

VIRTUAL MODELLING AND VISUALIZATION OF BODY DESIGN IN THE AUTOMOTIVE INDUSTRY

Abstract: In this paper, we present the different modelling steps commonly used in car & motorcycle-body design along with our personal approaches on solving complex geometry and our own design iterations. This study offers an insight in how concept cars and motorcycles are modelled, how their different iterations are developed starting from the initial design and how to create a photorealistic render. The paper is presented in a step by step structure to aid future car designers in improving their workflow when using Autodesk 3Ds Max 2014 and achieving better presentation results using the V-Ray plug-in.

Key words: 3DS Max, Polygonal modelling, V-Ray, Photorealistic images

INTRODUCTION

3DS Max is a 3D modelling program used in the gaming industry, animation in movies, architecture and advertising. It is also the most used software in designing and visualizing products in the Automotive Industry. In this regard, 3DS Max 2014 offers the possibility of exploring the shapes and designs of different body parts and deliver high quality photorealistic images.

2. INFORMATION

2.1 The modelling process of cars

The car model from which the modelling has been started is the LaFerrari. The first step is the assembly of the blueprints inside the program. The images are based on the technical drawings of the car, representing its orthographic projections. The blueprints are mounted on the three main planes as bitmap files (top, left, front and back – fig. 1) [1].

The modelling itself starts from simple geometric shapes. For this particular automobile it started from two tube bases to define the outline of the wheels and from a horizontal plane which will serve as the basis of the hood.

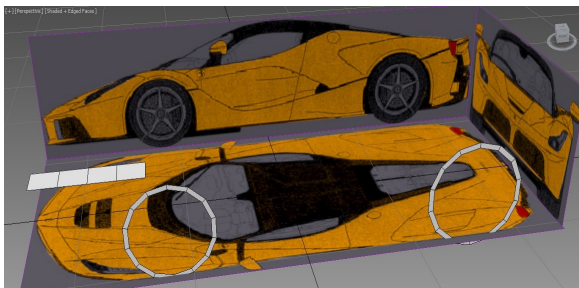


Fig. 1 Mounting the blueprints and the beginning of the modelling process

What needs to be kept in mind when modelling any object is to follow the outline of the blueprints in all three perspectives in order to get the desired 3D shape (fig. 2). This is done by individually positioning each vertex according to the reference image.

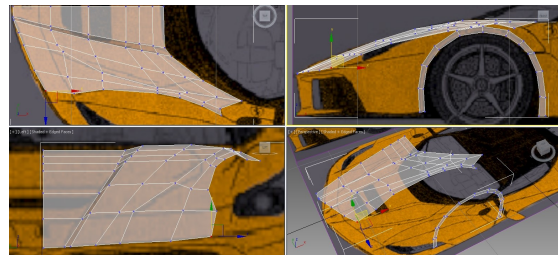


Fig. 2 Following the outline of the blueprints

Using the Extrude function next, the rest of the hood was extended until completed. This procedure represents close to 70% of the modelling process, the whole body of the car being built this way. To connect the hood to the side of the car, the correspondent vertices have been joined using the Target Weld function.

Continuing modelling the body, a more complex feature of the car was the air vent near the door (fig. 3).

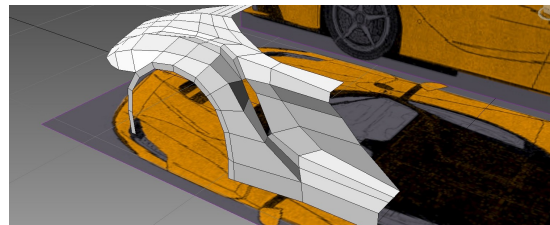


Fig. 3 Modelling the air vent

This part had a more organic shape and modelling it out of polygons was going to pose a challenge. In this regard, we postponed its modelling in order to establish the adjacent geometry first. Once this step was complete, the edges of the vent have been extruded inwards and connected to the door with the Bridge function (fig. 4).

