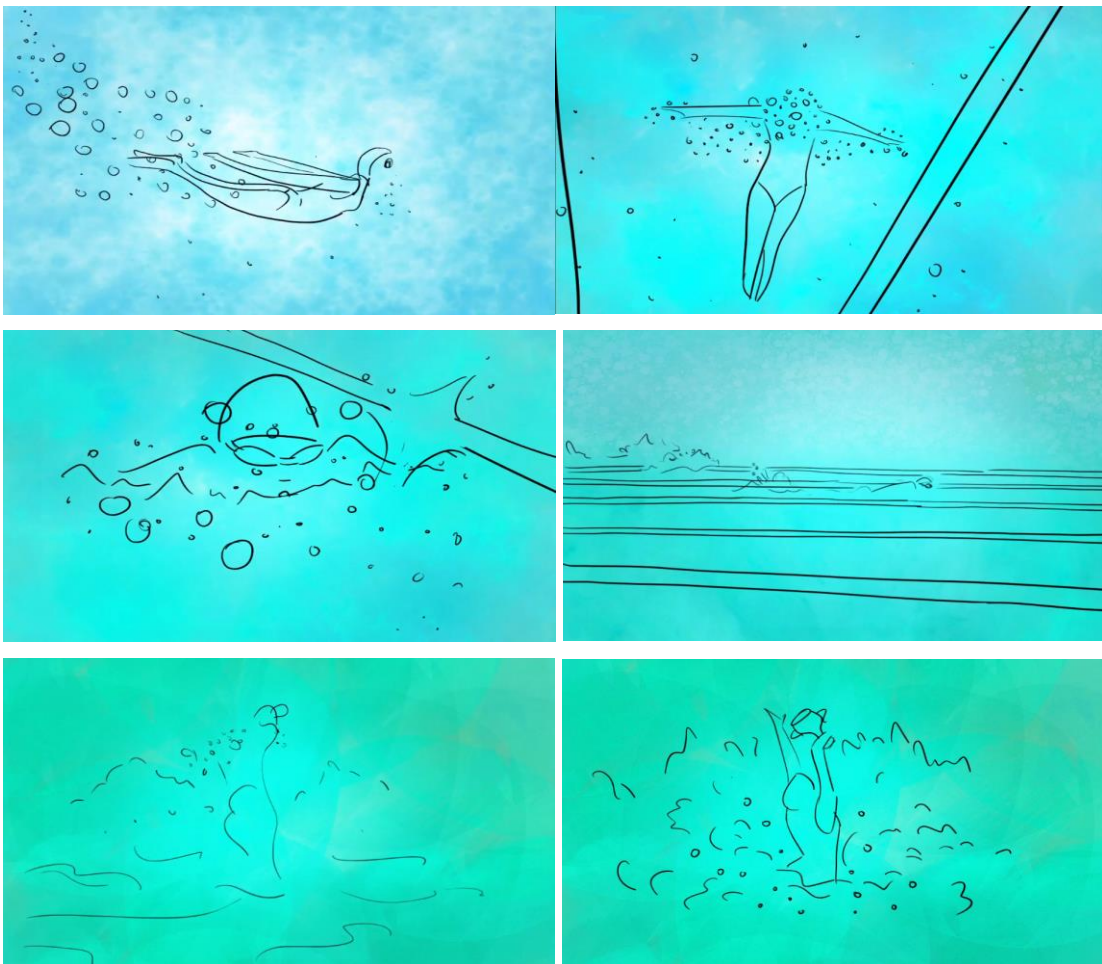
Visually, it is very different from the first sequence in that, the first sequence dealt with still photographs and this one deals with movements of the character. This also serves as a bridge for the transitions I was going to show in the third dream sequence. I wanted to therefore add really small transitions, just to get the viewer's eyes adjusted to the possibility of morphing landscape and transitions.

The treatment of the backgrounds differed too. In the previous sequence as the characters were still, I had the liberty to animate the backgrounds faster and make them more dynamic. In this sequence there was already so much action to show that constantly changing, bright backgrounds would really confuse the audience. Therefore I decided to go with backgrounds inspired by water theme and have really subtle differences between these templates to keep the BG moving and interesting.

