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НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ «ЗАПОРІЗЬКА ПОЛІТЕХНІКА»

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Кафедра комп'ютерних систем та мереж

Пояснювальна записка

до дипломного проєкту (роботи)

магістра
(ступінь вищої освіти)

на тему 3D MODELING FOR ROBOTS

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Освітня програма (спеціалізація)
«Спеціалізовані комп'ютерні системи»

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Форма № 25

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ

Національний університет «Запорізька політехніка»

Факультет Комп'ютерних наук і технологій

Кафедра «Комп'ютерні системи та мережі»

Ступінь вищої освіти магістерський

Спеціальність 123 Комп'ютерна інженерія
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Освітня програма (спеціалізація) «Спеціалізовані комп'ютерні системи»
(назва освітньої програми (спеціалізації)

ЗАТВЕРДЖУЮ
Зав. кафедри Кудерметов Р.К.
"____" ____________ 2023 року

З А В Д А Н Н Я
НА ДИПЛОМНИЙ ПРОЄКТ (РОБОТУ) СТУДЕНТА

DONG YU
(ПРІЗВИЩЕ, ім'я, по батькові)

1. Тема проєкту (роботи) 3D modeling for robots

керівник проєкту (роботи) PhD, associate professor, HRUSHKO Svitlana
(науковий ступінь, вчене звання, ПРІЗВИЩЕ, ім'я, по батькові)

затверджені наказом вищого навчального закладу від "24" жовтня 2023 року № 400

2. Строк подання студентом проєкту (роботи) 10 грудня 2023 року

3. Вихідні дані до проєкту (роботи) available 3D modeling programs, existing principles and models of building robots

4. Зміст розрахунково-пояснювальної записки (перелік питань, які потрібно розробити)

1) Software for 3D modeling;
2) Industries involved in 3D modeling;
3) Modeling Strategies;
4) Modeling design by Blender;
5) 3D Modeling for Robotsby by Blender.

5. Перелік графічного матеріалу (з точним зазначенням обов'язкових креслень)

6. Консультанти розділів проєкту (роботи)

Розділ	ПРІЗВИЩЕ, ініціали та посада консультанта	Підпис, дата	
		завдання видав	прийняв виконане завдання
1-5	HRUSHKO S., associate professor		
нормоконтроль	SHCHERBAK N., senior lecturer		

7. Дата видачі завдання 01.10.2023 р.

КАЛЕНДАРНИЙ ПЛАН

№ з/п	Назва етапів дипломного проєкту (роботи)	Строк виконання етапів проєкту (роботи)	Примітка
1	Software for 3D modeling	10.10.2023 р.	
2	Industries involved in 3D modeling	15.10.2023 р.	
3	Modeling Strategies	20.10.2023 р.	
4	Modeling design by Blender	05.10.2023 р.	
5	3D Modeling for Robotsby by Blender	20.11.2023 р.	
6	Formalization of the withdrawal results	25.11.2023 р.	
7	Design of graphic material	01.12.2023 р.	
8	Registration of supporting materials	10.12.2023 р.	

Студент ______ (підпис) DONG YU (ім'я, ПРІЗВИЩЕ)

Керівник проєкту (роботи) ______ (підпис) Svitlana HRUSHKO (ім'я, ПРІЗВИЩЕ)

ABSTRACT

EN: 70 p., 75 pictures, 10 references

3D MODELING, BLENDER SOFTWARE, INDUSTRIAL DESIGN, GAME DEVELOPMENT, ROBOTICS, VIRTUAL REALITY

Object of Development: The thesis focuses on the development of 3D models for robots using Blender, a 3D computer graphics software. Subject of Development: The subject is the application of 3D modeling techniques in the field of robotics, emphasizing the use of Blender software for creating detailed and efficient models.

Purpose of the Work: The main goal of the thesis is to demonstrate the process of creating 3D models for robots, showcasing the capabilities of Blender in this context. It aims to contribute to the fields of virtual reality, game development, and industrial design by providing insights into effective 3D modeling practices.

These 3D objects can be generated automatically, or created manually by deforming the mesh or otherwise manipulating the vertices. 3D models are used in a variety of media, including video games, movies, architecture, illustration, engineering, and commercials.

This paper presents a learning-based 3D modeling method and implications. The significance of 3D modeling, its historical development, the current mainstream software illustrates its use, and a 3D model of one is completed by ourselves. I used a software called Blender 3.4 to handle the correspondence between the input image and the output 3D model, which utilizes a representation of the 3D model in the form of point cloud data. We conducted experiments on several datasets and compared it with existing methods. The experimental results show that our method performs well in generating high-quality 3D models with high efficiency and stability.

The method in this paper can be applied to several fields, such as virtual reality, game development, and industrial design.

CONTENTS

INTRODUCTION

The 3D modeling process produces digital objects that can be fully animated, which makes it a necessary process for character animation and special effects.

The core of the model is the mesh, which is best described as a collection of points in space.

These points are mapped to a 3D mesh and connected together in polygonal shapes (usually triangles or quadrilaterals). Each point or vertex has its own location on the mesh and by combining these points into shapes, the surface of the object can be created. The created 3D model is usually exported to other software for use in games or movies. But some 3D modeling programs allow the creation of 2D images using a process called 3D rendering. This technique is useful for creating ultra-realistic scenes using complex lighting algorithms. Research problem and objectives Significance and motivation of the study.

3D modeling research has important significance and objectives, which mainly include the following aspects:

Virtual reality and augmented reality applications: 3D modeling can provide high-quality virtual environments and scenes for virtual reality and augmented reality applications, enabling users to experience the virtual world more immersively.

Game development: 3D modeling plays a key role in game development, enabling the creation of realistic game scenes, characters, and objects to improve the visual effect and immersion of the game.

Industrial design and product development: 3D modeling enables virtual prototyping and testing during product design and development, reducing the cost and time of actual manufacturing.

Architecture and urban planning: 3D modeling can help architects and urban planners better visualize and design buildings and cityscapes, improving design efficiency and quality.

Medical and bioscience research: Through 3D modeling, human organs, cells and molecules can be accurately visualized and simulated, helping the progress of medical and bioscience research.

Overall, 3D modeling research aims to provide high-quality virtual environments and scenarios that help people better understand and apply the real world and improve efficiency and innovation in a variety of fields.

1 SOFTWARE FOR 3D MODELING

1.1 Maya

MAYA is like a learned old professor or a heavy dictionary [1], with a very large knowledge system and structure, often learning a module is enough [1]. And according to the software modules will have different job assignments, such as modeler, animator, binding division too much, and the use of different areas, MAYA is more suitable for film and television animation and so on, not for that short and fast projects.

Figure 1.1 – Maya

1.2 Cinema 4D

The freedom of operation is high, 3D texture painting can be done directly on the 3D model using this module. Rich and powerful preset library, you can easily find from its presets you need models, mapping, materials, lighting, environment, dynamics, and even camera lens presets, greatly improving the work efficiency C4D also has the world's most advanced hair system; and can be seamlessly integrated with the post software AE.

And C4D is now also used in many industries, not only film and television post, ui, plane can be used. Modeling, animation, lighting, materials, or rendering, all do not matter, just become a hot new three-dimensional net red.C4D is also a super friendly 3D software for graphic designers or individual users [2].

Figure 1.2 – Cinema 4D

1.3 3DS Max

The best 3D software for Windows.

3ds MAX, is a PC-based 3D animation rendering and production software developed by Discreet (later merged by Autodesk). Its predecessor was the 3D Studio series of software based on the DOS operating system. Before the advent of Windows NT, industrial-level CG production was monopolized by SGI graphics workstations. 3ds Max has a very powerful toolset for 3D modeling, not to mention fluid simulation, hair, and character manipulation and animation. It uses direct manipulation and procedural modeling techniques, and a large library of different modifiers makes the modeling process easier for new or intermediate 3D artists. Nowadays it performs more strongly mainly in the architectural and mechanical fields, which require CAD for floor plans, and 3ds MAX is better adapted to CAD.

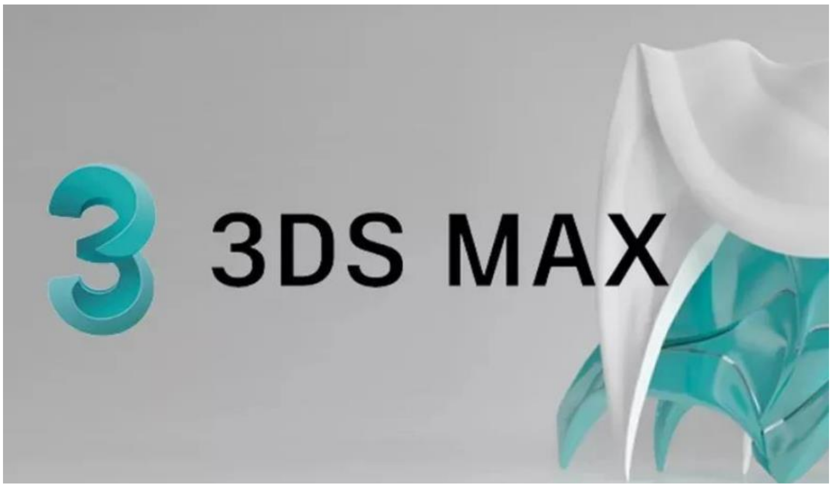

Figure 1.3 – 3DS Max

1.4 Zbrush

The most advanced 3D sculpting software ZBrush is a unique thinking 3D software developed by Pixologic, which has both the easy operability of 2D software and the powerful functions of 3D, and was officially released for PC and Mac in 2009. By today, ZBrush is recognized as the most advanced 3D sculpting software on the market. What sets ZBrush apart from other 3D tools is that ZBrush emulates traditional sculpting techniques that are done digitally on the computer. Sculpting with ZBrush is similar to using a digital clay ball and shaping it just as if it were handmade. In 3D printing, from the virtual to the real world. Capture real models quickly with ZBrush and 3D scanning [3].

ZBrush is a popular choice for artists who want to 3D print toys and mannequins, and there are also tools specifically for 3D printing. ZBrush is also an industry leader for the creation of mannequins. It is used in human models, and the software can sculpt the models in great detail, showing both structure and muscle alignment clearly. ZBrush is capable of sculpting models with up to 1 billion polygons, so the limit is only the artist's own imagination.

Figure 1.4 – Zbrush

1.5 Blender

Free software with professional-level features Blender is a complete process software for computer 3D art. With it you can basically do all the work needed for 3D art, and it is the only software that can do it from pre-setting to post-editing out of the film. Blender 2.8 is also more powerful with the launch of Blender 2.8. 2.8 has more advanced 3D view display capabilities, more versatile and free display methods, and EEVEE's superb view display allows your scenes to be modeled and airbrushed in PBR materials, with the minimum graphics card requirement increased to OpenGL 3.3. (EEVEE is a new physics-based real-time rendering engine. based real-time rendering engine that can be used as both a final render output and as a real-time rendering engine for views.) Blender 2.80 introduces a new way of managing Collections and view layers, and the outline view management is also much enhanced, allowing for more intuitive management, editing, and filtering. blender is also an open source software, always get the latest version, try the latest features. blender also has open source community, the community will share resources, free public code, etc. [4].

Figure 1.5 – Blender

1.6 Houdini

The special effects power behind today's movies and TV Houdini is developed by the Canadian company Side Effects Software Inc. It is widely used in the visual effects industry to create a range of stunning 3D images [5].

Houdin runs on Linux, Windows, Mac OS and other operating systems, and is based entirely on a node-based model that differs significantly from other 3D software in its structure and operation. This nodal workflow is not to everyone's liking, but Houdini also has more traditional tools for interacting directly with on-screen polygons.

Houdini's own renderer is Mantra, based on the Reyes rendering architecture, so it can also quickly render motion blur, depth of field, and displacement effects. mantra is a proven, product-proven renderer for cinematic-level rendering requirements. The point is that SideFX offers Houdini Apprentice, a free version of Houdini FX that students, artists and hobbyists can use for their personal, non-commercial projects. The free version gives you access to almost all the features of the award-winning Houdini FX to develop your skills and work on personal projects. The full-featured Houdini Indie also offers an affordable commercial option for small studios.

Figure 1.6 – Houdimi

1.7 Rhino

The sparrow is small, but it has everything you need.

Rhino, also known as Rhinoceros, is a NURBS-based 3D modeling software introduced by Robert McNeel in 1998. Fully featured, affordable, and user-friendly, many small and medium-sized studios use Rhino to design their products.

As the most popular software in recent years in the industrial and architectural fields, Rhino's modeling ideas are very free, but this freedom is also a "double-edged sword": compared to other similar software, Rhino in the rapid use of 3D software to express the design, more advantageous. However, Rhino is still a kind of modeling logic, if the structure of the grasp is not rigorous enough, to 3D printing is easy to make mistakes, in the butt manufacturing industry and other industries that need to produce a solid mold, is not very suitable. In addition, relative to other similar software, it is no special choice of computer operating system, the hardware configuration requirements are not high. Secondly, it is not like other three-dimensional software has a huge body, easily hundreds of megabytes, all installed only a few 20 megabytes. And this software currently has a relatively wide range of domestic use, tutorials are more, want to start self-learning is also more convenient. If only rendering effects, the combination of Keyshort rendering will be enough for many scenes [6].

Figure 1.7 – Rhino

1.8 Modo

The most user-friendly 3D software.

As the development team behind LightWave 3D, Modo has evolved from a basic subdivision surface modeling system to the full-featured digital content creation application we know today. Its tools are well thought out and well implemented, making it very user friendly.

It is a comprehensive 3D software for advanced polygonal subdivision surfaces, modeling, sculpting, 3D painting, animation and rendering. With modeling at its core, Modo is one of the best applications for creating polygonal forms, using direct tools and process techniques. Adding the best MeshFusion Boolean system simply extends its modeling capabilities.

Its workflow differs from the vast majority of 3D software in that its basic design principles are simplicity, flexibility, clarity, and intuitiveness. Unlike the mainstream software like Maya and 3ds Max, which require learning and facing a large number of sidebar tools and parameters, modo tends to use a combination of more compact tools to form highly variable and flexible original tools.

Relatively speaking, modo is more suitable for concept designers.

Figure 1.8 – Modo

1.9 Conclusions to Chapter 1

Designers usually run more than one 3d software, and with the upgrading of the software, the hardware will not be able to meet the requirements of the designers, there will be a lag and crash, this situation can not be every time in order to meet the needs of the new software to keep upgrading the hardware, and the computer to replace the generation of fast, high rate of depreciation, and the cost is also relatively too high. So before doing a modeling project, you can predict the size of the project, the details required, select the appropriate modeling software, efficient modeling.

2 INDUSTRIES INVOLVED IN 3D MODELING

2.1 Entertainment industry

One of the fastest growing industries in the world is the entertainment industry, which has countless other job opportunities. Today, entertainment companies are providing a lot of 3D modeling work because of the heavy use of 3D modeling software needed to create new things in movies, serials, etc. The emergence of unnatural effects, models and designs can be challenging for 3D graphic designers.

2.2 Video games

Companies addicted to the gaming industry are using 3d modeling software wisely to create more realistic games. Animated cars, characters, and incarnations with special impact scenes, etc. But being a 3d modeler in the gaming industry is required of challenging personnel. Share the most comprehensive domestic 3D game modeling series related resources, 3Dmax, Zbrush, Maya and other next-generation game animation modeling software teaching, as well as the production of mechanical, props, characters, monsters and other models. Learning enterprise-goose circle: it begins with the number: 684, in the middle is: 763, located at the end of the number: 871 , the above three groups of numbers can be combined in sequential order! Create a full range of analysis from zero-based to project development hands-on practice! [7].

2.3 Real estate and construction

The design of the building, the interior of the building site, and even high-quality blueprints need to be perfectly rendered. 3D architectural engineering and 3D architecture is part of the latest design in today's construction industry.

2.4 Work Release

Producing book covers, digital posters and illustrations is now a comprehensive career for 3D modelers worldwide. You can be a freelance illustrator or join a large publishing company to create 3D book covers with beautiful illustrations, abstracts, etc. This is really a field of artwork.

2.5 Advertising and marketing companies

Advanced 3D modeling work comes with a diverse range of specialties, even in advertising and marketing companies. You can use modeling software to create new packaging, product designs and prototype structures, and develop outstanding renderings. Using 3D modeling software and programs has multiple benefits because it saves time, effort, energy and cost at the same time.

2.6 Science and Technology

3D modeling professionals are now also a part of science and technology. To understand earthquakes, trenches, terrain stresses, etc. around the world, 3D modeling software is used. Even in health, medicine, flight patterns, climate and many other scientific fields, 3D modeling programs are widely used.

2.7 Conclusions to Chapter 2

In summary, it can be found that 3D modeling is used in the construction, manufacturing, and engineering industries, where 3D modeling technology can help professionals to design and plan more quickly and accurately, thus increasing efficiency. In the manufacturing and design industries, 3D modeling technology can help designers and engineers create more accurate product models to improve product quality and performance. In the medical and engineering fields, 3D modeling can be used for surgical simulations, engineering predictions, and more, helping professionals better assess risk and improve safety. In the gaming, film and animation industries, 3D modeling technology can create more realistic and stunning visual effects to enhance the entertainment experience. In the field of education and training, 3D modeling can create more vivid teaching scenes and simulation experiments to improve the teaching effect. So the above is to introduce the advantages of 3D modeling and understand the effect of its role in various industries.

3 MODELING STRATEGIES

3.1 Modeling methods

3.1.1 Using a computer to describe the behavior of a system

For example, a spreadsheet program can be used to process financial data to represent the behavior of a company; to develop a business plan; and to assess the possible impact of changes in a company's operations.

3.1.2 The use of computers to describe objects and their spatial relationships mathematically

For example, computer-aided design (CAD) programs can generate objects on the screen, using equations to produce straight lines and shapes that are precisely placed in relation to each other and to the two- or three-dimensional space in which they are located.

3.1.3 Application and data modeling

Application and data modeling is the process of identifying, documenting, and implementing data and process requirements for an application. This includes looking at existing data models and processes to determine if they can be reused, and creating new data models and processes to meet the unique requirements of the application. Key activities in the modeling process include:

– defining data and its associated processes (e.g., field salespeople need to view online product catalogs and submit new customer orders);

– defining the data (e.g., data types, sizes, and default values);

– ensure data integrity (using business rules and validation checks);

– define operational processes (e.g. security checks and backups);

– choose data storage technology (e.g., relational, hierarchical, or indexed storage technology).