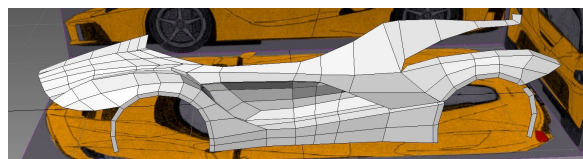


Fig. 4 Modelling the geometry around the door

Using the same extruding process, the car body around the engine and the rear headlights has been built but the back side was created separately starting from a parallelepiped (fig. 5). It is only required to model half of the car, the other half will be automatically duplicated using the Mirror function. The headlights were also built starting from an individual basic shape. This method has been chosen in order to ease the modelling process and not load the main object with unnecessary polygons.

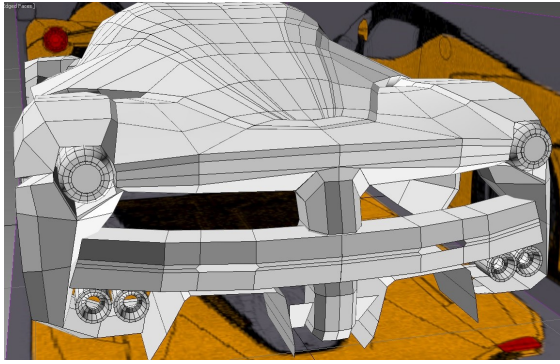


Fig. 5 Modelling the rear of the car

The roof and the windows were built from the body of the car and they were later on separated from the main geometry using the Detach function, becoming individual objects (fig. 6). This method of working ensures the continuity of the shapes, the transition from the body to the cockpit being a smooth one. If the modelling was to start from a new geometry there would have been difficulties in aligning the vertices of the two surfaces.

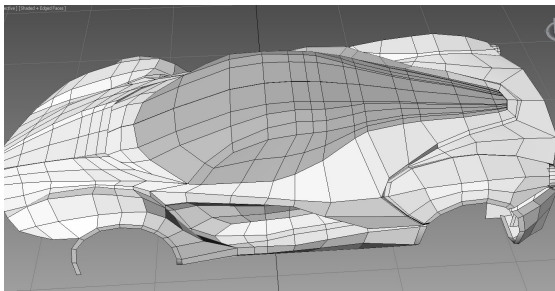


Fig. 6 Detaching the roof and the windows from the car body

This particular model of Ferrari has “Seagull” type doors, the opening system continuing on the roof. In order to delimit the shape of the doors before they are detached it is necessary to rearrange the vertices according to the blueprints (fig. 7). This stage requires the use of constraints, more precisely edge constraints. These allow the movement of the vertices only on the edges of the existing polygons, removing the possibility of spoiling the general flow of the objects.

After that, the door is separated from the rest of the car to better define its shape. In this regard, the Chamfer function has been applied to the exterior edges to create another row of polygons at a 45° angle. These were later deleted in order to give the door the effect of depth.

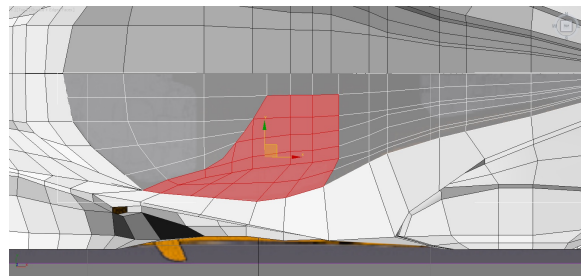


Fig. 7 Remodelling the geometry of the doors

In this stage, the base geometry of the vehicle is complete, but the shapes obtained through the polygonal modelling have an unfinished aspect and sharp corners. To give a more realistic look to the car, the Turbosmooth function was used to divide each polygon into 4 different ones, rounding all edges (fig. 8). However, in the case of some elements, we needed to keep the edges sharp. This is possible by adding new rows of edges to strengthen the desired shape, which can be done automatically using the Swift Loop function.

