FINAL YEAR PROJECT REPORT

SMART CITY BUILDING PLAN IN THE CONTEXT OF BANGLADESH

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Multimedia and Creative Technology

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APPROVAL

This Project titled **"SMART CITY BUILDING PLAN IN THE CONTEXT OF BANGLADESH"**, submitted by Anisul Haque Sohan to the Department of Multimedia and Creative Technology, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Multimedia and Creative Technology and approved as to its style and contents. The presentation has been held on 13th February, 2022.

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I hereby declare that, this project has been done by me under the supervision of **MD. Salah Uddin, Lecturer, and Department of MCT** Daffodil International University. I also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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Finally, I must acknowledge with due respect the constant support and patients of my parents.

ABSTRACT

3D Visualization is a medium of presenting a concept with digital art and the help of 3D software. Human mind is a vast area of unpredictability & filled with extra ordinary imagination which can be expressed properly by the help of visualizing the thought.

The concept of creating 3D visualization came to reality long before the 1990s when it became available for everyone. From the generation of Euclid (AKA the Father of Geometry) to 3D Printing it's a massive evolution of digital footprints. In 1960s there was the first advancement of 3d happened by CAD (Computer Aided Design) software. In 1963 Ivan Sutherland created Sketchpad (AKA Robot Draftsman).

The main objective of this project is to creating Smart City Features in perspective of Bangladesh and how they can be implemented properly and with possibility. We tried to visualize potential improvement possibilities. There was a lot of challenging tasks when the project was under development.

We used Blender to create 3D elements and CyclesX (Integrated by default in Blender) for rendering.

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CHAPTER 1

Introduction

Creating 3D models for the city we dreamt of. The city we always chase. Bangladesh is a country where mixed people's live. We have poor and rich. We are still a developing country. In daily life we faced a lot of problem for unplanned construction, traffic, schooling and many more. We choose " Smart City" for our project to make our own city smart and developed. Here we showed our struggle, researchers, restrictions and also the solution. We always kept in our mind the environment, the temperature and also the consumers choice. Also, our economy played an important role here. As we are still developing country we had to keep the plan very creative and friendly. We created our 3D models for the main factors regarding this. We make smart design for residence, school, waste management, traffic and etc. Here is a story of our dream city where life will be little easier and we can save our environment, energy, water and also control pollution. Here is our journey for new hopes and looking forward to lead a developed country.

CHAPTER 2

Background Study

The main part of our project was finding the key point of a Smart City. We did a lot of study behind this project. We searched for the best smart cities in the world. We found New York city, Dubai city, Singapore city, Oslo city and (). I pointed out the possible improvements about a smart city which makes our life more comfortable as the smart city do. We figured out quite few major points from our research, like mobility system, healthcare, security system, pure water, Energy power, engagement and community, residence and waste management. These are major improvements we have to develop to make a city smart. Then We found some complications to make it happen in my country. As we are an under developed country so We have to keep in my mind quite few things. So, we pointed out some major area to work on which can make a smart city as well. We took 5 major point from here. Like a proper residential system, a decent waste management system, healthcare, security, traffic control.

Then we tried to find out about the scope, worked on the city map and the temperature as well. Also studied about the current situation of the economy and last but not the least study about our culture, people's mind and the age. Most of the people of our country are poor and also not like other developed country.

The city should be consumers preferable. After studying about all this we started making the plan map for the city. Always kept in mind about the temperature, culture and consumers preference during this project also study about residential design to control the temperature and the sunlight to every corner of the house. Smart health care system which contains smart facilities for the consumers, smart schooling, a security system which will help to occur less crime and smart transportation to have comfort to the daily life.

As a team, we made our plan, started doing our 3d models as per plan and map, we also made the animation for more visualization. And also set the camera, using proper lighting and render settings for the final output. We also made a show reel video to make it more under stable.

2.1 Research:

Smart cities are not so much different than general cities but they are in some crucial sections. Like a city's architectural structure or transportation system or security measurements. My topic is "Smart City Architecture in the Context of Bangladesh". There are many smart cities but not all of them are smart in their building structural plan.

As an example, Singapore has the most complex and efficient residential complex structure in the world which is without any doubt "The Interlace". The Interlace was designed by one of the most brilliant and bravest architects in the world "Ole Scheeren". As I went deep down into my research I found out that this structure not only saves spaces but also has some special social features like community involvement and it has a great air and light passing ability.

These buildings resemble the Jenga blocks which are irregularly stacked upon each other. So, when we thought about implementing the concept of interlace in Bangladesh, there are several problems that we faced. The interlace is a brilliant idea but Bangladesh is a small country so we made the interlace smaller but kept the idea the same. After accomplishing air access and light we thought about the power. I used solar powered electronics. But solar can not power a whole structure which contains heavy home appliances like, washing machine, refrigerator, iron, computers, so we decided to split the priority in two sections. Light electronics are powered by solar power systems and the rest are traditional power systems.

While planning the buildings, I noticed that if industrial buildings are too close to the residential complex or main city it will pollute the air so I planned to use a large amount of exhaust to the industrial site to keep the working environment clean and healthy while exhaling the bad smoke far away from the city.

There are supposed to be a lot of corporate buildings in a city. It's not possible to renovate or reconstruct everything. So our main project focuses on smart features, not rebuilding a smart city. So, I planned to implement some of our smart features like smoke detectors, water sprinklers, biometric & RFID entry management systems etc. Planning was my sole part on the project so placing each and every feature to proper places was my concern.

In our country, buildings are not only badly planned but also follow no safety and security measures. A smoke detector can detect a particular level of smoke. When it exceeds the normal level there is an alarm that goes off and the water sprinklers start to water down the area the smokes are coming from. Having all smart features under one data server management system is even smarter because when there is an incident it can send alerts to your phone when you are not even home. As we speak the smart door lock system does the same.

These features are not new but they are still not available in our country. I tried to implement features and improvement in the context of Bangladesh.

CHAPTER 3

Details of Software

3.1 Blender:

Blender is a free and open source 3D software which runs by donations. Instead of using pirated 3D software we decided to use powerful open source software like blender. Movies like **Captain America Winter Soldier** (2014)**, Spider Man - 2** (2004)**, Next Gen** and many more are made with Blender 3D Software. Dutch animation studio **NeoGeo** developed this software as an in-house application, January 2, 1994 is considered to be Blenders birth date. Blender Version 1.00 released in 1995 with the primary author being the company co-owner and software developer **Ton Roosendaal.**

Fig 3.1.1 Blender

Also, he is known as the original creator of Blender. Blender was named from a song of **Yello** (A swiss electronic band). Blender was released publicly online on January 1, 1998 as SGI freeware. Blender is a very flexible 3d Software. Python expressions can be used directly into number entry field. Also, we can use Addons/Plugins to make blender work easier. By using blender toolset, we can make animated films, 3D printed models, visual effects, motion graphics and many more. Blender features include 3D modeling, UV unwrapping, texturing, raster graphic editing, rigging, fluid simulation and smoke simulation, particle simulation, sculpting, animation and much more.

3.2 Adobe Premier Pro:

There is many timeline-based video editing software available in the market, but we choose to use **Adobe Premiere Pro**, and this software is a part of **Adobe Creative Cloud** licensing program. It was first launched in 2003 and it is a successor of **Adobe Premiere** which was launched in 1991. International news channels like **CNN** and **BBC** is using this video editing software since 2007.

Fig 3.2.1 Adobe Premier Pro

And movies like **Deadpool, Gone Girl** and **Terminator** was edited on this software. Adobe Premiere Pro supports **MP4, MPG, MPEG, MPE, AVI** and many more. This software can do all common video editing tasks necessary for producing broadcast quality video. Also, we can work with videos and still images together at this software. And we used this software to import the rendered images as sequence.

3.3 Adobe After Effects:

Adobe After Effects is another software of **Adobe Creative Cloud** licensing program. This is also a timeline-based video editing software, but this more than just a video editing software. This software is usually used for **Visual Effects, Motion Graphics, and Compositing.** It is mainly used for post-production visual animation process. **David Herbstman, David Simons, Daniel Wilk, David M. Cotter, and Russel Belfer** was original creator of Adobe After Effects.

Fig 3.3.1 Adobe After Effects

They created this software at **Company of Science and Art** in **Rhode Island** where they released first two version (1.0 and 1.1) of this software. In 1994 Adobe acquired this software and they released their first version **Adobe After Effects 3.0.** And we used this software to motion track some parts of our project.

3.4 Adobe Photoshop:

In the names of raster graphics editor software **Adobe Photoshop** comes at first place. It was developed by **Adobe Inc. Thomas** and **John Knoll** was originally created this software in 1988. Since then it was industry standard. The name of this software became generic trademark in Raster Graphics Editing and Digital Art world. **Adobe Photoshop** can edit and compose raster images in multiple layers. It has several color modes including **RGB, CMYK** and others.

Fig 3.4.1 Adobe Photoshop

With this software we can adjust individual parts of image with different layers and different tools such as pen tool, lasso tool, quick selection tool etc. Also, we can boost highlights, contrast, saturation, levels etc. to increase the quality of a photo. This software helped us a lot to make ready our texture images. We used this software to boost details of the texture images mainly

3.5 Adobe Media Encoder:

Adobe Media Encoder is a helping software of **Adobe Premiere Pro.** This is an encoding software mainly. This software lets users to export multiple files without interruption in Premiere Pro. This software allows to save drive space when exporting videos. Gives option to reduce resolution and decrease file size. This thing simplifies lot of works.

Fig 3.5.1 Adobe Media Encoder

3.6 Cycles X:

Cycles is a render engine. It is a default renderer of Blender 3.0. And it is almost 11 years almost since the renderer Cycles was released. And Cycles X is named after its 10th year of celebration. Cycles X is ten time faster than Cycles. Also, real-time interactivity of rendered viewport in Cycles X is faster than before. Cycles has total three denoiser to develop it's render quality. Which are NLM, Optix and OpenImageDenoise. But, Denoiser OpenImageDenoise is improved

in this version. We completed most of our render works by using this rendering engine. This is the best result giving renderer among blender default renderers.

Fig 3.6.1 Cycles X

3.7 Evee:

Evee is speed and interactivity focused real-time render engine. It also can render high quality frames. Evee uses same shader nodes as Cycles, but Evee is not a ray tracing render engine like cycles. Instead of using ray tracing, Evee uses rasterization process. We rendered some of our shots with Evee because of high render time of some projects.

Fig 3.7.1 Evee

3.8 Pure Ref 1.11:

Pure Ref is a light weight and powerful software for artists of 3Dimensional world. It lets us to collate image reference for a project. This collate makes working speed faster. It is really easy to use as an image organizer. We used this software to make 3D objects from image sources in our project. This thing made our work very smooth at the very beginning of a model.

Fig 3.8.1 Pure Ref

CHAPTER 4

Project Work Flow

4.1 Collecting Reference:

4.1.1 Brain Storming:

First, we searched for potential references. Then the selected some of them, that implies with our project. Next, we discuss with the team, how to apply them in our project.

4.2 Modeling:

3D Modeling is a digital illustration technique. By using 3d modeling software to manipulate vertex points in 3d space, we can create a collection of vertex points which forms into objects. These 3d models can be used for multiple purposes.

We used blender to create ours 3d models. Blender offers a large variety of toolset such as, subdivision modifier, mirror modeling, solidify modifier, curve modifier, displacement modifier, shrinkwrap, surface deformation, array modifier, bevel modifier, advance boolean.

We used advanced physics simulation to create realistic simulations such as, particle system(hair), cloth simulation, advanced collision control.

Here is a proper outline how we used these features to create our models.

4.2.1 Big Belly Bin:

Big belly trash can, can be a very complex model but we minimized the complexion by using as less vertexes as possible. We used bevel modifiers to smooth the edges, extrude and inset to manipulate the faces and used advanced Boolean tool to create opening locker.

We crated two different big belly bins. One of them are used for recyclable trashes such as plastic, can, glass, paper and the other one is used for non-recyclable trashes such as food, packages and single used items.

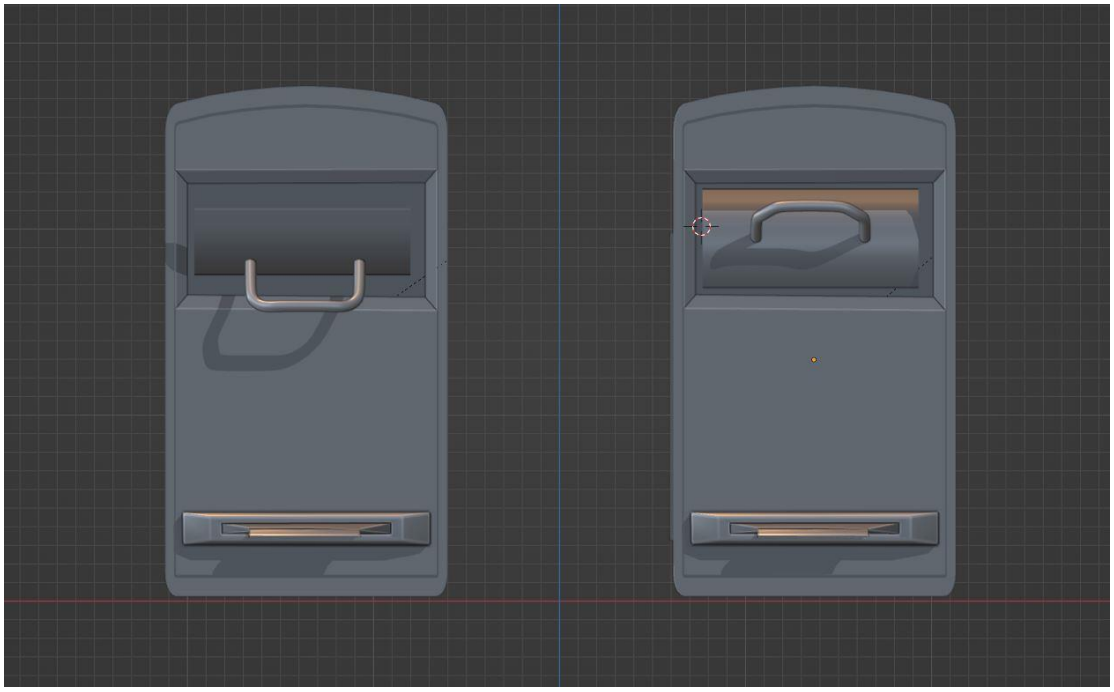

Fig 4.2.1.1 Big Belly Bin Modeling.

Fig 4.2.1.2 Big Belly Bin wireframe.

4.2.2 Bus Station:

This is a smart bus station model, comes from an original bus station which is situated at Tianjin, China. The idea of this bus station is based on solar powered system. When we took a close look to the real model we noticed that the both side of this model is exactly the same. So, we used mirror modifier to create one side of the model to the perfection so the other side of the model can be mirrored perfectly. By using this modifier, we skipped the hassle of modeling both sides.

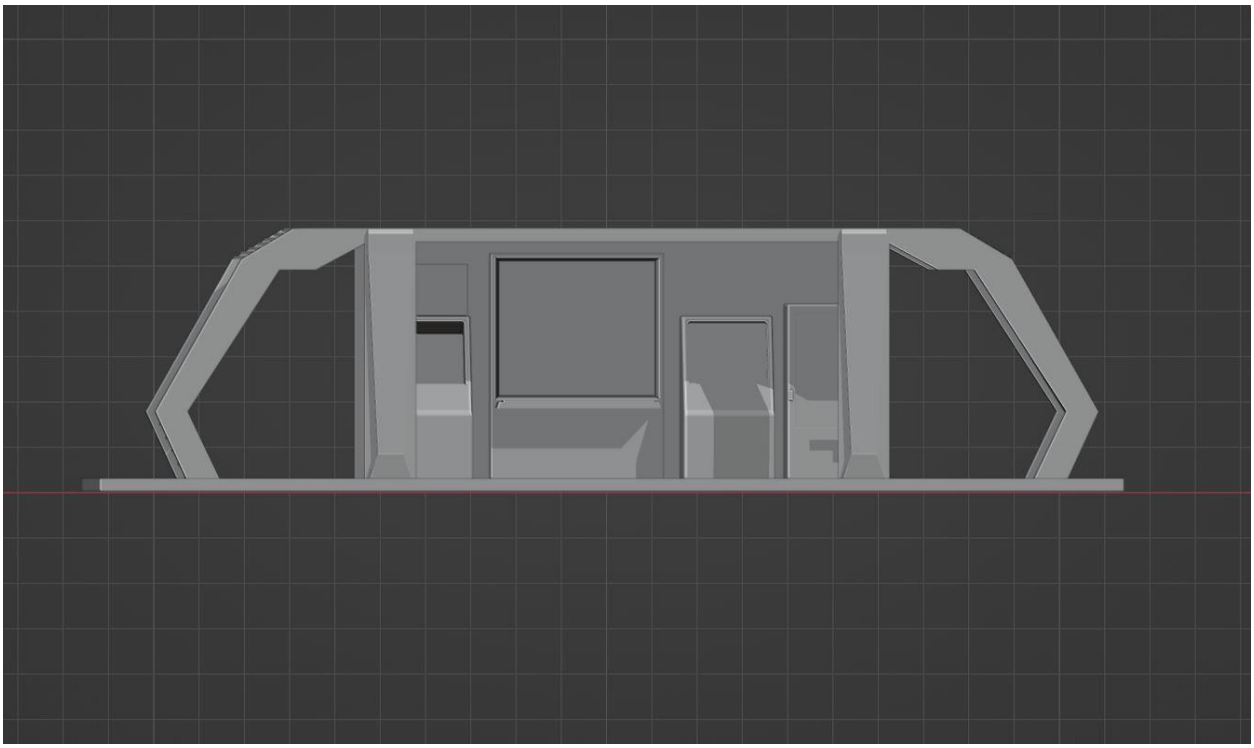

Fig 4.2.2.1 Bus Station Model.

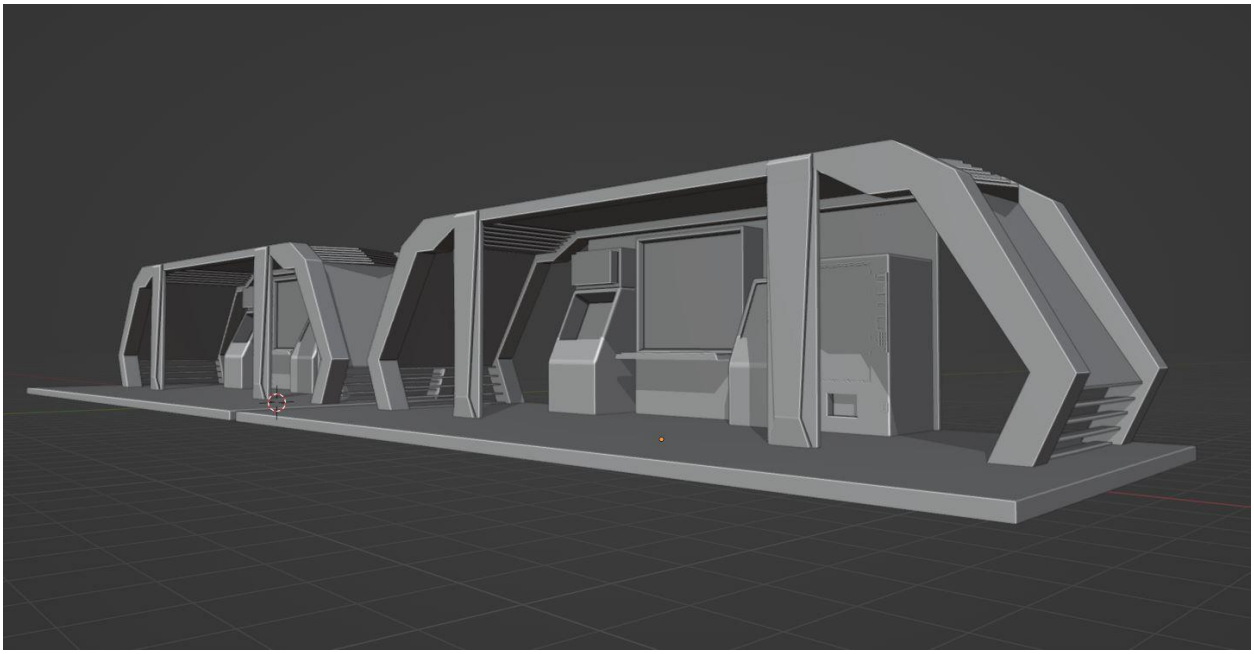

Fig 4.2.2.2 Bus Station Model.

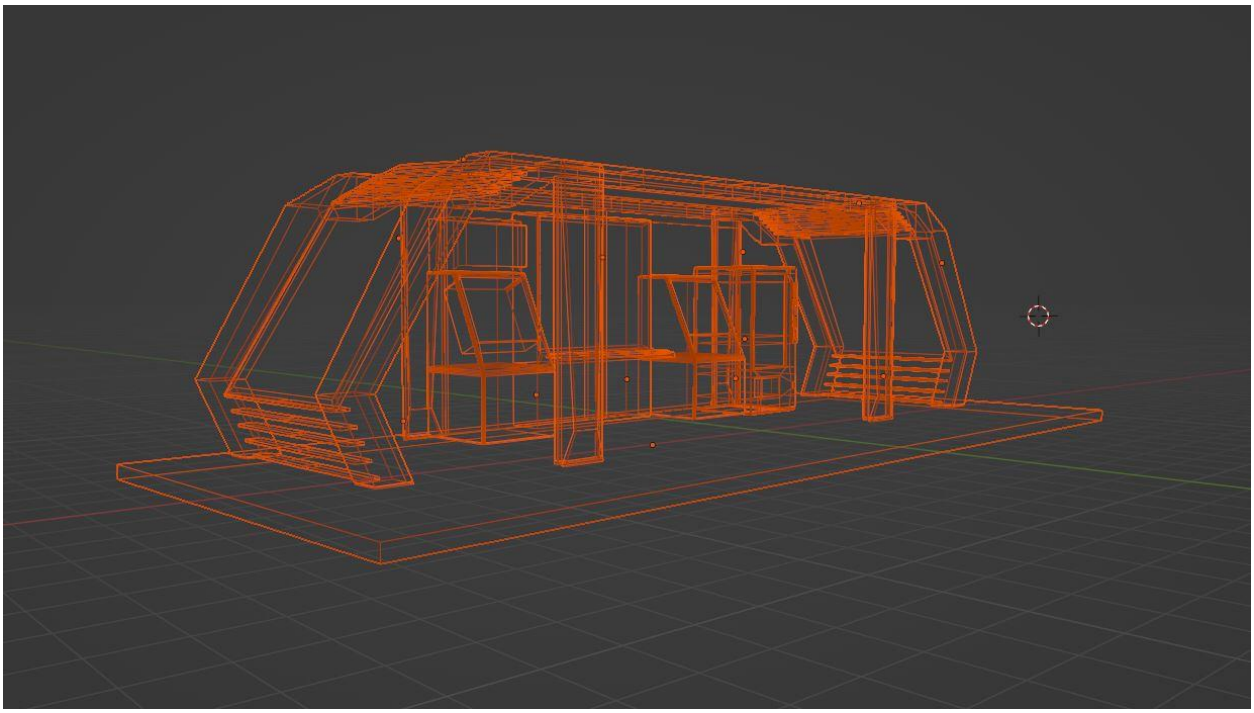

Fig 4.2.2.3 Bus Station wireframe.

4.2.3 Smart Speed Camera:

The smart speed camera model is a part of another large model (Road). Speed cameras are still not available for mass traffic in our country but which should be. So, we decided to create a simple but modern speed camera model to implement in our roads. We created the model from a basic cube. We manipulated the cube by using inset, extrude and bevel modifier to create the camera shape. The cable shapes are created by using curves and after that the curves are converted into mesh because afterwards we needed to uv-unwrap and texture it.

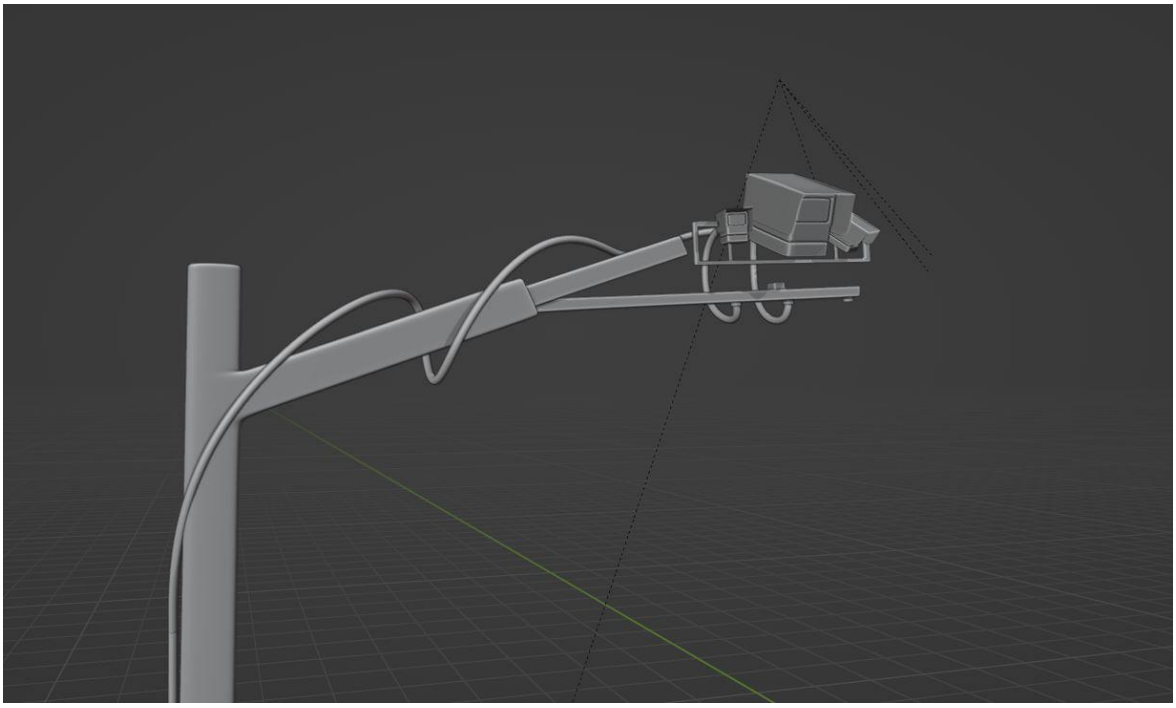

Fig 4.2.3.1 Smart Speed Camera model.

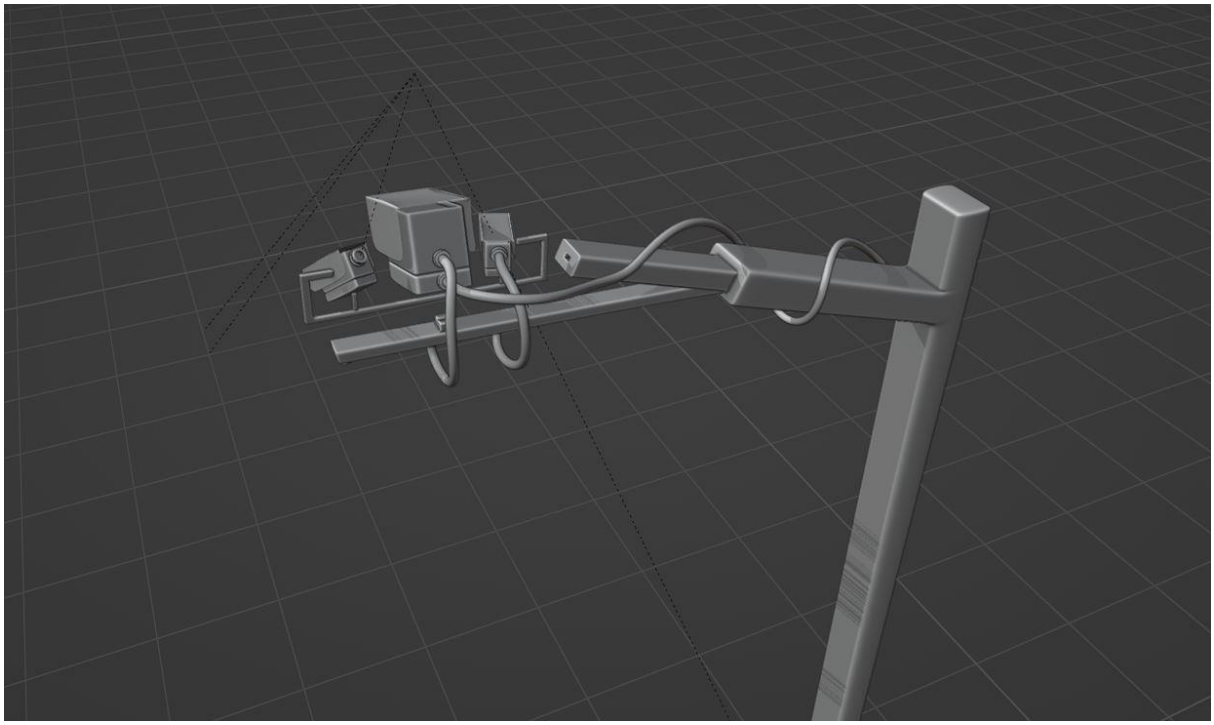

Fig 4.2.3.2 Smart Speed Camera model.