Templates used: They all have very similar colors but vary in their texture. This allows for animating a constantly changing vibrant background without drawing too much attention to it.



Final animation screenshots:

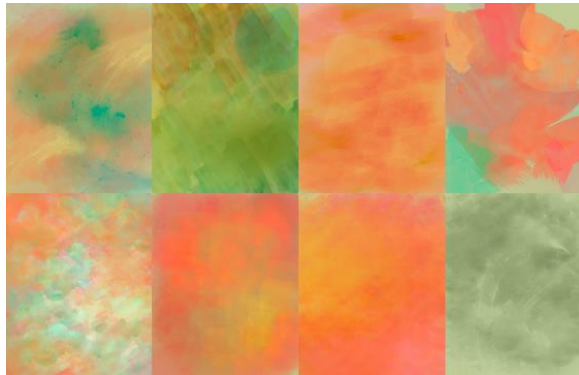


### Dream Sequence 03

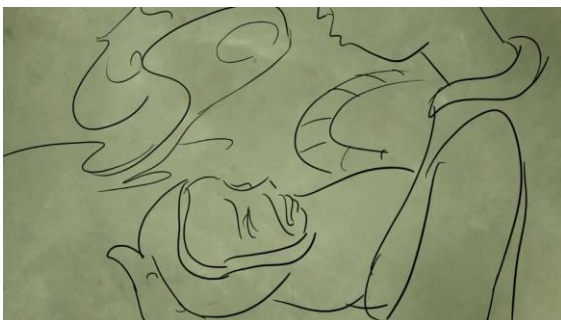
The third and final dream sequence was also the most complicated of all of them. I had to transition from her wedding day, to her current life 10 years later in a matter of 5-6 seconds. The sooner I show this transition, better the effect on the audience. With this in mind, I decided to start putting down the key elements in her life that she would see if she is having a mental breakdown. The sequence starts with an elegant dance between her and her husband and in a quick transition I show the husband disappearing from her arms and instead leaving out the door ready for work. As the husband dissolves away, his figure shrinks into that of a baby that the surprised mom holds gingerly in her hands. A quick swoop of the camera zooming in on the baby's face and as it draws out again; we see her standing amidst a stroller, toys and an elder kid of about 6 running with his toy plane around the husband's office desk. This pretty much sums up her life right now. Her husband is too caught up with work to be able to spend time with family and she is left to deal with taking care of the family members.

Due to the large number of transformations, I needed to use the transformations in the BG cleverly. The BG also needed to transform in terms of color and saturation. It starts out with bright warm colors and gets to dull greens and greys towards the end. I could either gradually change these backgrounds or make the transitions sudden and jarring. For this section, I went with the later as it felt more in tune with her state of mind. I used the transformations in the actions on screen to quickly change the BG to convey the change in mood immediately.

Color Templates:



Final Animation Screenshots:

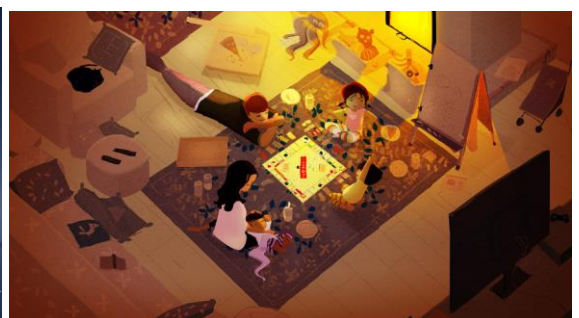


## Portraits

Knowing very well my lack of expertise with sketching, I had decided to get some help in this section. I enlisted the help of 2 main artists and 2 helpers, including me. A huge part of the film rested on the successful completion of the portrait photographs. As the mother is reminiscing about her past, those set of photographs play a crucial role in connecting the present with the memories of the character. Also, all around the house and on the fridge are pictures of the family. There were a total of about 40 pictures to be drawn and coordinated between the artists.

In order to make sure that every artist matched a similar style, I gave them each a reference photograph of what I wanted the poses to look like and a style of painting they needed to follow. I had been following Pascal Campion's work for a while and really loved the simplicity in his paintings. Many of his paintings focused on the family, the precious moments such as the first kiss or a baby's first steps etc. These are the moments that really make a family special. These were the perfect theme for my photographs too.