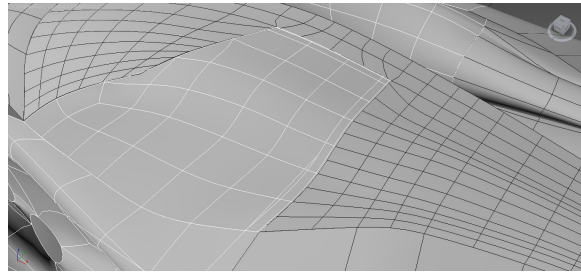


Fig. 8 Finishing process - Turbosmooth

3DS Max offers the possibility of creating different variations of the product, in this case, of the automobile. In this regard, starting from the original model of LaFerrari, we modelled a personal design of the car, inspired from the Formula 1 concepts (fig. 9).



Fig. 9 Personal variations of the design

2.2 The rendering process

For visualizing the modelling projects it is required to render them using a specialized program. All the renders presented in this article were made using V-Ray. This plug-in offers a basic material library with the option of editing and creating customized materials (fig. 10).

Making a scene ready for the rendering process involves modelling an environment, setting the camera, placing the light sources depending on the visualization angle and finally creating and assigning materials to each object in the scene (fig. 11).



Fig. 10 Rendering of the original car



Fig. 11 Rendering of the personal variation

2.3 The modelling process of motorcycles

The motorcycle model from which this project has been started is Suzuki GSX R 1000. Modelling a motorcycle is different from modelling a car as it contains a lot more geometry and individual parts, especially around the engine area. Modelling these elements is difficult due to their complexity, asymmetry and their 3D layout (fig. 12). Because of this aspect, when building a motorcycle, beside the mandatory blueprints [2], we used plenty of reference images [3] to better see the general shape and assembly of the objects.

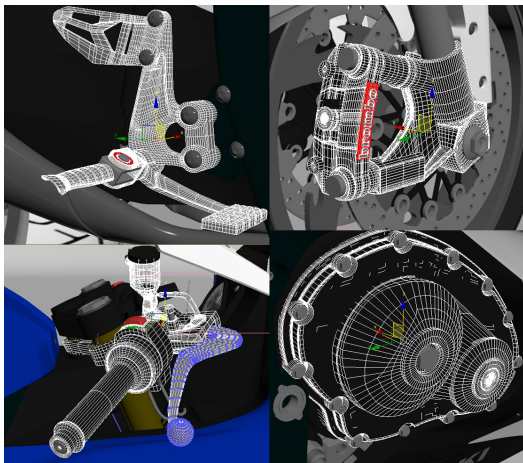


Fig. 12 Individual complex elements

The first step of the modelling process is the assembly of the blueprints inside the program. This step is identical to that of the cars but the starting geometry is based on preferences. In the case of motorcycles, modelling is made by sections, each one being treated individually. For this Suzuki the front part of the body was modelled first. Once the basic shape was complete we applied the Turbosmooth function and strengthened the edges that needed to be sharp by adding Swift Loops.

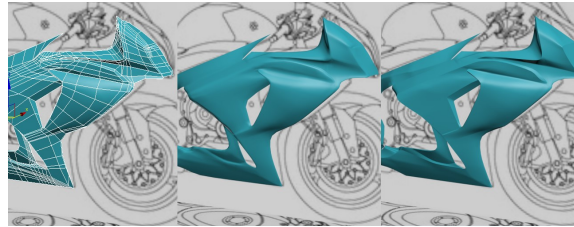


Fig. 13 Modelling and finishing the body

If it is necessary to keep some corners perfectly sharp we utilize the command panel of Smoothing Groups. It allows us to separate certain polygons into finishing groups, keeping the edges between adjacent surfaces with different ID's perfectly sharp (fig. 13).

Modelling the wheels is done by first building a single section of the rim, in this particular case having a 72° angle. We later multiplied it by using the Array function, adjacent vertices being joined with the Weld function. The tire is a simple tube and we created the dents using a pattern previously made in Photoshop that we applied as BumpMap (fig. 14). This function automatically makes the holes in the tire following the reference image.