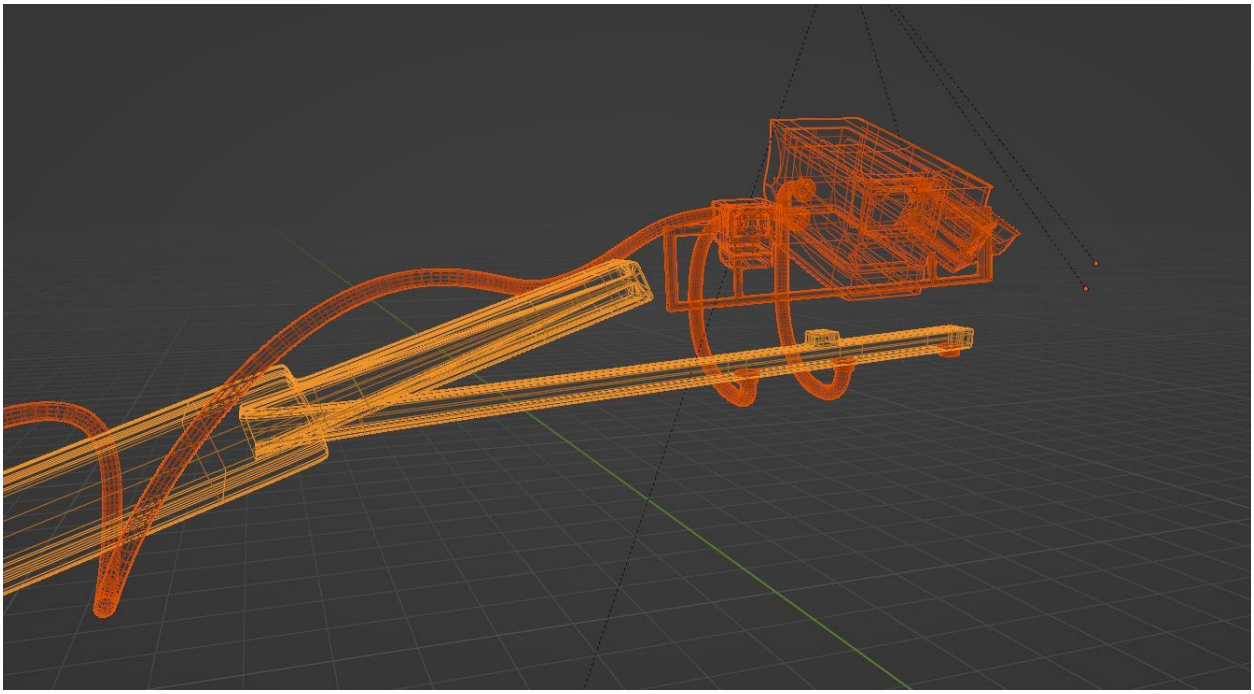

Fig 4.2.3.3 Smart Speed Camera wireframe.

4.2.4 Smart Door Lock:

Smart door lock is a modern key less door security system. It came from the idea of smart home. Key lock door security system makes our daily life much easier and secured.

We tried to keep our model simple but it became complex when we tried to make it realistic, though it was supposed to be a low poly model but the poly count went higher. We used simple modeling technique such as inset, extrude, intrude and bevel modifier and finally used subdivision surface to increase the quality.

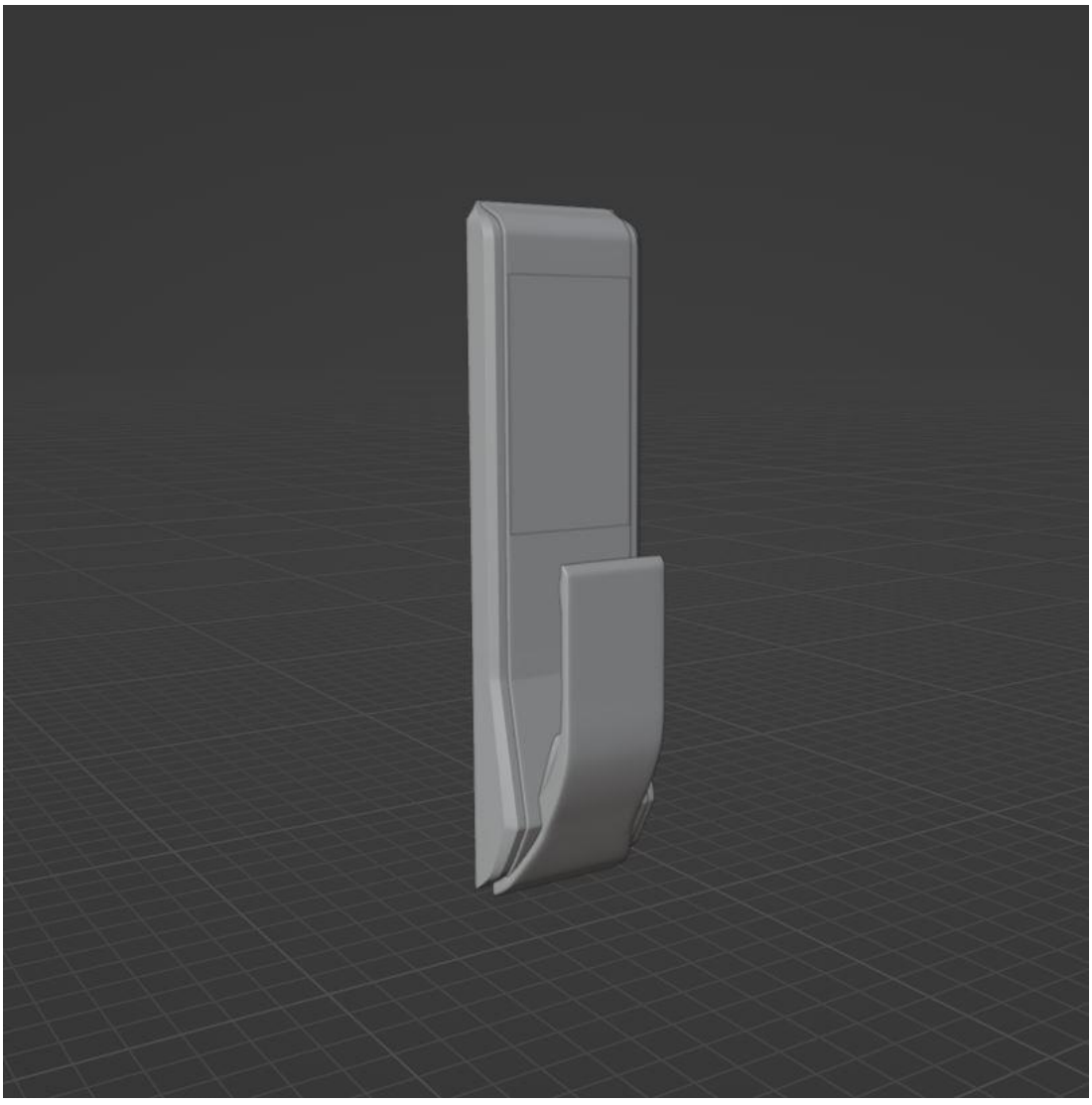

Fig 4.2.4.1 Smart Door Lock Model.

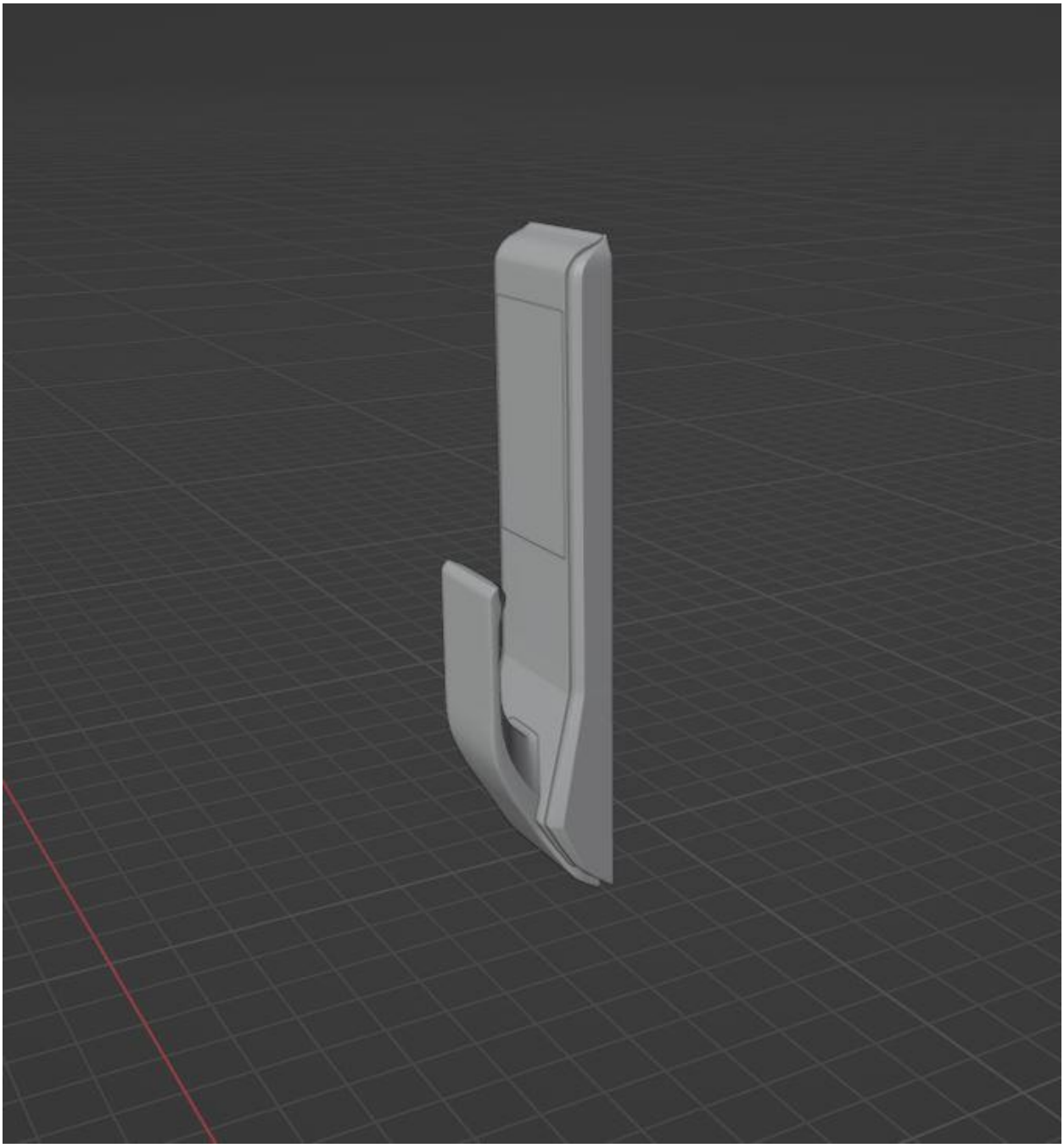

Fig 4.2.4.2 Smart Door Lock Model.

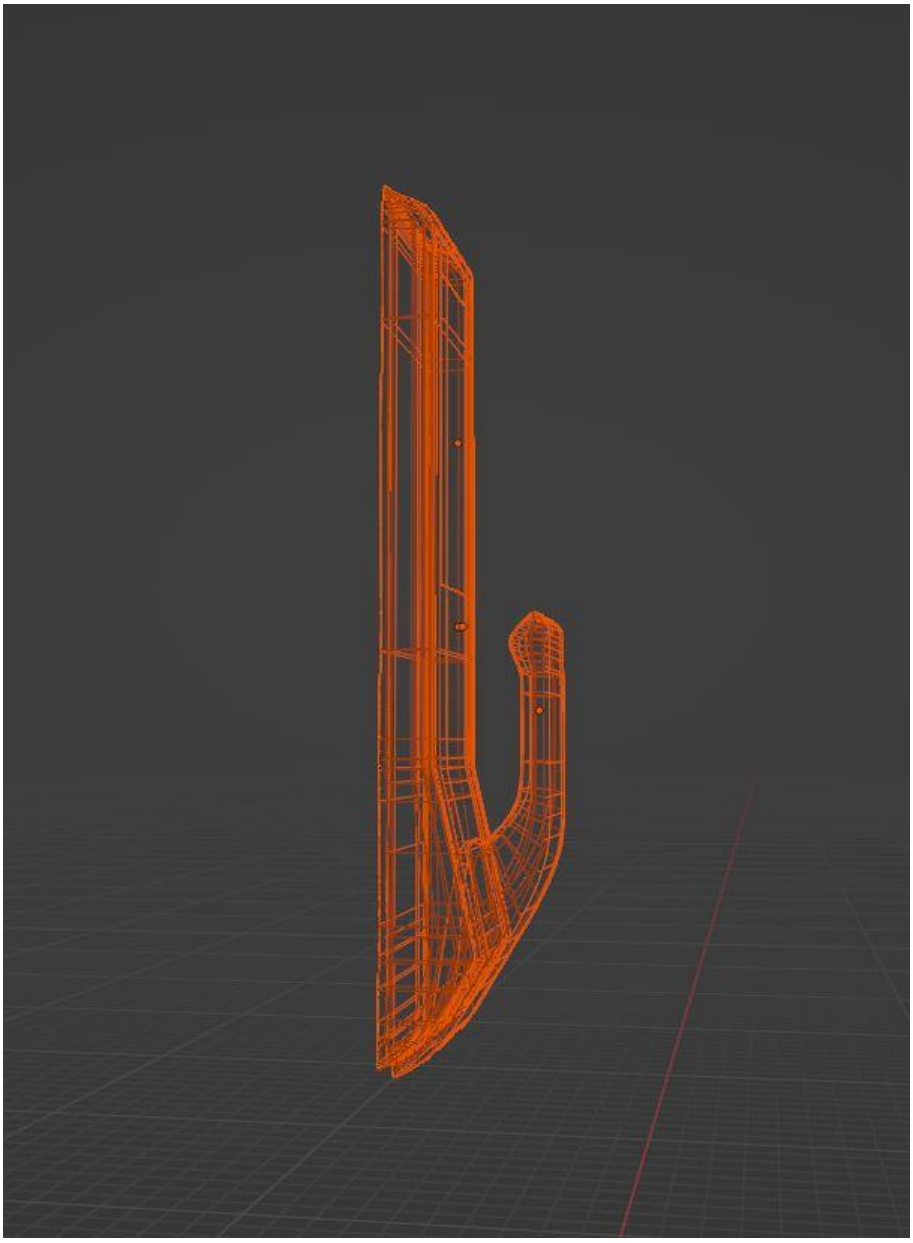

Fig 4.2.4.3 Smart Door Lock wireframe.

4.2.11 Filling Station:

The concept of a smart filling station comes from the idea of self-serving policy. We searched for a proper reference image to create the model and then we setup the reference image. We started by modeling the base structure.

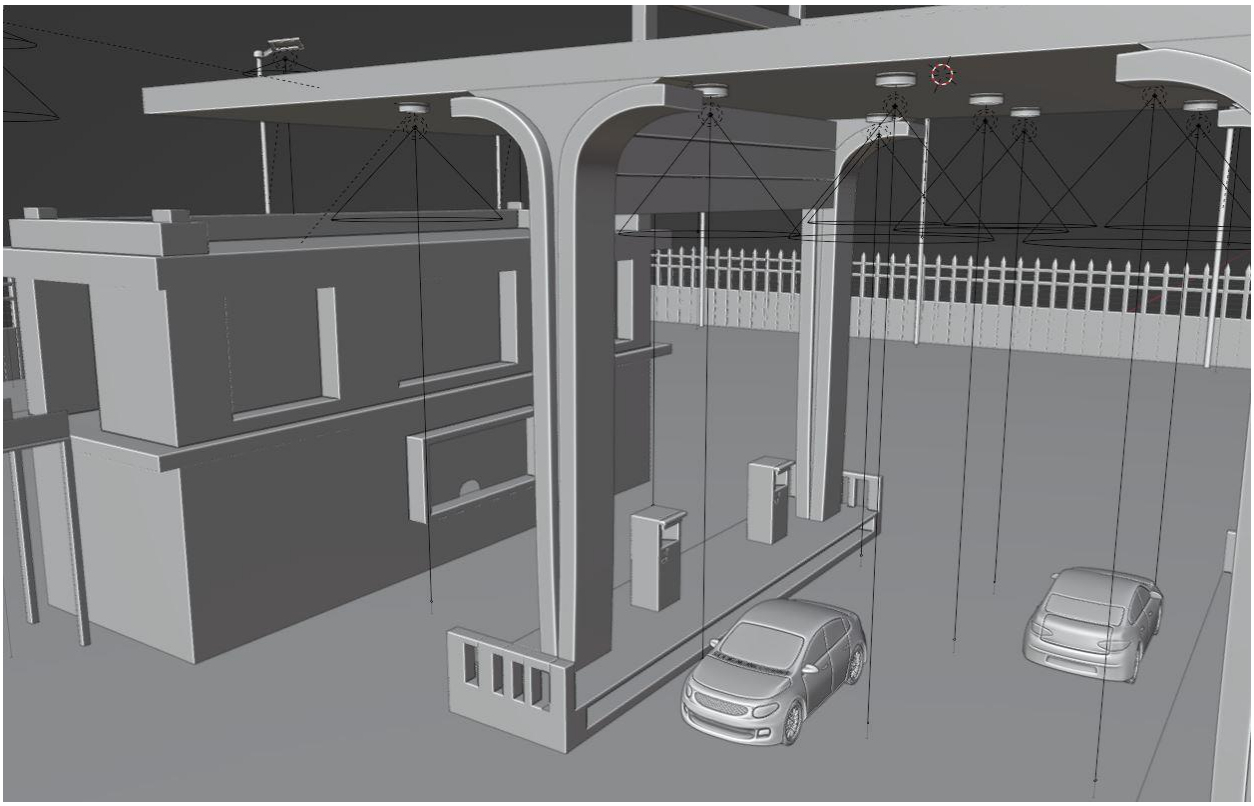

Fig 4.2.11.1 Filling Station Model

To create the base structure, we extruded the faces and then created the arch shape as you can see and then mirrored the arch shape in the X Global axis to complete the structure. Then duplicated the whole structure to another side to create one side of the main filling station base and selected one whole side of the structure again duplicated the structure and placed it to the other side to complete the main base structure of the filling station.

Fig 4.2.11.2 Filling Station Model.

After finishing the main base structure, we started creating the fuel pump machine which is not a very complex model but it looks realistic because we used photogrammetric texturing. By using extrude, intrude, inset, bevel modifiers and subdivision surface to we matched the main parts of the fuel pump machine according to the image we used for photogrammetric texturing. It is an important task because it will not feel real if we don't match the details.

Spot lights are used in simple cylinder to make the lights realistic which is coming from the roof. There are several lamp posts for external lighting around the whole composition. The fences & stairs are created with array modifier and proper axis coordination. We also used glass to create the stair barriers.

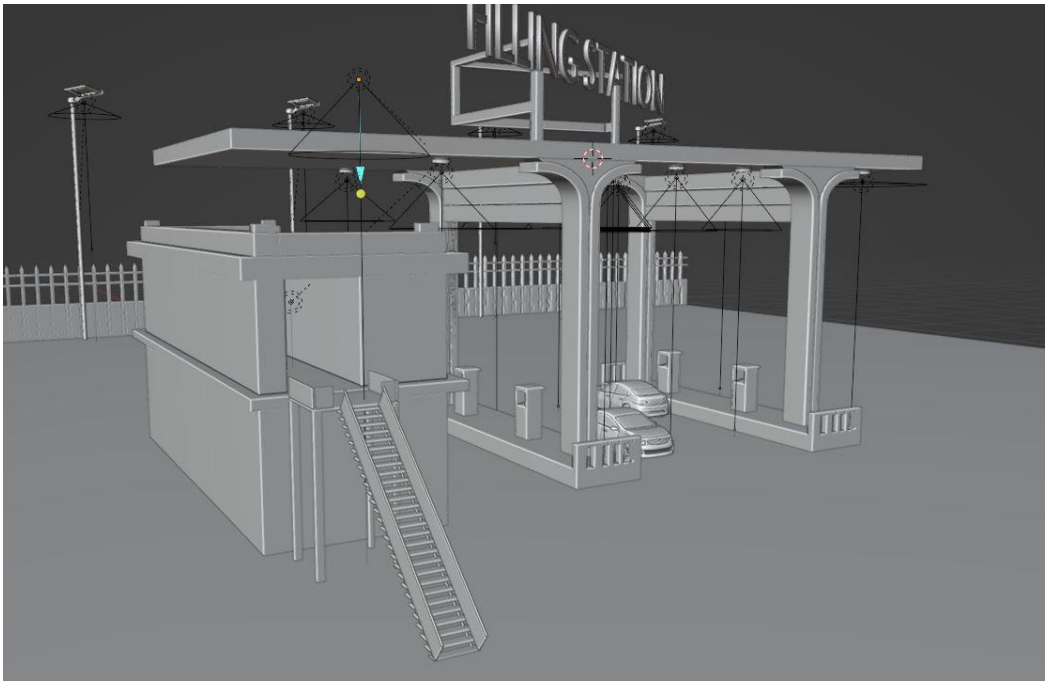

Fig 4.2.11.3 Filling Station Model.

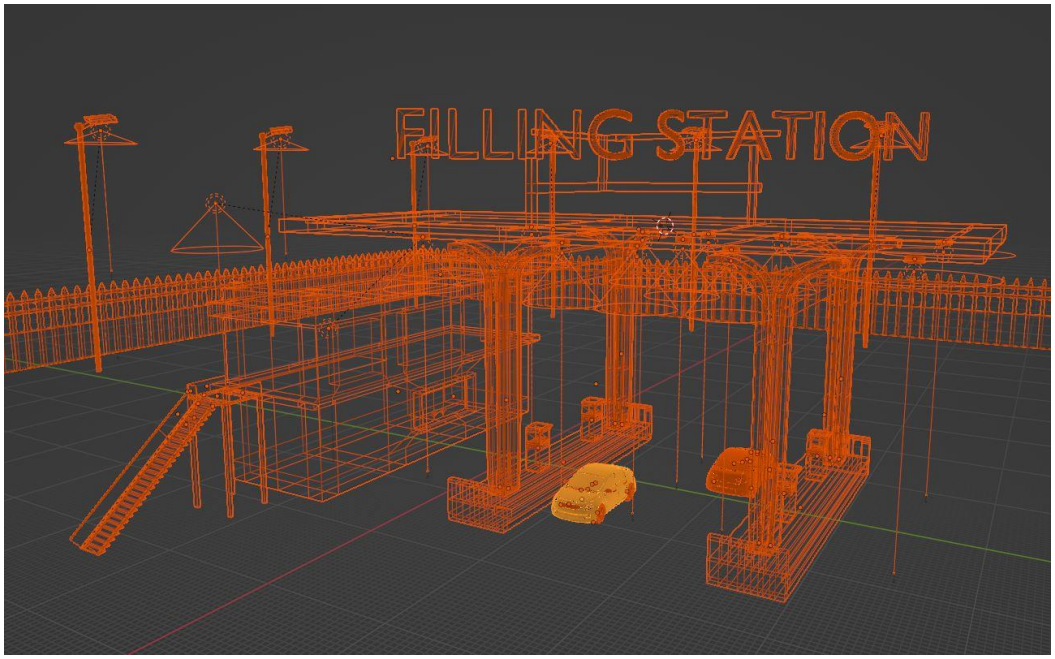

Fig 4.2.11.4 Filling Station Wireframe.

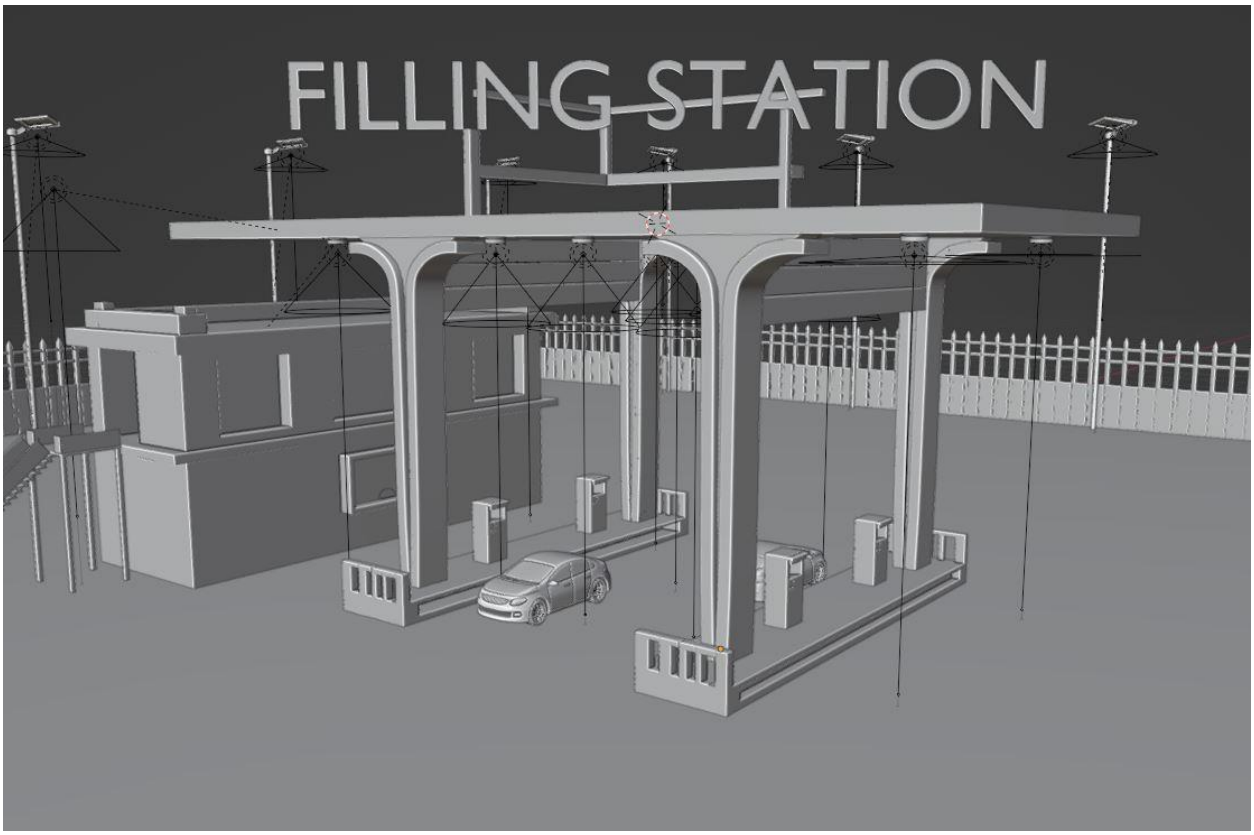

Fig 4.2.11.5 Filling Station Model.

4.2.6 Smart Parking System:

The smart parking system concept is totally new for our country but in other countries they are already very known and popular to the mass people. So, we tried to create a smart parking system to implement in our country.

This model has a very complex infrastructure in real life and also in the 3d model. So, when we started the 3d modeling process we had to research the whole concept and find high resolution reference images as a start. We started by modeling the car chamber.

