

# CS 6360 : COMPUTER GRAPHICS

## PROJECT REPORT

### DESIGN OF DIFFERENT SOFT ANIMATION CHARACTERS

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## 1 Introduction

Animation is the process of creating motion and shape change illusion by means of the rapid display of a sequence of static images that minimally differ from each other. It has got wide range of application in various fields such as film industry, modelling, architecture etc. The usage of animated 3D characters and objects adds beauty. 3D modelling and animations are used in many science-fiction films where the non-existent characters are modelled and animated. It also let the architects to give a three dimensional and more interactive view of building models. Many online e-commerce websites make use of 3D modelling for virtual dress-trials.

The 3D modelling and animations have got many applications in various fields. This project is an attempt to design soft animation characters using open-source platform called Blender and OpenGL. There are different methods to design and animate soft bodies as well as the rigid bodies. Rigid Bodies contain bones using which their animations are implemented where as in soft bodies, the animation depends on the material properties of the soft body like elasticity, gravity, friction etc. Simulation and control of soft characters is extremely challenging due to coupling between the skeleton and the soft body dynamics.

## 2 Problem Definition

To design some characters and bring them alive introducing a few dynamics like walk, dance, gestures etc. The objective is the physical realization of 3D models, carve and deform the object to reach equilibrium. To design a character in its neutral poses as well as a set of deformed target poses with smooth non-jerky animation.

## 3 Theory and Algorithm

For implementing the soft body animation, we need to select a mesh structure for it based on its physical behaviour. Every soft object is represented by a number of tetrahedra, each of which has its own position, physical properties and constantly influences the state of every adjacent element. We need the renderable mesh information, coordinates of polygon and tetrahedral mesh vertices, information of joints and their types and physical properties like mass, friction, gravity etc to simulate a soft body.

In order to "deform" an object, we must apply some appropriate combination of translation or rotation or scaling to only some subset of the vertices of the object probably weighting that transformation accordingly. To make the deformed object looks nice, it will be necessary to use more vertices than the original mesh. For example, a simple cylinder may only have vertices at either end, but if we want that cylinder to bend in the middle, we will need vertices there as well.

If we are interested in very specific, one-off deformations of very simple shapes we could probably just do this manually. But such a technique would not scale well and would be very tedious. Since it is very tough to correctly figure out how to weight a transformation to each individual vertex, we had to

use a technique called Skeletal Animation. It involves associating a separate set of geometry called the "skeleton" with the associated mesh. It represents the bones of the object and we define a mapping between the vertices of the real model and the bones of the skeleton. That is which bones are associated with each vertex and how much that bone affects the deformation of that vertex. Then the skeleton is animated directly. The animation is transferred to the real model through the relationship between the bones and their vertices.

## 4 Work Done

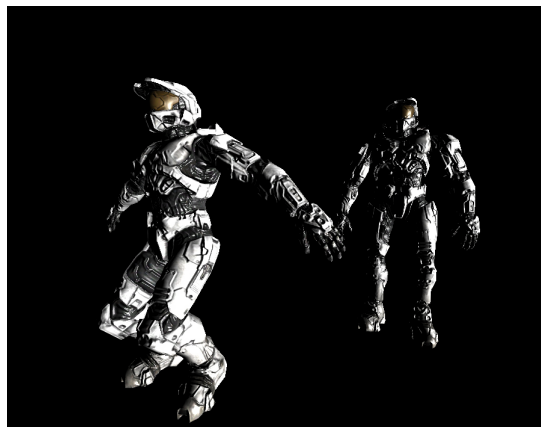
We implemented the skeletal animation and tried to implement deformation using the Bullet Library, which was not succeeded. The following are the steps involved in making an animated character using the skeletal method:

- For the 3D object design purposes we used Blender 2.74 software which is freely available and allows us to create our own plug-in extensions. We chose a 3D astronaut model (.obj file) from the online Blender Repository which is free to use.
- The open-source software OgreExporter was used to convert the chosen file to the desired formats, Material (.material) and Mesh (.xml).
- We used Visual Studio 2010 as the IDE for the project. The converted material file and mesh file in XML format were loaded into to the main project file. The structure of skeleton, which is a set of joints, was written in XML format and which was also loaded.
- Visualization is performed in real time by OpenGL and Glut library-based rendering engine written in C++.