Be sure to know that modeling often involves the management of your company in unexpected ways. For example, data ownership (and the implied responsibility for data maintenance, accuracy, and timeliness) is often questioned when new insights are gained about which data elements should be maintained by which organizations. Data design often drives companies to recognize how enterprise data systems are interdependent, and encourages them to seize the efficiency gains, cost savings, and strategic opportunities that come with coordinated data planning. By the end of modeling, you have fully defined the requirements of your application, identified data and services that may be reused by other enterprise-wide applications, and laid a strong foundation for future expansion.

3.2 Modeling Categories

There are many popular 3D modeling software in the industrial design field. They can be roughly divided into two categories, namely CAID and CAD.

CAID class probably includes Alias Studio, Rhino, etc. are good appearance design software, surface editing freedom, more conducive to design in the push.

CAD class also has like Pro/Engineer, UG (Unigraphics NX), CATIA, Solidwork and so on these practical engineering modeling software, suitable for mold class professional.[7]

3.3 Modeling stage

3.3.1 Pre-preparation

Before making a drawing, first make sure the unit used is millimeter, then use Shift+I to import CAD into 3DMAX. Move the imported CAD drawing to the world coordinates (0, 0, 0), then select all the imported lines to group them as the base map and freeze the base map. Next, call in the other CAD planes. Open 2D capture and set the capture points to vertical and midpoint so that it is easy for pre-drawing operations. Stack the outer contours of the imported layers together, and then move the top layer along the Y-axis in the TOP drawing as a reference.

Similarly, import each elevation of the building, group them so that their outer contour lines are aligned with the outer contour of the plane, and then freeze them as a reference. Rotate the elevation along the X-axis by 90°. Be sure to check the capture settings if you find that you cannot capture the frozen points.

3.3.2 Generate solids

With the help of the base drawing, it is extremely easy to pull the wall on it. It is important at this point to make sure that the new wall has the least number of faces and the least amount of calculations possible. It is best to retrace the shape of the flat wall with a line so that the drawn line is a whole. At this point, it is important to check off the check mark after "StartNewShape", so that the line can be drawn as a whole. Then add the "Extrude" command to the wall line, set the width of the building's exterior wall to 370mm or 240mm, and treat the window frames on the façade as a whole to save the surface. This is the time to assign materials to the strong body.

There are a lot of small components in the 3D modeling process, so be sure to assign materials to each model in time after it is built, while each material is best marked with a name on the material ball, so that if further adjustments are needed in the future, you can select the material ball, select the objects using the same material, and edit the objects in a separate viewport by Alt+W keys. After determining the changes, add the editablemesh command to the objects using the same material to collapse them into the same object, so as to reduce the number of surface and line operations as much as possible and improve efficiency. But collapse command is not reversible, use must be careful when using.

3.3.3 Camera

After completing the collapse you can append a target spotlight to the object. Pressing C in any viewport switches it to the camera window. Then adjust the height of the camera and the target point, generally in the front view kind of move it to the Y direction of 1600mm can be. At this point in order to facilitate observation, the window layout will generally be adjusted [8].

3.4 Conclusions to Chapter 3

So for 3D modeling we should have an overall strategy; from modeling methods, to modeling categories, and modeling stages have a clear understanding, so that when the need to do an example of 3D modeling, the project will have a full preparation, easy to complete the project quickly and smoothly [9].

4 MY MODELING DESIGN BY BLENDER

4.1 Modeling Orbits in a Magnetic Field

I modeled orbits with double cylinders, batteries with large cylinders, and magnetic fields with arrows, and I will be bringing this into my teaching of magnetic fields in physics.

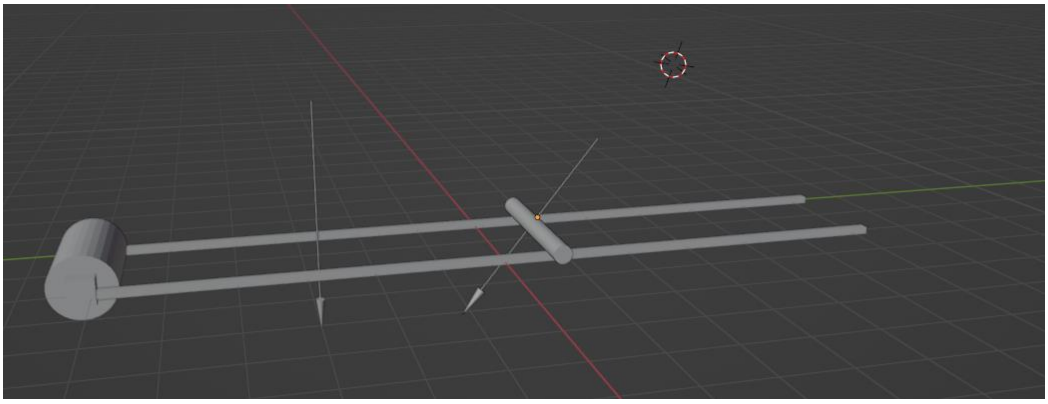

Figure 4.1 – Twin rod model

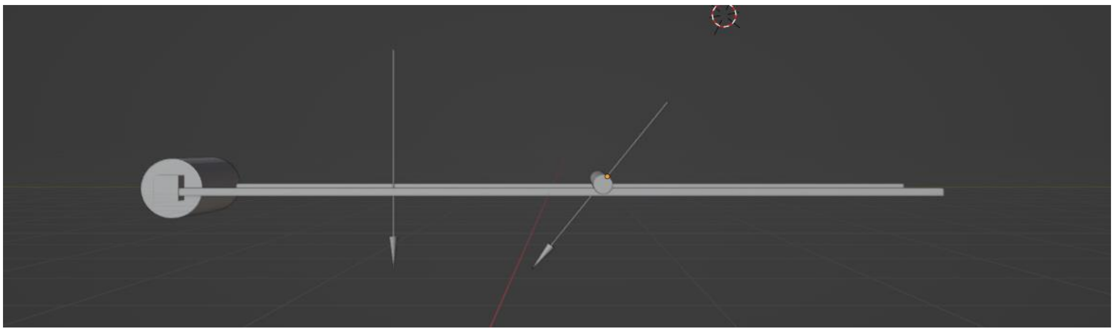

Figure 4.2 – Twin rod model

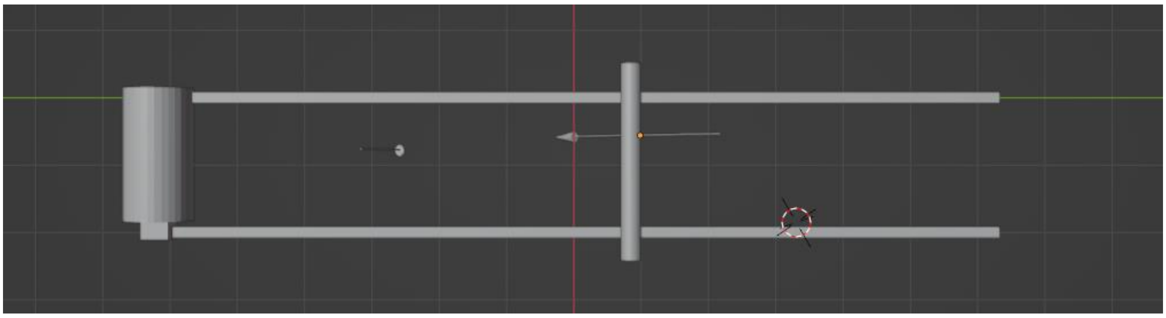

Figure 4.3 – Top view

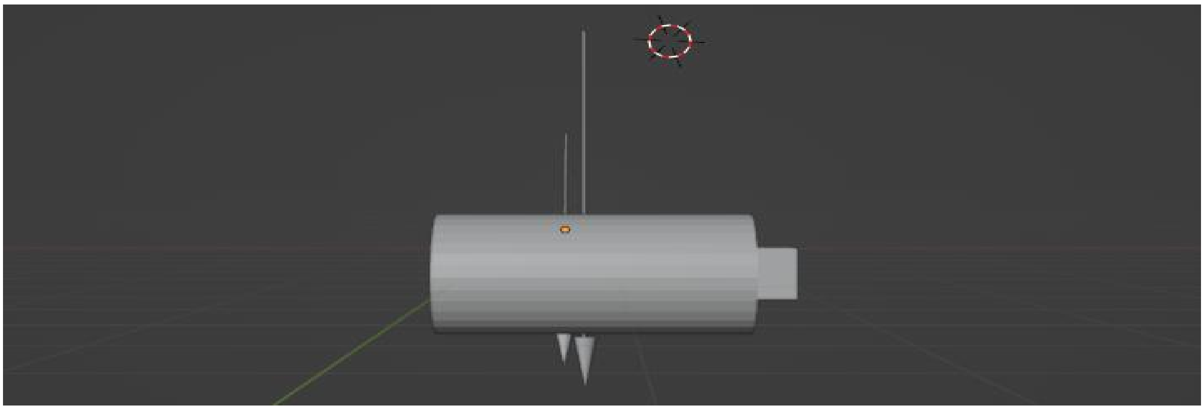

Figure 4.4 – Side view

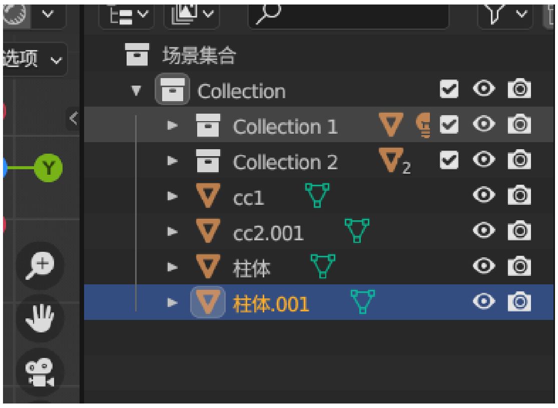

Figure 4.5 – Scene Collection

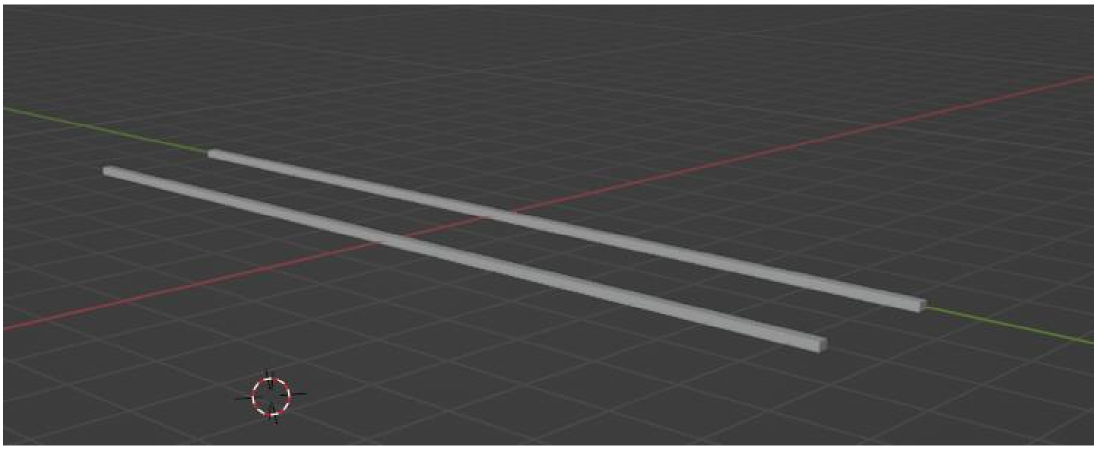

Figure 4.6 – DoubleCylinder

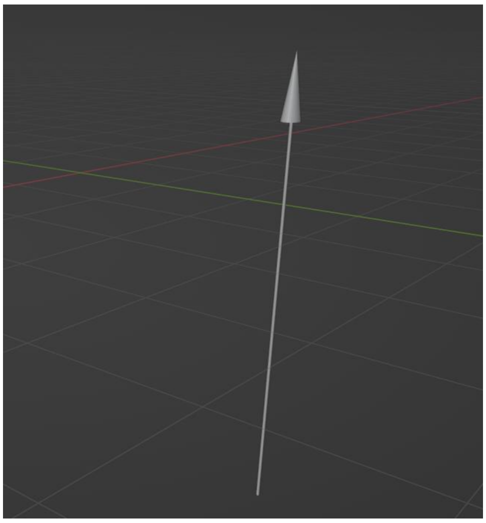

Figure 4.7 – No.1 Cylinder with Cone

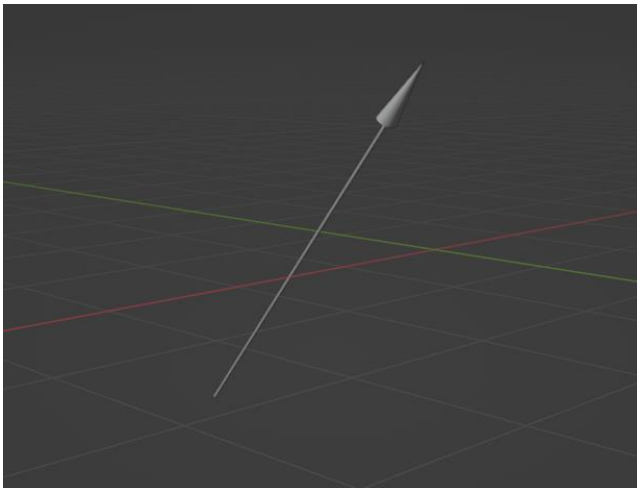

Figure 4.8 – No.2 Cone plus Column

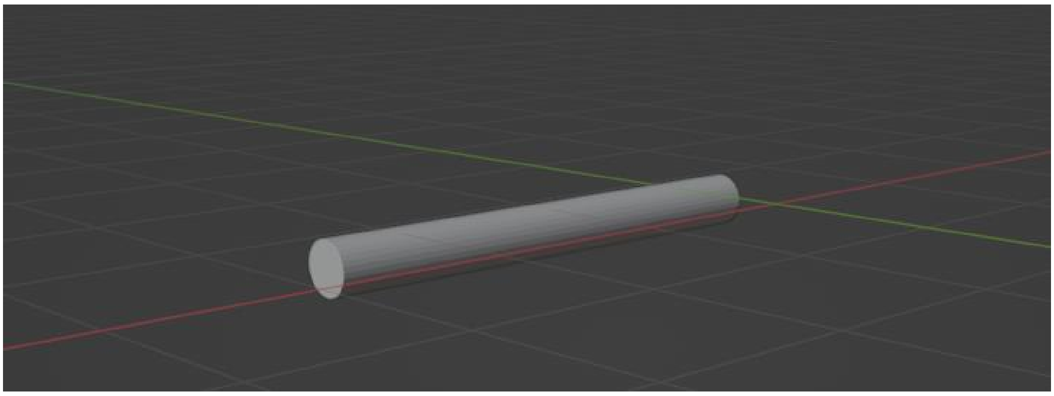

Figure 4.9 – Cylindrical

4.2 Conclusions to Chapter 4

The above uses Blender to initially complete a modeling, the part of the modeling used in Blender's basic shapes, and in the basic shapes of the deformation, and ultimately the combination of these basic shapes, the formation of a model, and from the different observation face of the model to observe, to fully illustrate the feasibility of modeling with Blender.

5 3D MODELING FOR ROBOTS BY BLENDER

5.1 The connection between 3d modeling and robotics

3D robot modeling refers to the use of computer software to create virtual models to demonstrate and design the appearance and structure of a robot. This modeling technique can be used for various types of robots, including industrial robots, service robots, and medical robots.

In 3D robot modeling, designers can use specialized computer-aided design (Blender) software to create the robot's exterior and interior. These software usually have powerful modeling tools that can help designers accurately build the robot's shape, parts, and structure.

Once a 3D model has been created, designers can conduct virtual tests to simulate the robot's motion, function, and performance. In this way, designers can identify and solve potential problems without having to conduct actual physical tests, saving time and costs.

During the robot modeling process, designers can also add details and textures to make the model more realistic. This helps customers and stakeholders better understand how the robot will look and function.

Overall, 3D robot modeling is an important tool when designing and developing robots, and it helps designers better understand and demonstrate the appearance and functionality of robots, thus promoting the development and adoption of robotics.

5.2 Blender

5.2.1 Blender's Unique Advantages

Blender is a free open source and lightweight 3D software, so light that it is only about 300MB in size. Although the software is small, it is full-featured, it collects: modeling, sculpting, binding, particles, dynamics, animation, interaction, materials, rendering, audio processing, video editing, as well as a series of animation tools such as motion tracking, post-synthesis and other short films. And it has a variety of user interfaces, which is convenient to use in different jobs.

What's more, Blender has built-in Cycles renderer and real-time rendering engine EEVEE, and also supports third-party renderers, and commercial creations are permanently free - a must-have for creative development. Many 3D artists in the conceptual design and real-time rendering circles are very fond of using Blender, such as the open source animated short film "Spring" produced by Blender: this short film uses almost all the features of the Blender software. After reading it seems to be able to understand why everyone favors this software so much!

Figure 5.1 – Spring1

Figure 5.2 – Spring2

Figure 5.3 – Spring3

5.2.2 The advantages of Blender compared other 3D software

The advantages of Blender compared other 3D software:

– blender has enough features;

– it has a wide range of built-in plug-ins;

– blender has a wide range of built-in plug-ins and powerful 3D creation tools. These tools give Blender one of the most important features that differentiate it from other 3D software: the ability to create short animations on its own;

– the ability to create short animations on its own.

5.2.3 Blender has the following powerful advantages

Blender has the following powerful advantages:

- two built-in rendering engines. The renderer Cycles has built-in ray tracing rendering. This approach is similar to offline rendering, which will take some time. The rendering effect is more realistic, and can even be movie-quality. EEVEE is a very good quality dual-purpose real-time renderer that can be used either as the final rendering output . It can also be used as a view of the real-time rendering engine;

- completely free and open source. Compared to most 3D software on the market are very expensive, Blender completely free is very attractive. Therefore you don't have to worry about copyright issues when doing commercial development, and the open source nature of the software allows us to use it at any time. Open source software allows us to modify the software at any time not smooth;

- small size. Blender's software package is only about 87MB.After the installation is complete, the entire software is only a few hundred megabytes! With other mainstream three-dimensional software can easily be a few G compared to , the Blender with a USB flash drive can easily take away. Startup speed is also very fast.