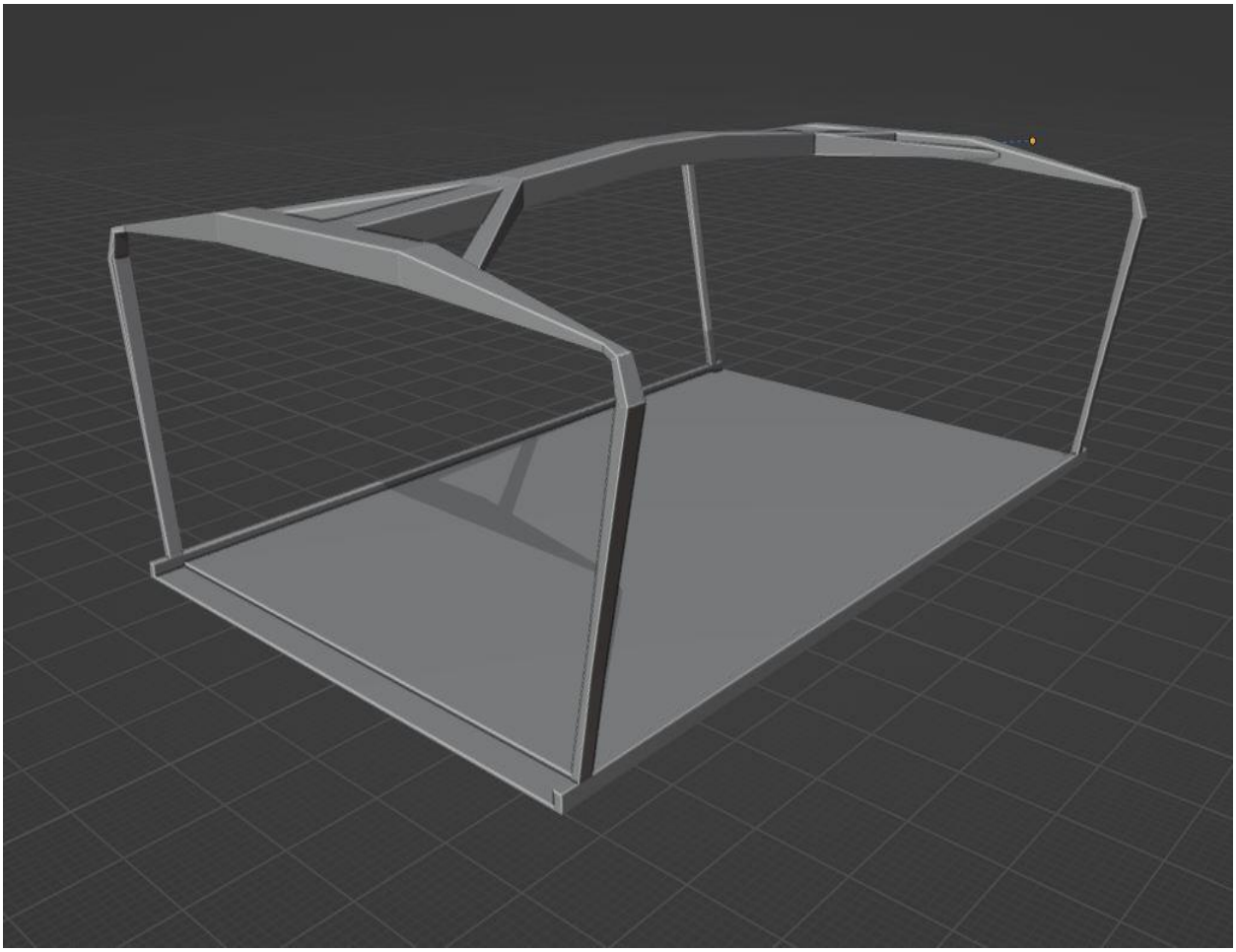

Fig 4.2.6.1 Smart Parking System Chamber Model.

After modeling the chamber, we started on the main base structure which will hold the chambers and the chains. The base structure is complex but we did it by using a simple plane and manipulating vertexes and connecting faces.

After creating the base shape, it came to life by simple extruding the remaining plane in edit mode and there we have it. Afterwards we just duplicated the structure to the other side to create the whole base structure.

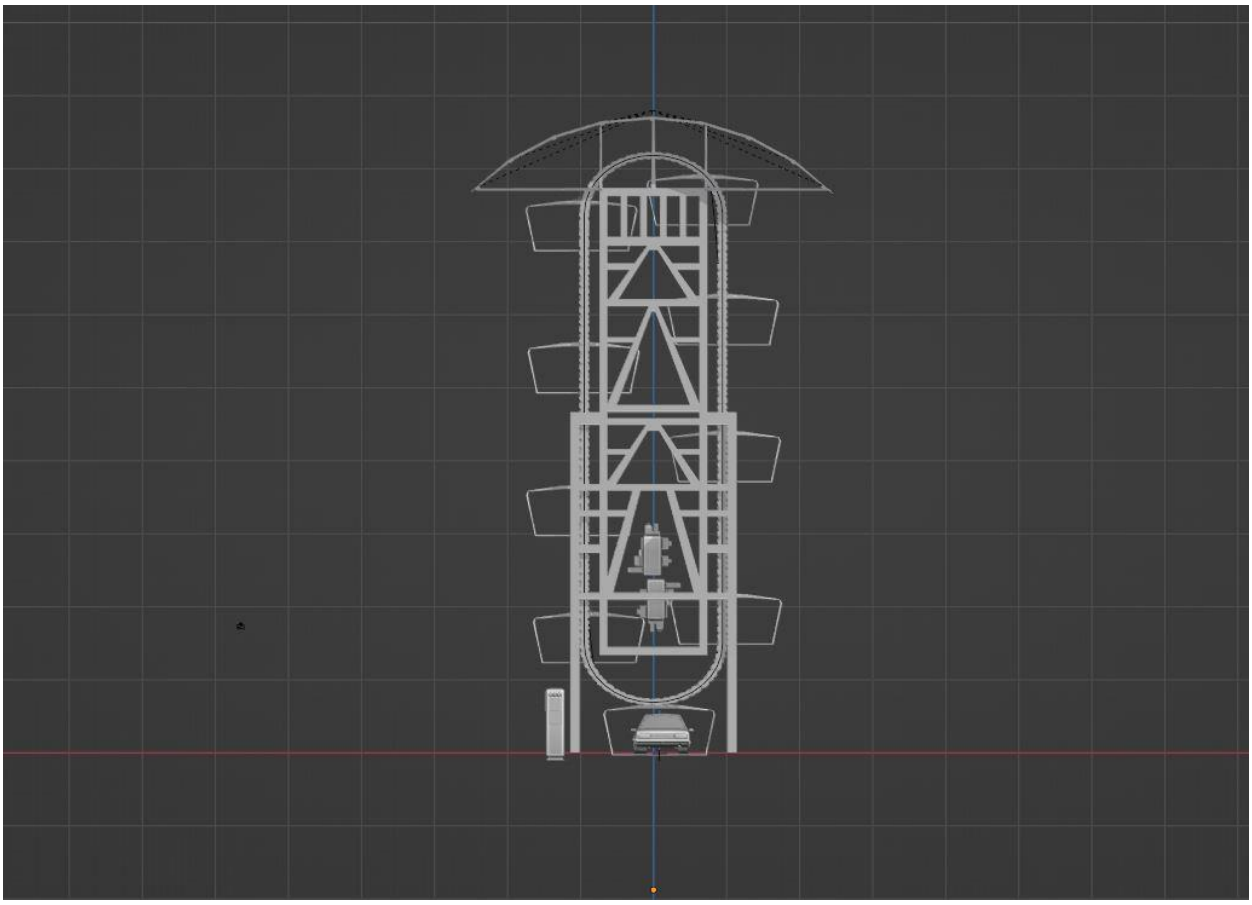

Fig 4.2.6.2 Smart Parking System Model.

This smart parking system has control panel by which users will control it. We used simple intrude, extrude and bevel modifiers to create it.

Fig 4.2.6.3 Smart Parking System control panel Model.

Then we started modeling the chains which will move the chambers through the base structure. The chains were the hardest and most complex section of this whole model.

A chain is easy to model by using simple tools but when we thought that we need to animate the chains it became very complex and we couldn't find any solutions about how a chain could move in a particular path and doesn't change its form. Which should have been not that complex but it did because we used array modifier to create a whole bunch of chain segments into a proper working chain. So, when we tried to move the chain through the path the chain become unstable and impossible to animate.

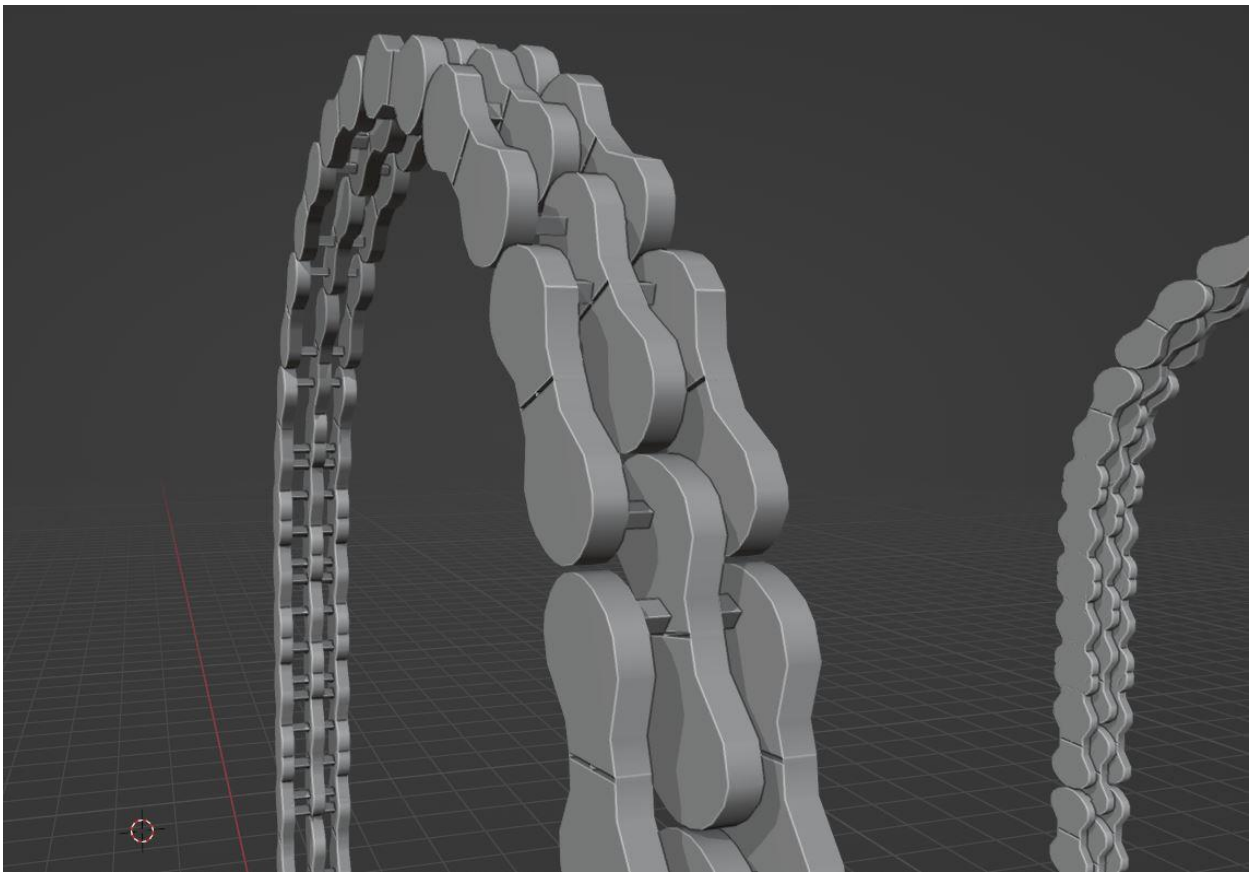

Fig 4.2.6.4 Smart Parking System Chain Model.

Then we started from the beginning and this time we used curves instead of path to follow. Then the chains become much more stable and possible to animate.

After that we synchronized those chambers with the chain by creating another curve. Then a new problem appeared which is, the chambers were following the curve but by following the curve, axis deformation started. The chambers were stuck to the curve at a single axis. Then we had to find a new way to resolve this issue.

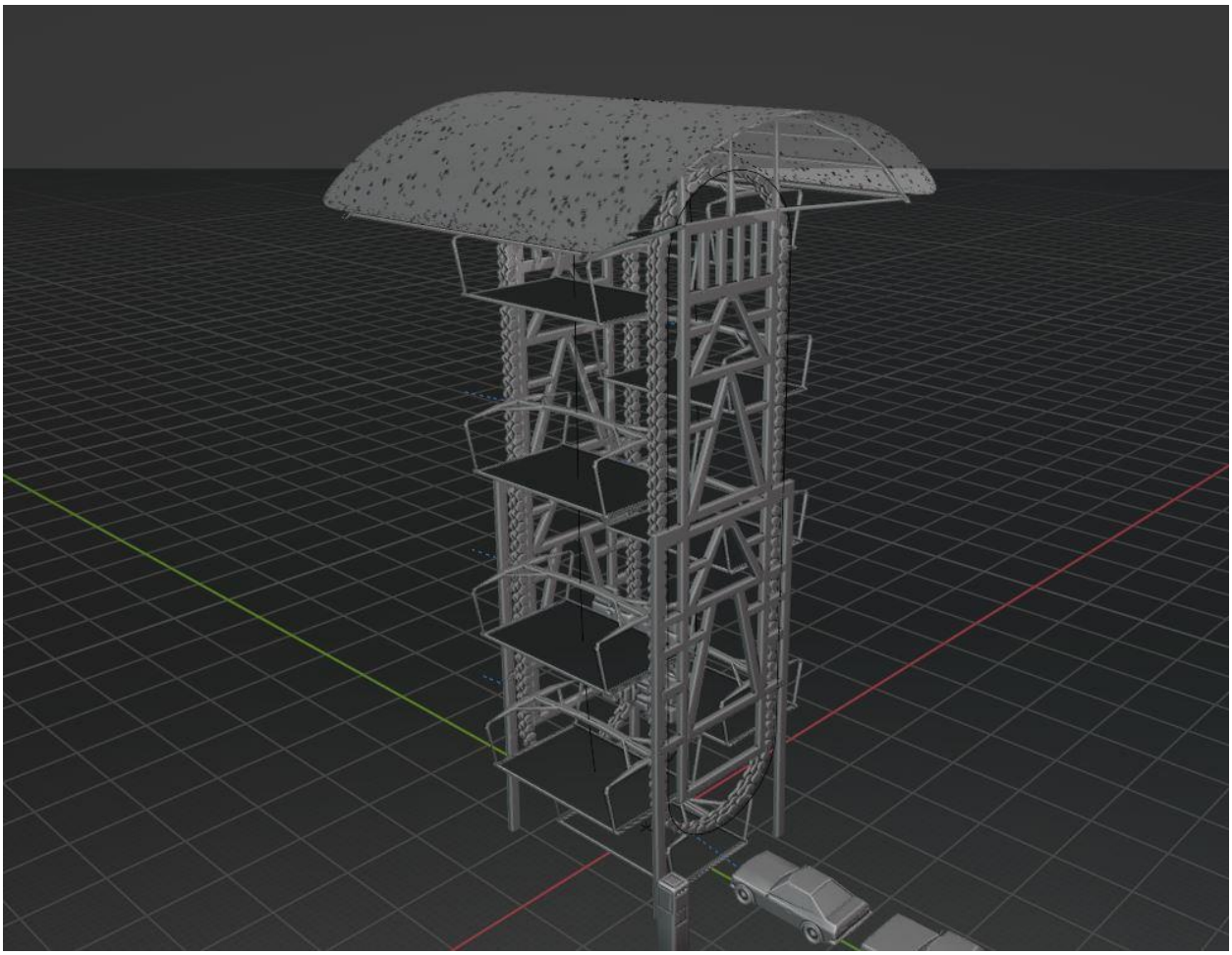

Fig 4.2.6.5 Smart Parking System Model.

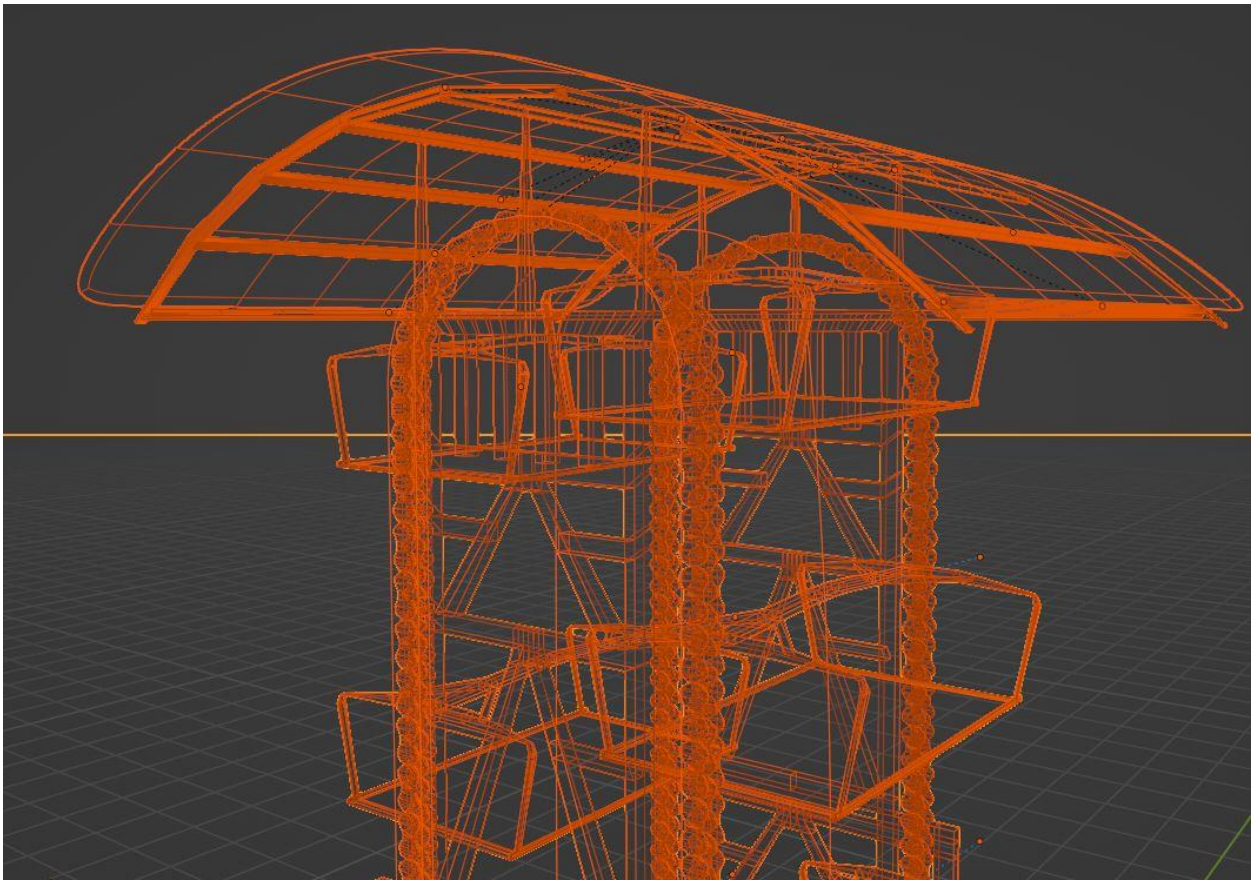

Fig 4.2.6.1 Smart Parking System Wireframe.

After connecting the chambers to the chains, the model was completed.

4.2.9 Pillow (Sculpting):

Pillow is a pretty difficult model if we want to make it realistic. We tried to make it better. But we have some time issue that's why we keep it simple. First, we take a cube and go to the edit mode then take the vertex and make it a pillow shape. We don't use the presser modifier for the time issue that's why we use the sculpting method, then we apply the subdivision modifier to make the pillow smooth.

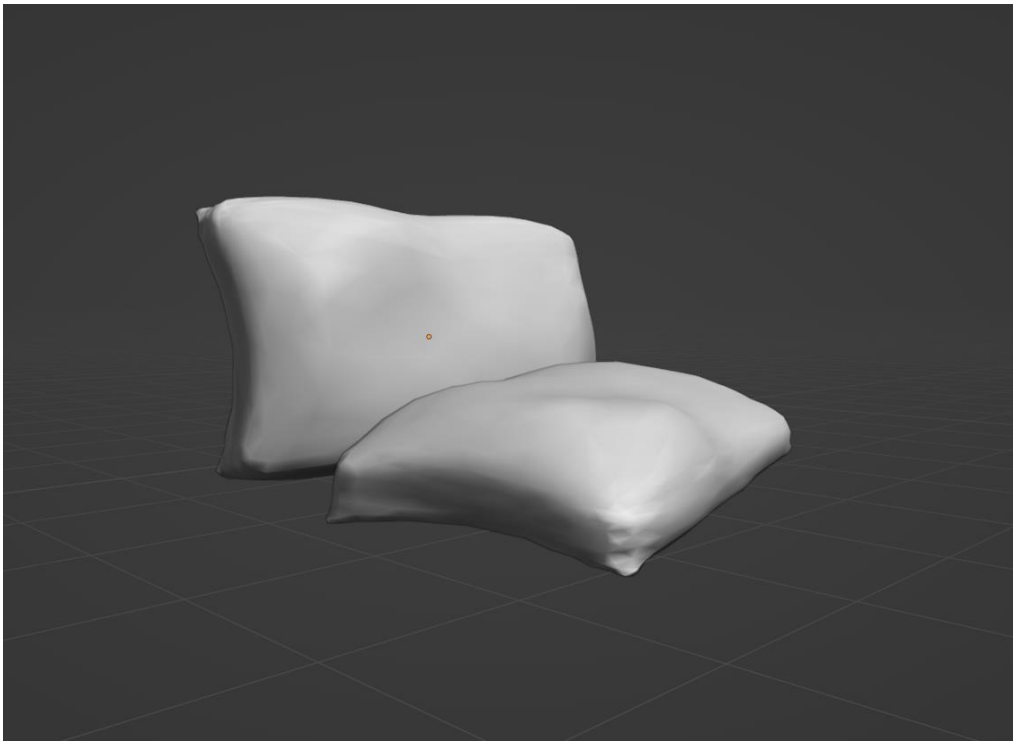

Fig 4.2.9.1 Pillow (Sculpting) Model.

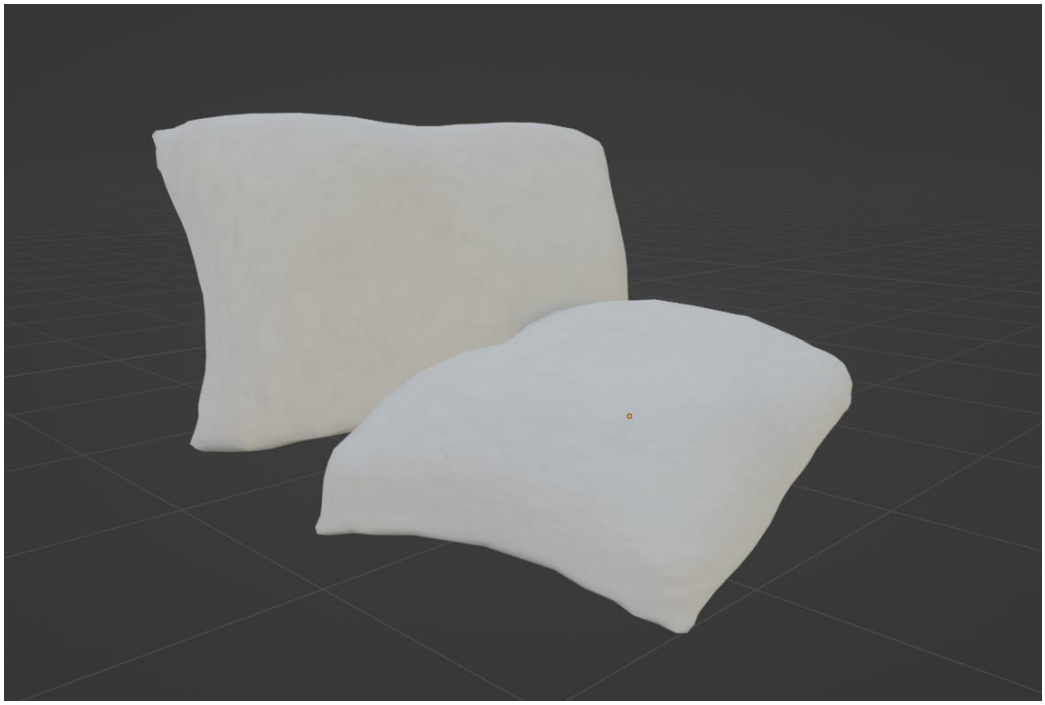

Fig 4.2.9.2 Pillow (Sculpting) Model.

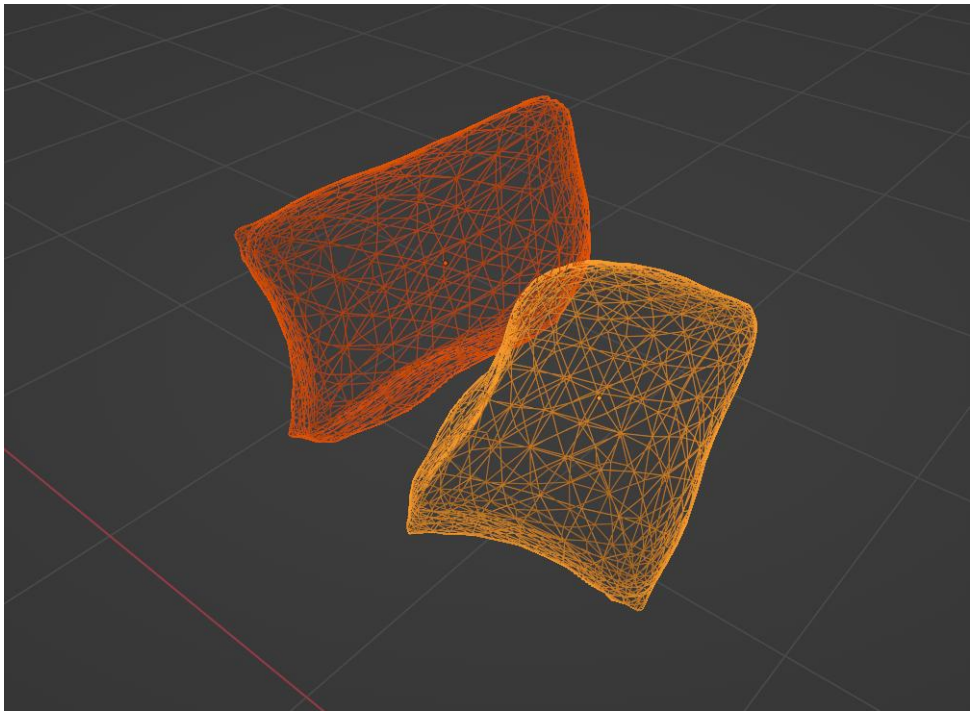

Fig 4.2.9.3 Pillow (Sculpting) Wireframe.

4.2.12 Patrol Pump Machine:

Patrol pump machine is a basic model that we use it on the filling station. It's a not a difficult model but it took many times. For making this model first we take a cube and then go to the edit mode take vertex and faces to make the pump machine shape, we also use the Boolean and bevel modifier to cut the machine shape. Then we used an image for photogrammetric modeling.

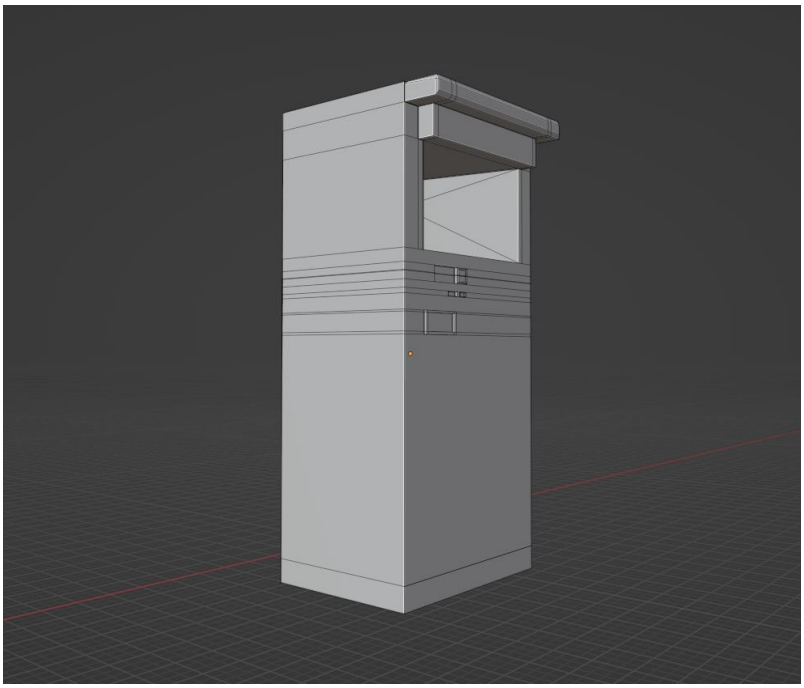

Fig 4.2.12.1 Patrol Pump Machine Model.

Fig 4.2.12.2 Patrol Pump Machine Model.