Reference pictures for color and style of drawing (all the paintings below are by Pascal Campion):





Final Portraits (Artists: Nola Ennis, Nirja Desai, Raymond Szigeti)



## Rendering and Compositing

One of my main goals in the film was to explore a new rendering technique. I wanted to make use of the toon lines in Maya, but with a new look to it. I experimented with a simple prop to try and add the toon lines to it. I wrote a script that I could run on any toon line selected, to connect that toonLine's attributes to custom attributes that I had setup. These were opacity, thickness, randomness. I also set the rig up such that I could use a damping attribute on each of these to dial down its effect from the max value set by the user, down to zero. This way the default settings of the toonLines need not change. If at any time, I needed to change the way a line appeared, I could use the damping values to adjust them.

I used a toon shader on the object and assigned it to pure white. That way, the object rendered out white with toon lines as boundaries. This was essentially a white and black paint map that I could then multiply on top of my renders to get a 2d stroke effect. This technique worked very well for one prop that I tested.

The real challenge however was to apply this to each and every prop in the scene. With almost 200 props in the kitchen, this was no easy task to do. This was one of the main reasons I decided to build a reusable rig file. I created this rig in an empty maya scene file with a control curve. This control curve had all the options such as damp, opacity, thickness etc. All the calculations were preformed based on these values and the output passed to a group called the output\_GRP. Now, all I had to do is import this file multiple times into the Maya scene and connect the output\_GRP values to the toonLines.

I tested this out on a much larger scene. The bedroom setup was not as complicated as the kitchen but still had enough props to make it a good test case. I came up with some really satisfying results. I however knew that, to achieve this render, I had to render the entire movie as a separate pass using just toon lines. And this had to be applied on top of a fully rendered, color corrected film. I therefore decided to get to this stage of rendering after finishing every other aspect of my film. I was however not able to get to this part, as in the last weeks the render farm stopped working forcing me to batch render my entire film, leaving no time to get to the next stage of rendering.

I also rendered my film without smoothing any of the models. In my initial tests, toon shading lines looked way better on rough edged models than the smooth ones. So, with this in mind, I rendered my entire film with a smooth mode of 0.

Snapshots of the bedroom with the toon lines test:

Primary lighting and shadows from key light:



Shadow and occlusion pass:



Toon Lines pass:



Composite Image without toon lines:



Composite Image with toon lines:



As seen above the toon lines are very subtle. But, when seen in motion, they add a very nice quality to the render as they change their shape and thickness ever so slightly adding a dynamic quality to the renders. However, my final renders before post processing were as shown in the first picture above.

## Post Processing

I had some really great help from Soheil Khosravinejad in post processing. I knew I did not want a straight up composite of all my renders to be my final film. I was therefore aiming for the 2d toon lines look for the film. When it was clear that I might not have the time to do a toon shading pass, I approached Soheil for help. We discussed different way of adding filters to make the film look more warm, cool, etc and after a few tests, settled with a very cinematic lens quality post processing.

We used Nuke for compositing and focused on depth of field, color correction and lens filter to slightly warp the edges to give everything a more cinematic feel. Also, as I had rendered the film with hard edges, most of the renders showed some very harsh light and shadow zones. The gradual fall off of the lighting that we get on smooth models was absent in my renders. So, I wanted to blur out this effect using post processing. This, I felt would set my 3D world apart from my 2D enough to make a good distinction.

Render image and Post processing final image Comparison: (HD NTSC, 1920 x 1080, H.264)





## Music and SoundFX

My music composer was Yuya Takeda, who graduated from the 3D Digital Graphics program at RIT. This was my first collaboration with him and I really liked what he came up with. I wanted my music to also resonate with the mother's mood. In the first draft of the music, Yuya had composed different tunes, one for sad, another for happy and so on. He then tried to fade these in and out as the mood of the film changed. Although the individual pieces of music were great, they did not come together well as a wholistic piece.