5.2.4 A few useful shortcuts tips

Here are a few tips that we have summarized:

- you can open blender by [shift + A] to bring up the create menu;
- by [r, g, s] the three keys, you can rotate, move and scale the model;
- [shift + D] can realize the copy function;
- use the [Z] key to switch to wireframe mode, and press it again to switch back;
- [Tab] key can switch to "Edit Mode", and back to the current mode;
- in "Edit Mode", you can switch to "Point Line Surface" selection mode by [Ctrl + Tab];

- after selecting the model part, you can use the [E] key to extrude;
- use the [X] key to call up the delete menu, select the data to be deleted.

5.2.5 Blender experience sharing

From the use of feelings on the talk, the final decision to create the effect of our elements are mainly in three areas: software skills, art skills, renderer adjustment.

Software skills: It's not difficult to get started with Blender, but the things you learn at a later stage will be more complicated. Learning anything will invest a lot of time, learning software, it is best to carry out a full process to try to master the rendering of simple scenes, modeling - rendering - drawings.

Art skills: aesthetics is also extremely critical for the CG animation industry, more good works to cultivate taste. Now everyone's eyes are getting wider and wider, if you do it with the thinking of painting, you will consider more design modeling, composition skills and atmosphere rendering, the final effect is definitely different.

Renderer Adjustment: When adjusting the renderer, you have to consider how to arrange the light and shadow, composition and content placement how to layout and so on, all of these for the overall aesthetics and effects to serve, the renderer adjustment is based on the completion of the model on the basis of the final debugging.

In general, the study and use of Blender, help to think about the overall spatial layout and the position of the light caused by the impact of the surrounding environment, will Blender and other three-dimensional software linked together, will allow animation production to a higher level.

5.3 Components of a robot

5.3.1Components of a robot

At its most basic level, the human body consists of five major components:

– body composition;

– muscular system, used to move body structures;

– sensory system to receive information about the body and surroundings;

– energy source, used to energize muscles and senses.

The brain system, which processes sensory information and directs muscle movement.

Of course, there are intangible characteristics of humans, such as intelligence and morality, but on a purely physical level, this list is quite complete.

The components of a robot are very similar to those of a human being. A typical robot has a movable body structure, a motor-like device, a sensing system, a power source and a computer "brain" that controls all of these elements. Essentially, robots are human-made "animals", machines that mimic human and animal behavior.

Figure 5.4 – Bionic Kangaroo Robot

The definition of a robot ranges widely, from industrial robots for factory service to home cleaning robots. By the broadest definition available, something is a robot if it is considered a robot by many people. Many roboticists (people who make robots) use a more precise definition. They specify that a robot should have a reprogrammable brain (a computer) that is used to move the body.

By this definition, robots differ from other moveable machines, such as automobiles, in their computerized elements. Many new automobiles have an on-board computer, but it is only used to make minor adjustments. The driver directly controls most of the vehicle's components through various mechanical devices. Robots, on the other hand, differ from ordinary computers in their physical characteristics; they each have a body attached to them, whereas ordinary computers do not.

Most robots do share some common characteristics.

First of all, almost all robots have a body that can move. Some have nothing more than motorized wheels, while others have a large number of movable parts that are generally made of metal or plastic. Similar to the human skeleton, these separate parts are connected with joints.

The wheels and axles of a robot are connected by some kind of transmission. Some robots use motors and solenoids as actuators; others use hydraulics; still others use pneumatics (systems powered by compressed gas). Robots can use any of these types of transmissions.

Second, robots need an energy source to drive these actuators. Most robots will use batteries or a wall outlet for power. Additionally, hydraulic robots require a pump to pressurize the fluid, while pneumatic robots require a gas compressor or compressed air tank.

All of the actuators are connected by wires to a piece of circuitry. This circuit directly powers the electric motor and solenoid and operates an electronic valve to activate the hydraulic system. The valves control the path of pressurized fluid flow within the machine. For example, if a robot were to move a hydraulically powered leg, its controller would open a valve that is fed by a hydraulic pump to a piston barrel on the leg. The pressurized fluid will push the piston, causing the leg to rotate forward. Typically, robots use pistons that provide thrust in both directions to allow the part to move in both directions.

The robot's computer controls all the parts connected to the circuit. To get the robot moving, the computer turns on all the motors and valves it needs. Most robots are reprogrammable. To change the behavior of a particular robot, you simply write a new program to its computer.

Not all robots have sensing systems. Very few robots have a sense of sight, hearing, smell, or taste. One of the most common senses that a robot possesses is kinesthesia, which is its ability to monitor its own movement. In the standard design, the robot is fitted with wheels with grooves carved into the joints. On one side of the wheel is a light-emitting diode that emits a beam of light that passes through the groove and shines on a light sensor located on the other side of the wheel. When the robot moves a particular joint, the grooved wheel rotates. In the process, the notch will block the light beam. The optical sensor reads the pattern of the light beam flashes and transmits the data to the computer. The computer can accurately calculate how far the joint has rotated based on this pattern. The same basic system is used in computer mice.

These are the basic components of a robot. There are countless ways that roboticists can combine these elements to create infinitely complex robots. Robotic arms are one of the most common designs.

5.3.2 How robots work

The English term "robot" comes from the Czech word robota, usually translated as "forced laborer". It is an apt description of most robots. Most of the world's robots are used to perform heavy, repetitive manufacturing tasks. They are responsible for tasks that are very difficult, dangerous or boring for humans.

The most common type of manufacturing robot is the robot arm. A typical robotic arm consists of seven metal parts that are connected by six joints. A computer will rotate stepper motors connected to each joint individually in order to control the robot (some large robotic arms use hydraulic or pneumatic systems). Unlike normal motors, stepper motors will move precisely in increments. This allows the computer to move the robot arm precisely so that the arm keeps repeating the exact same motion over and over again. The robot utilizes motion sensors to make sure it is moving exactly the right amount.

This six-jointed industrial robot closely resembles a human arm, with the equivalent of a shoulder, elbow and wrist. Its "shoulder" is usually mounted on a fixed base structure (rather than a moving body). This type of robot has six degrees of freedom, meaning that it can turn in six different directions. In contrast, a human arm has seven degrees of freedom.for example, the following figure.

Figure 5.5 – Joints of a six-axis industrial robot

The role of a human arm is to move the hand to different positions. Similarly, the role of a robot arm is to move end-effector. You can attach a variety of end-effector to a robotic arm for specific application scenarios. One common type of end-effector that grips and moves different items is a simplified version of a human hand. Robotic arms often have built-in pressure sensors that are used to tell a computer how hard the robot is gripping a particular object. This keeps the object in the robot's hand from falling or being crushed. Other end-effectors include blowtorches, drills and paint sprayers.

Industrial robots are specialized to perform the exact same job over and over again in a controlled environment. For example, a particular robot might be responsible for screwing lids on jars of peanut butter being transferred on an assembly line. To teach the robot how to do this job, a programmer would use a handheld controller to guide the robotic arm through the entire set of actions. The robot stores the exact sequence of motions in memory and thereafter does the set of motions over and over again whenever a new jar is transferred on the assembly line.

Robotic arms are one of the basic components used in the manufacture of automobiles.

Most industrial robots work on automobile assembly lines and are responsible for assembling cars. When it comes to doing a lot of this kind of work, robots are much more efficient than humans because they are very precise. No matter how many hours they have been working, they are still able to drill holes in the same position and screw screws with the same amount of force. Manufacturing robots also play a very important role in the computer industry. Their incredibly precise hands can assemble a tiny microchip.

Robotic arms are relatively easy to build and program because they only work in a limited area. Things get a little more complicated if you're sending the robot out into the vast outside world.

The primary challenge is to provide a viable locomotion system for the robot. If the robot only needs to move on flat ground, wheels or tracks are often the best choice. If the wheels and tracks are wide enough, they are also suitable for more rugged terrain. But robot designers often want to use legged structures because they are more adaptable. Building robots with legs also helps to inform researchers about natural kinematics, a useful practice in the field of biological research.

A robot's legs are usually driven back and forth by hydraulic or pneumatic pistons. The individual pistons are attached to different leg parts, like muscles attached to different bones. Getting all these pistons to work together in the right way is certainly a challenge. As a baby, the human brain must figure out which muscles need to contract simultaneously to keep it from falling over when walking upright. Similarly, the designer of a robot must figure out the correct combination of piston movements associated with walking and program this information into the robot's computer. Many mobile robots have a built-in balancing system (e.g., a set of gyroscopes) that tells the computer when the robot's movements need to be corrected.

Figure 5.6 – Boston Dynamics' newly upgraded Atlas humanoid robot

Bipedal walking is inherently unstable and therefore extremely difficult to realize in robotics. To design robots that are more stable, designers often look to the animal kingdom, especially insects. Insects have six legs, and they often have exceptional balance, adapting to many different terrains.

Some mobile robots are remotely controlled, allowing humans to direct them to perform specific tasks at specific times. Remote controls can communicate with the robot using a connecting wire, radio, or infrared signals. Remote robots are often referred to as golem robots, and they are useful in exploring environments that are fraught with danger or inaccessible to humans, such as the deep ocean or the interior of a volcano. Some robots are only partially under remote control. For example, an operator may instruct a robot to reach a particular location, but will not guide it on a route, leaving it to find its own way.

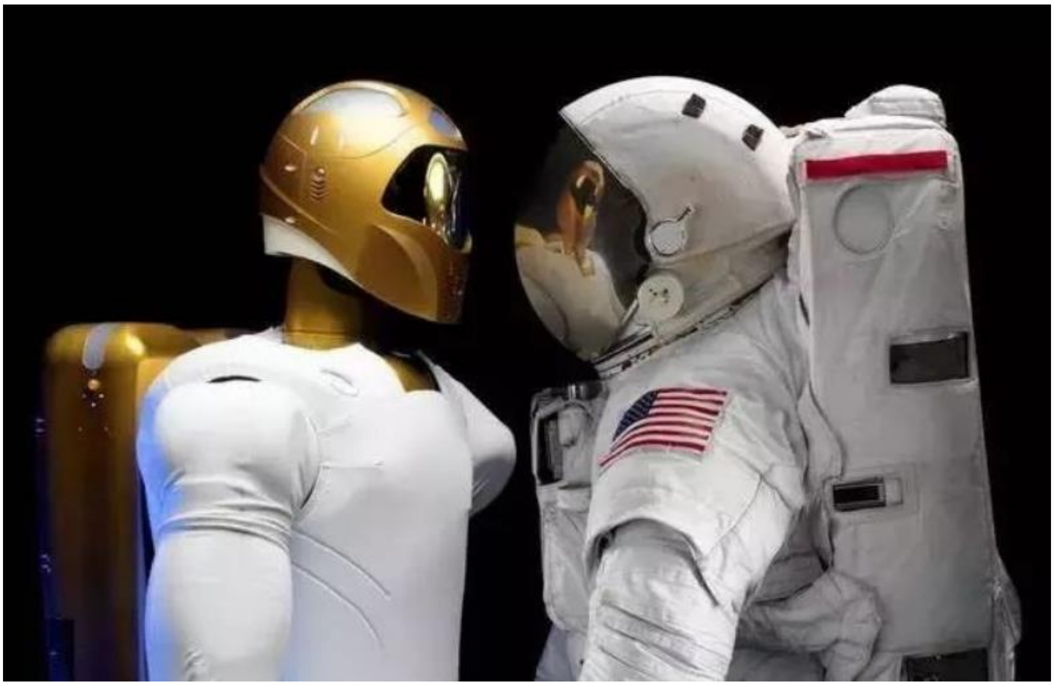

Figure 5.7 – NASA develops remotely controllable space robot R2

Automated robots can act autonomously without being dependent on any controller. The basic principle is that the robot is programmed to respond to external stimuli in a certain way. Extremely simple collision-responsive robots can be a good illustration of this principle.

This robot has a collision sensor that is used to check for obstacles. When you start the robot, it zigzags along a generally straight line. When it hits an obstacle, the impact is applied to its collision sensor. Each time a collision occurs, the robot's program instructs it to back up, then turn right, and then continue on. Following this method, the robot changes its direction whenever it encounters an obstacle.

Advanced robots will utilize this principle in more refined ways. Robotics experts will develop new programs and sensing systems in order to create robots that are more intelligent and perceptive. Today's robots can thrive in a variety of environments.

Simpler mobile robots use infrared or ultrasonic sensors to sense obstacles. These sensors work in a similar way to an animal's echolocation system: the robot sends out a sound signal (or a beam of infrared light) and detects the reflection of the signal. The robot calculates the distance between it and the obstacle based on the time taken for the signal to reflect.

More advanced robots utilize stereoscopic vision to see the world around them. Two cameras provide the robot with depth perception, while image recognition software gives the robot the ability to locate objects and recognize various objects. Robots can also use microphones and odor sensors to analyze their surroundings.

Some automated robots can only work in limited environments with which they are familiar. For example, lawn mowing robots rely on boundary markers buried in the ground to determine the extent of a grassy field. And robots used to clean offices need maps of buildings in order to move between locations.

More advanced robots can analyze and adapt to unfamiliar environments and even to areas of rough terrain. These robots can associate specific terrain patterns with specific actions. For example, a rover robot would use its vision sensors to generate a map of the ground ahead. If the map shows a rugged terrain pattern, the robot will know that it should take a different path. Such a system would be useful for exploratory robots working on other planets.

There is an alternative set of robot designs that use a looser structure that introduces an element of randomization. When this robot gets stuck, it moves its appendages in all directions until its movements have an effect. It accomplishes its tasks in close collaboration with force sensors and actuators, rather than a computer directing everything through a program. This is similar to when ants try to get around obstacles: instead of making snap decisions when they need to get past an obstacle, ants seem to keep trying things until they get around the obstacle.

5.3.3 Home-made robots

The most compelling fields in the world of robotics: artificial intelligence and research robots. Experts in these fields have made great strides in the science of robotics over the years, but they are not the only makers of robots. For decades, the small but passionate number of people who have taken up this hobby have been building robots in garages and basements all over the world.

Home-built robots are a rapidly growing subculture with a considerable Internet presence. Amateur robotics enthusiasts assemble their own creations using a variety of commercial robotics tools, mail-order parts, toys, and even old VCRs.

As with professional robots, there is a wide variety of home-built robots. Some robotics enthusiasts who don't work until the weekend build very elaborate walking machines, while others design home robots for themselves, and still other enthusiasts are keen to build competitive robots. The most familiar of the competitive robots are the remote-controlled robot fighters, like the ones you see on BattleBots. These machines are not "real robots" because they don't have reprogrammable computer brains. They are just enhanced remote control cars.

The more advanced competitive robots are controlled by computers. For example, soccer robots play small soccer matches without any human input at all. A standard robot soccer team consists of several individual robots that communicate with a central computer. This computer "sees" the entire pitch through a video camera and distinguishes between the soccer ball, the goal, and its own and opposing players based on color. The computer processes this information at all times and decides how to direct its team.

The personal computer revolution was marked by its remarkable adaptability. Standardized hardware and programming languages allowed computer engineers and amateur programmers to build computers for their specific purposes. Computer parts bear a passing resemblance to craft supplies, and their uses are innumerable.

Most robots to date have been more like kitchen appliances. Robotics experts have built them to be specialized for specific purposes. But they are not very adaptable to completely different application scenarios.

That's changing. A company called Evolution Robotics is pioneering the field of adaptive robotics hardware and software. The company hopes to carve out its own niche with an easy-to-use "robotics developer's kit".

This kit has an open software platform that specializes in a variety of commonly used robotics functions. For example, roboticists can easily endow their creations with the ability to track targets, follow voice commands, and bypass obstacles. From a technical point of view, these functions are not revolutionary, but what is unusual is that they are integrated into a simple software package.

The kit also comes with some common robot hardware that can be easily combined with software. The standard kit provides some infrared sensors, motors, a microphone and a camera. Robotics experts can put all of these parts together with a reinforced mounting kit that includes some aluminum body parts and sturdy, durable wheels.

Of course, this kit is not for you to make mediocre pieces. It retails for over $700 and is by no means a cheap toy. It is, however, a big step toward a new kind of robotic science. In the not-too-distant future, if you want to build a new type of robot that can clean your room or take care of your pets while you're away, you may be able to do it by writing a BASIC program that will save you a ton of money.

5.3.4 Artificial Intelligence

Artificial intelligence (AI) is undoubtedly the most exciting area of robotics, and undoubtedly the most controversial: everyone agrees that a robot can work on an assembly line, but there is disagreement about whether it can be intelligent.

Like the term "robotics" itself, it is also difficult to define "artificial intelligence". The ultimate artificial intelligence is the reproduction of human thought processes, i.e. an artificial machine with human intelligence. Artificial intelligence includes the ability to learn anything, the ability to reason, the ability to speak, and the ability to form one's own opinions. Robotics experts are currently far from being able to achieve this level of artificial intelligence, but they have made great strides in limited areas of artificial intelligence. Today, machines with artificial intelligence can already mimic certain specific elements of intelligence.

Computers already have the ability to solve problems in a limited domain. The execution of problem solving with AI is complex, but the basics are very simple. First, an AI robot or computer gathers facts about a scenario through sensors (or manual input). The computer compares this information with information already stored to determine what it means. The computer calculates the various possible actions based on the information gathered and then predicts which action will work best. Of course, a computer can only solve problems that its program allows it to solve; it is not analytical in the usual sense. A chess computer is an example of this type of machine.

Some modern robots also have limited learning capabilities. A learning robot is able to recognize whether a certain action (e.g., moving its legs in a certain way) achieves a desired result (e.g., bypassing an obstacle). The robot stores this type of information and when it next encounters the same scenario, it tries to make a move that it can successfully respond to. Again, modern computers can only do this in a very limited number of scenarios. They cannot collect all types of information as humans can. Some robots can learn by imitating human actions. In Japan, robotics experts showed dance moves to a robot so that it could learn to dance.

Some robots have interpersonal communication capabilities.Kismet, a robot created by MIT's Artificial Intelligence Laboratory, recognizes human body language and speech tones and responds accordingly.Kismet's authors are interested in the way adults and infants interact with each other based on tone of voice and visual information alone. This low level of interaction could be the basis for a human-like learning system.

5.3.5 Robotic modelling

Modeling process used Blender

Instantiation of the robot's approximate drive part The main placement is the arm position, foot position, and body position as shown in the figure below, so that the position of the other parts can be easily determined.

Making the torso 01.

Figure 5.8– Approximate drive part

Perfecting the arm part of the robot 02.

Figure 5.9– Arm

Perfecting the robot's thigh section 03.