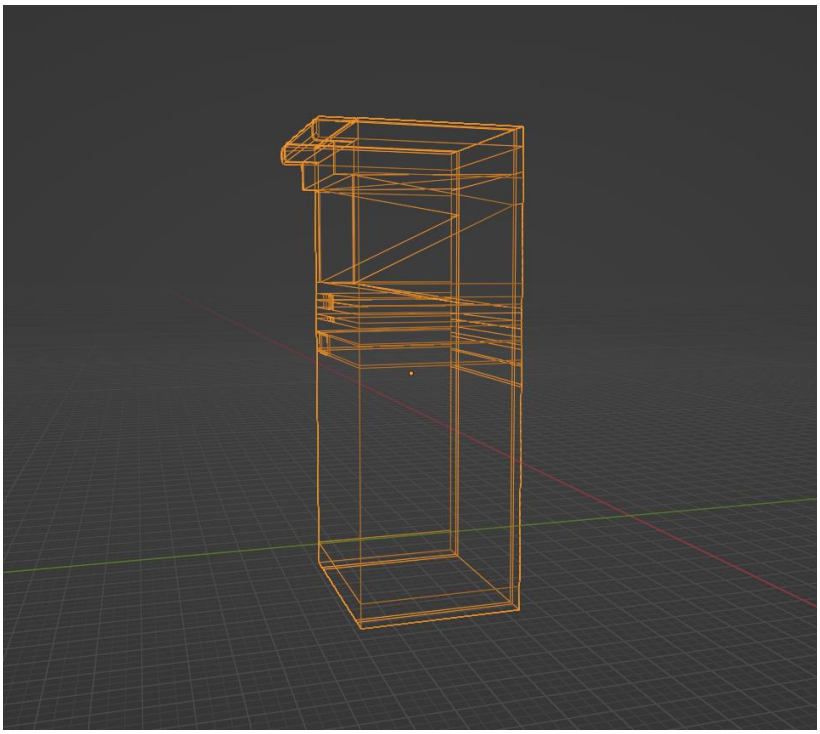

Fig 4.2.12 Patrol Pump Machine Wireframe.

4.2.23 Bed:

Bed is our one part of Home interior model. It took so much time to make to finished. First, we take two cubes to make the main base of bed. The base is basically two part that's why we take two cube and make it the shape of bed. after we made the base then start making the pillow. The pillow made with the **Sculpting** technique. First, we take a cube and go to the edit mode and took the vertex to shape of pillow. Then we apply the subdivision modifier to make it smooth look. Then we take a plane to make a rug. We take the plane and apply the hair practical modifier to make this rug.

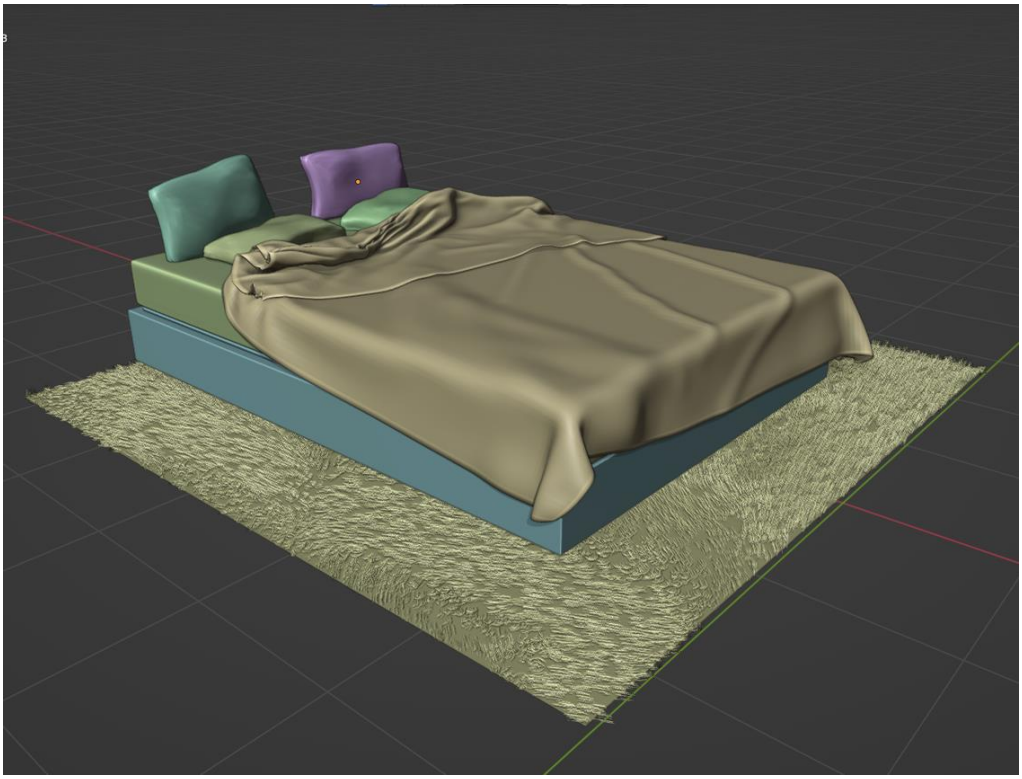

Fig 4.2.23.1 Bed Model.

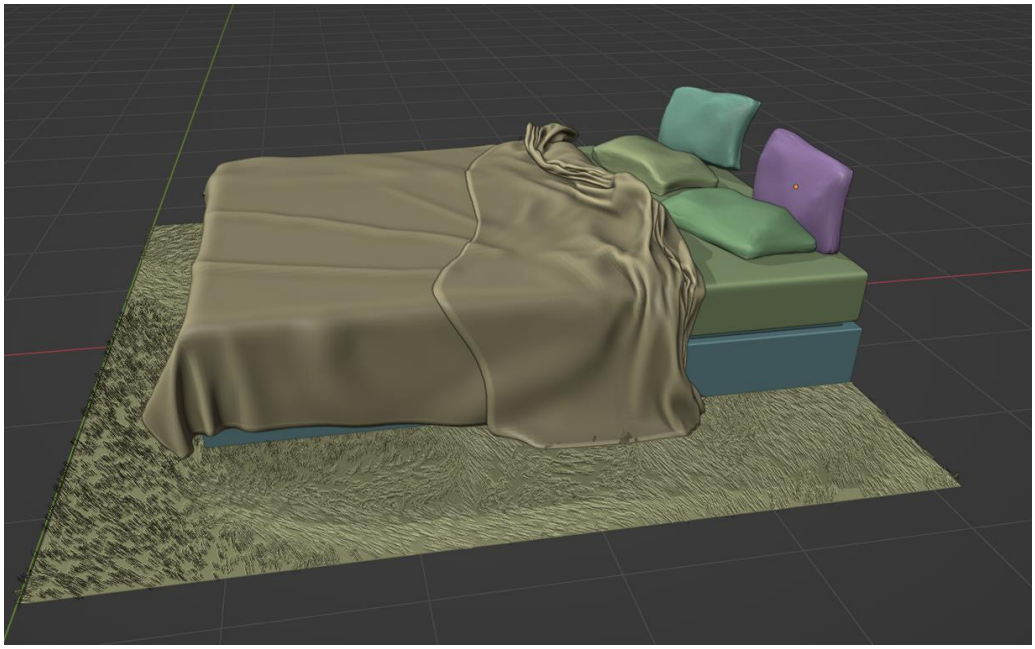

Fig 4.2.23.2 Bed Model.

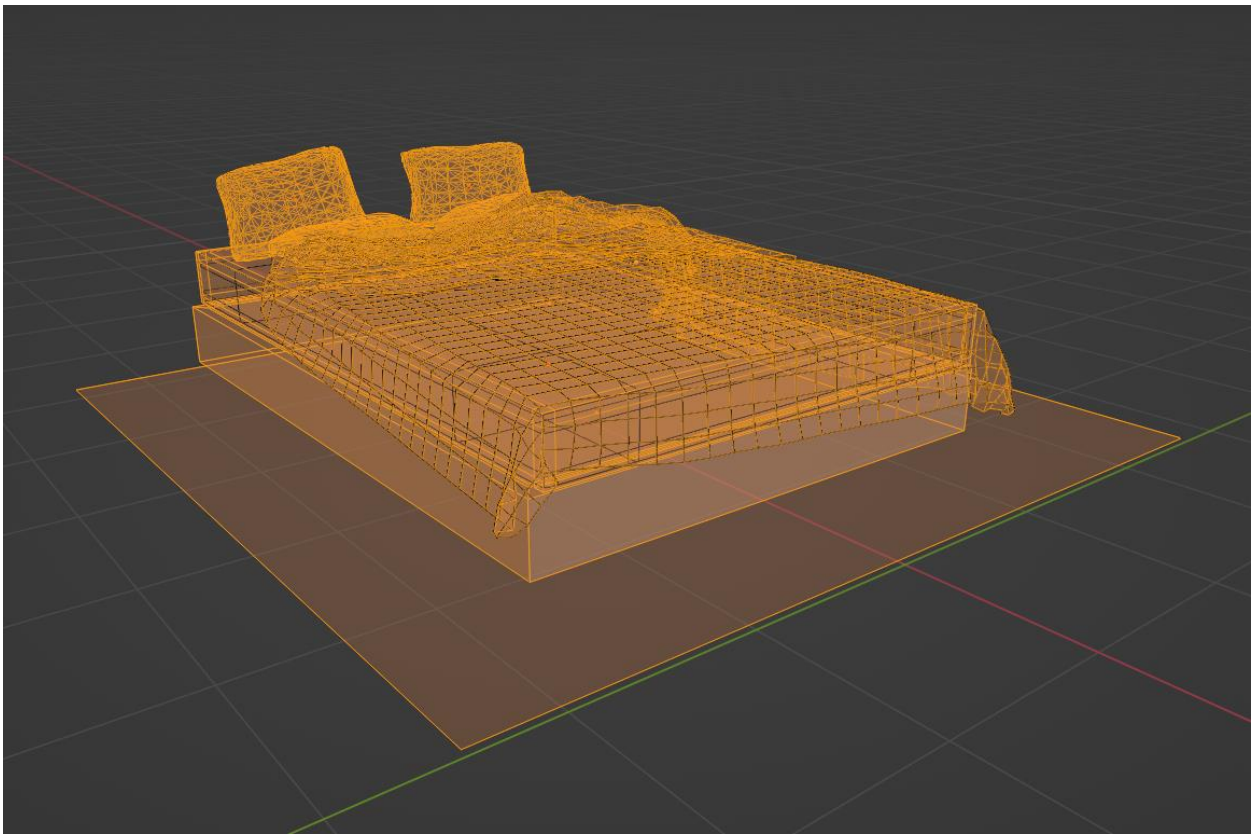

Fig 4.2.23.3 Bed Wireframe.

4.2.10 Bed Sheet (Cloth Simulation):

Bed sheet model looks a very easy model but when we making this model we face many problems to create it. For making this model we take a plane and going to the edit mode and take the vertex to make a proper shape of bed sheet. When we find the shape, we apply the simulation to the bed sheet and orientation the map. We spend many times for this because very first four time we failed to simulation. But the five time we apply the process then we success to made it.

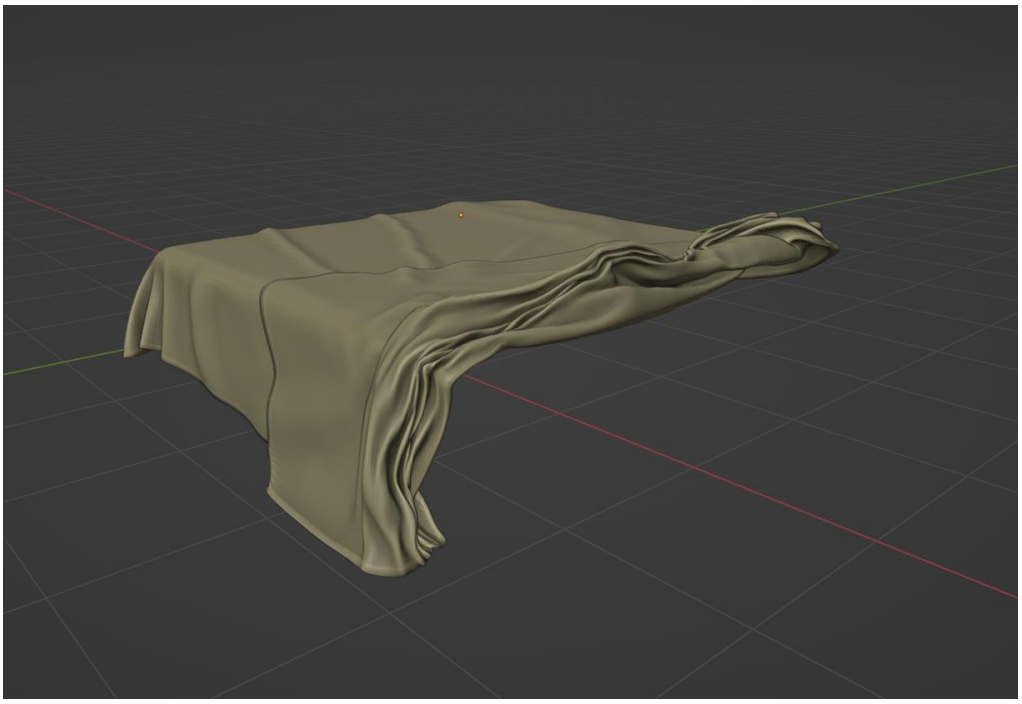

Fig 4.2.10.1 Bed Sheet (Cloth Simulation) Model.

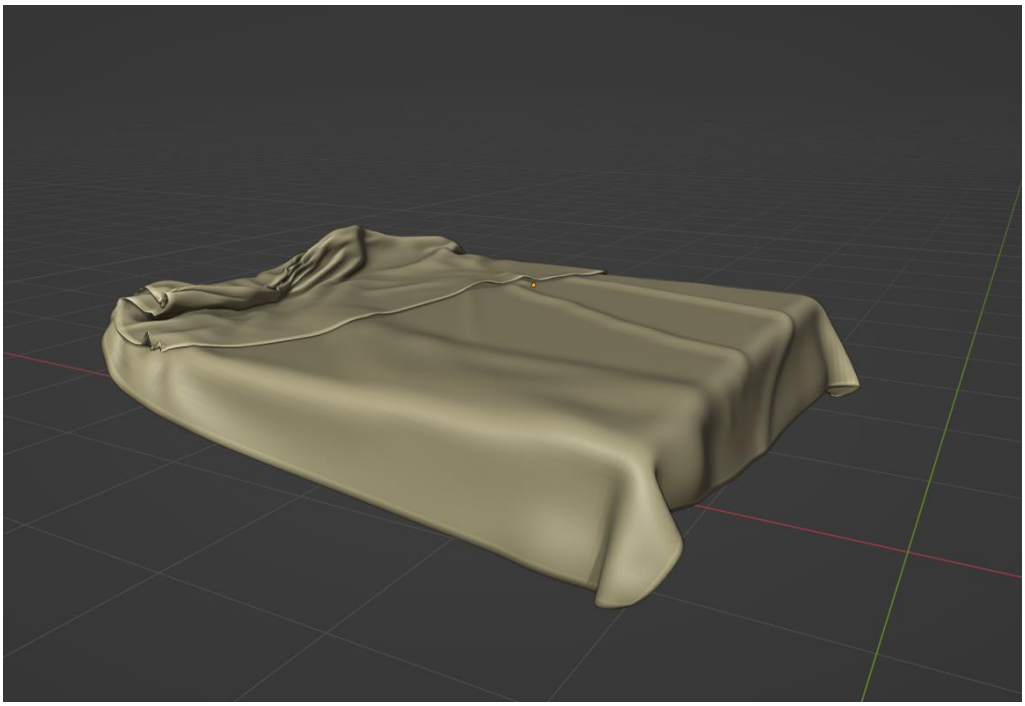

Fig 4.2.10.2 Bed Sheet (Cloth Simulation) Model.

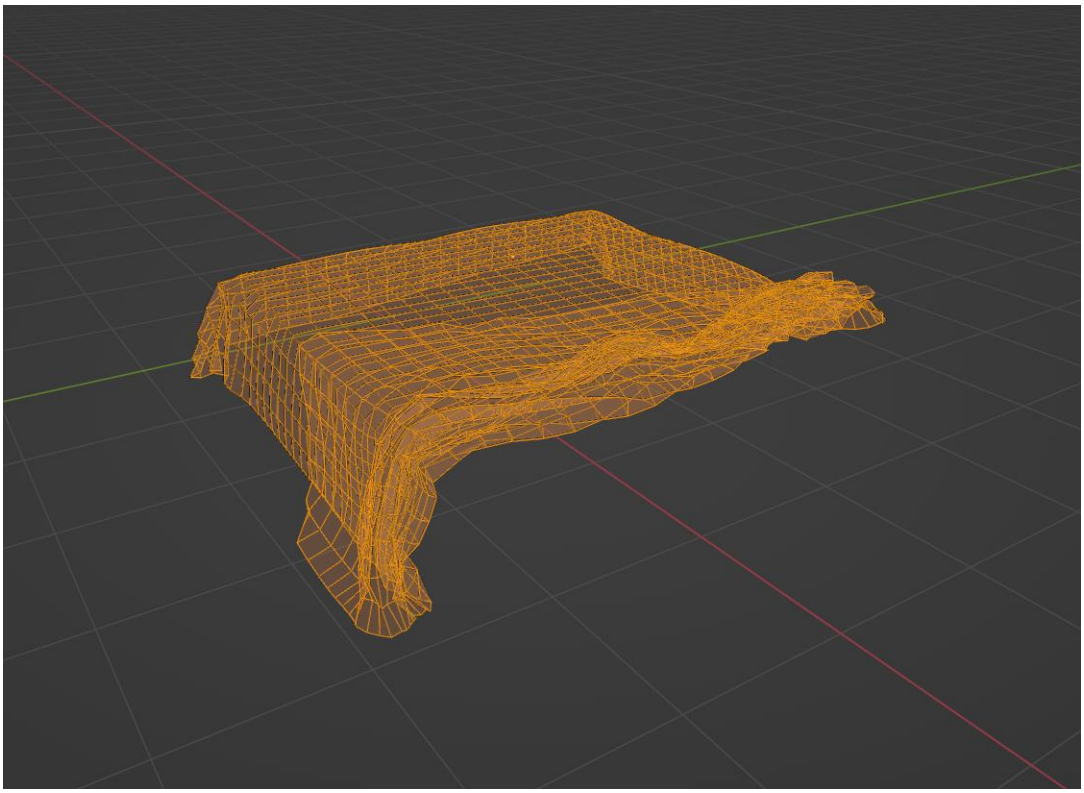

Fig 4.2.10.3 Bed Sheet (Cloth Simulation) wireframe.

4.2.7 Home Exterior:

A home is place that reflects a person's characteristics and represents his/her habitants & personality. A home/house contains two different parts. The interior and the exterior. We tried to create an exterior model which focuses on realism. After researching exterior structures, we found that the more we search for exterior references the more we were getting confused. We stopped searching and started drafting the base model. The idea of this house came from a family home.

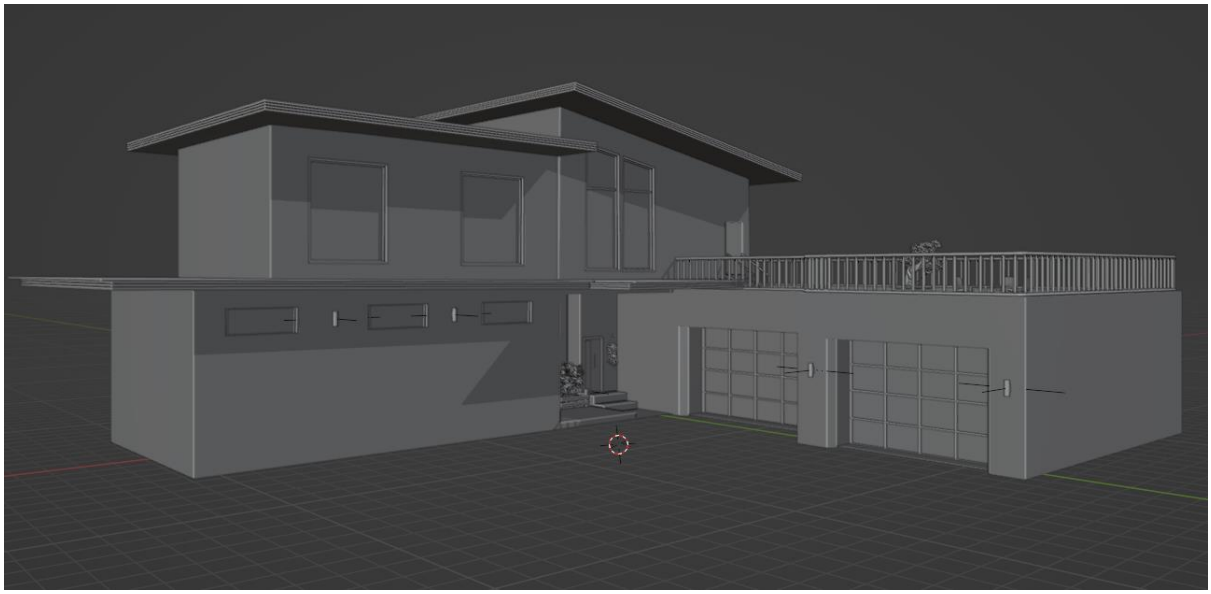

Fig 4.2.7.1 Home Exterior Model.

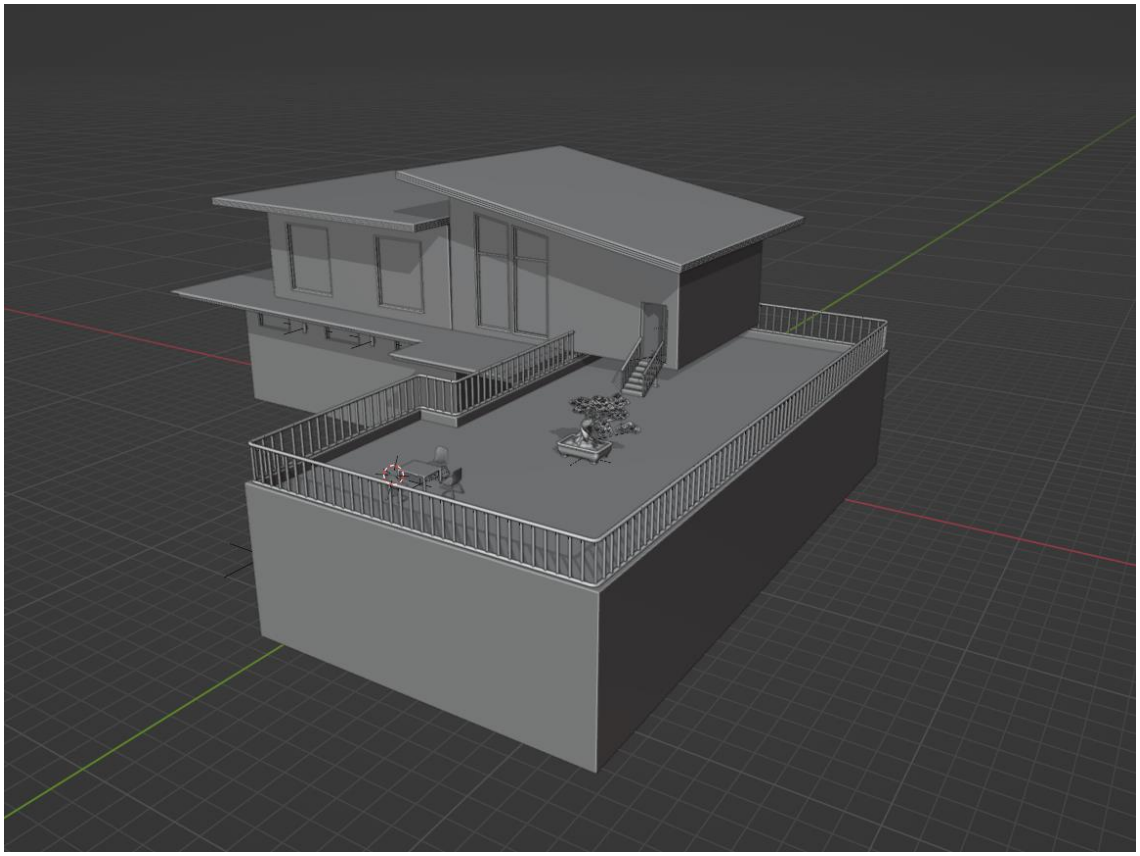

Fig 4.2.7.2 Home Exterior Model.

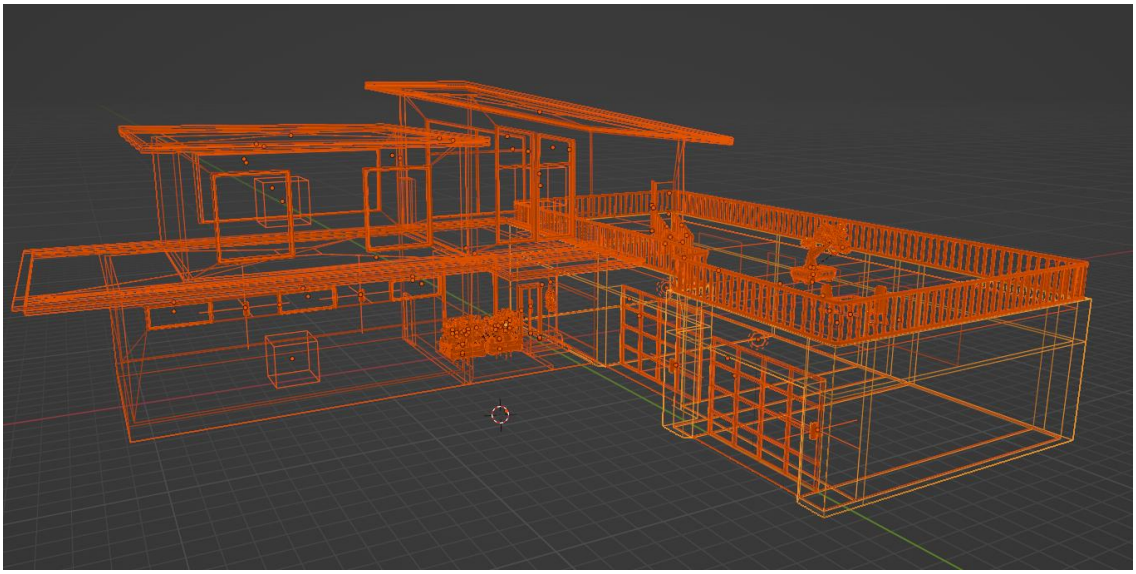

Fig 4.2.7.3 Home Exterior Wireframe.

We started by one room which is the right upper on as you can see. But then we started to feel that lighting is a bigger part of this model, so we started finding a good HDRI with a farm and soft lighting which doesn’t burn our realism.

Fig 4.2.7.4 Home Exterior Lighting Model.

We had to move around the HDRI and position the lights to make a proper lighting. After positioning the lightings, we started to create other rooms of the house. So, we started thinking about real lights into the room. So, we didn't used traditional folding curtains. A glass BDSF shader material is used for the large window. So that the natural light can go through the window.

Fig 4.2.7.5 Home Exterior Lighting Model.

The roof needed a fence which we created by array but after using the array modifier we noticed that the alignment of the fence is not properly placed. So, we used curve to follow for the array modifier.

Some free addons helped us with the front yard plantation.

4.2.16 Fire Hydrant:

Fire Hydrant is most important part of our model. Its use most of the environment of our project. Its looks very simple but it's too difficult when we create in blender. But we made it. First, we take a cube and extrude it the basic measurement size of fire hydrant. Then we apply the subdivision modifier on this, next we apply the bevel modifier on the four side of the hydrant. Then we take a circle shape to make the cape.

Fig 4.2.16.1 Fire Hydrant Model.

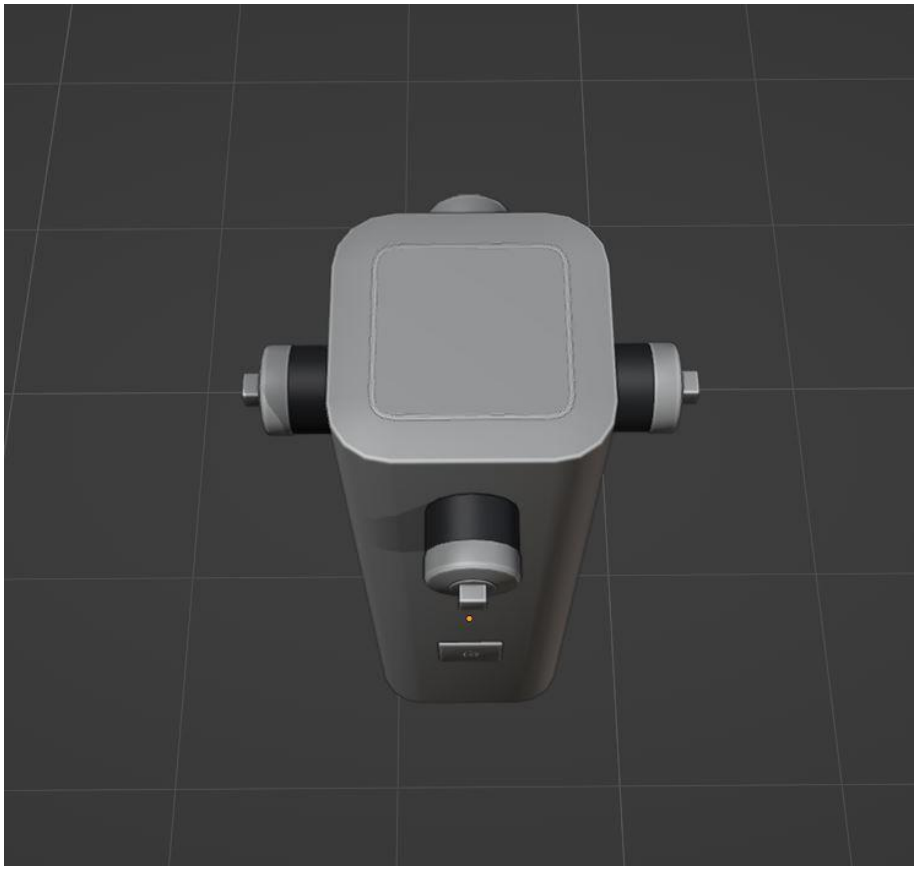

Fig 4.2.16.2 Fire Hydrant Model.