After a few failed attempts, he felt he would be most comfortable composing the music after the entire animated version of the film was done. He wanted to try a radical approach to composing the music and felt that he could do justice to the music only after he had the entire film with him. This was a huge risk of course. We were both hoping he would be able to compose and perform the music in the last week. I managed to finish the film about four days before the screening. I still had to render a few shots, work on post processing and credits. But, visually the film was complete. I sent the film to yuya so he could start composing the music.

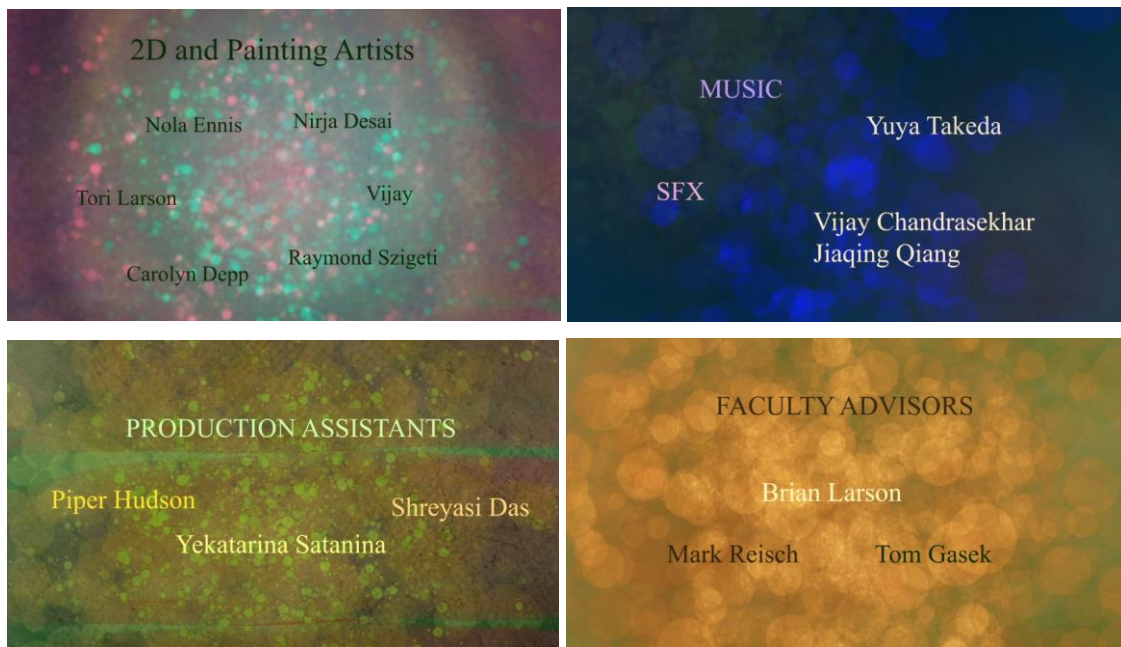
This time, Yuya watched the film about 5-6 times, mentally composing the music all along. The 7<sup>th</sup> time he started to watch the film, he picked up his piano and started to compose the music as he was watching the film. This was a single take composition that worked out very well. He seemed to hit every mood perfectly. We were both very happy with the end result.

While Yuya was working his magic, I relied heavily on the RIT sound library and FreeSound.org to collect all the soundFX I wanted. I had a lot of fun mixing these sounds. I had some really tricky sounds to compose. What would it sound like when the walls of the bedroom collapsed to reveal the kitchen? What would it sound like when I was making the transitions from the dream sequences to the 3D real world? Could I use sound to draw the stark contrast between these two lives? I had some help through Jiaqing Qiang in this phase. He helped me mix the sounds for about a minute of the film that takes place when the mother is cooking, while I was collecting the sounds for the rest of the film.

## Credits

I absolutely hate white text on black screen. I feel this is valuable screen time that could be used to further expand on the story. At the very least, some of the same theme from the film could be extended for the credits.

I had only about one day left for the credits. So, as much as I wanted to expand the story by showing more family portraits in the credit section, I decided to use the same 2D backgrounds drawn for the dream sequences to show my credits. The text was animated very slightly so they moved and scaled in size. The backgrounds were also animated to give a slow spin and scale animation to them.