Figure 5.10 – Thigh section

Perfecting the inside of a robot's torso 04.

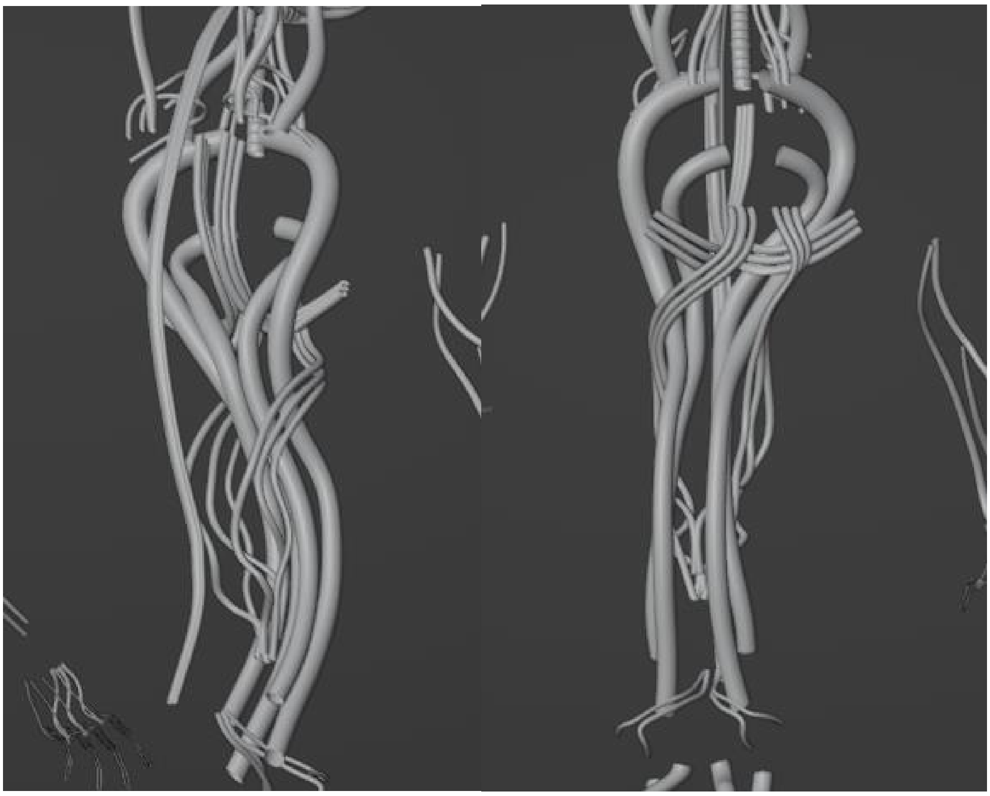

Figure 5.11– Torso

Making the robot's neck frame 05.

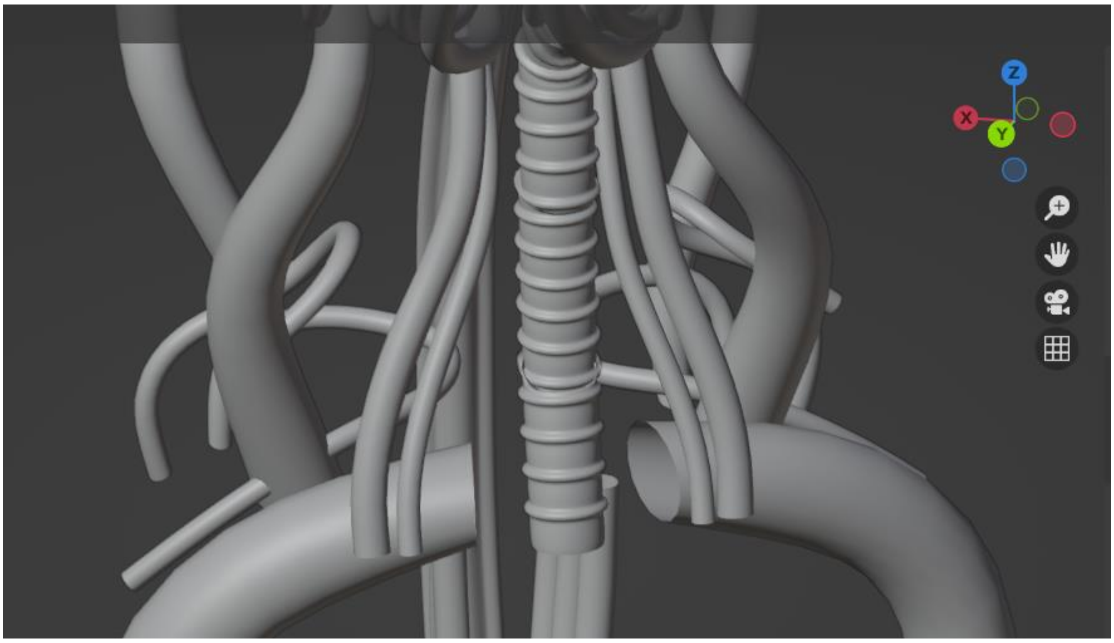

Figure 5.12– Neck frame

Making the robot's head frame 06.

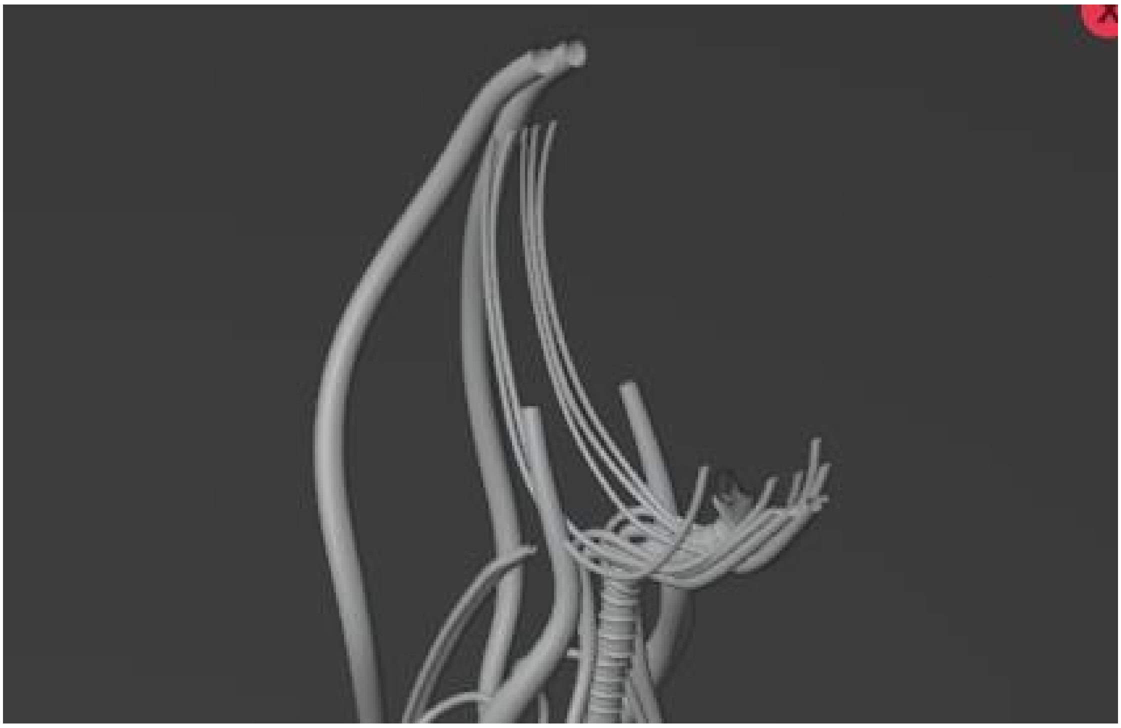

Figure 5.13– Head frame

Making Robot Eyes 07.

Figure 5.14– Eyes

Making a robot's facial frame 08.

Figure 5.15 – Facial frame

Adjusting the robot's eyes and facial fit 09.

Figure 5.16 – Eyes and facial fit

Subdividing the back of the robot's head 10.

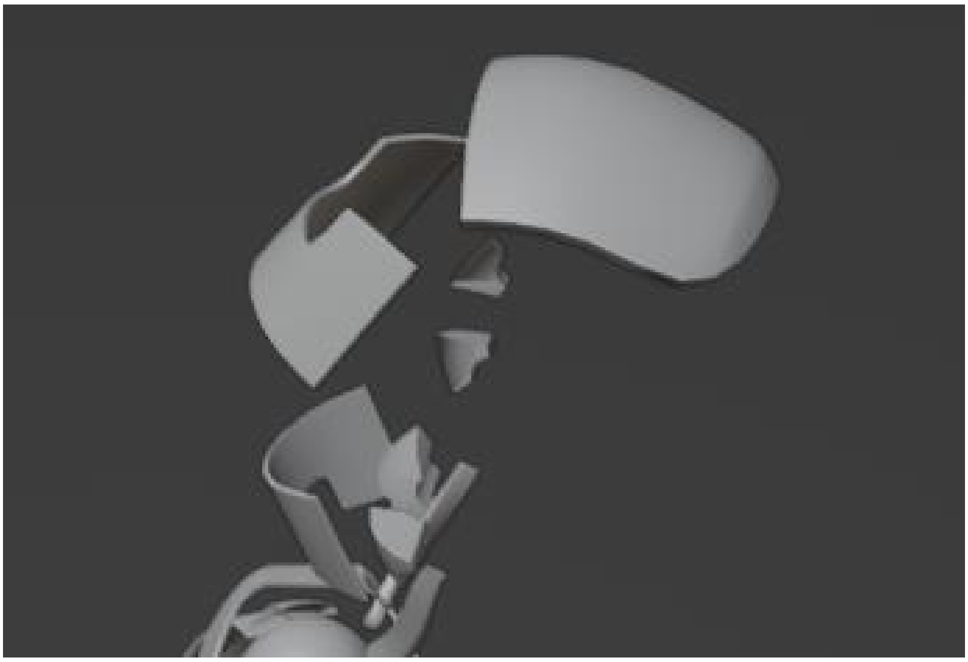

Figure 5.17 – Head

The left side of the robot's shoulder is subdivided 11.

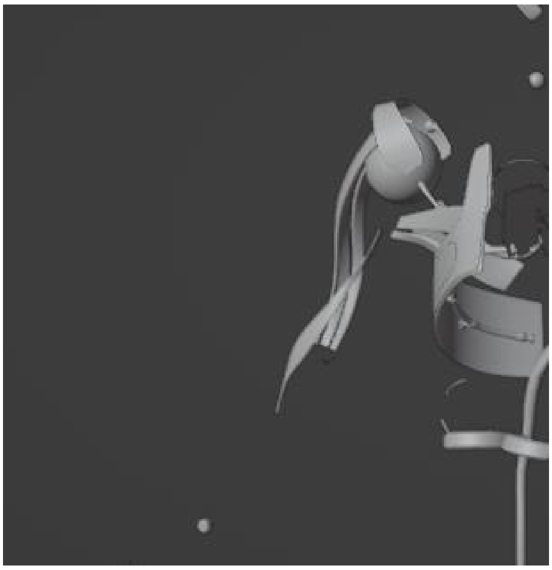

Figure 5.18 – Shoulder

Subdividing the robot's right shoulder 12.

Figure 5.19 – Right shoulder

Adjust and coordinate the robot's chest as well as the left and right shoulders13.

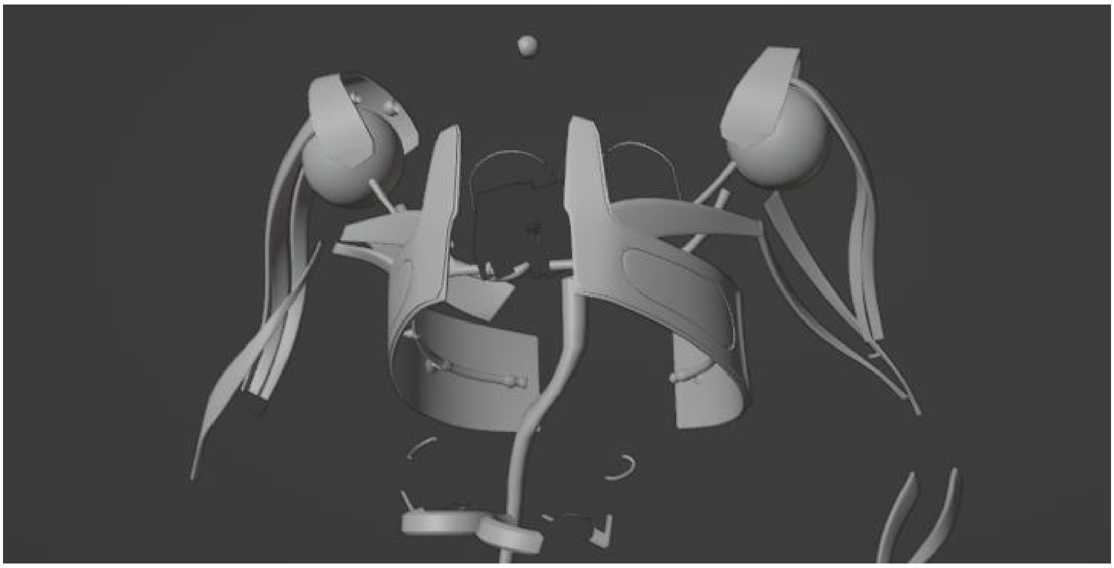

Figure 5.20 – Chest

Modelling the complete palm section (right)14.

Figure 5.21 – Palm section (right)

Modelling the complete palm section (left) 15.

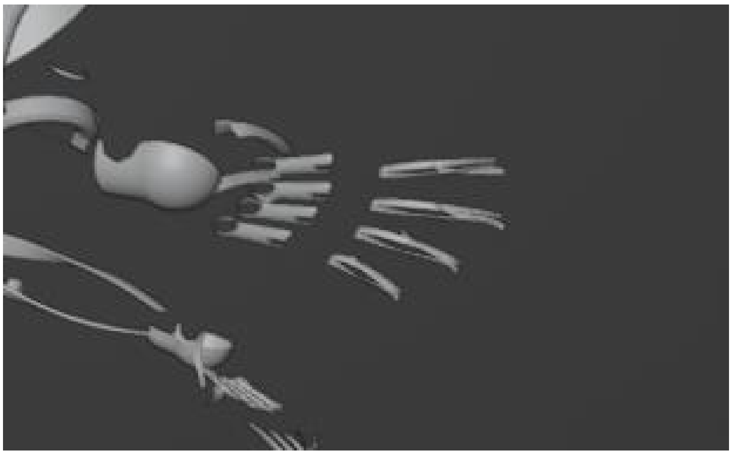

Figure 5.22 – Palm section (left)

Replacing a robot's elbow with a small ball 16.

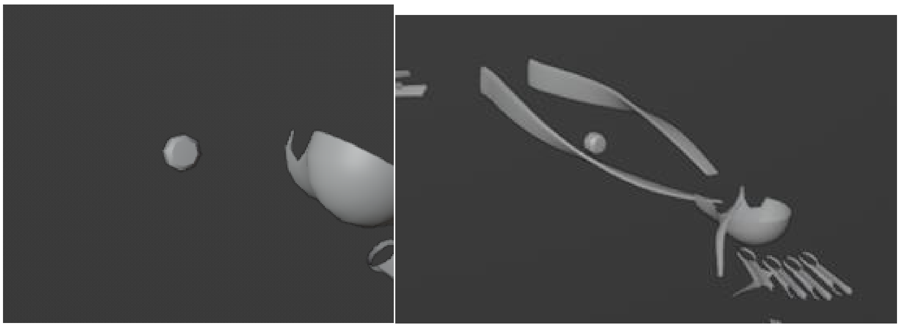

Figure 5.23 – Elbow

Modelling the leg muscles of a robot 17.

Figure 5.24 – Leg muscles

Modelling the calf muscles of a robot 18.

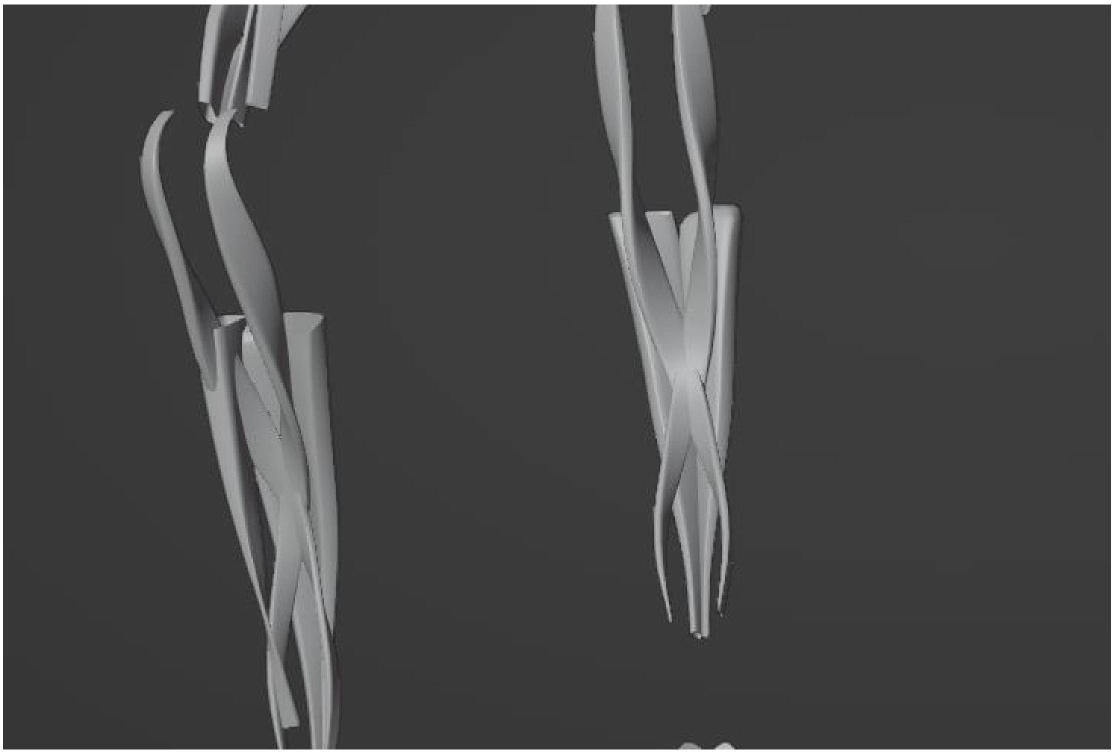

Figure 5.25 – The calf muscles

Initial modelling of the robot's feet 19.