Here is the model we create properly, it took pretty much time.

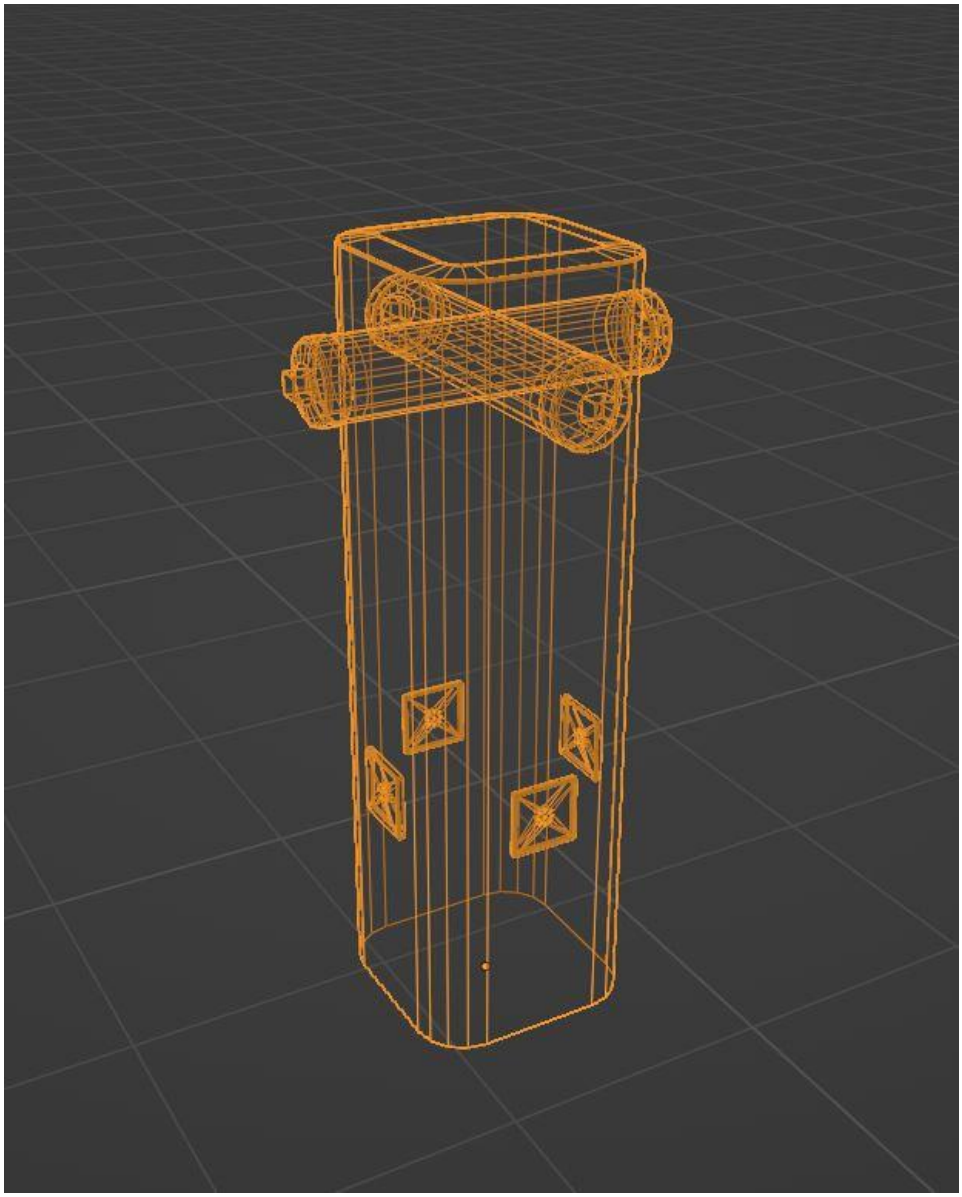

Fig 4.2.16.3 Fire Hydrant Wireframe.

4.2.19 RFID Flap Barrier:

RFID flap barrier is the smartest technology now a days. Its use official building, School and many more. It's a hart model for us, we attempt 5 time to make it. In the four time we doing many mistakes like wrong modifier apply, wrong tool. Then we finally note the mistake and overcome to the project model. First, we took the reference picture and take a cube then go to the edit mode. In this mode we find many vertices, we take the vertex and make it the shape of RFID flap barrier. After that we apply some modifier like subdivision, bevel, Boolean to create that.

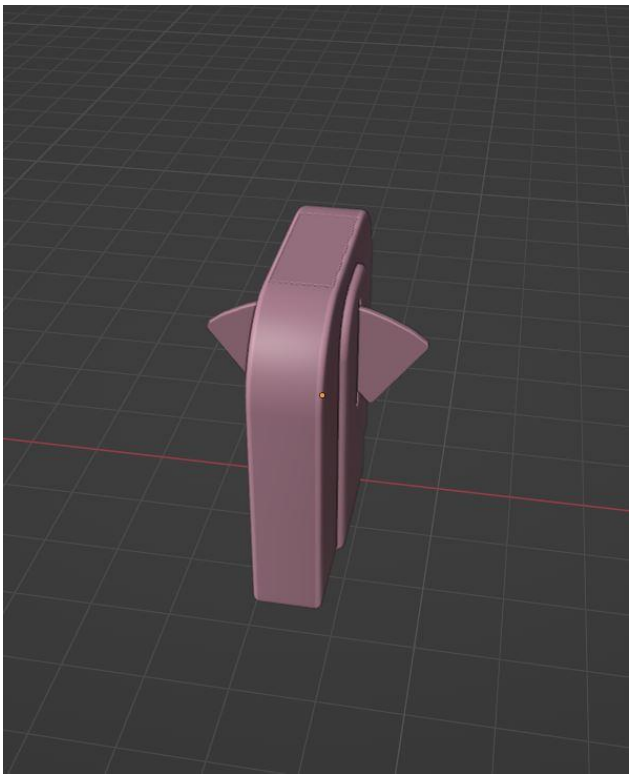

Fig 4.2.19.1 RFID Flap Barrier Model.

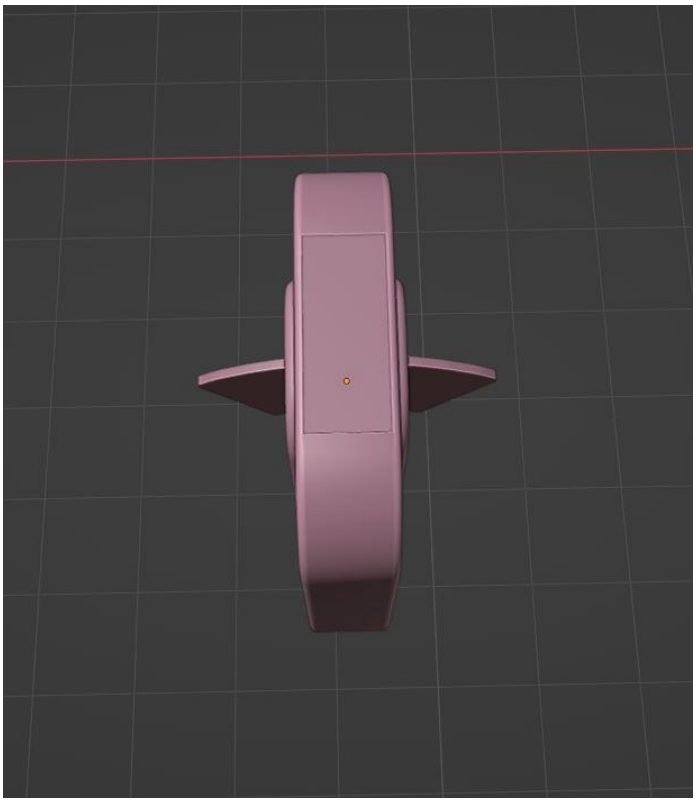

Fig 4.2.19.2 RFID Flap Barrier Model.

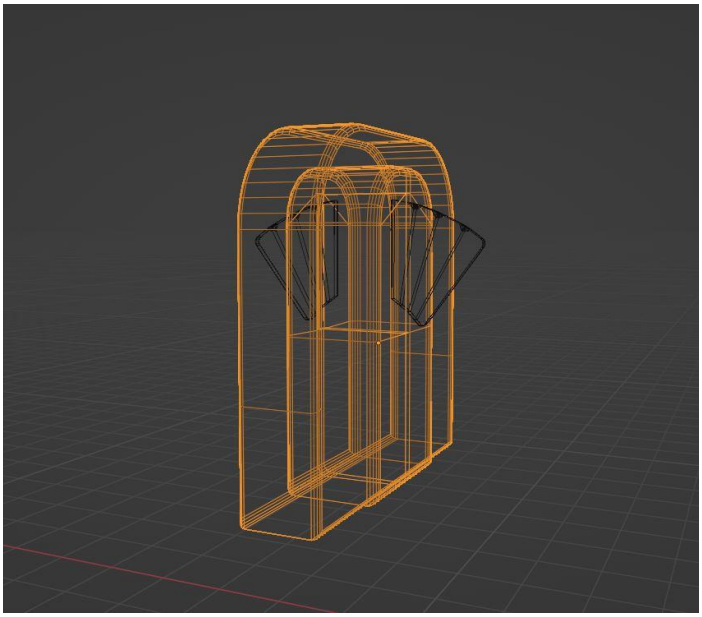

Fig 4.2.19.3 RFID Flap Barrier wireframe.

4.2.26 Smoke Detector:

Smoke detector is very useful thing now days. It's a common thing and it's an important model of our project. We used it every building like office, school, residential. To make this model first we took a cube and go to the edit mode and take the vertex to shape. Then we take another circle to make another shape. Next when we find the shape then we apply the subdivision modifier to smooth the model. We used some extrude and inset into the model.

Fig 4.2.26.1 Smoke Detector Model.

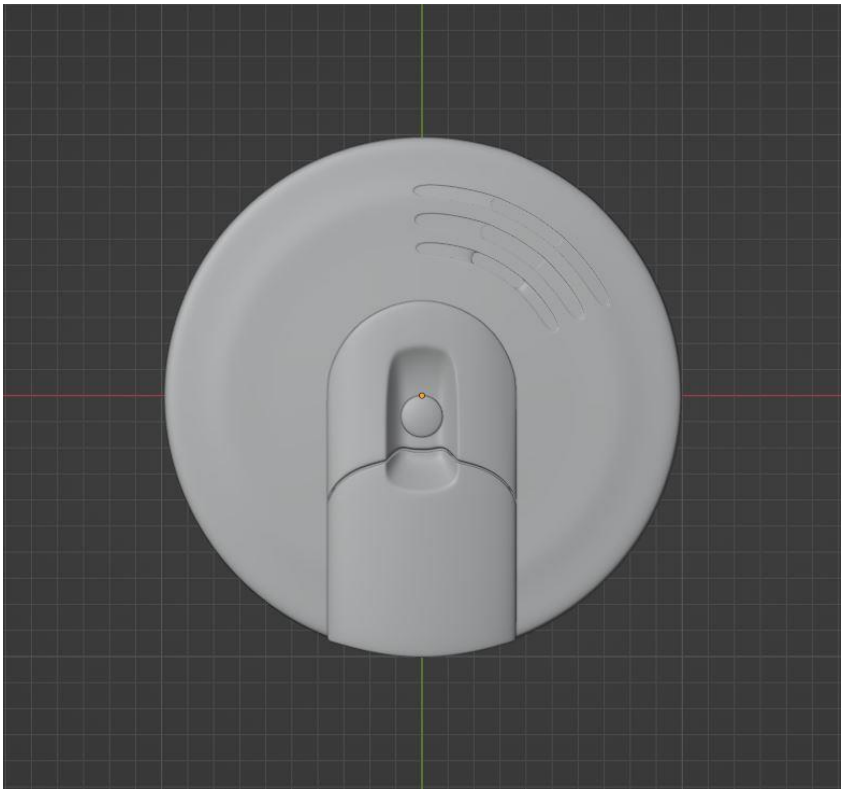

Fig 4.2.26.2 Smoke Detector Model.

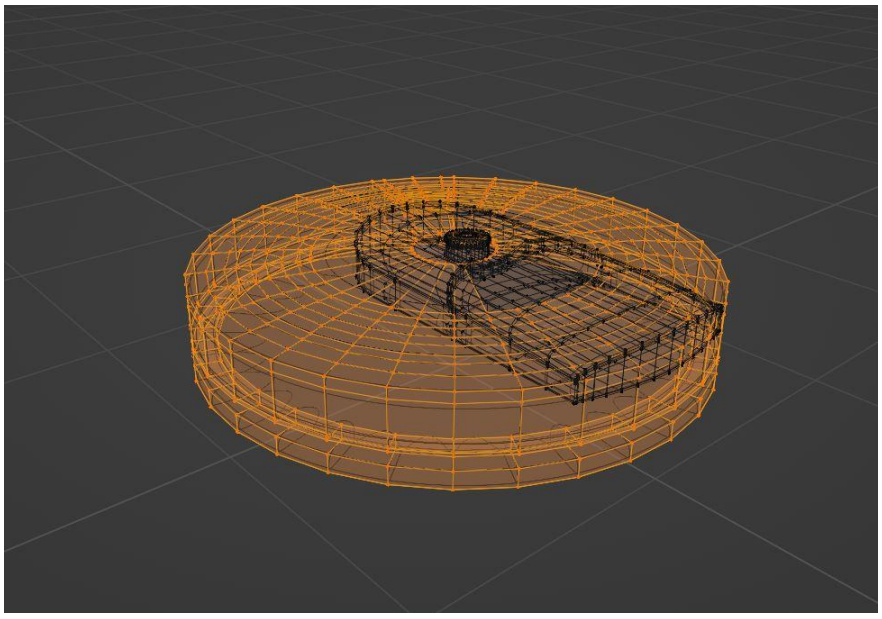

Fig 4.2.26.3 Smoke Detector Wireframe.

4.2.14 Solar Panel:

Solar Panel is most important environment friendly. Its saves electric energy of our daily life. Now our whole life is dependent on electric energy so we have to use it properly. Solar panel also important model of our project. By creating this model, we have to use some shape like plane, cube, circle. we take a plane and extrude a little bit then apply the subdivision modifier so that its look even smother. Another part we take a circle shape and extrude it to proper handle. We make it low poly.

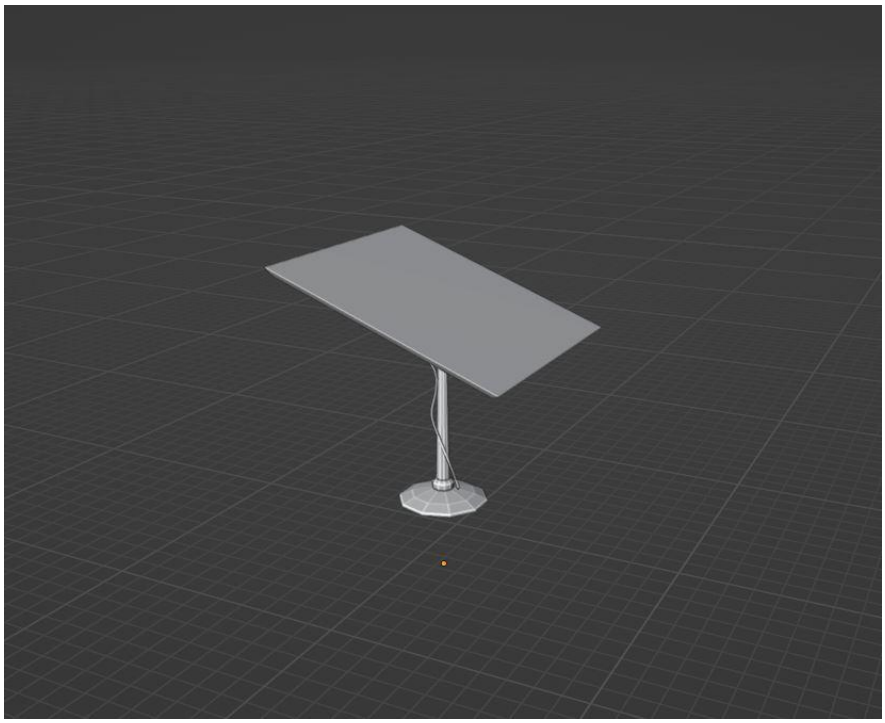

Fig 4.2.14.1 Solar Panel Model.

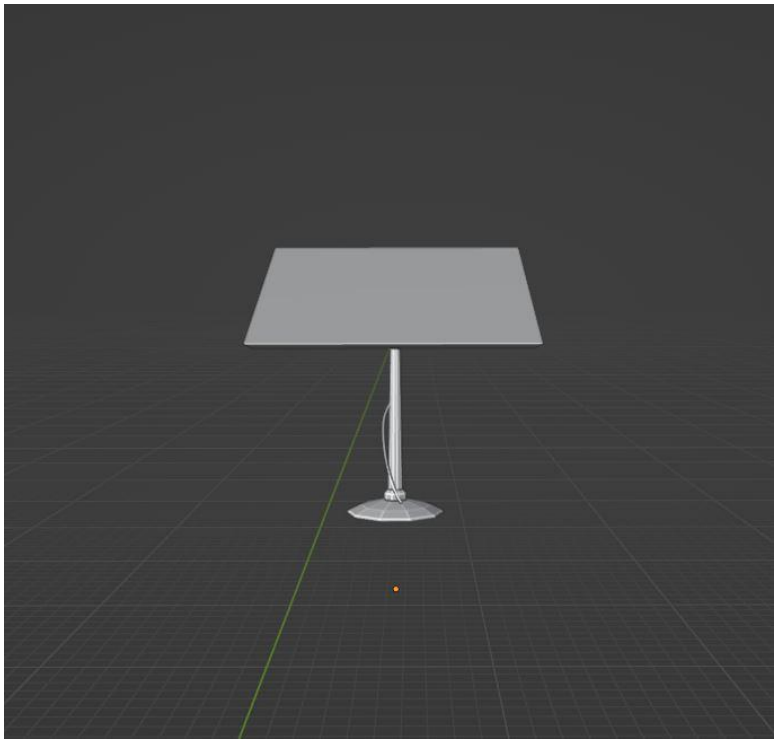

Fig 4.2.14.2 Solar Panel Model.

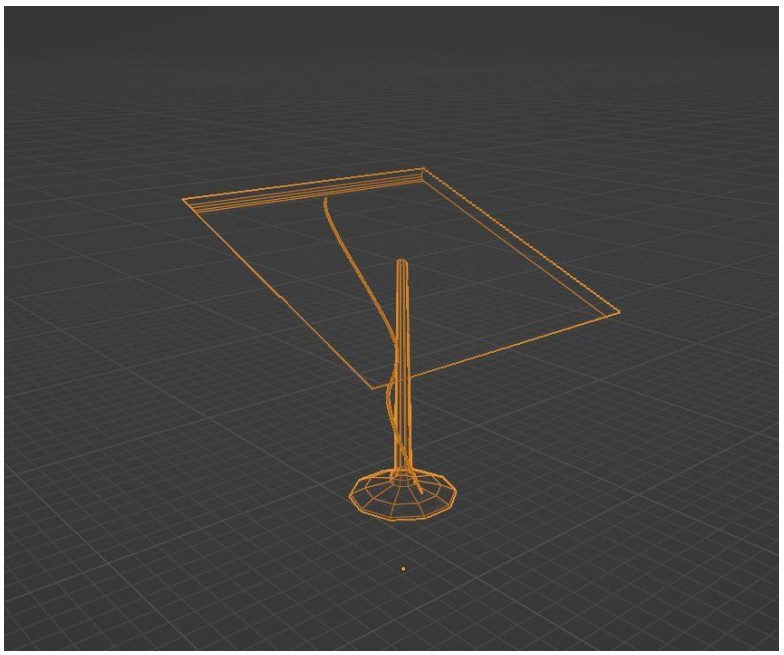

Fig 4.2.14.3 Solar Panel Wireframe.

4.2.27 Water Sprinkler:

Water sprinkler is very important device for every building. It's a fire alert device so its need in every sector. Its look small but when we create it it's a difficult task for us. First, we took two shape like cylinder, cube. Basically, its three-part model. We create part by part. First, we took the cylinder and make it proper shape, then we apply some modifier like subdivision. We extrude little bit to make it proper line up.

Fig 4.2.27.1 Water Sprinkler Model.

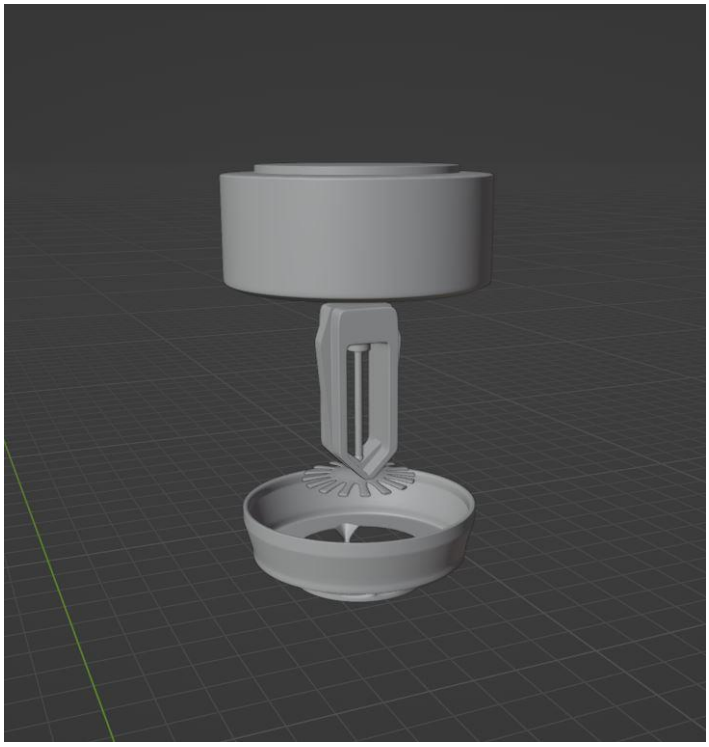

Fig 4.2.27.2 Water Sprinkler Model.

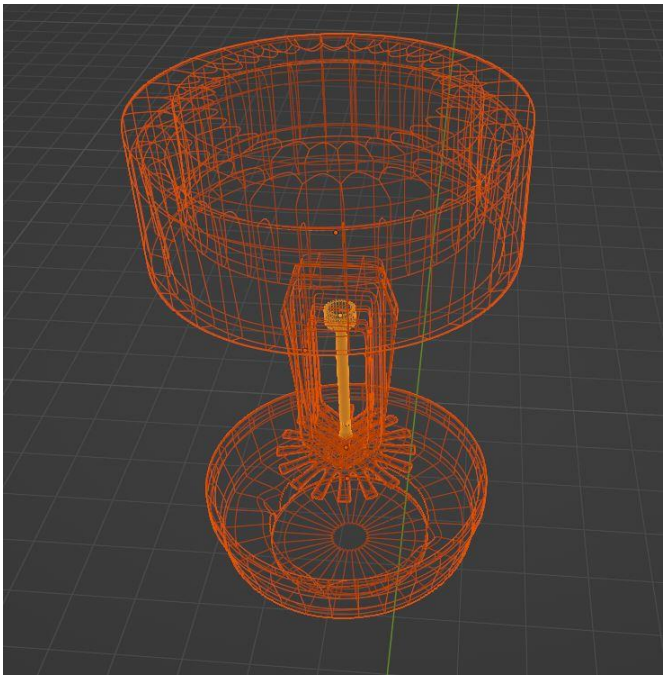

Fig 4.2.27.3 Water Sprinkler Wireframe.

4.2.28 Trash Storage:

This model is part of a waste management sector. We find many resources to find this model but we don't find it. Then we make it our own way. We make a draft for this and made it. Its quite difficult task for us to make it. It took lots of time. We took a cube and go to edit mode and take the vertex proper shape basically we play with the vertex in this model. We apply the subdivision modifier to make it smooth. In the left side we make a glass so that the whole process we can see.

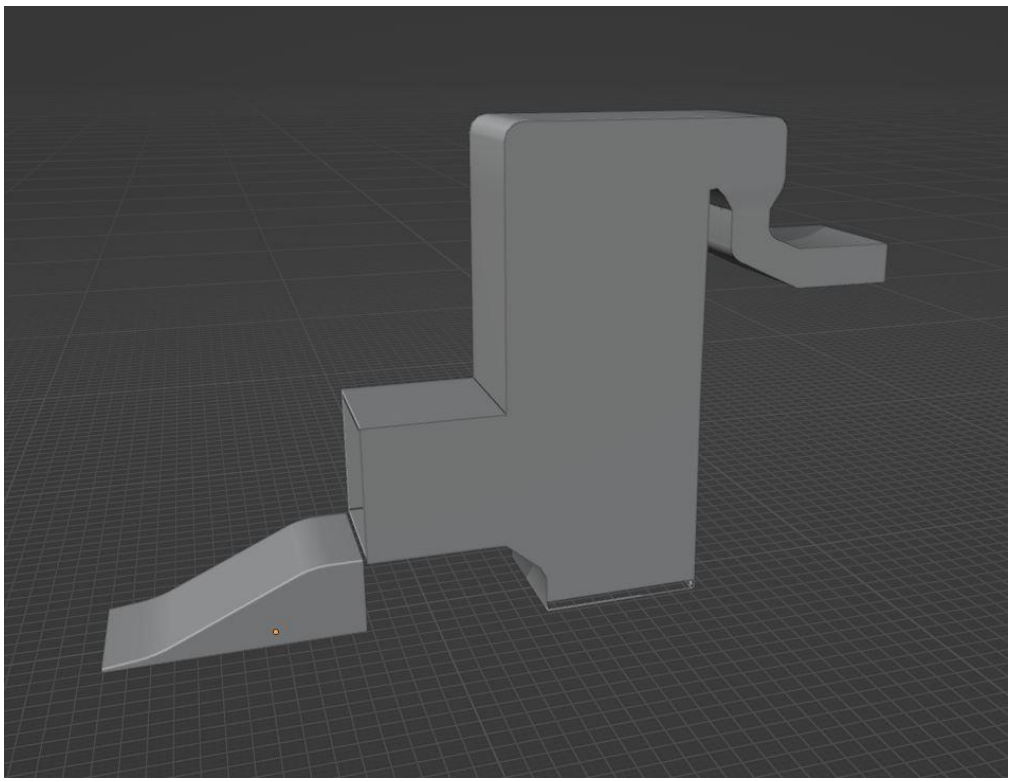

Fig 4.2.28.1 Trash Storage Model.

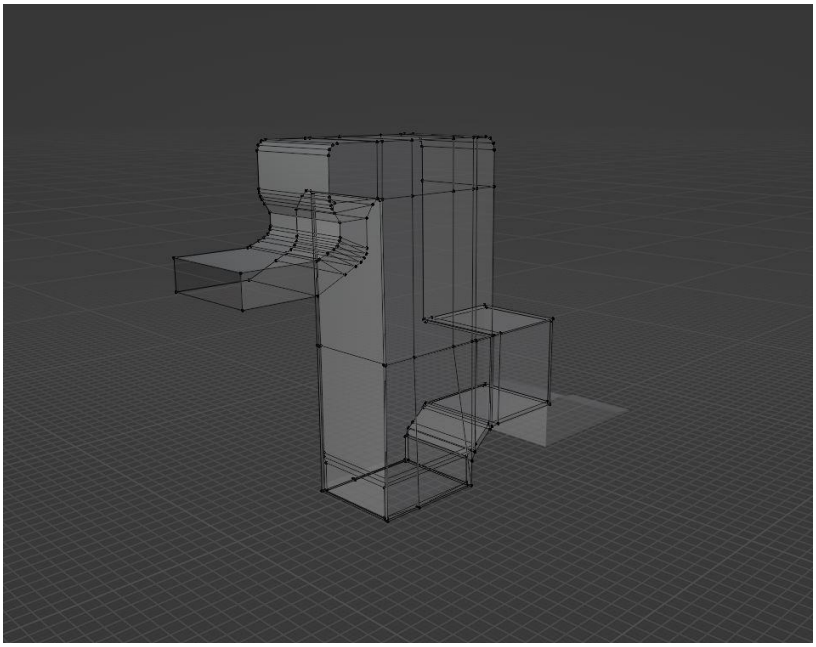

Fig 4.2.28.2Trash Storage Model.