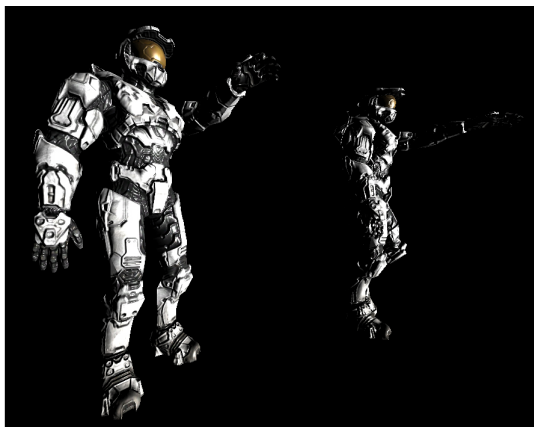
We chose another soft body 'Minion' (a character from the movie Despicable Me) with no skeleton, from the same online repository. We chose the Bullet Physics library to apply deformations. Due to frequent crashes and errors we were unable to use the Bullet Physics Library for the same. Later we manually tried deformations by applying rotation, translation and scaling operations. It did not really help to get the desired poses.

## 5 Results

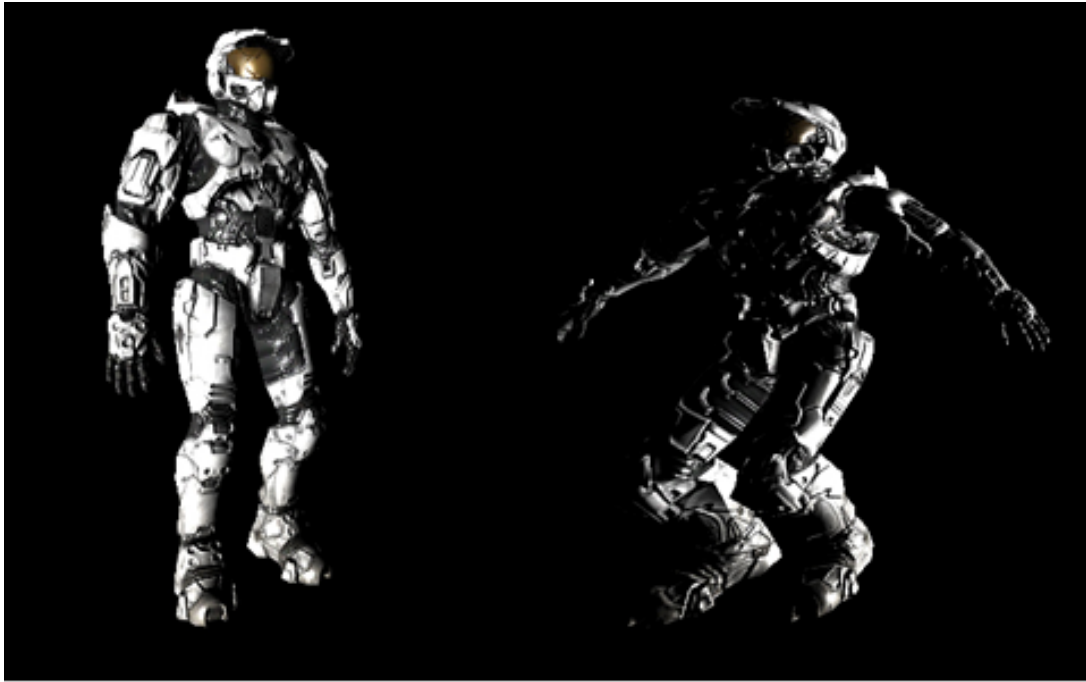
We successfully created an animated character and implemented the basic translation, rotation operations on a soft body. The figures below are the snapshots of the skeletal animation obtained using OpenGL:



NORMAL POSES



LEFT-HAND RISE



STILL POSE

SIT-UP MOTION

## 6 Conclusion

We implemented different skeletal motions using OpenGL. We also tried implementing deformations on soft body character using Bullet Physics Library but were not able to implement it because of the frequent system crashes. With proper versions of bullet library, we could have implemented the deformations on soft animation characters along with the skeletal motions that we have implemented.

## 7 References

1. Simulation and Control of Skeleton-driven Soft Body Characters by Libin Liu, KangKang Yin, Bin Wang, Baining Guo.
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3. Workflow for real-time simulation of deformable objects by Karolina Lubiszewska.
4. Computational Design of Actuated Deformable Characters by Melina Skouras, Bernhard Thomaszewski, Stelian Coros, Bernd Bickel, Markus Gross.
5. Make It Stand: Balancing Shapes for 3D Fabrication, Romain Prevost, Emily Whiting, Sylvain Lefebvre, Olga Sorkine-Hornung, in SIGGRAPH 2013 ( <http://i.gl.ethz.ch/projects/make-it-stand/>)