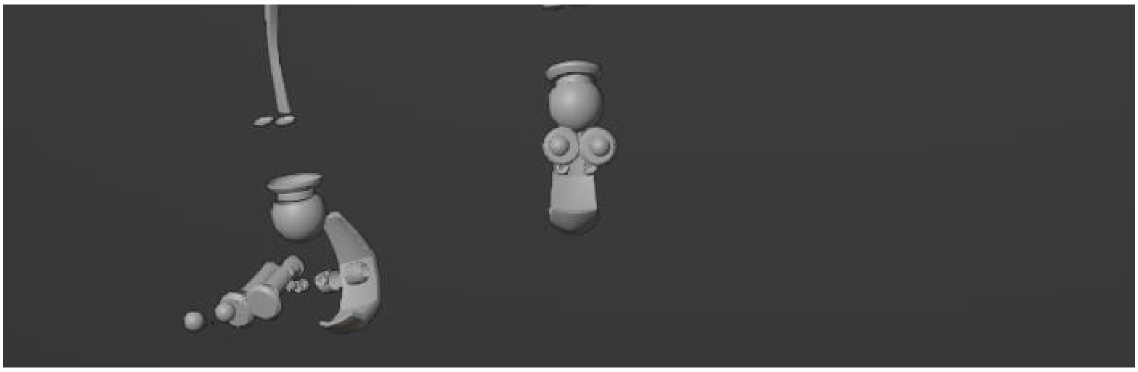

Figure 5.26 – Feet

Decorate the calf part with small parts to make the robot more machine-like 20.

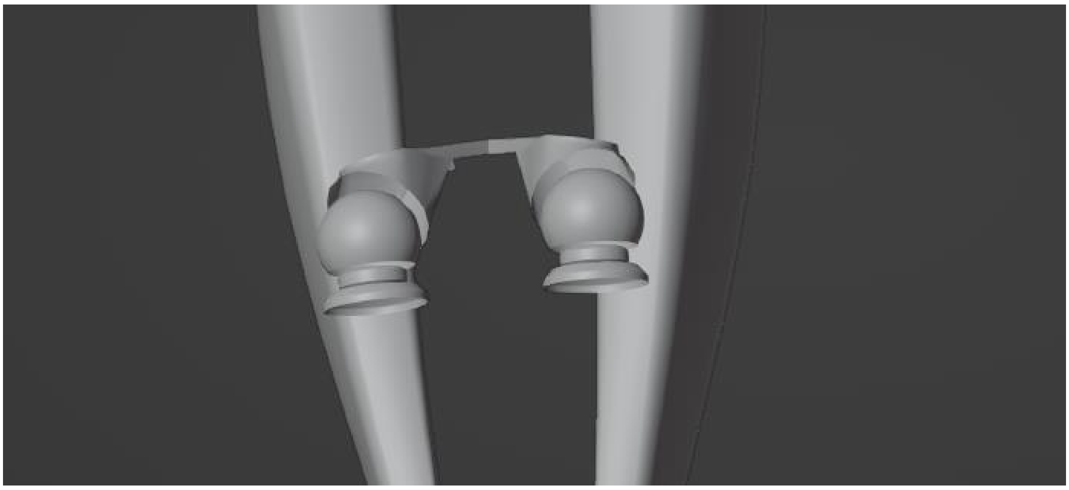

Figure 5.27 – Small parts

Modelling the knee part of the robot 21.

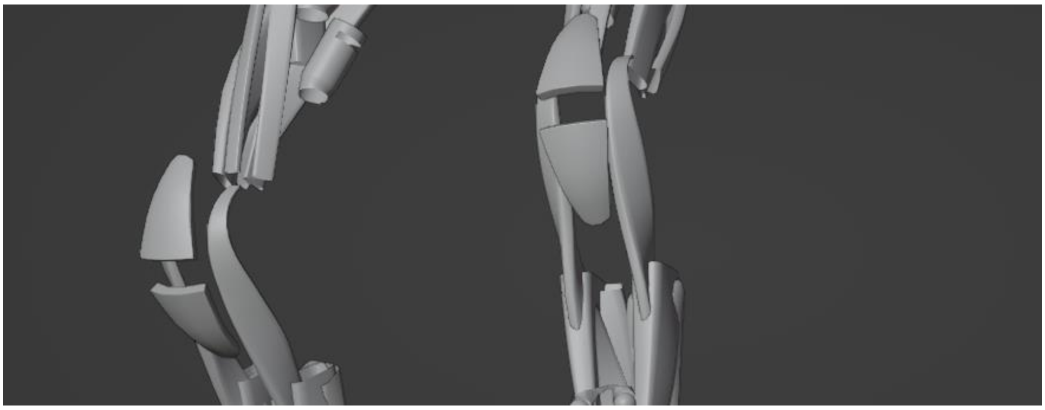

Figure 5.28 – Knee part of the robot

Modelling the thigh section of a robot 22.

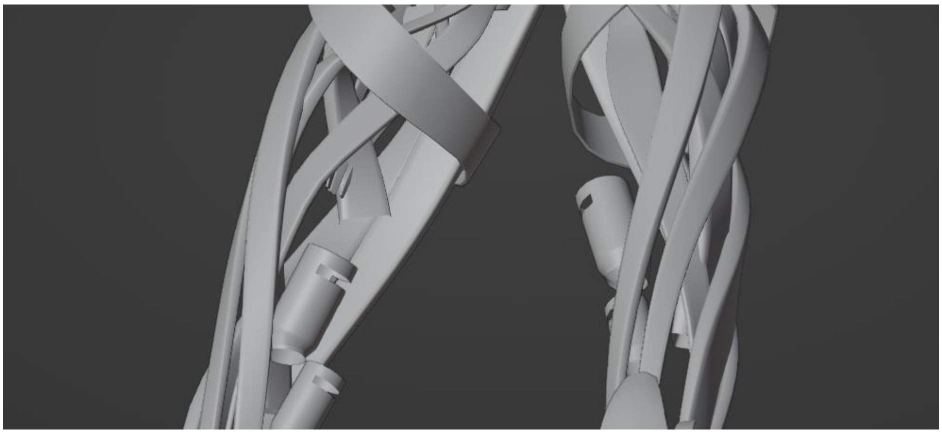

Figure 5.29 – Thigh section of a robot

Modelling a robot's buttocks 23.

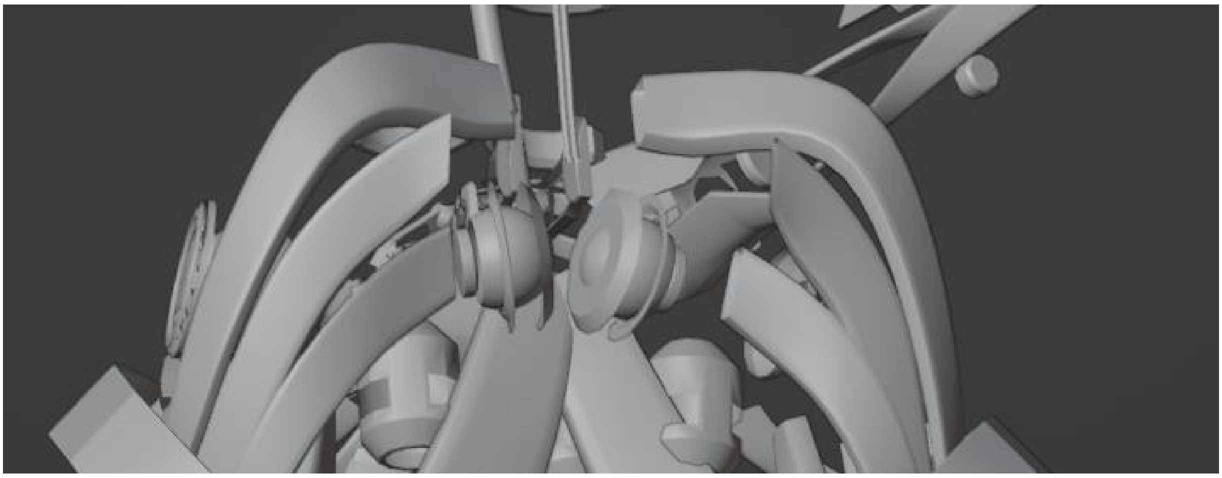

Figure 5.30 – Robot's buttocks

Modelling a robot's ribcage 24.

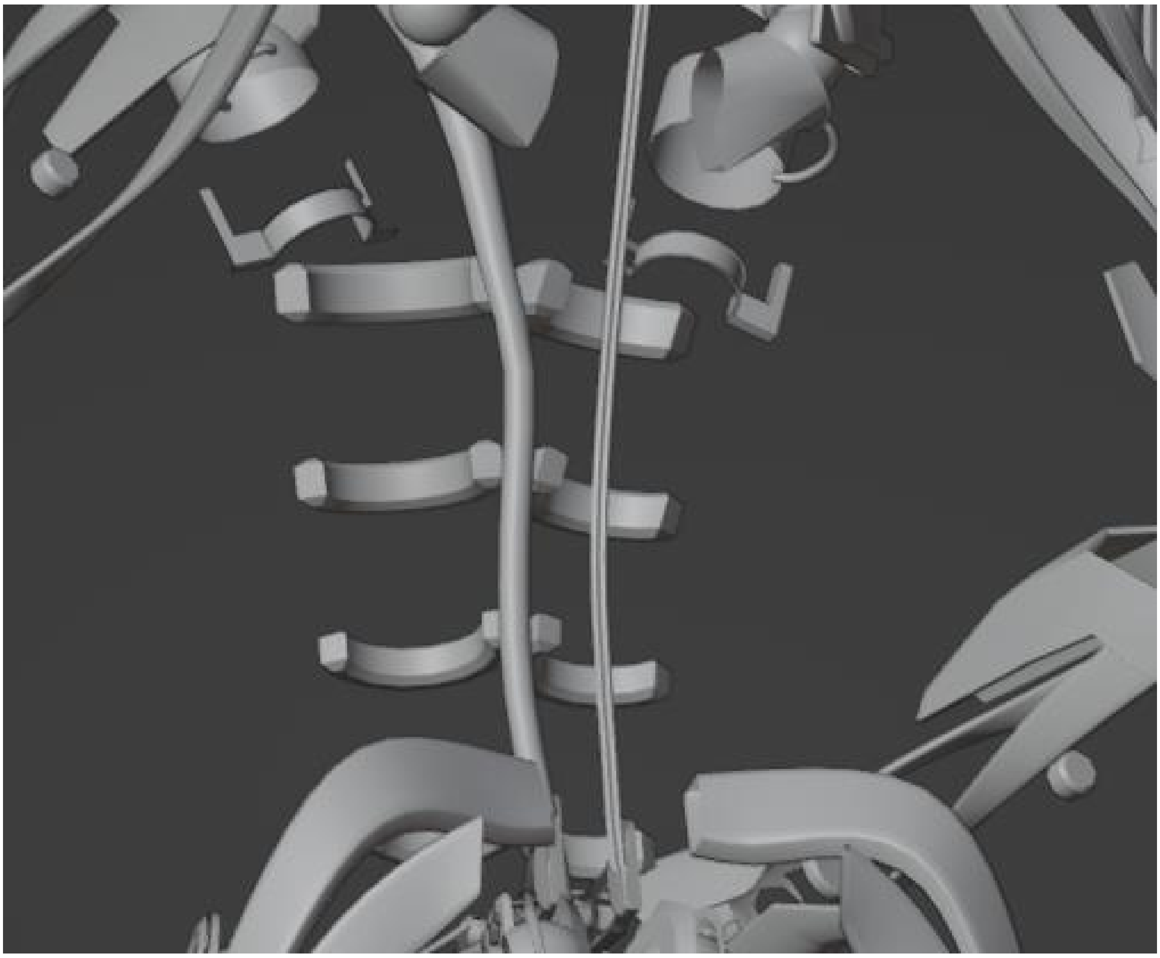

Figure 5.31 – Robot's ribcage

Refinement of the arm of the modelling robot 25.

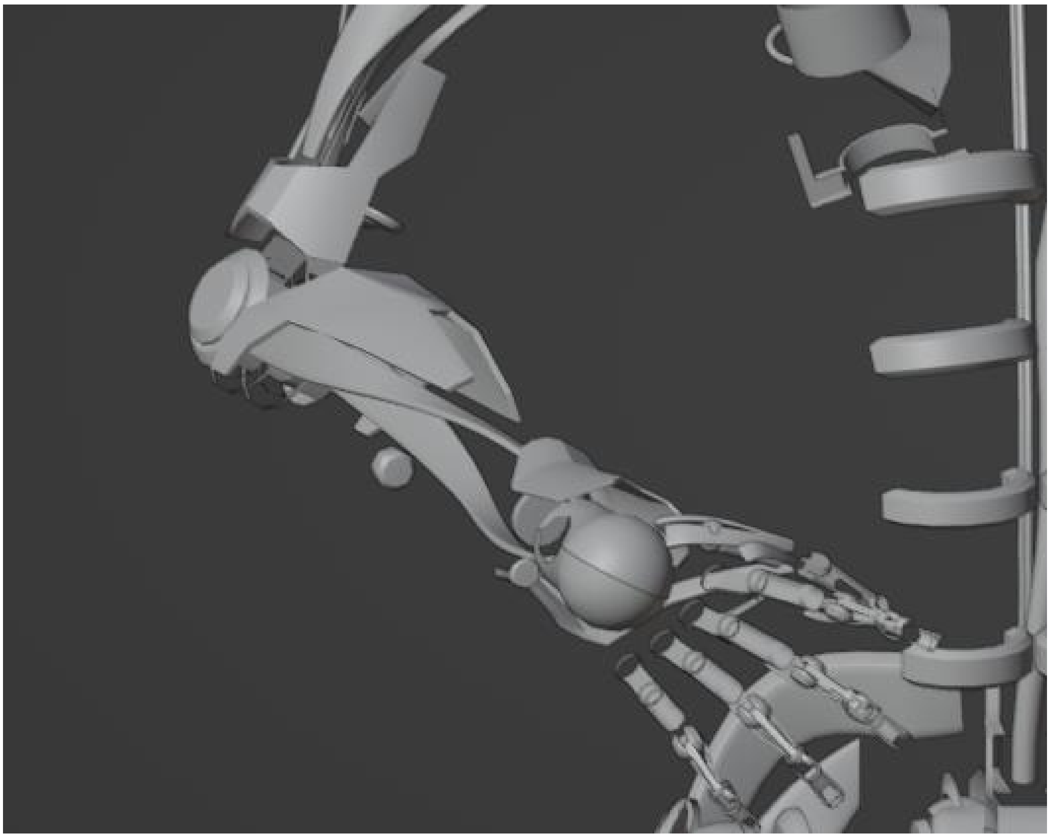

Figure 5.32– Arm of the robot

Perfecting the clavicle of a modelling robot 26.

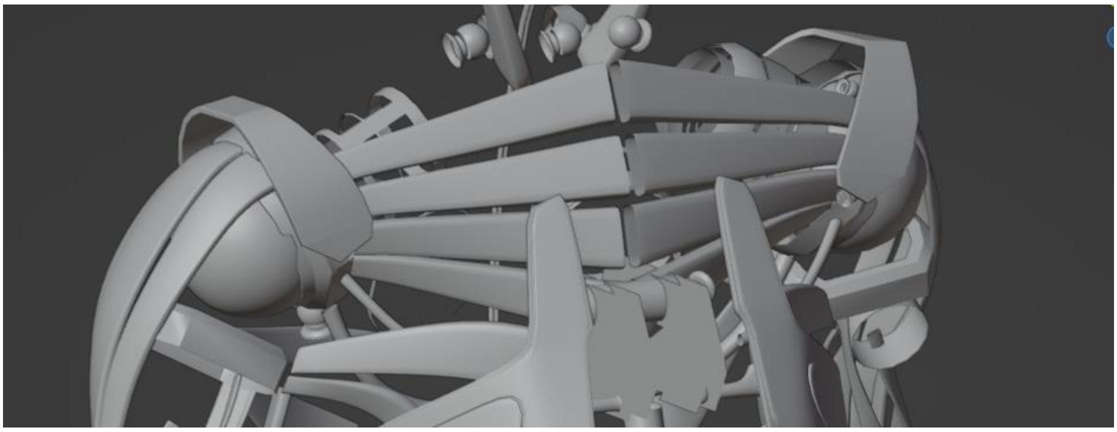

Figure 5.33 – Clavicle

Modelling the back of a robot 27.

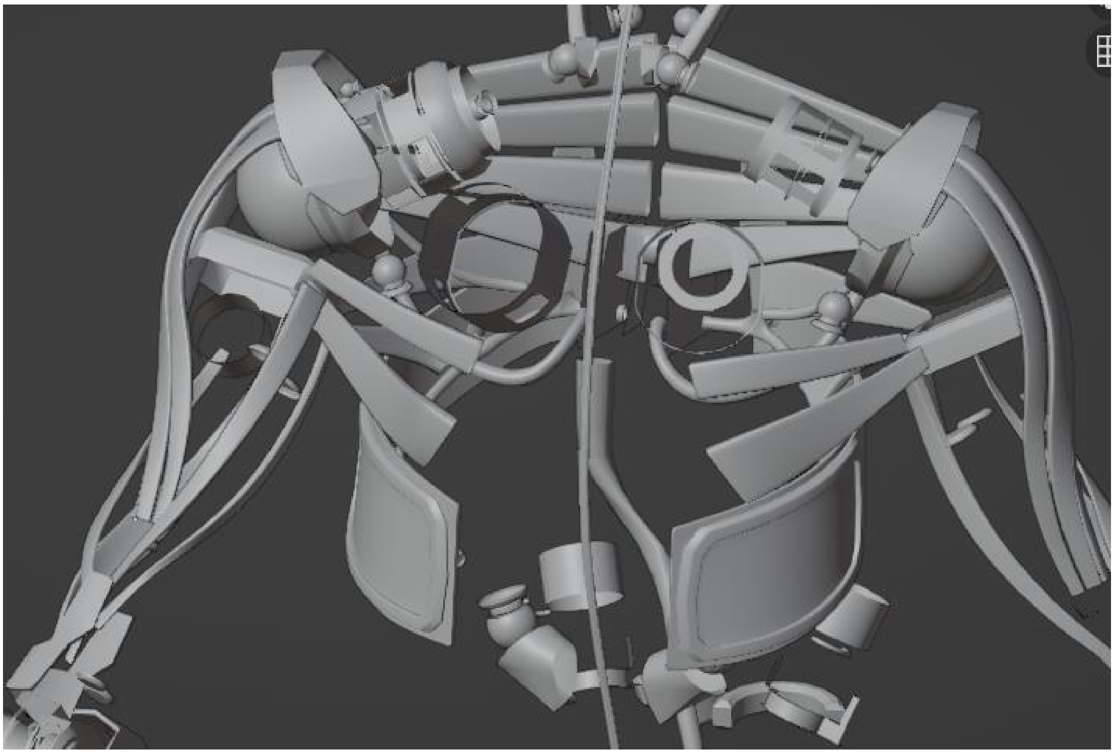

Figure 5.34 – The back of a robot

Further refinement of eye modelling for robots 28.