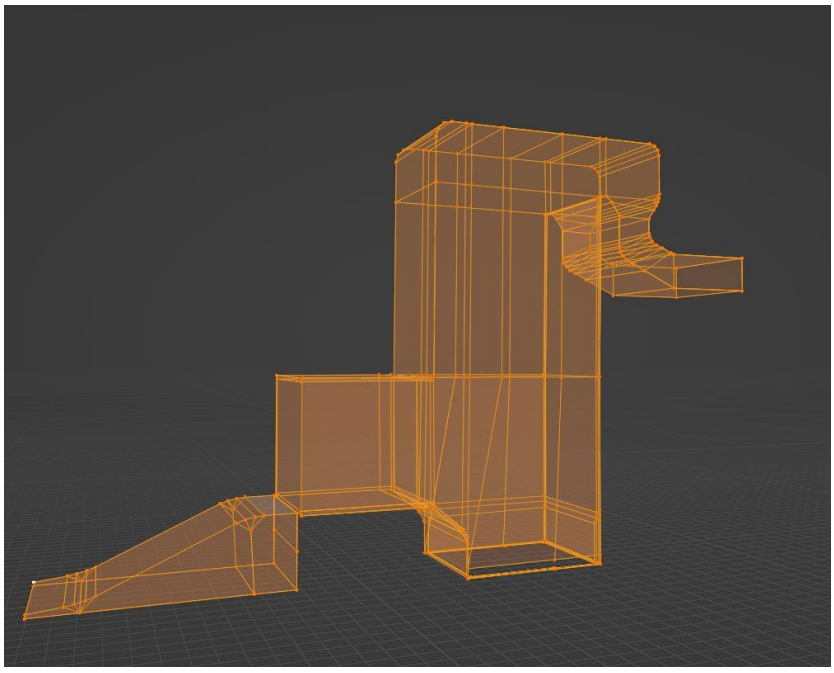

Fig 4.2.28.3 Trash Storage Wireframe.

4.2.15 Vending Machine:

Vending machine is very important thing now days. Every smart country uses it properly. Some smart country uses it for gold selling. Its quite easy to use, and everybody love it.

For making this model we took the cube and go to the edit mode and extrude and inset by the shape of the reference vending machine. We used photodramatic for this.

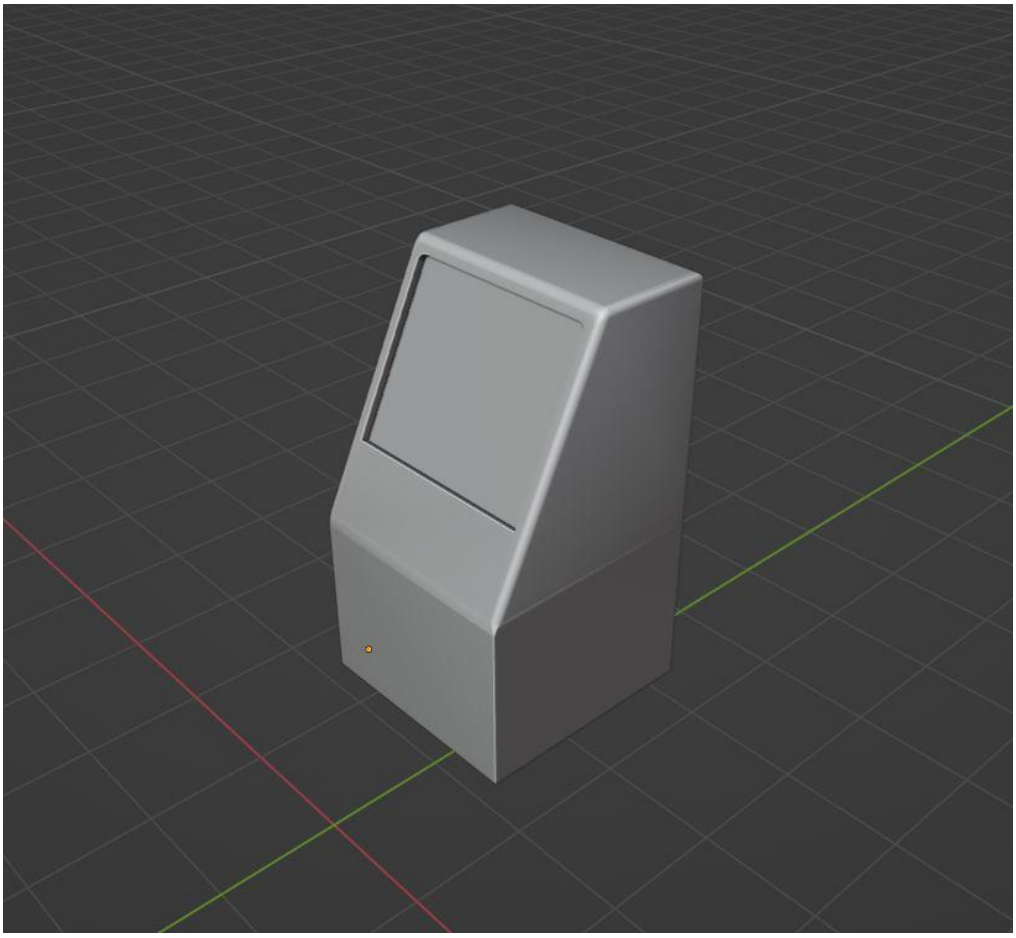

Fig 4.2.15.1 Vending Machine Model.

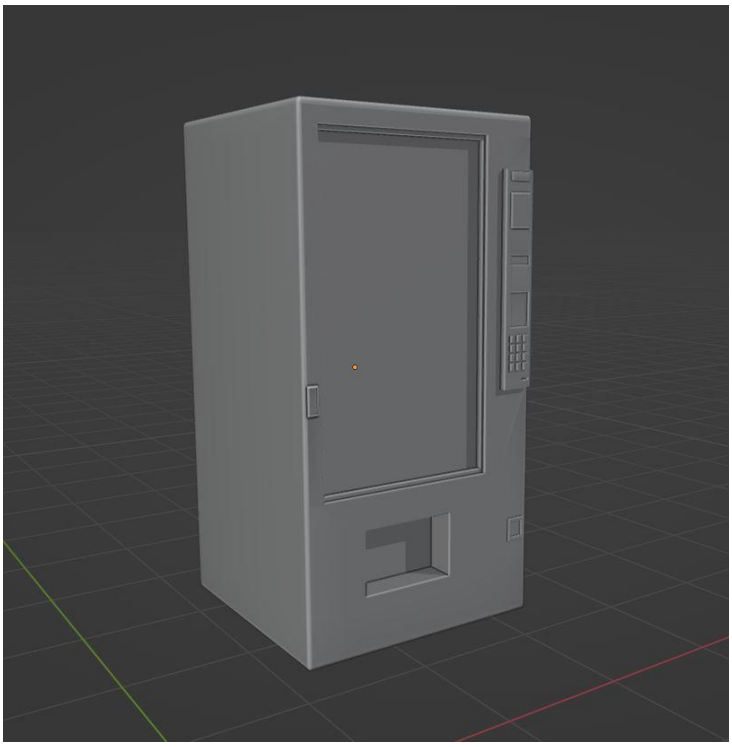

Fig 4.2.15.2 Vending Machine Model.

Fig 4.2.15.3 Vending Machine Model.

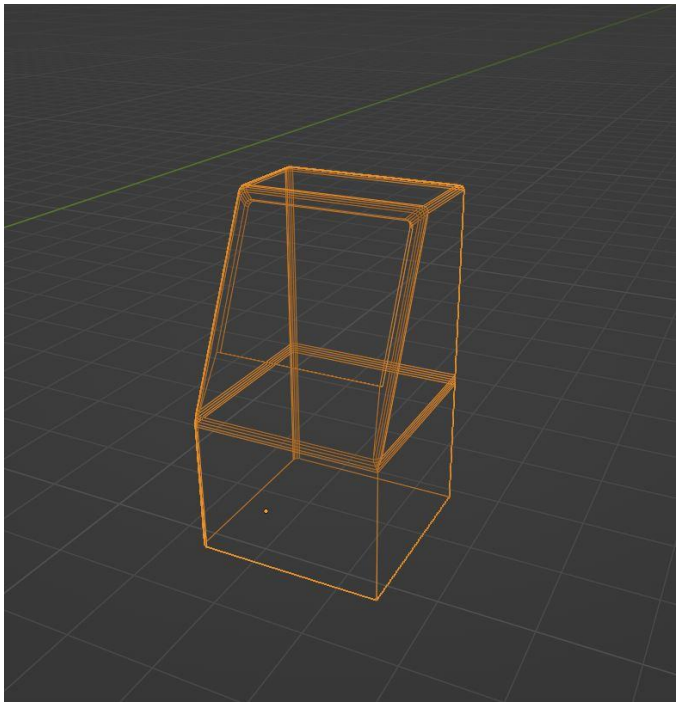

Fig 4.2.15.4 Vending Machine Wireframe.

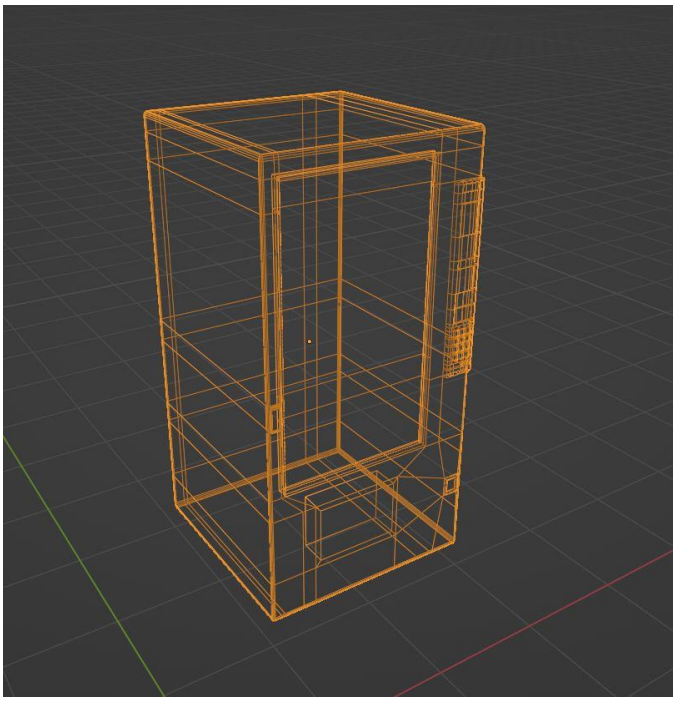

Fig 4.2.15. 5Vending Machine Wireframe.

4.2.29 Trash Burner:

Trash burner is part of waste management sector. It's a very important part of the pipeline. Its look very difficult model and when we create this model we faced many problems. To make this canon we take some shape like cube, cylinder, circle. By using this shape, we made it a proper trash burner canon. Then we apply some modifier like subdivision, array, nurbs spath. It's a huge shape and modifier model so it took large vertices. But we took this challenge and create this model properly.

Fig 4.2.29.1 Trash Burner Model.

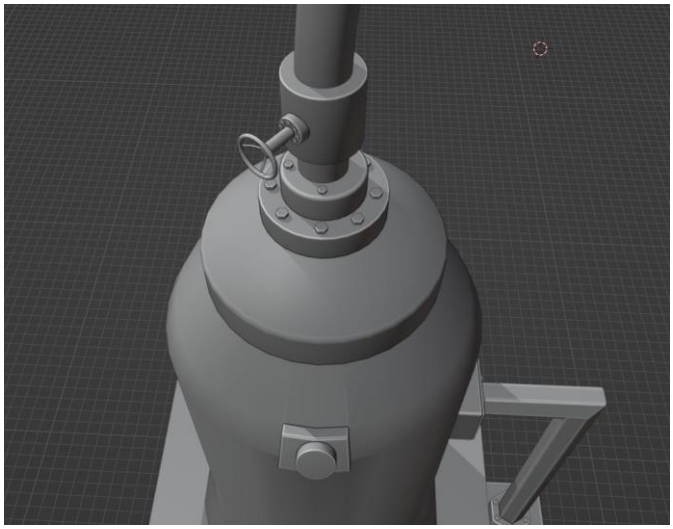

Fig 4.2.29.2 Trash Burner Model.

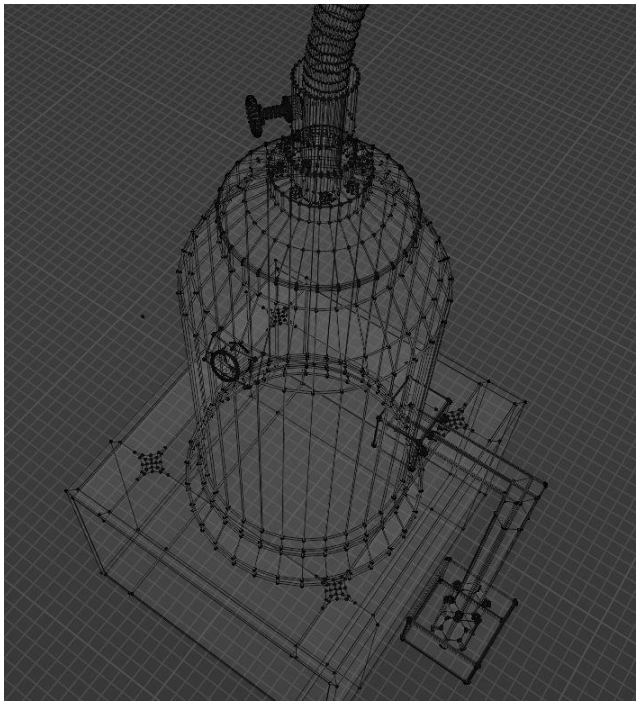

Fig 4.2.29.3 Trash Burner Model.

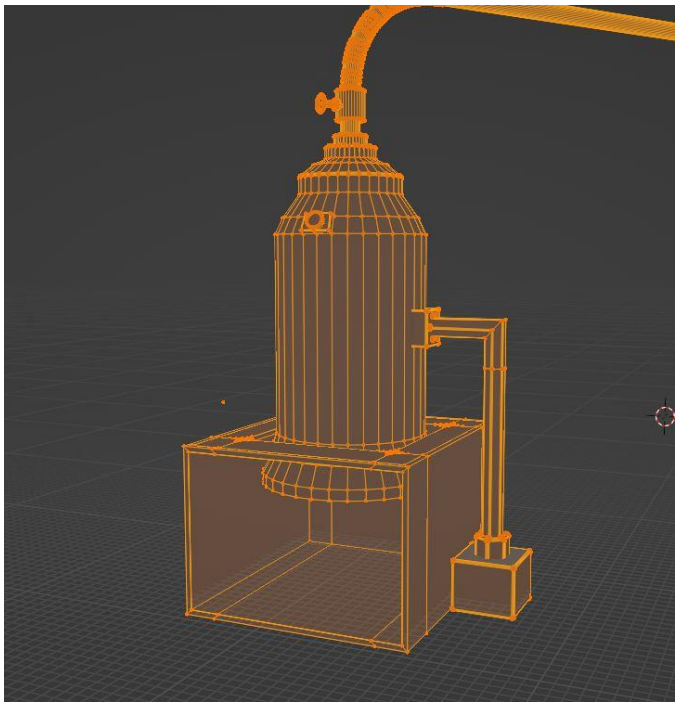

Fig 4.2.29.4Trash Burner Wireframe.

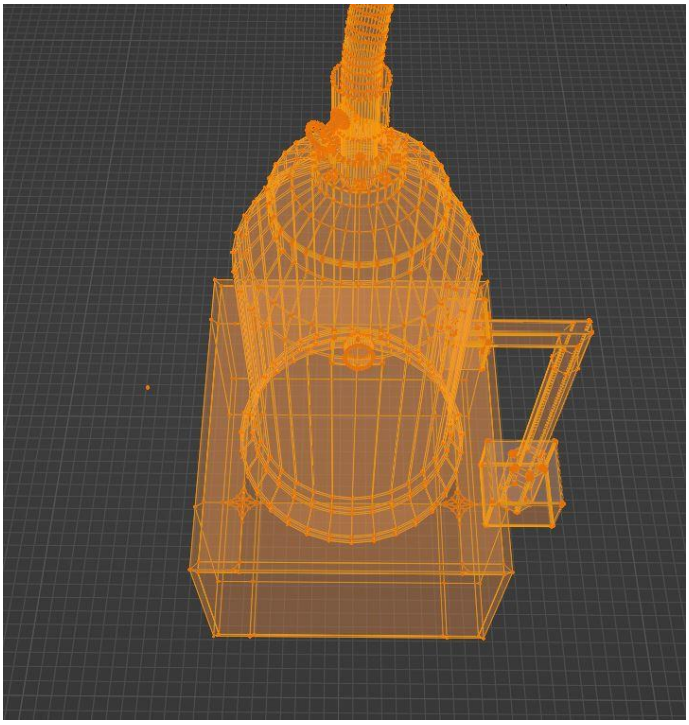

Fig 4.2.29.5 Trash Burner Wireframe.

4.2.31 Ash Conveyor Belt:

Ash conveyor belt is the part of west management sector. It's a very complex model, when we start making this model we faced many problems, specially when we input the animation the whole model destroys. After many times trying we find the solution and made it properly.

First, we take a cube and made the shape like our reference picture. We apply some modifier like Boolean, extrude, inset. After finishing this we started modeling the belt which move the whole belt through the structure. The belt was the complex section of this whole model. Its took many time.

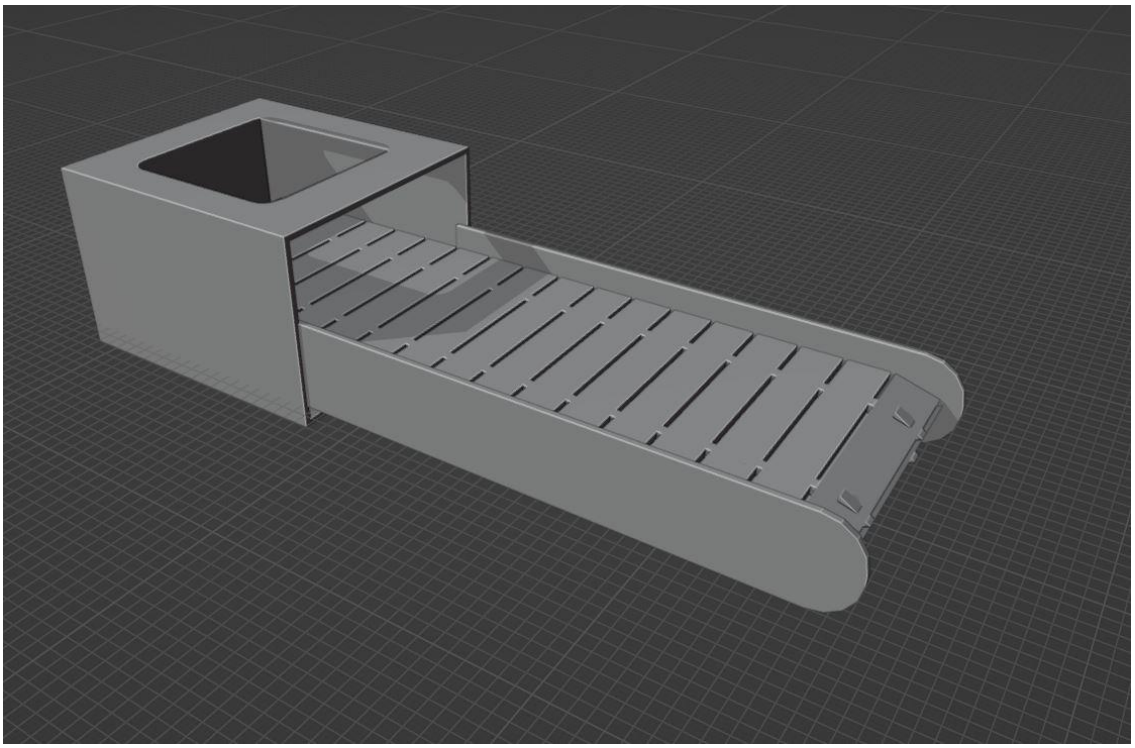

Fig 4.2.31.1 Ash Conveyor Belt Model.

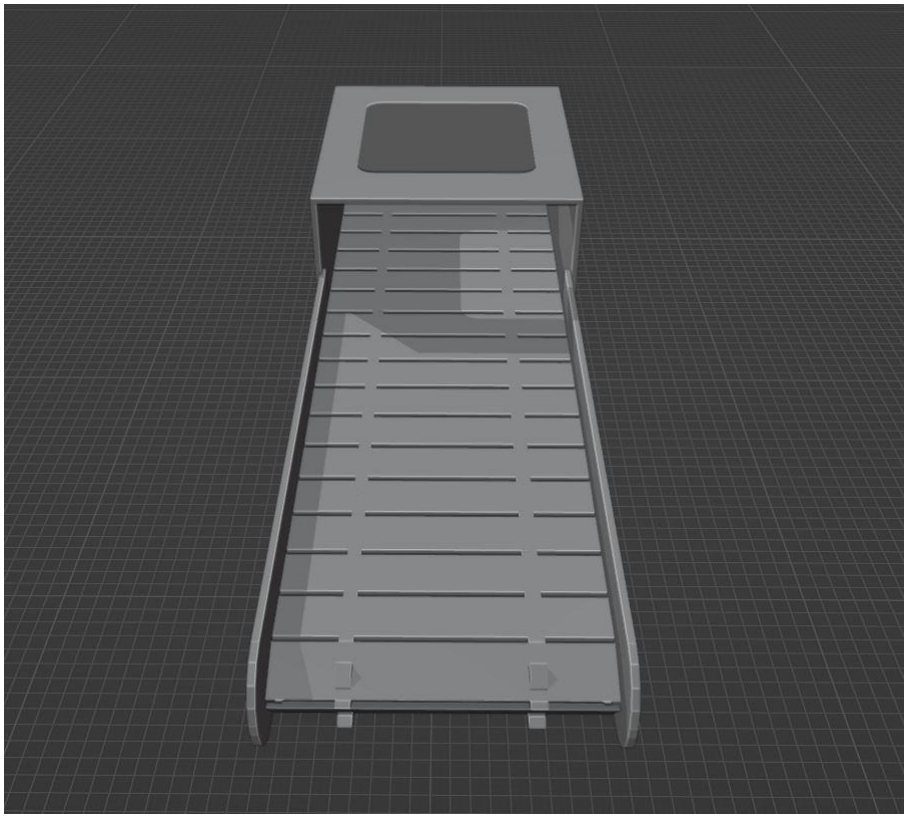

Fig 4.2.31.2 Ash Conveyor Belt Model.

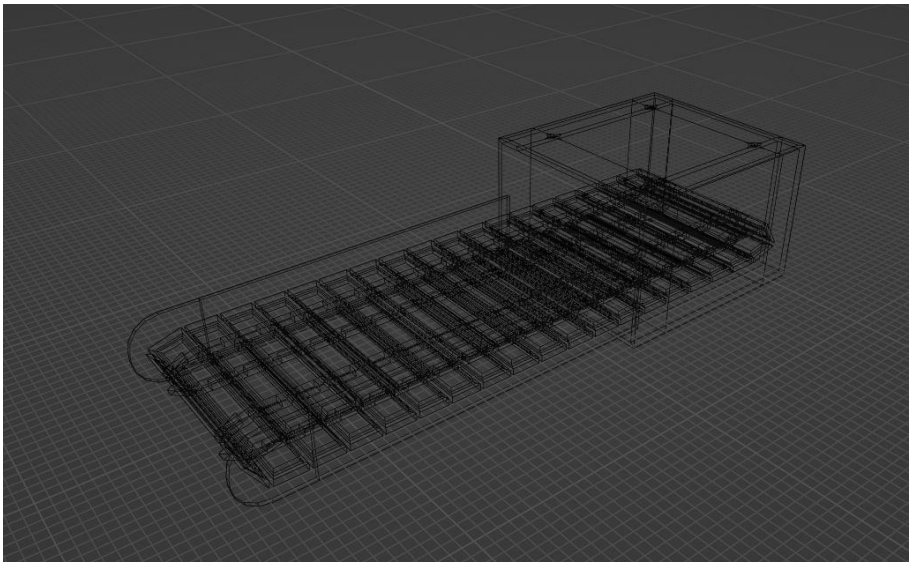

Fig 4.2.31.3 Ash Conveyor Belt Model.

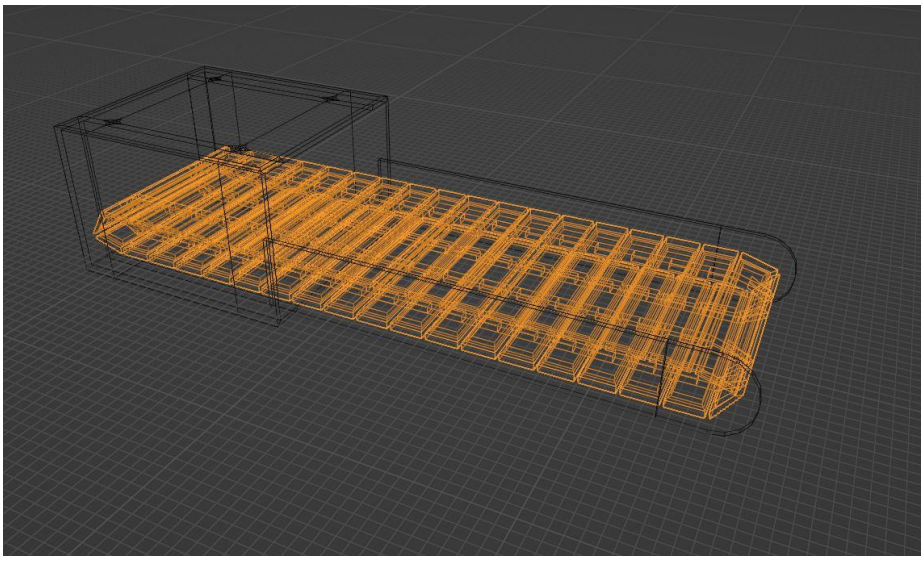

Fig 4.2.31.4 Ash Conveyor Belt Wireframe.

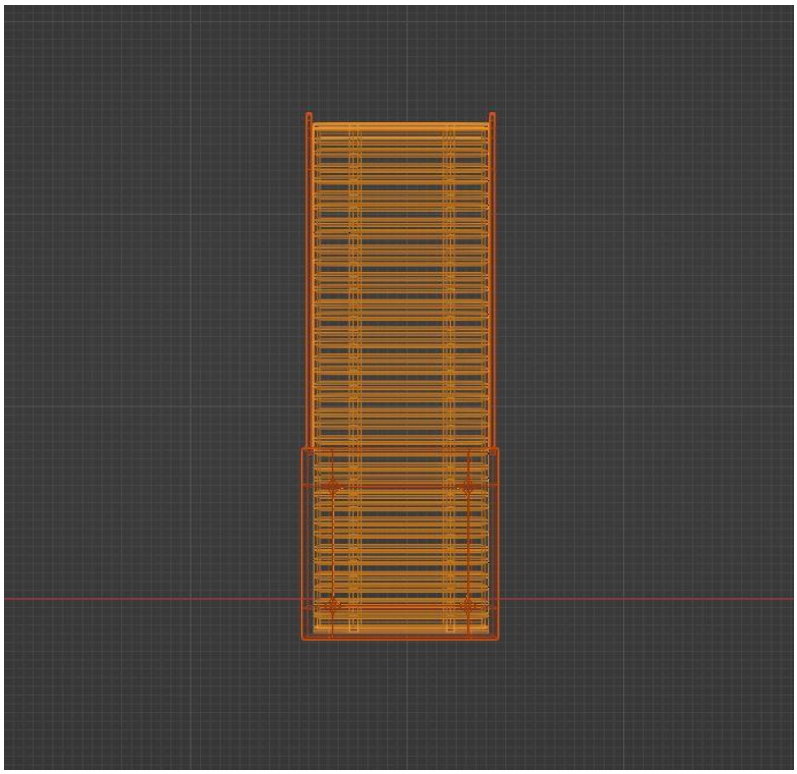

Fig 4.2.31.5 Ash Conveyor Belt Wireframe.

4.2.32 Mercury & Dioxin Removal System:

Mercury is also the part of waste management. It's a very important part, it's an environment friendly system. Its looks very complex model and it's actually a complex model. It took even more time to create. Many shapes were used on this model like cube, cylinder, circle. Then we took the reference picture and made the shape of this. Then we apply some modifier on this like subdivision, Boolean, bevel. Its quite hard to make the proper shape. But finally, we made it.