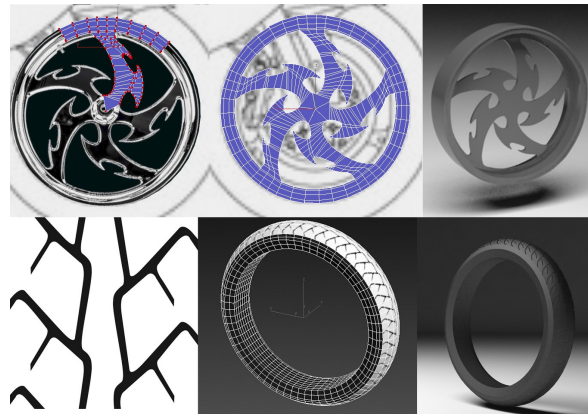


Fig. 14 Wheel modelling

The rest of the motorcycle parts were made using the same techniques presented previously (fig. 15). The smaller elements such as bolts, nuts, rivets, wires were all only modelled once and later on multiplied to serve as individual geometry elsewhere in the project.

Just like in the case of modelling cars, the other half of the motorcycle was automatically created using the Mirror function.

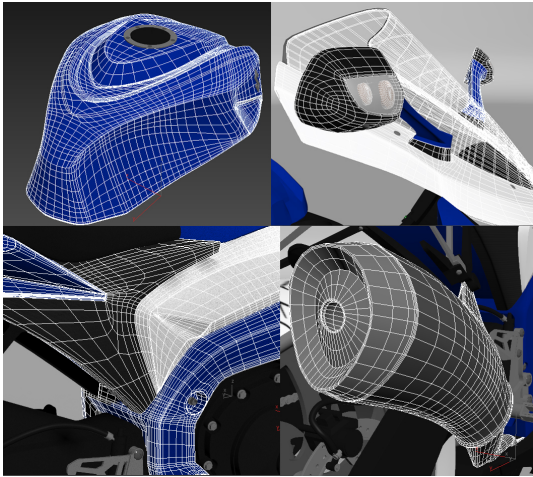


Fig. 15 Modelling different sections of the motorcycle

Starting from the original model of Suzuki GSX R 1000, we created a personal variation of its design, inspired from SF movies. In the case of motorcycles, because the modelling is made by sections, changing the aspect of different parts was relatively easy. They are built either by starting from a new basic geometry or by modifying current ones (fig. 16).

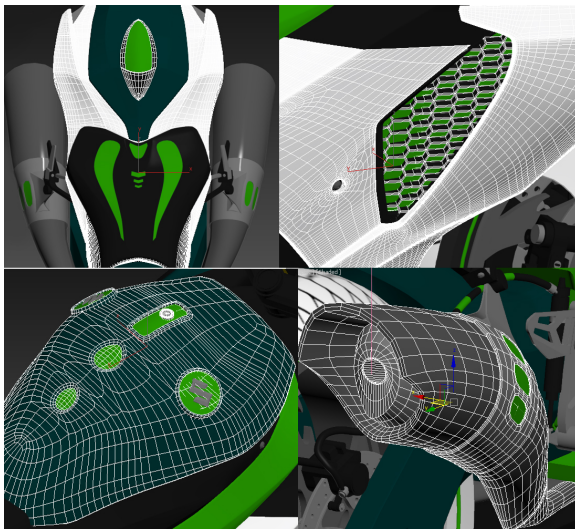


Fig. 16 Personal design variations

2.4 Photorealistic rendering

For the rendering process it was necessary to study beforehand what materials we were going to use. A particular material that required a lot of work was the aluminium. Different textures were created using the V-Ray material editor by adjusting the default values.

Creating a proper ambient is another very important step in order to get some well-defined final images. For the classic model of Suzuki (fig. 17) we realised a simple scene, an outdoor parking lot along with a virtual sky and sun and for the SF concept of the motorcycle we created a more organic ambient with shades of black and green to better emphasize its futuristic design (fig. 18).



Fig. 17 Final render of the original motorcycle model



Fig. 18 Final render of the personal design variation

3. CONCLUSIONS

As it is demonstrated in this article 3 DS Max immensely helps in the concept development phase of automotive industry due to its direct modelling techniques allowing the user to quickly define and capture geometry.

Design variations can be easily made, starting from the original design and can be visualised in real time.

REFERENCES

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