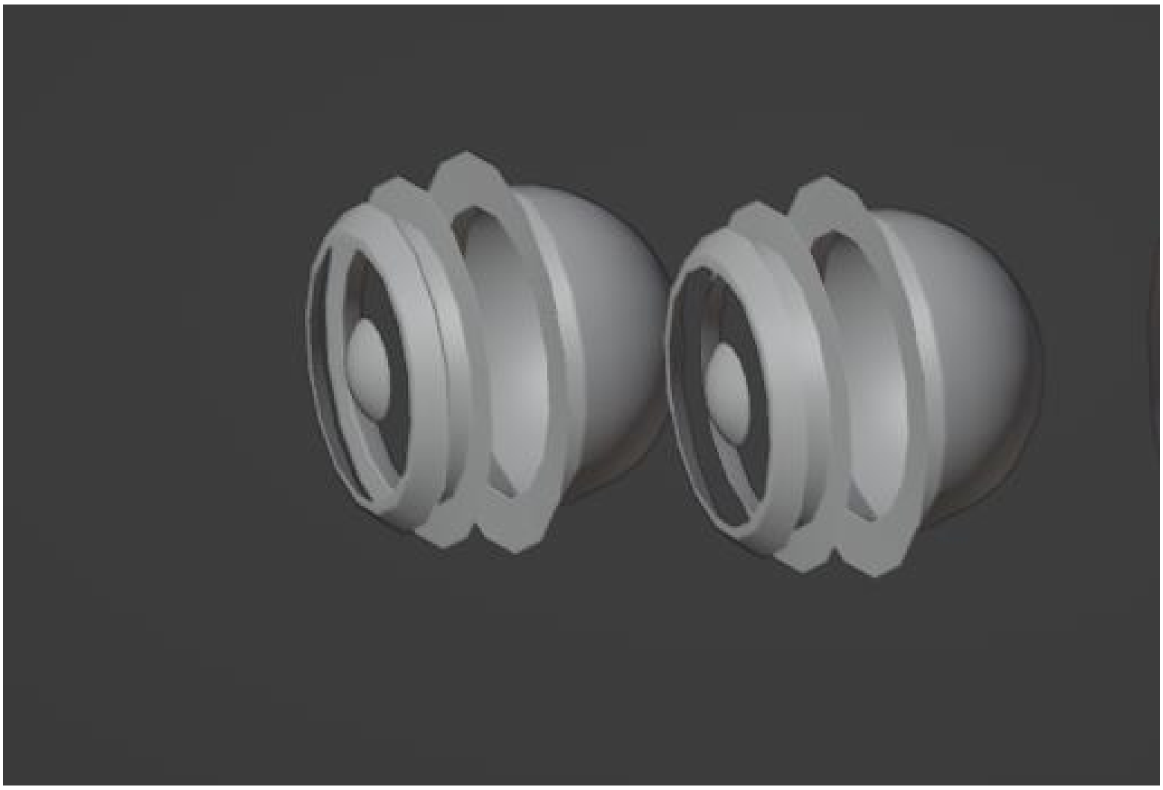

Figure 5.35 – Eye

Modelling the jaws of a robot head 29.

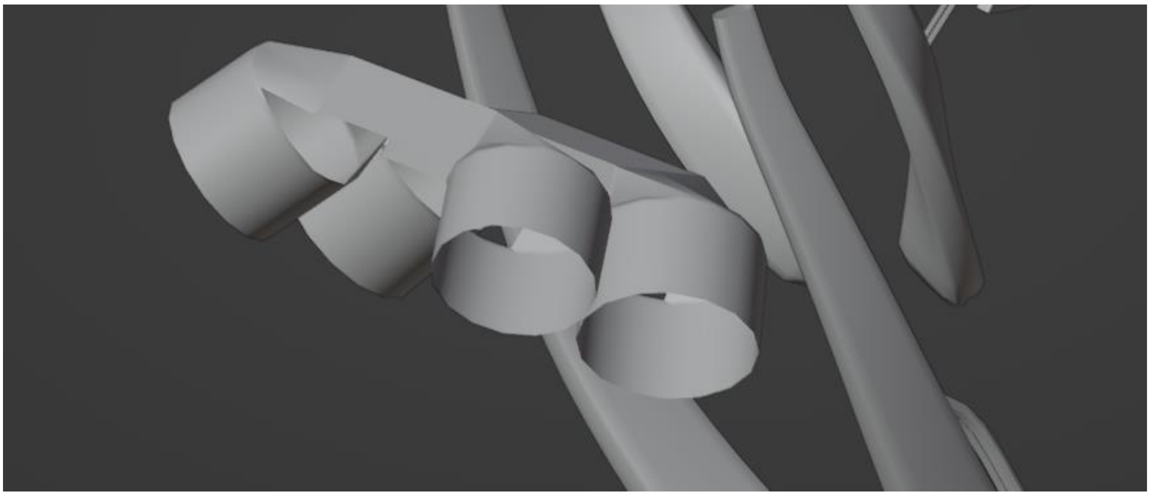

Figure 5.36 – Head

Modelling the robot's ears (left) 30.

Figure 5.37 – Robot's ears (left)

Modelling the robot's ears (right)31.

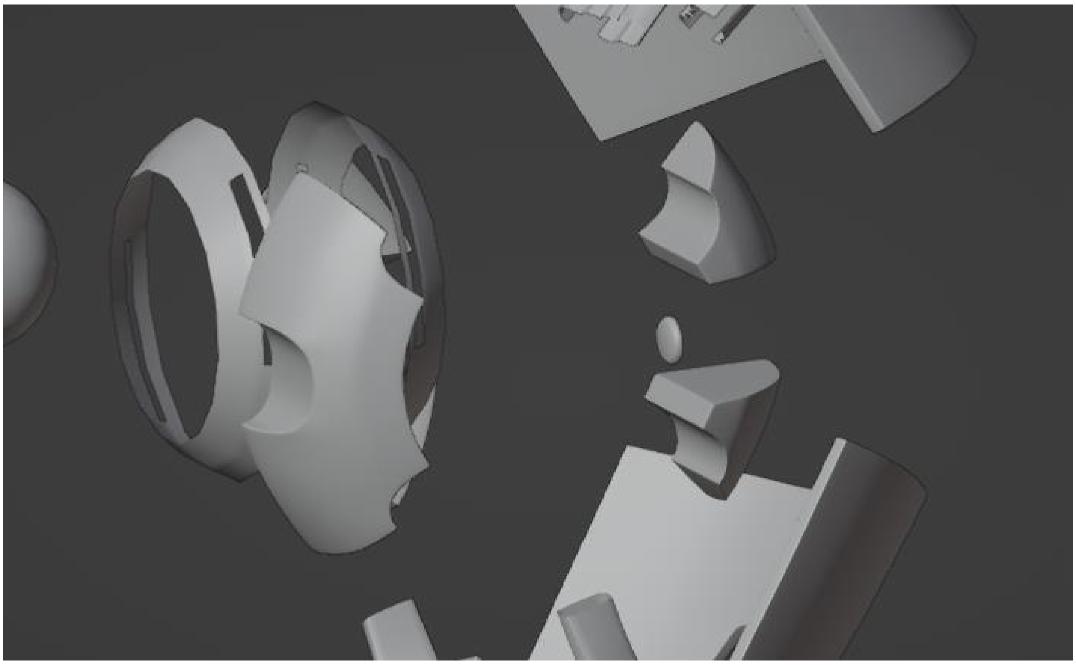

Figure 5.38 – Robot's ears (right)

further refinement of the robot's head 32.

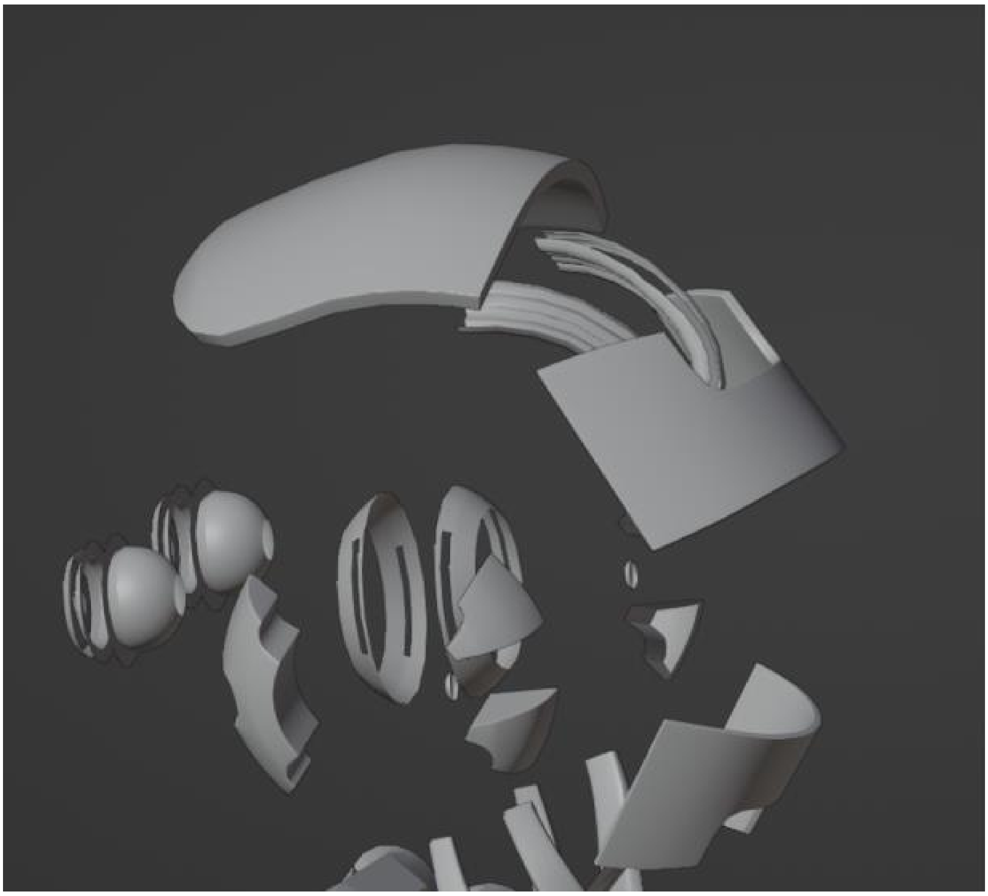

Figure 5.39 – The robot's head.

Refinement modelling robot head 33.

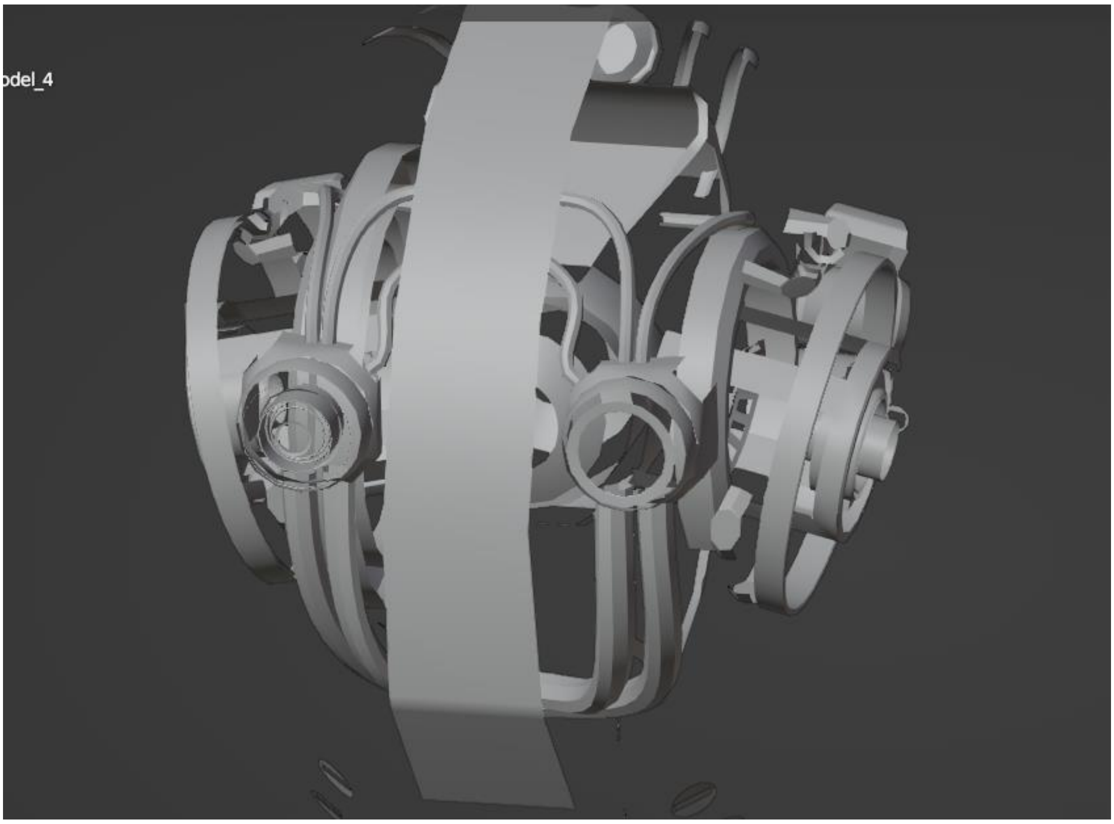

Figure 5.40 – Head

Refining the shoulder of a modelling robot 34.

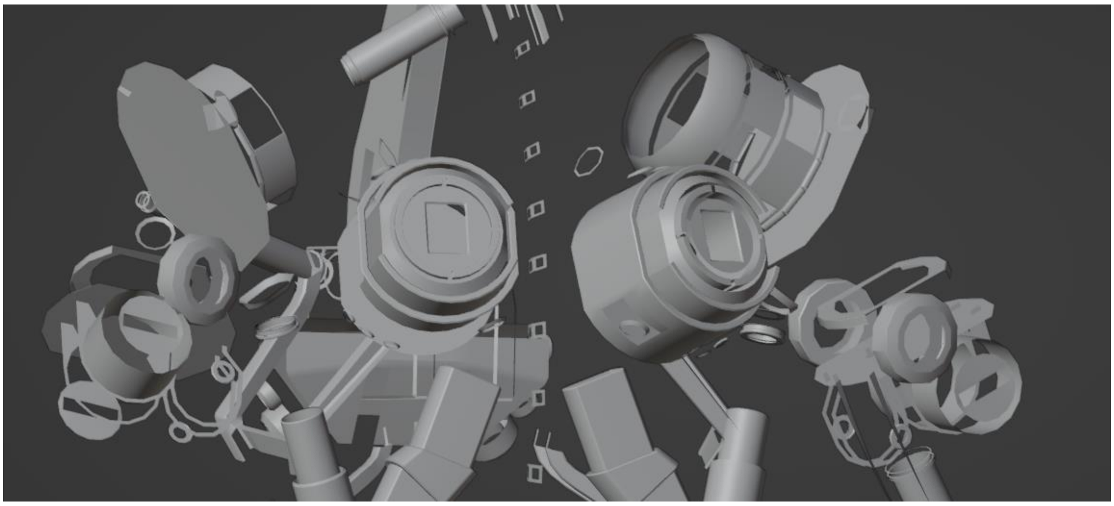

Figure 5.41 – Shoulder

Refinement of the torso part of the modelling robot 35.

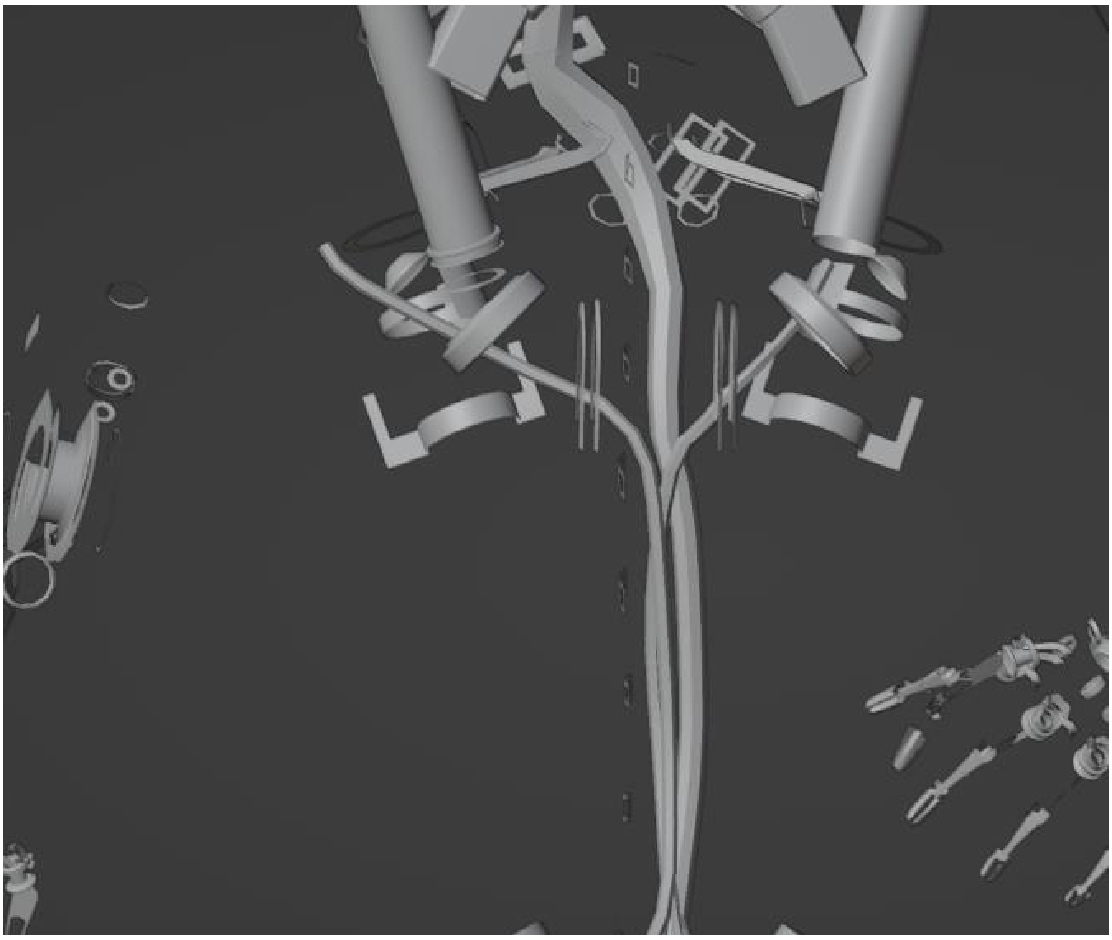

Figure 5.41 – Torso

Refined modelling of the inner thighs of robots 36.