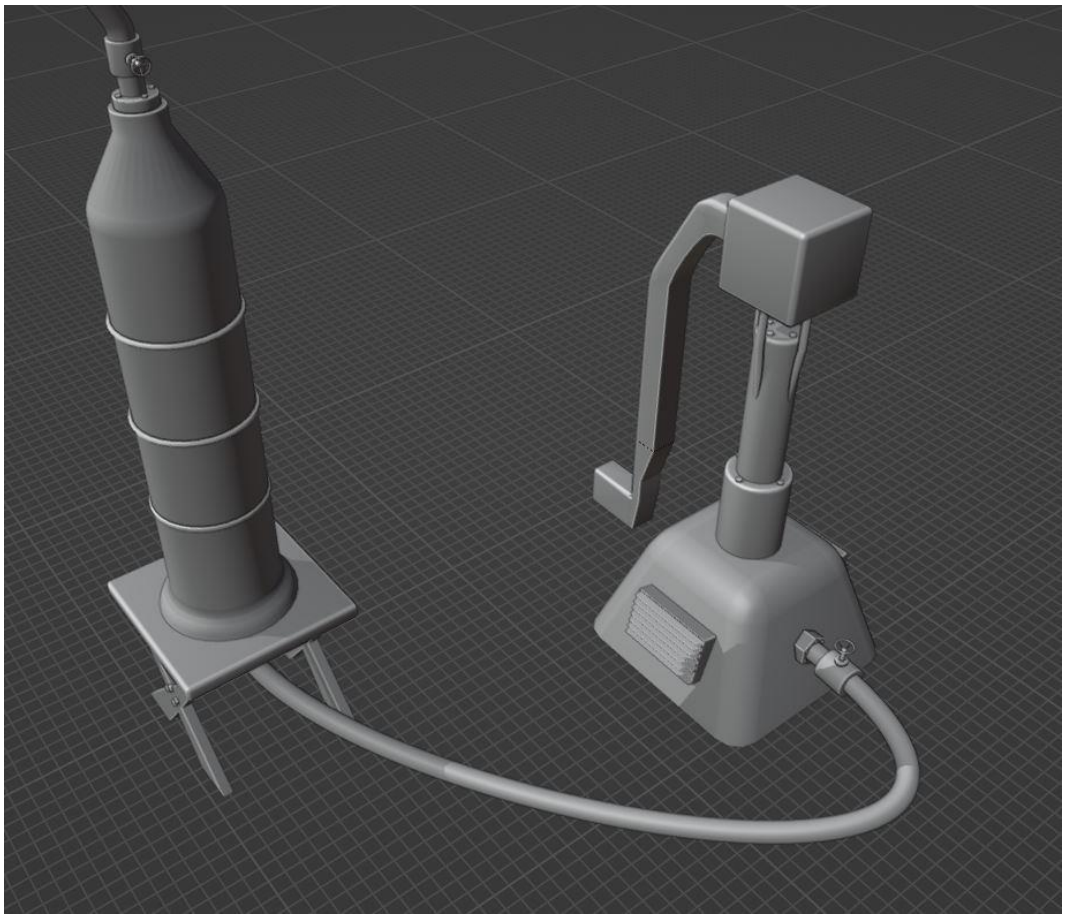

Fig 4.2.32.1 Mercury & Dioxin Removal System Model.

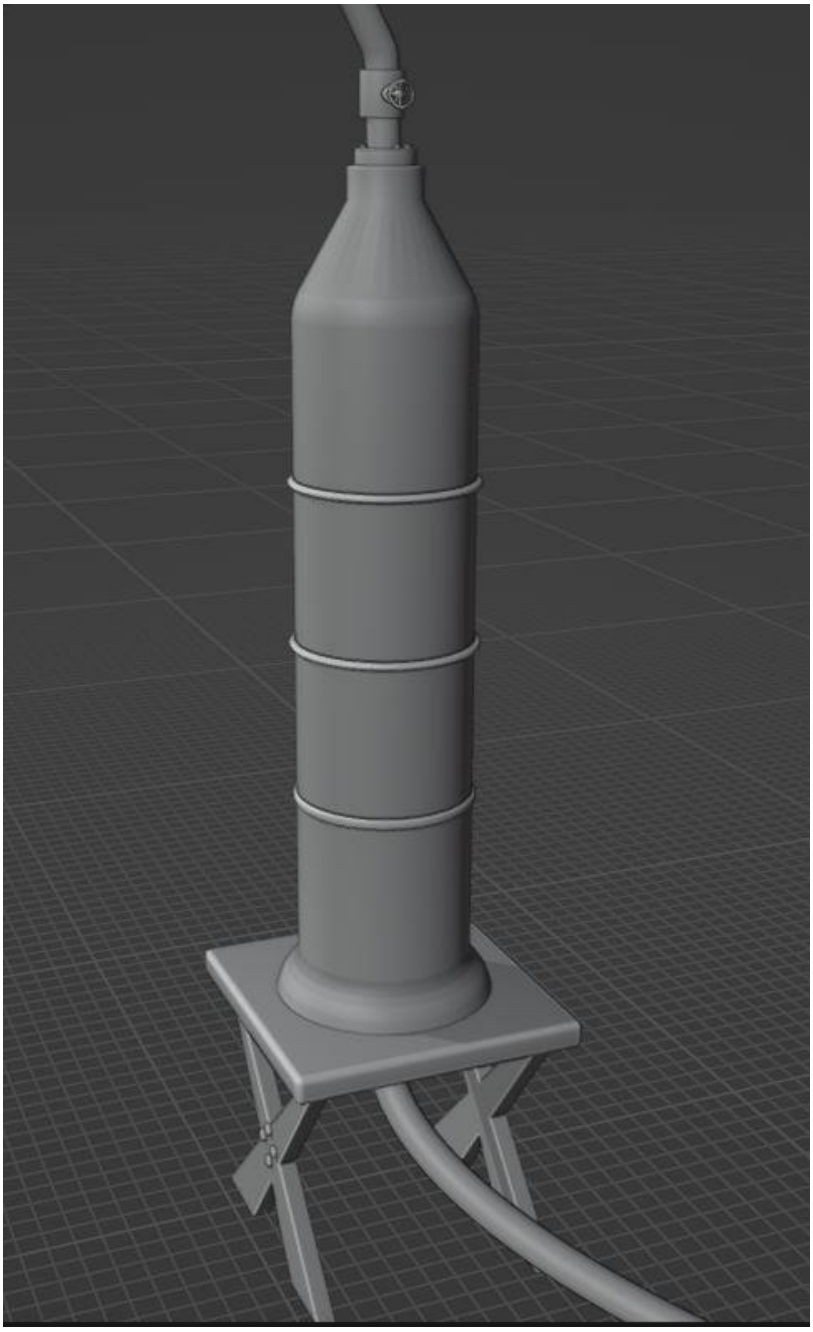

Fig 4.2.32.2 Mercury & Dioxin Removal System Model.

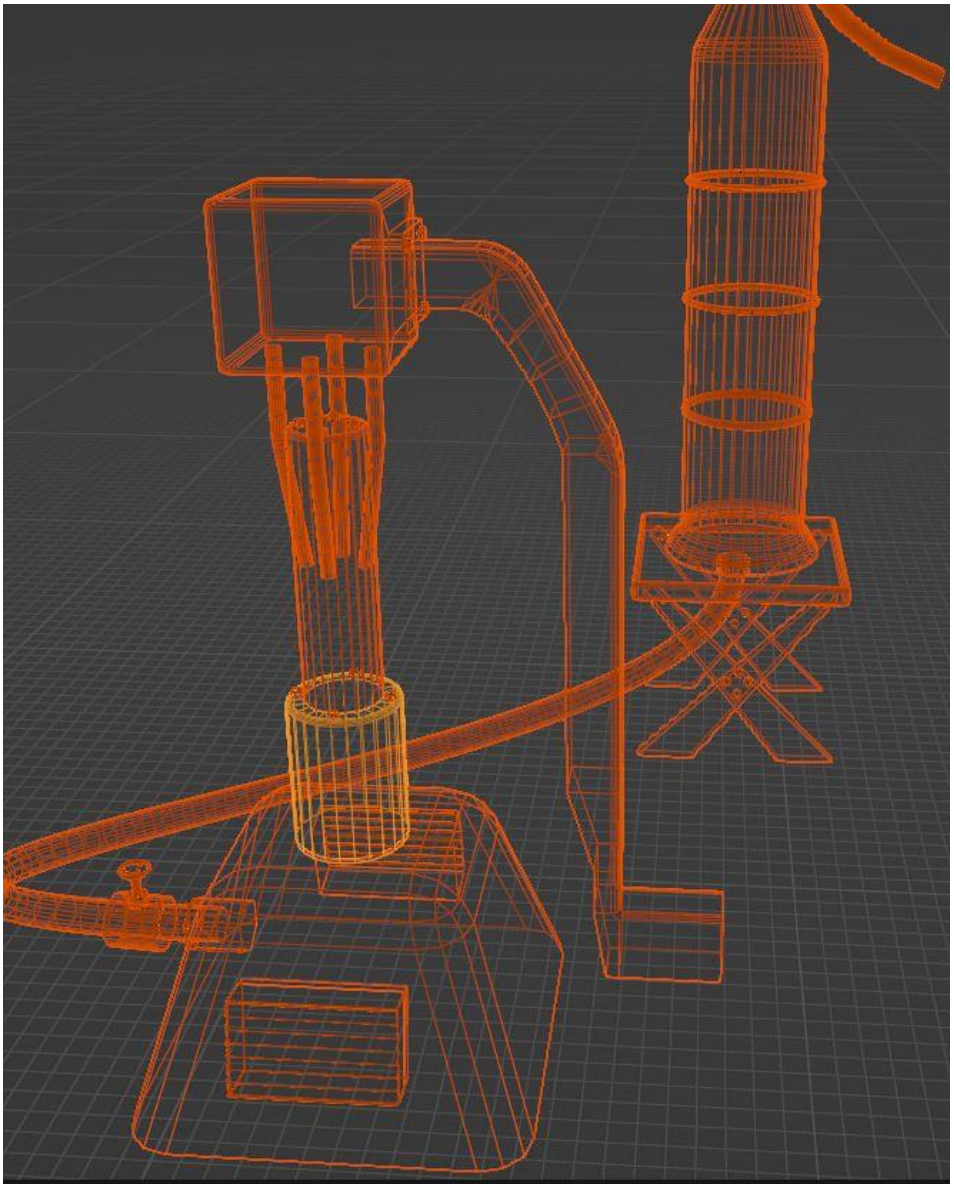

Fig 4.2.32.3 Mercury & Dioxin Removal System Wireframe.

4.2.34 Particulate Removal System:

Particulate removal system is the part of a waste management sector. We made it part by part, its quite hard to made this model. We took two cube and go to the edit mode and take the vertex and made the shape of the cabin. Then we take cylinder and make the pip and also apply some modifier to make it smooth. This pip was so difficult to made it it's a very time-consuming model.

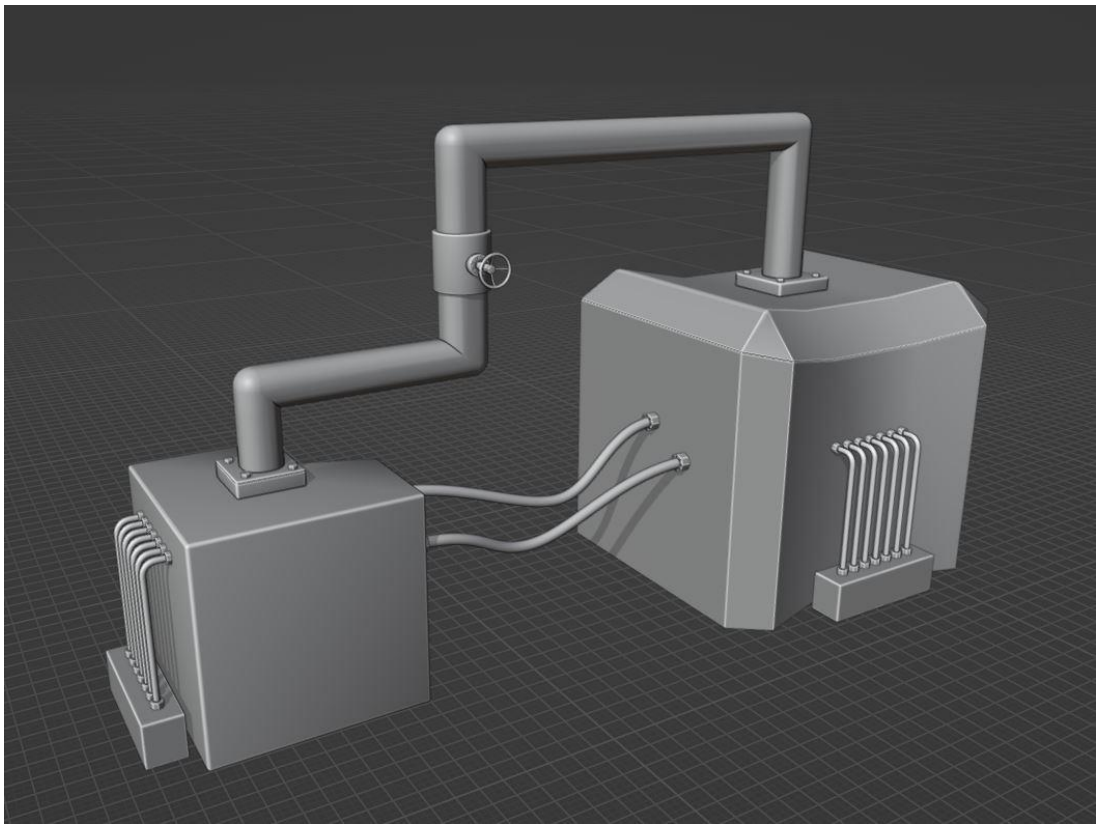

Fig 4.2.34.1 Particulate Removal System Model.

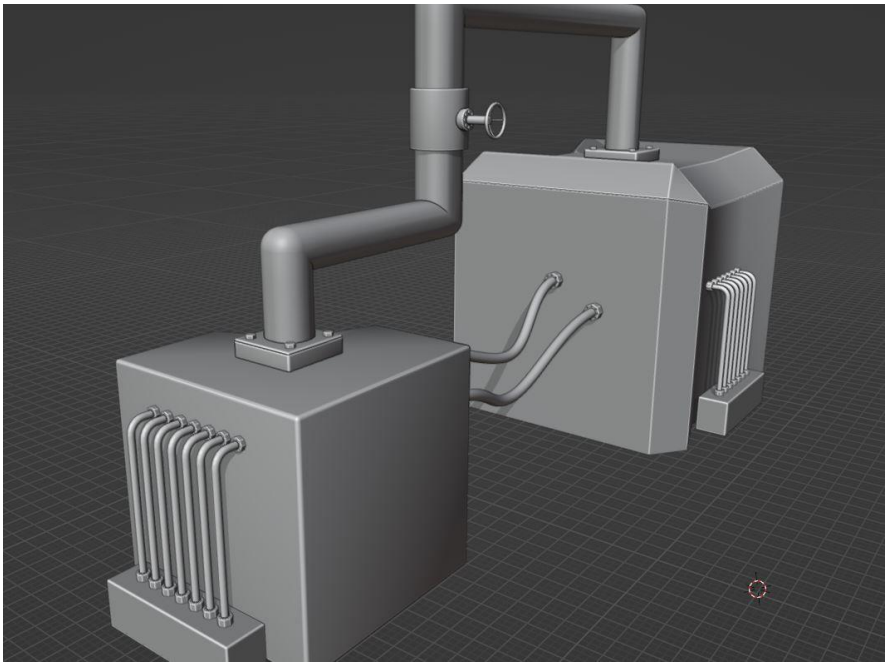

Fig 4.2.34.2 Particulate Removal System Model.

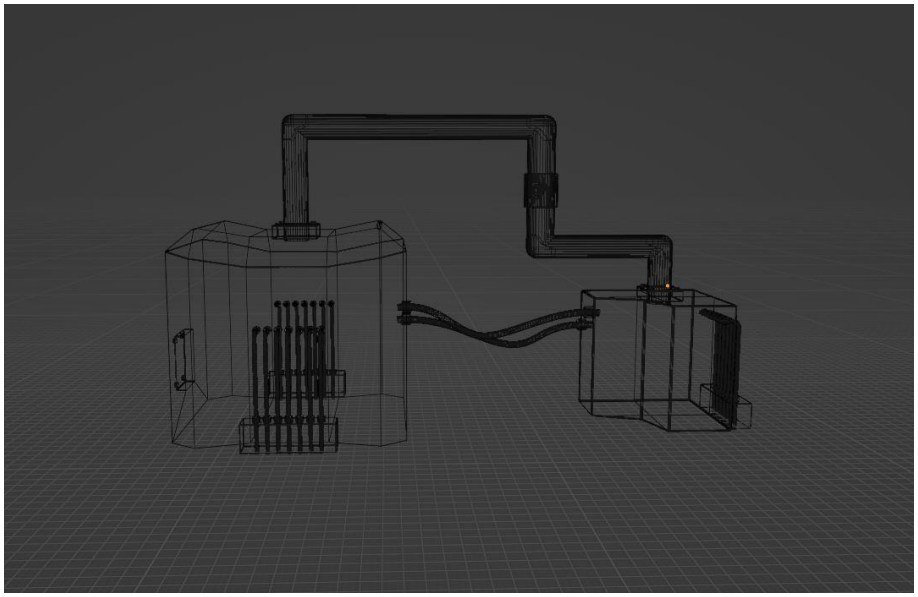

Fig 4.2.34.3 Particulate Removal System Model.

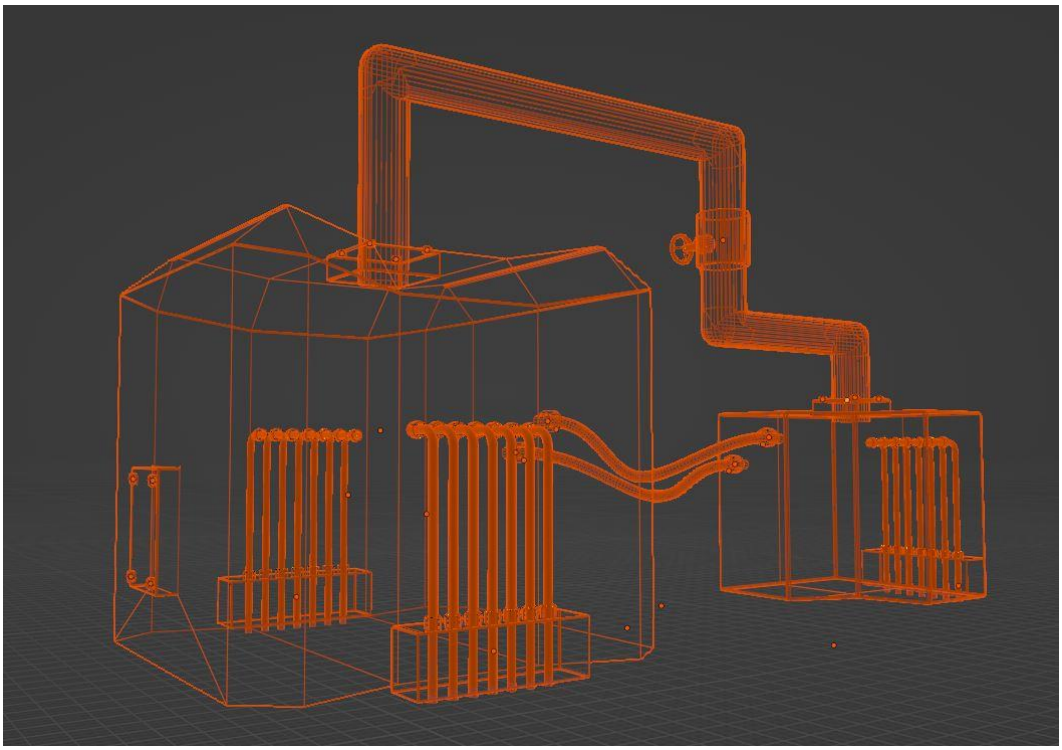

Fig 4.2.34.4 Particulate Removal System Wireframe.

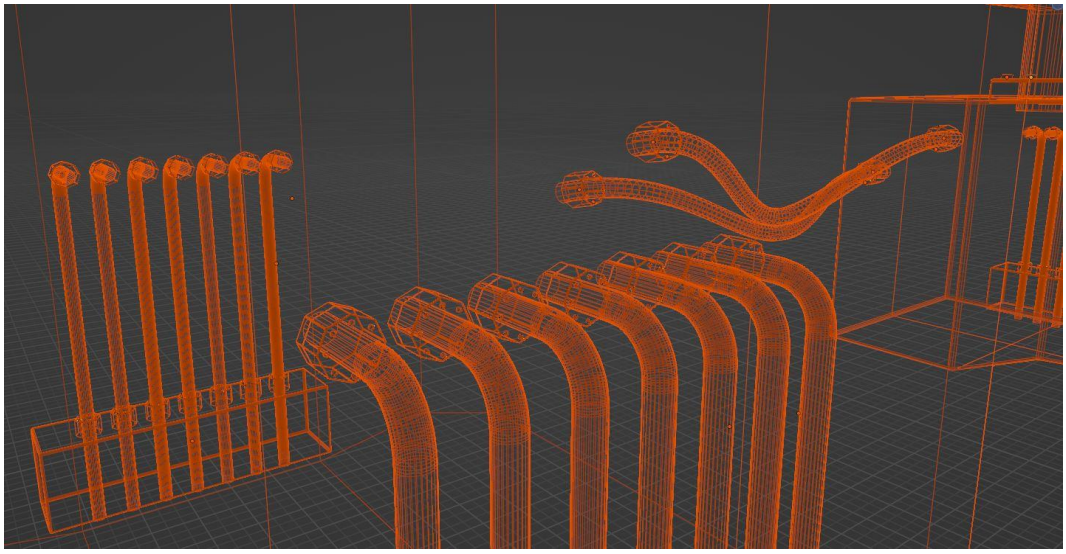

Fig 4.2.34.5 Particulate Removal System Wireframe.

4.2.30 Steam Pipe:

This is the also part of waste management system. Its look very easy model but its quite difficult to do. Its also a complex small model. First, we take some shape like cylinder, circle, cube. We took the cylinder by size of reference model. And apply some modifier to make it even smooth.

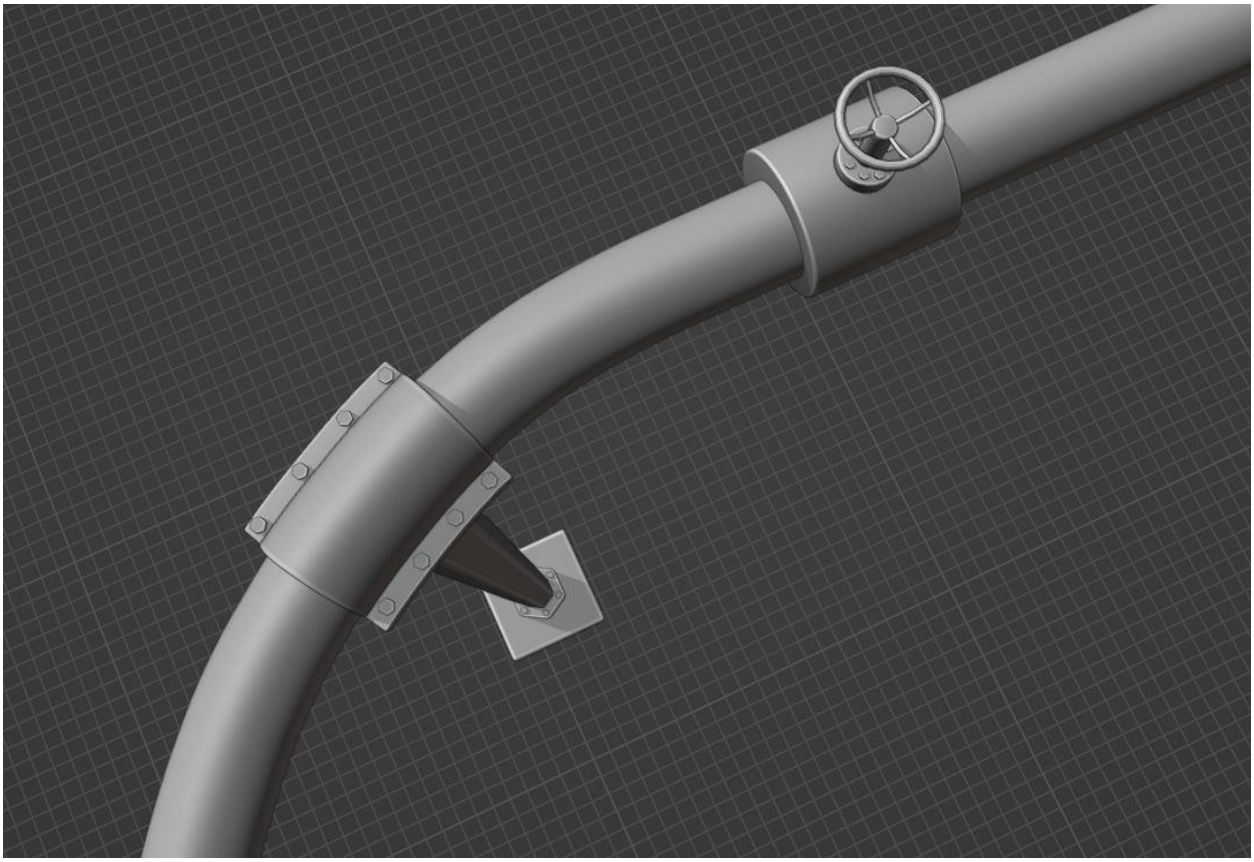

Fig 4.2.30.1 Steam Pipe Model.

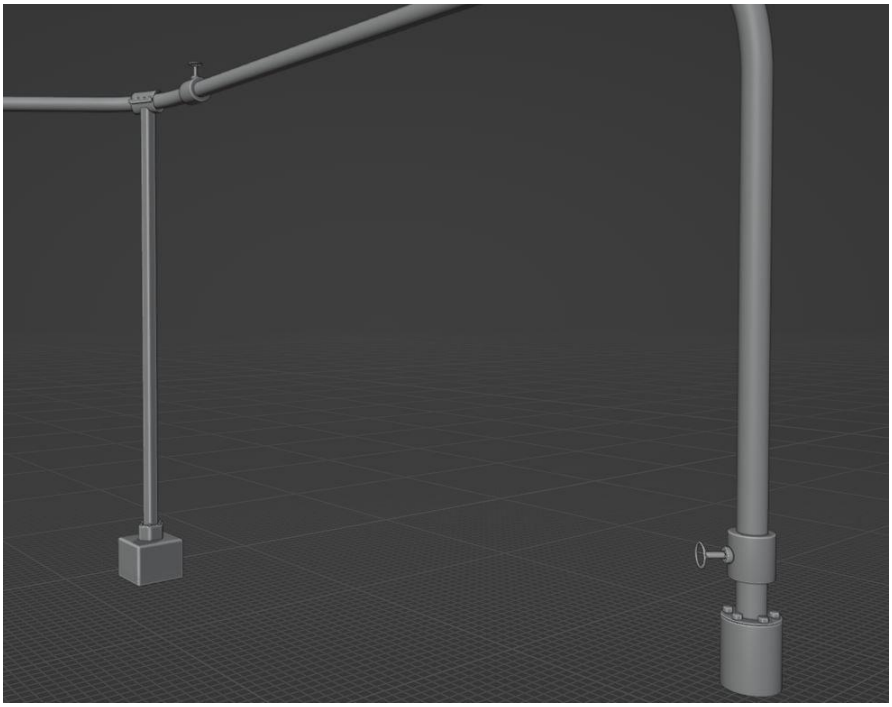

Fig 4.2.30.2 Steam Pipe Model.

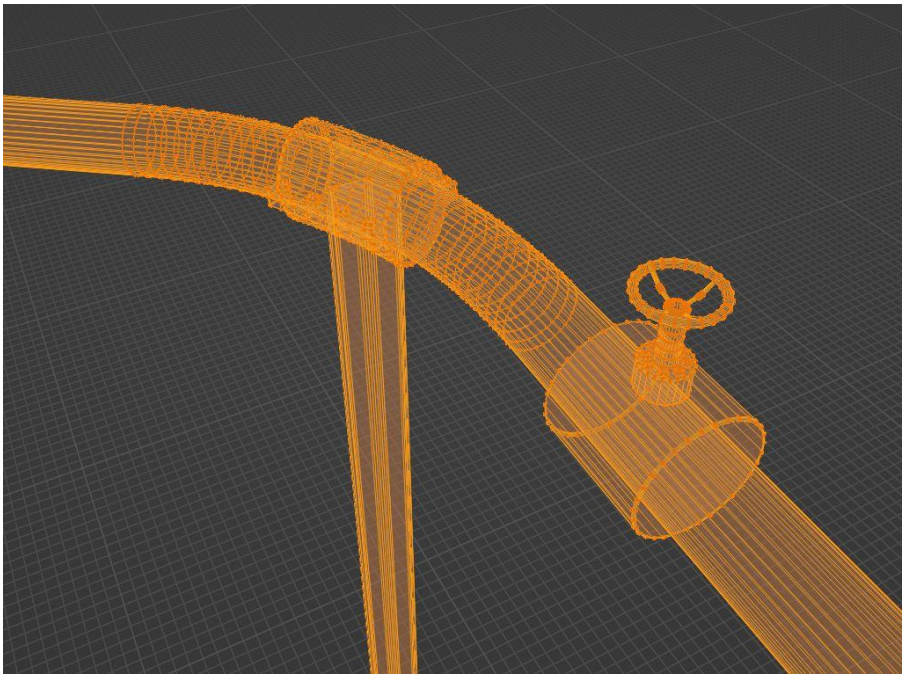

Fig 4.2.30.3 Steam Pipe Wireframe.