## Critique and Reception

On the whole the reception for the film was very good. The person I was really waiting to hear back from was my mom. I had based this film on her life and her sacrifices for our family. She called me after seeing the film and we had a long conversation about how happy she was that all her sacrifices have amounted to something in all our(family) lives. She related very well with the mother on screen and had no problems going between the recollections and the real world, the confusions in the character's mind and could relate them to her own life.

My second compliment came from Prema, my mother-in-law. Although I had not based this film on her life, she said she felt like she was watching her own life playing out when she saw the film. I had the same response from my sister-in-law too.

Atia Quadri, the other 3D animation faculty at RIT, felt I had done a good job capturing the essence of the life of a woman through my film. She felt I was able to portray the lives led by women in parts of Asia that she comes from very well.

On another day, Mark Reisch pinged me online and said that his wife was having a particularly tough day with the kids and work at home. And that, she felt like she was living the life of the main character in my film that day. It made me happy to know that people from different origins of life, and different age groups were able to relate to my film and character in their own ways.

Among my friends, I would say most of them were very clear on what I was trying to convey. There were a few though who did not get the connections between the past and present immediately. This was especially true in the first transition to the dream sequence. The mother picks up a bunch of photographs from the fridge and picks out one in which she is seen in her younger days with her friends. So, I go from the 3D mom, to the younger 2D sketch of the mom's photograph with two of her friends and then transition the photograph to the gesture animation in the 2D world. There are 2 transitions the audience have to relate with in a very short time. This was the major hurdle for few of them. They assumed the mother was looking at the picture of her daughter. They did not realise it was her own younger picture that she was looking at.

While most of the guys I spoke with thought the film was powerful, I just felt they could not relate to the film on a personal level as the girls had done. I also found that older men were able to relate better. Maybe they were reminded of their wives sacrifices?

Some others felt I could have modeled the mother, who was the main character in the film, to look more appealing. While part of it is the fact that I intended for her to look a little unappealing right from the start, I also think my modeling and texturing skills could use more work and refinement in future, to better portray the character in my thoughts.

Among my advisors, Mark felt the film was good, but he was wondering all the time why I had rendered the film with no smooth on any of the models, until I explained to him my failed attempt at rendering the toon lines. Tom had this to say: *“This is a very touching film, Vijay. You’ve done a nice job. The detail and memories are creative and are effective and the 3-D character performance is well timed and expressive. The performance in some scenes could probably have been pushed a little further”*.

I remember until the last day before screening, I was not sure how I would resolve the problem of bringing the whole family together through sounds at the very end of my film. I wanted to bring in the sounds of the family in the background and have those sounds bring the mother out of her stupor and confused state. Brian Larson knew this was going to be challenging and was very worried as my attempts of finding a good audio source were not successful. And there was only one more day to screenings. When I finally mixed together about 10 different sounds and clips to get the effect I wanted, this is what he had to say: *“I think it looks SO MUCH better with this sound treatment! It’s a world of difference and you did a great job with the sounds. The laughter is great (although maybe a little too far forward in space). Well done!!!!”*

## Conclusions

I loved working in this film. I was fully aware that this probably might be the last opportunity I get to have a creative input of my own, before I head out to face the studio world. I have come a long way as an artist through this film and my master's program. I had to postpone working on the thesis by a few quarters as I wanted to personally work on every pipeline to have a working knowledge on each of them. I am so glad I did that because I would never have become addicted to the wonderful world of rigging otherwise.

I started out with the objective to tell a story, explore visual storytelling, rendering techniques and deliver a powerful animation. While the animation obviously needs work, I did manage to start and learn 2 new pipelines: rigging and scripting through this thesis. I started out exploring these pipelines very late during my MFA. I am so glad I did though, as I have become quite proficient at rigging and scripting since.

I also enjoyed working on this film a lot because I got the chance to work with so many talented individuals. All of whom were so ready to help and collaborate to produce something special.

I remember the first question Brian asked me when I went to him with this story. His question to me was, "Do you want this film to win awards at film festivals, or get you a job in the industry? Remember, there is no wrong answer here." My answer was spontaneous, "Job. I don't care much about film festivals." Thanks Brian, I now have a job 😊

As concluding remarks, I would say, "Never be afraid to explore new roads in life. You never know where these new possibilities can take you. The next big surprise in life could be waiting for you, right around the corner."