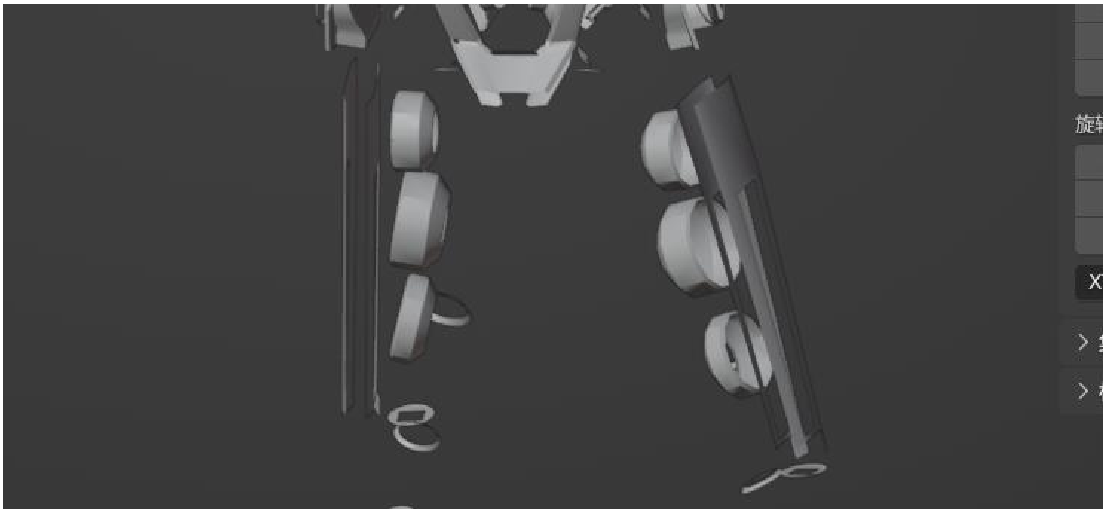

Figure 5.42– The inner thighs of robots

Further refinement of the robot's knee section 37.

Figure 5.43 – The robot's knee section

Refinement of the modelling robot foot section 38.

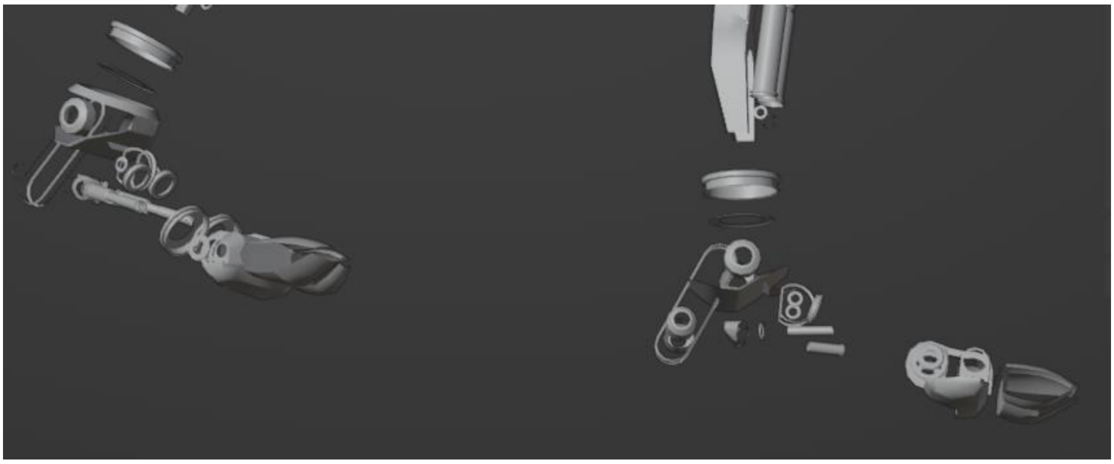

Figure 5.44 – Foot section

Final rendering after refining the robot's head (front and back)39.

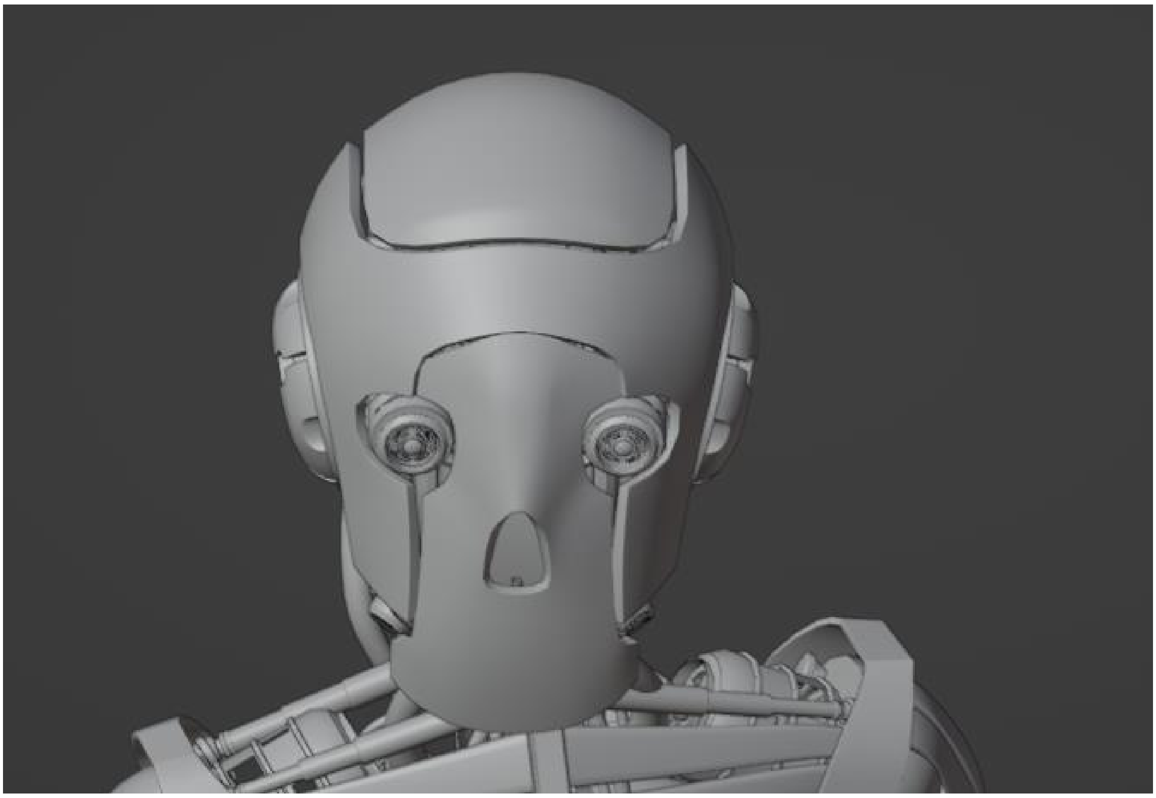

Figure 5.45 – Positively the robot's head

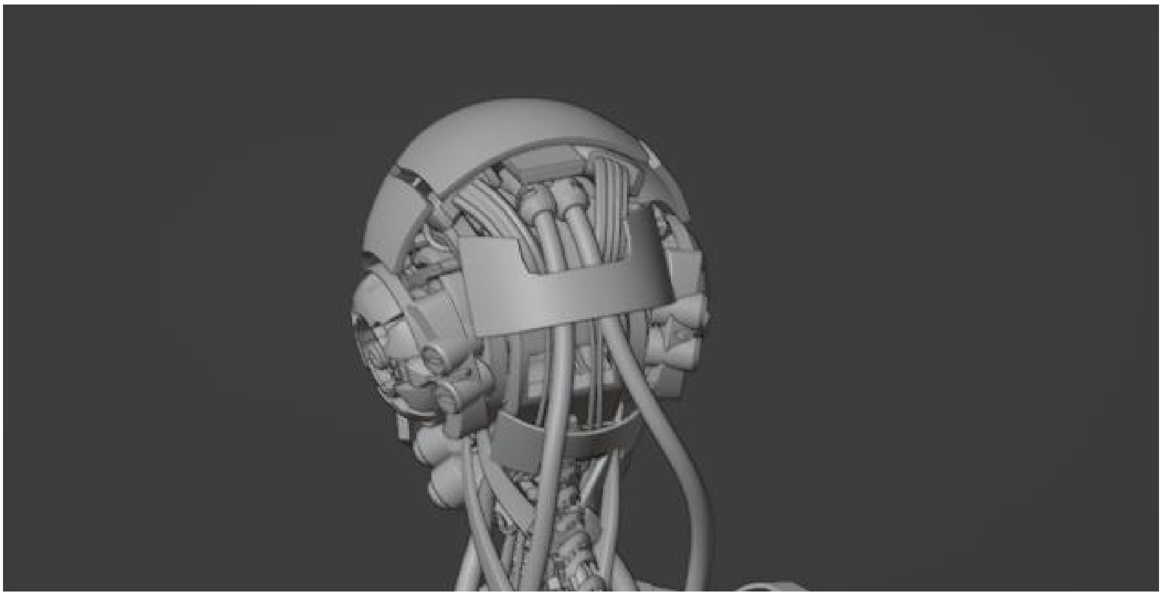

Figure 5.46 – The reverse side the robot's head

The effect after perfecting the robot's neck (front and back) 40.

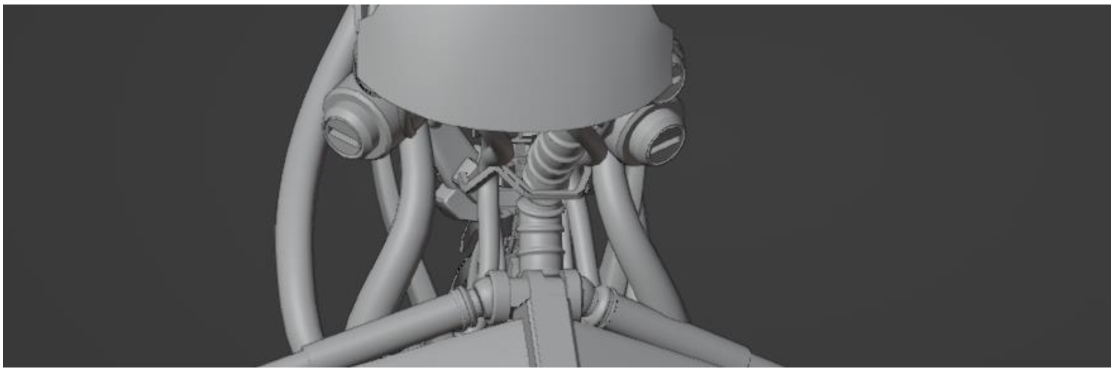

Figure 5.47 – Positively the robot's neck

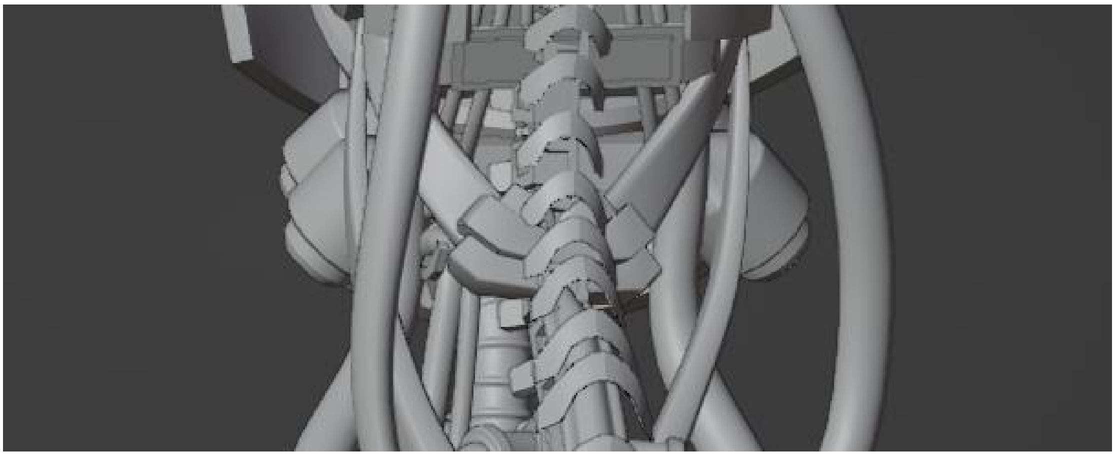

Figure 5.48 – The reverse side the robot's neck

The result after refinement of the robotic thorax (front and back) 41.

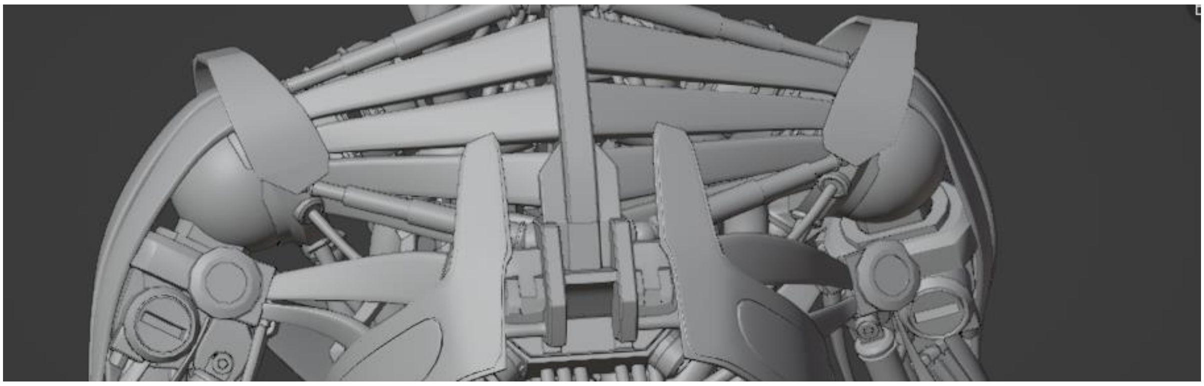

Figure 5.49 – Positively the robotic thorax

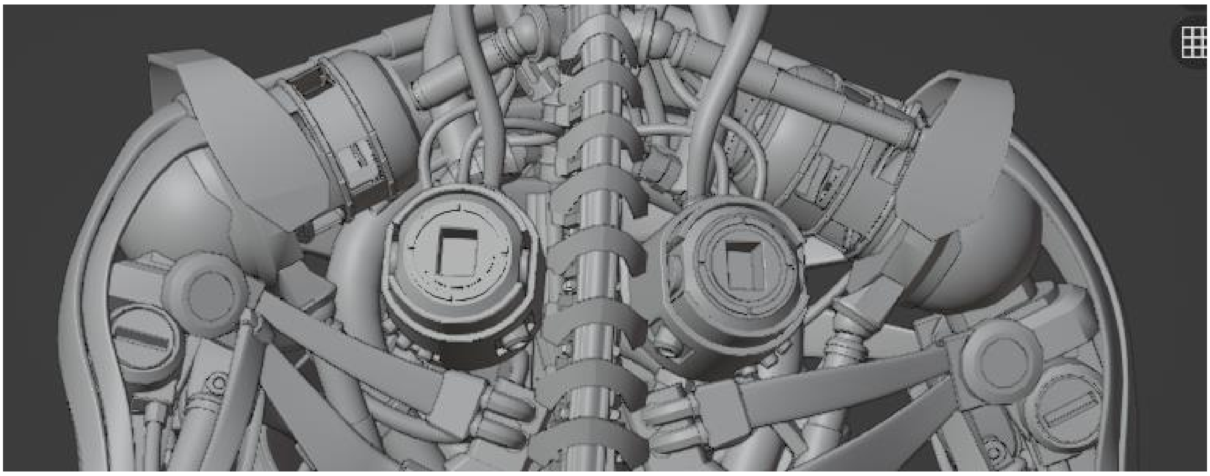

Figure 5.50 – The reverse side thorax

The effect of the arm after refining the robot (right and left hand) 42.

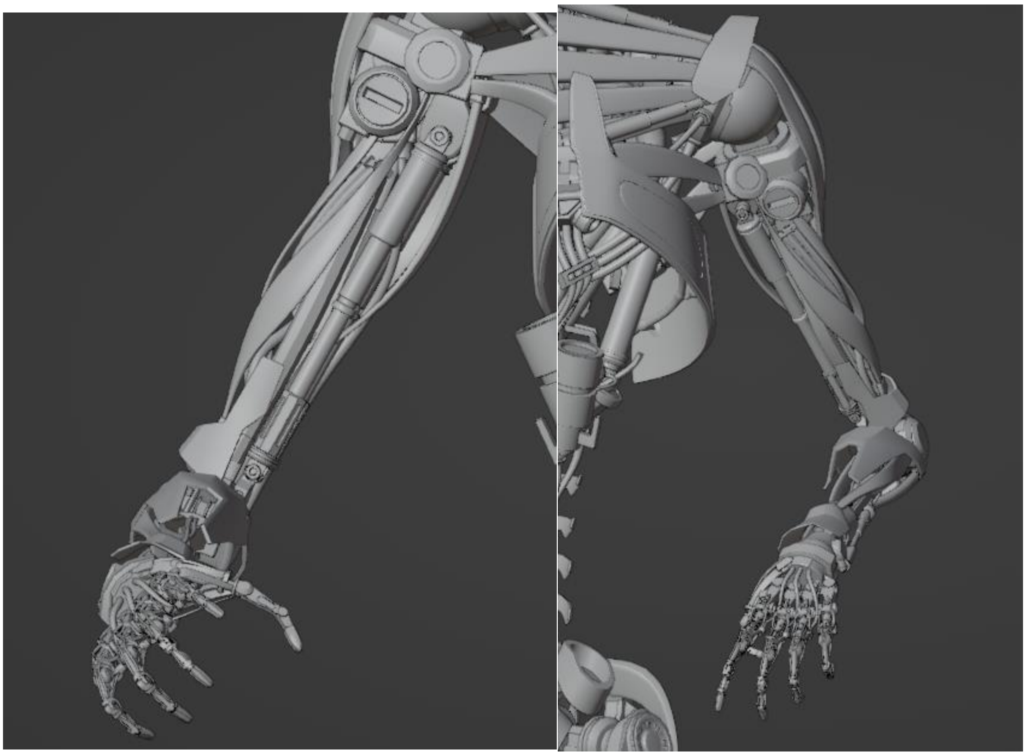

Figure 5.51 – Left hand, right hand

A picture of the thighs after perfecting the robot (front and back) 43.

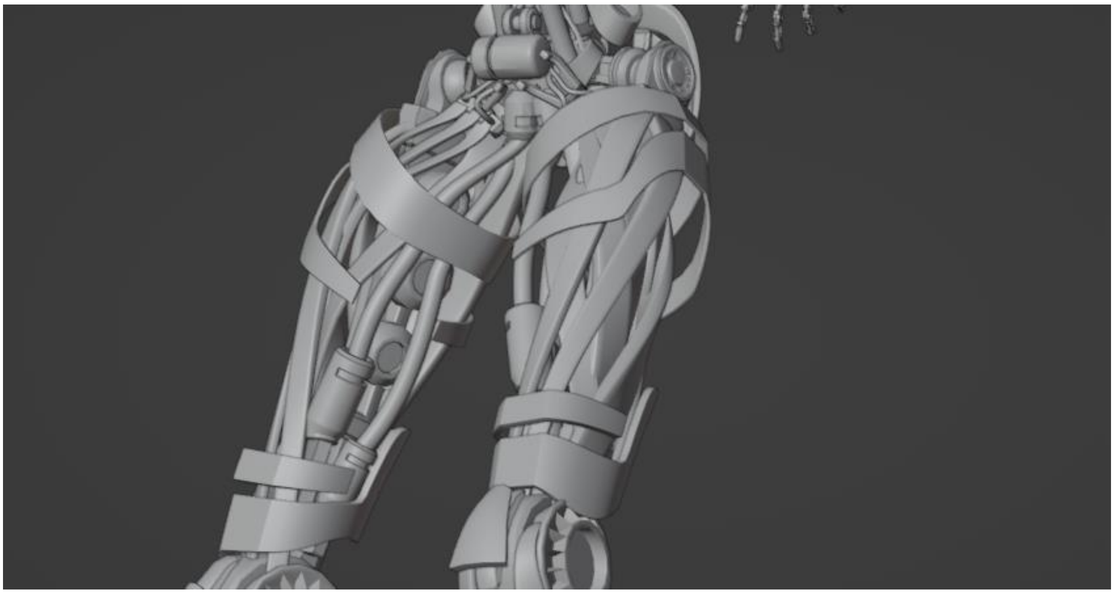

Figure 5.52 – Positively front and back

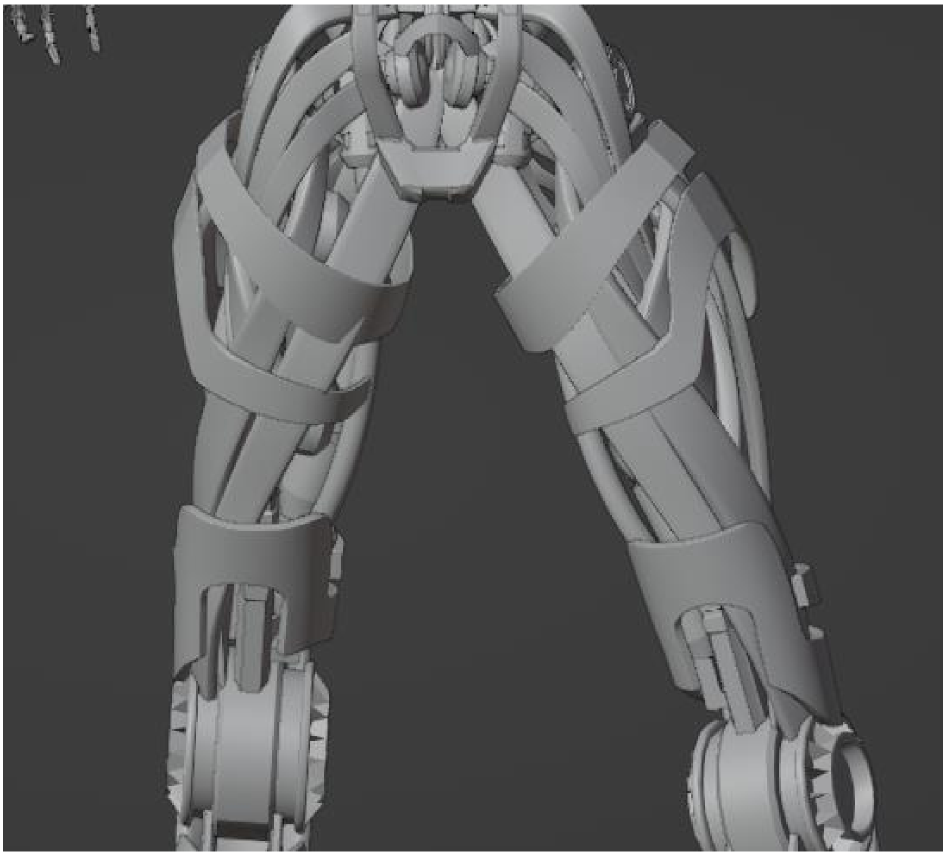

Figure 5.53 – The other side (of a problem etc) front and back

The effect of the calf section after refining the robot 44.

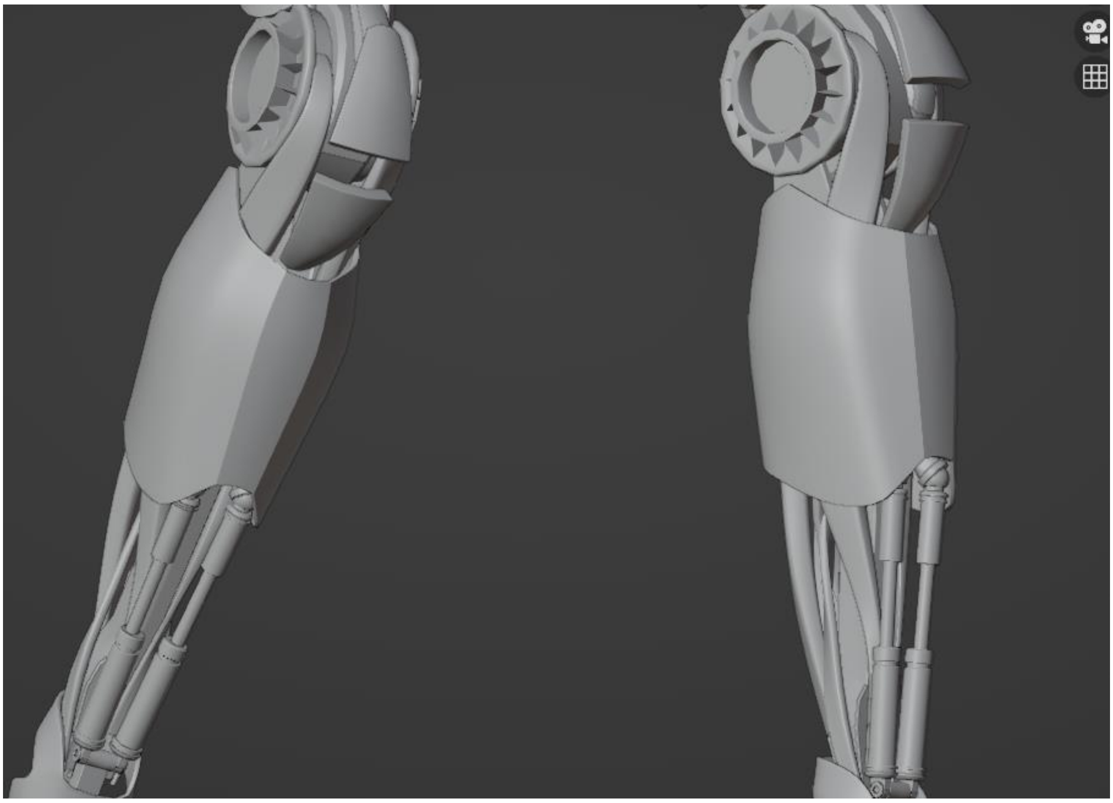

Figure 5.54 – The calf section

A view of the foot after perfecting the robot 45.

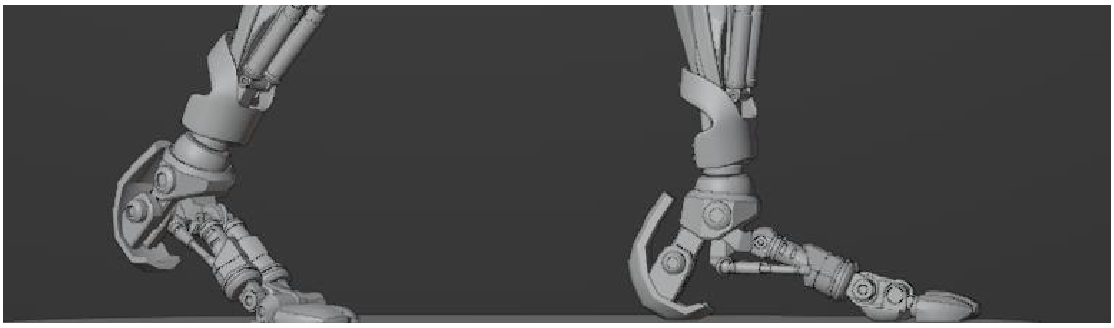

Figure 5.55 – The foot

Robot Final Result 46.

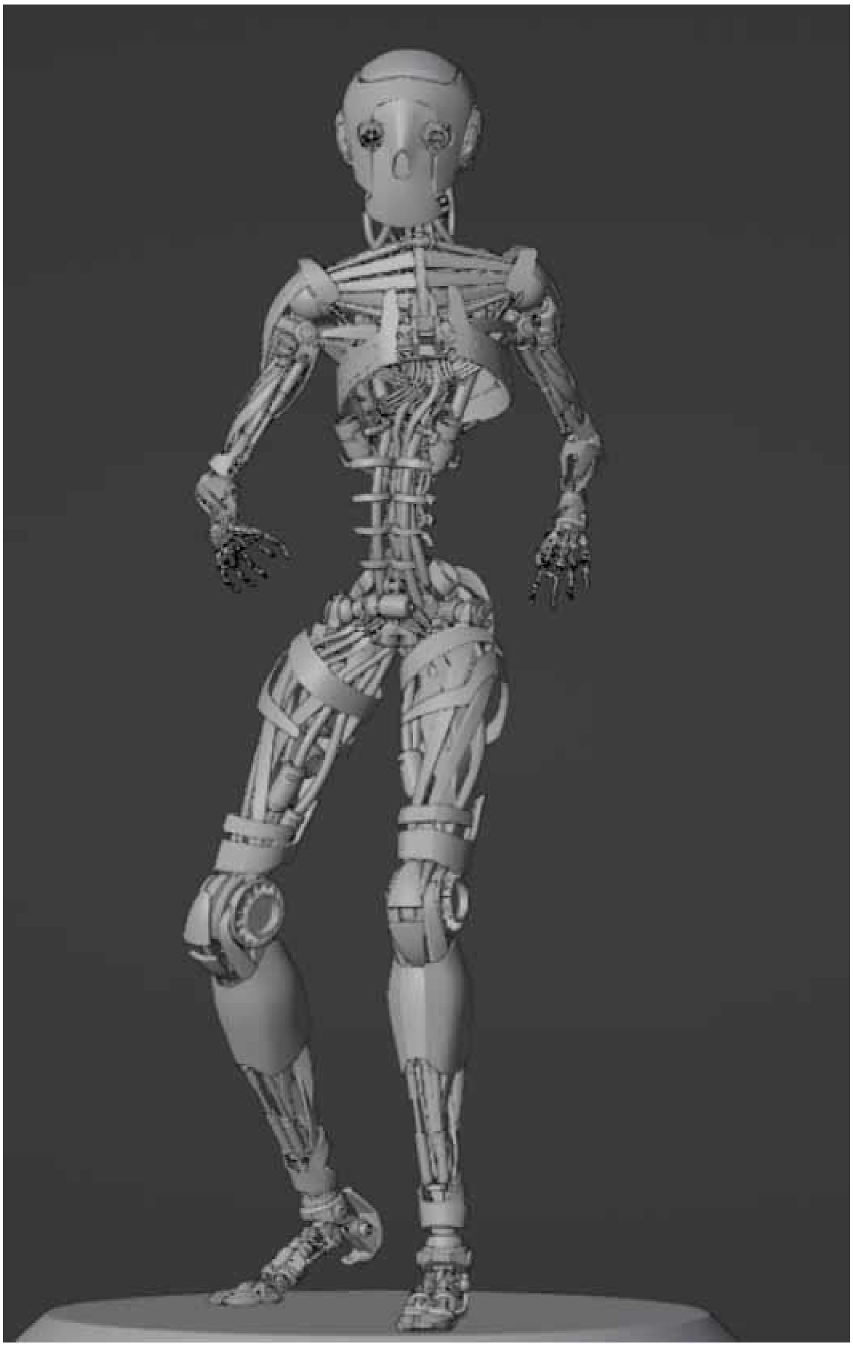

Figure 5.56 – Main view

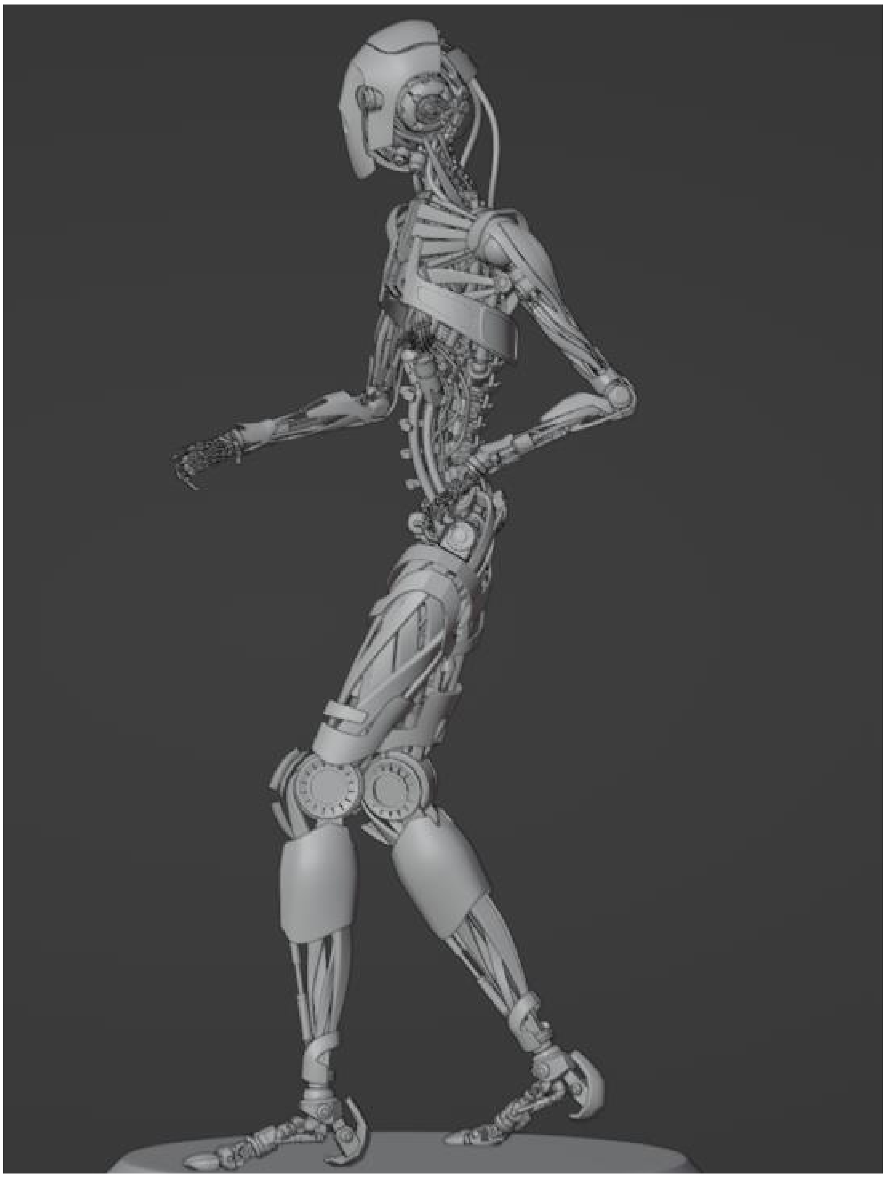

Figure 5.57 – Side view

Figure 5.58 – Rear view

5.4 Conclusions to Chapter 5

To sum up, this part is divided into three main parts, the first analyzes the advantages of Blender software, the second explains the composition structure of the robot and the details that should be paid attention to, and the third builds a model of the robot using Blender software.

CONCLUSION

The Internet has always been in 2D mode, but with the continuous progress of 3D technology, in the next five years, there will be more and more Internet applications presented to users in 3D, including network video, e-reading, online games, virtual communities, e-commerce, distance education, etc.. Even for the tourism industry, 3D Internet can also play a role in promoting some of the world's most famous places, sculptures, antiques will be in the form of 3D on the Internet for users to experience, the real shock of this experience to far beyond the 2D environment.

To the rapid development of e-commerce, for example, a large number of goods need to be displayed on the Internet, special, personalized, realistic display of goods is particularly important, but due to the constraints of 3D model production costs, these needs can only temporarily to meet the two-dimensional photos, resulting in the delivery of goods or objects to consumers information is not comprehensive, detailed, realistic, reducing the consumer's desire to buy and purchase accuracy . The 3D product display technology can be displayed on the web page in a three-dimensional interactive way, consumers can watch the characteristics of the goods in all aspects, intuitive understanding of commodity information, the effect and consumers directly facing the goods are comparable.[10] Many manufacturers have adopted the pseudo-3D effect (sequence photo rotation) to temporarily replace the 3D model display, which shows that the future market is eager to 3D modeling of this technology.

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