4.2.36 Clean Gas Exhaust:

Clean gas exhaust is part of our factory sector. It's an important part of the factory side. Its simple model but it's a complex. In this model we used many shapes like cube, cylinder, circle. We took the cylinder and extrude it the size of reference model. We used some modifier to making smooth. It's basically four-part model.

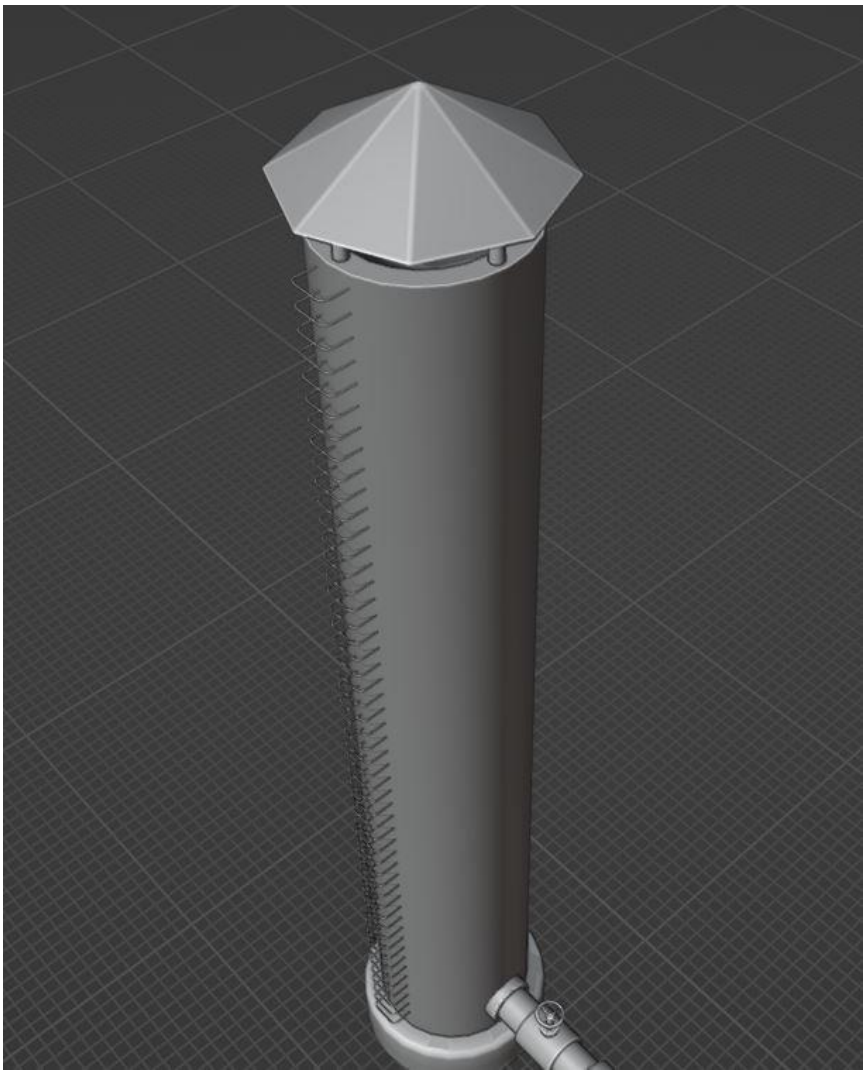

Fig 4.2.36.1 Clean Gas Exhaust Model.

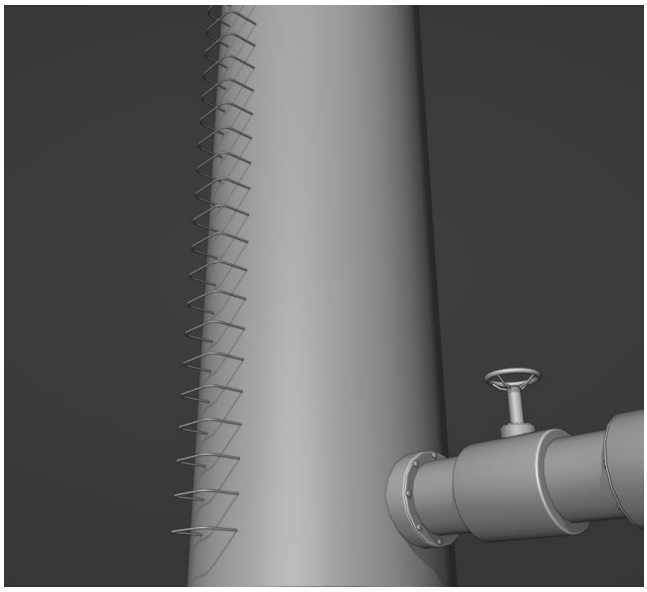

Fig 4.2.36.2 Clean Gas Exhaust Model.

Fig 4.2.36.3 Clean Gas Exhaust Model,

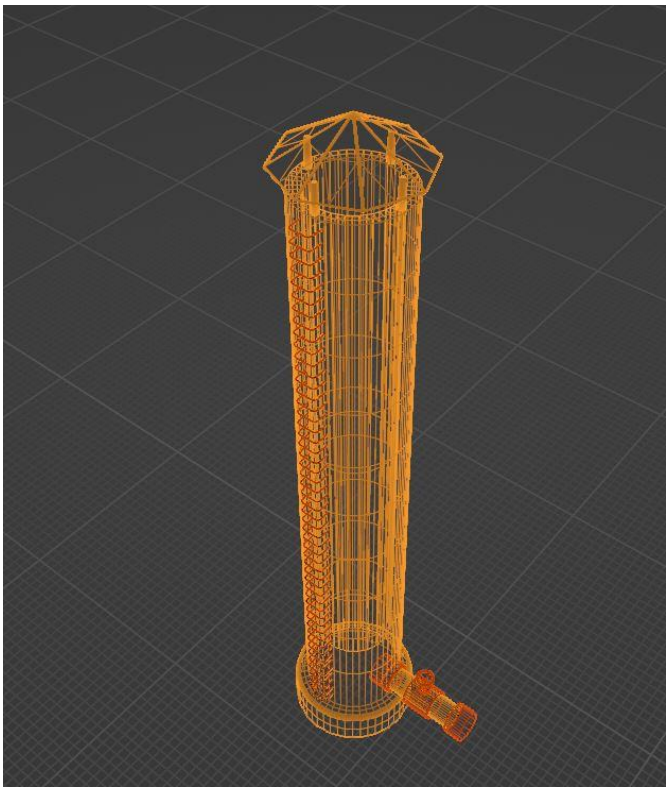

Fig 4.2.36.4 Clean Gas Exhaust Wireframe.

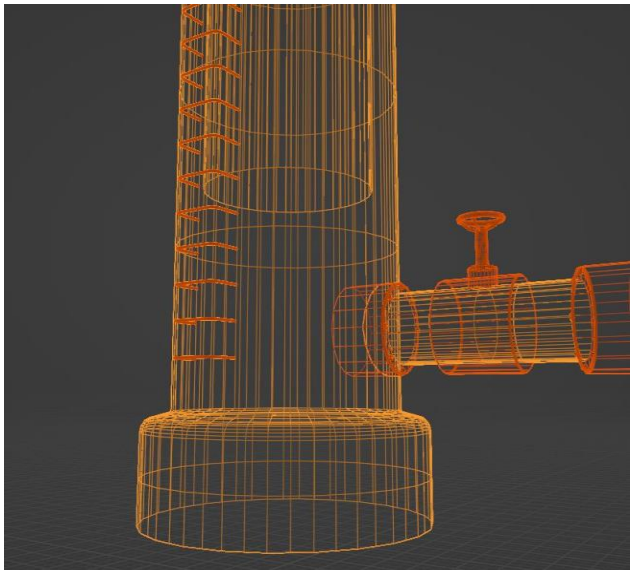

Fig 4.2.36.1 Clean Gas Exhaust Model.

4.2.37 Steam Generator:

Steam generator is very important part of the factory. First, we resource many sides and find some model. Then we input the reference picture and start create model. It's a very complex model. We face many problems by creating this. But finally, we made it.

First, we take cube a scale it by the reference model. Then we apply some modifier like bevel, Boolean, subdivision. Then we added some cylinder shape top of the generator to make it proper shape.

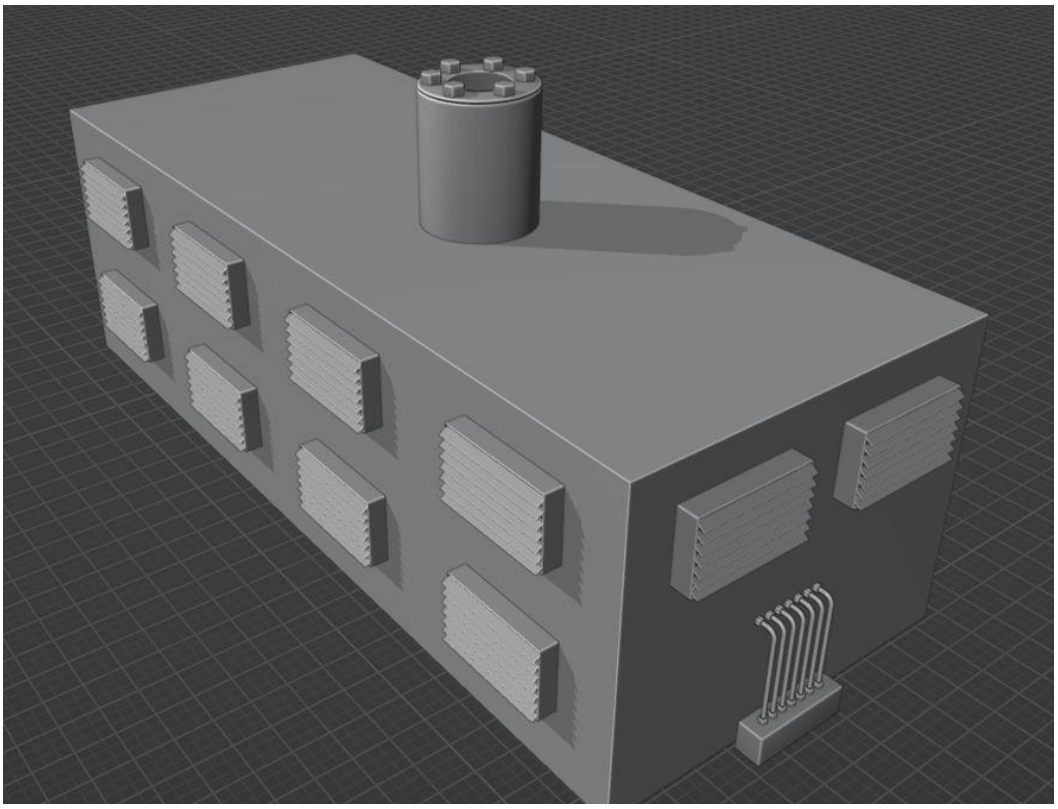

Fig 4.2.37.1 Steam Generator Model.

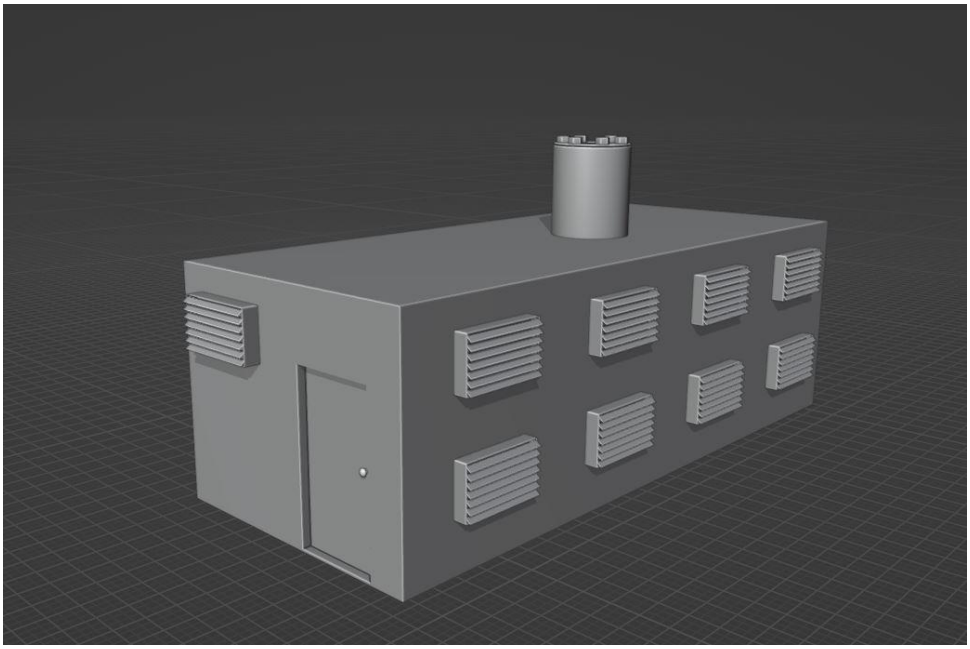

Fig 4.2.37.2 Steam Generator Model.

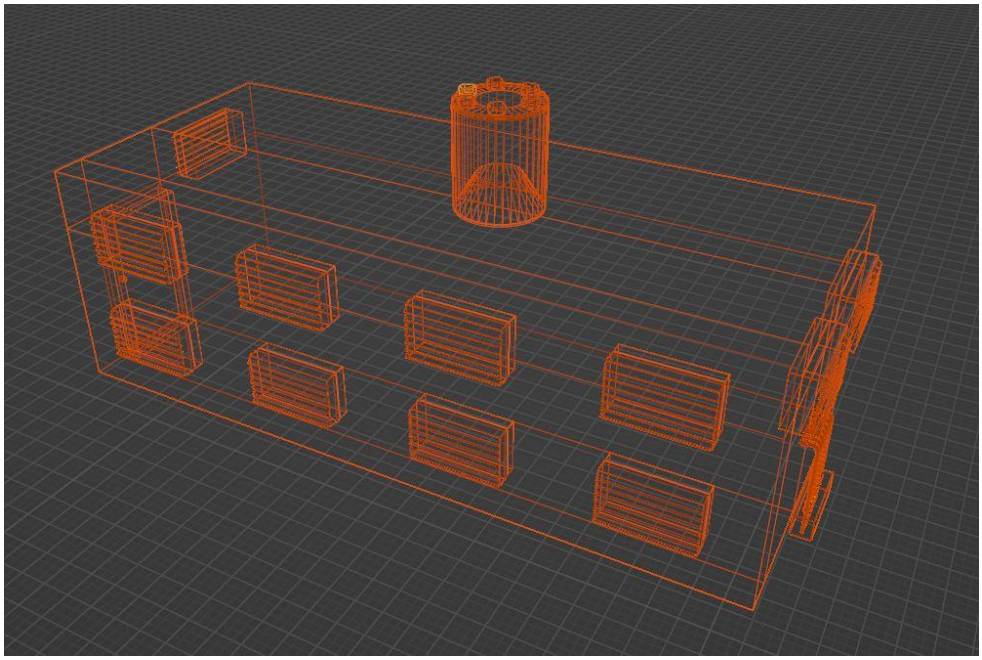

Fig 4.2.37.3 Steam Generator Wireframe.

4.2.38 Liquid Tank:

Liquid tank is part of the factory sector. The whole process dependent on this tank. We use it to our factory work flow. To create this tank, we have to used some shape like cube, cylinder. We took the cylinder and go to the vertices mode and make a proper shape of this tank. Then apply some modifier like subdivision, bevel. It takes much time to create.

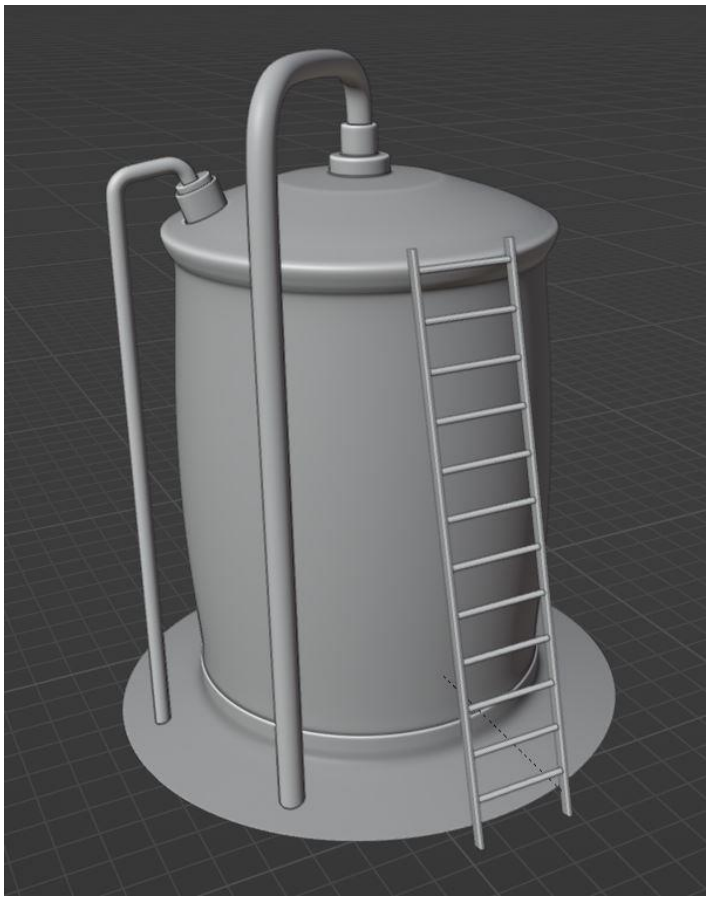

Fig 4.2.38.1 Liquid Tank Model.

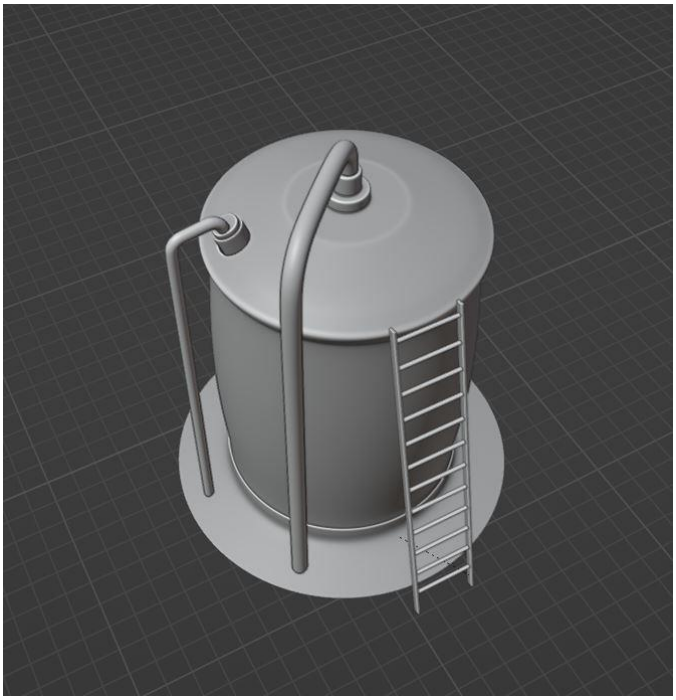

Fig 4.2.38.2 Liquid Tank Model.

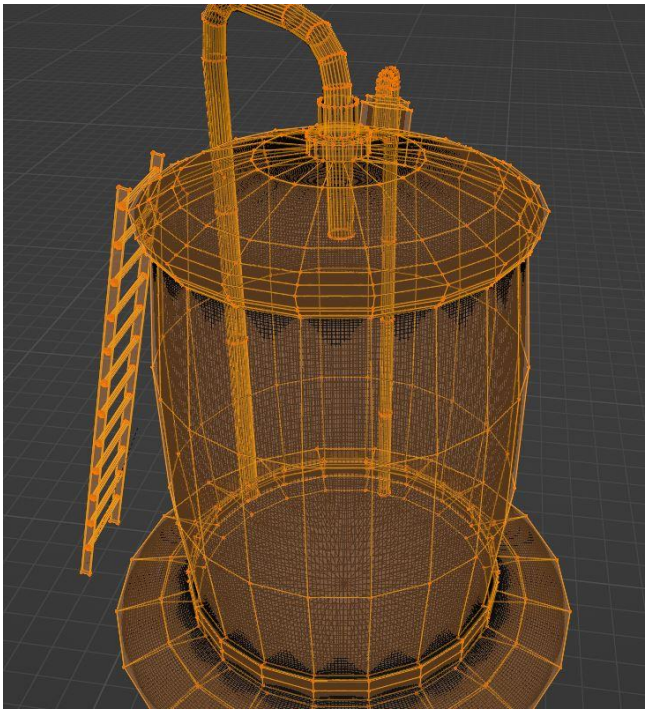

Fig 4.2.38.3 Liquid Tank Wireframe.

4.2.41 Book shelf:

Cabinet is our interior model. It's a simple model but when we create this we face some difficulty. We make this as a low poly model so we keep focus on this vertex. In this model we playing with the cube vertices. We take the reference picture and make it the proper shape on this model. Apply some modifier to looks even smoother.

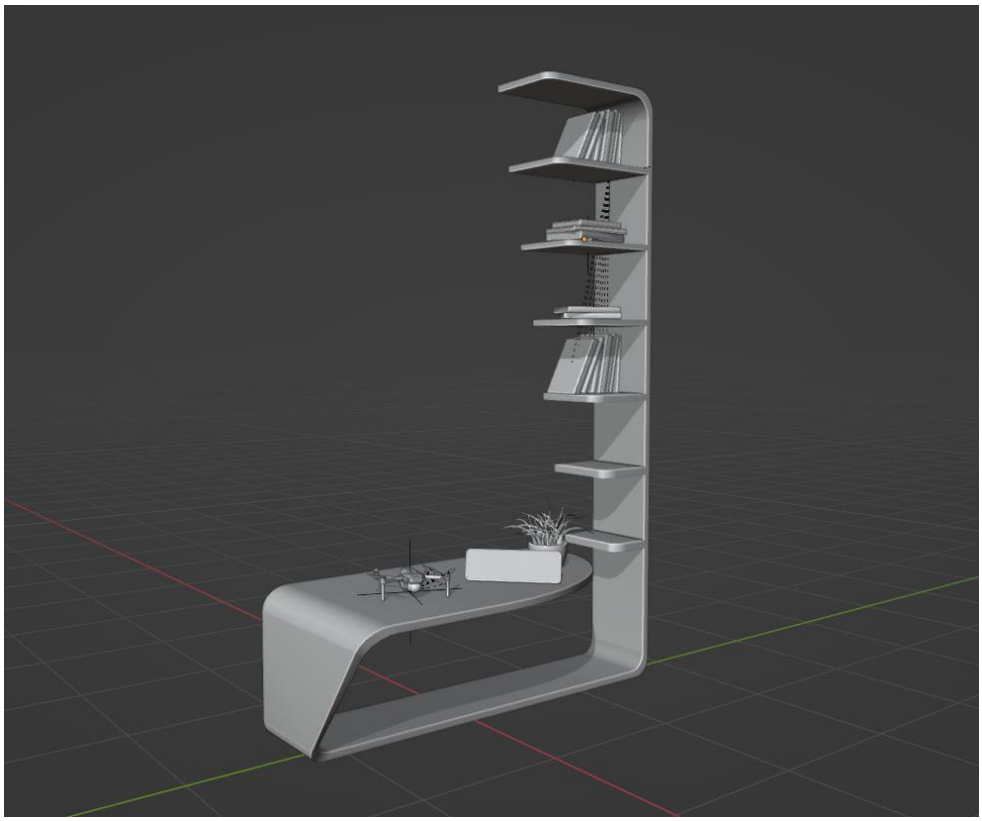

Fig 4.2.41.1 Book shelf Model.

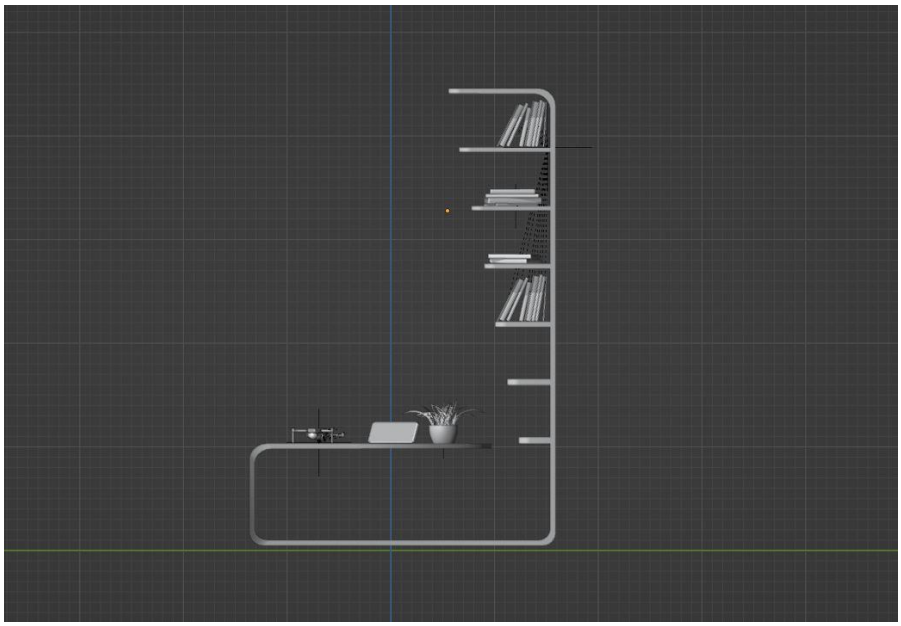

Fig 4.2.41.2 Book shelf Model.

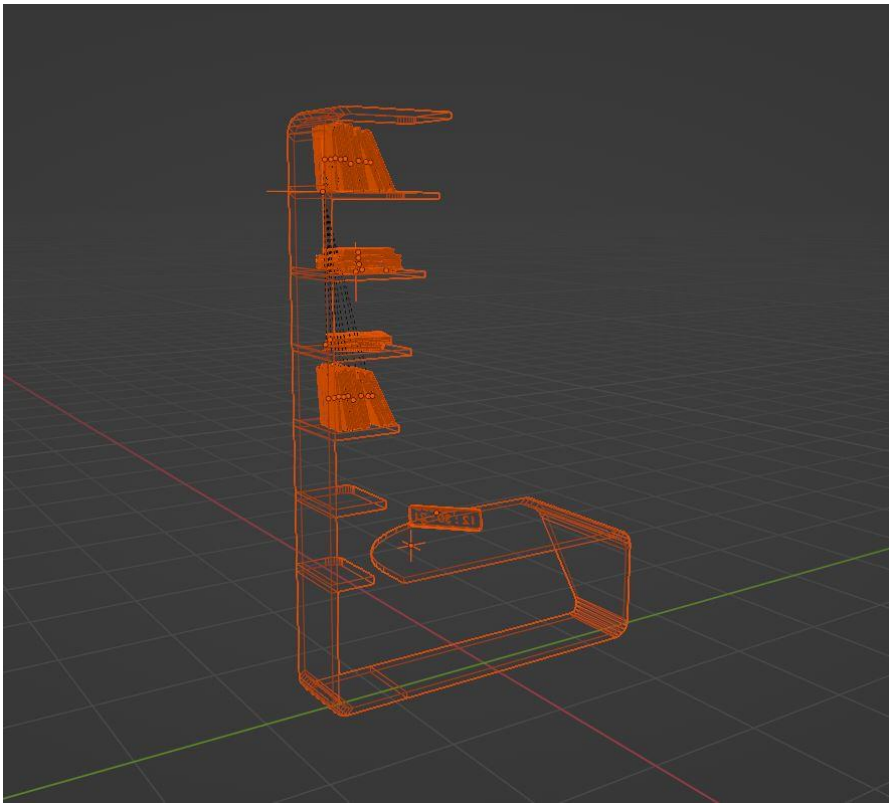

Fig 4.2.41.3 Book shelf Wireframe.

4.2.41 Cabinet:

Cabinet is part of our interior model. We used it in our smart home sector. It's a basic low poly model. We tried all model to stay low poly.

First, we take a cube and make it a proper shape of a cabinet by using extrude and bevel. The handle we used in cabinet made by the cylinder.

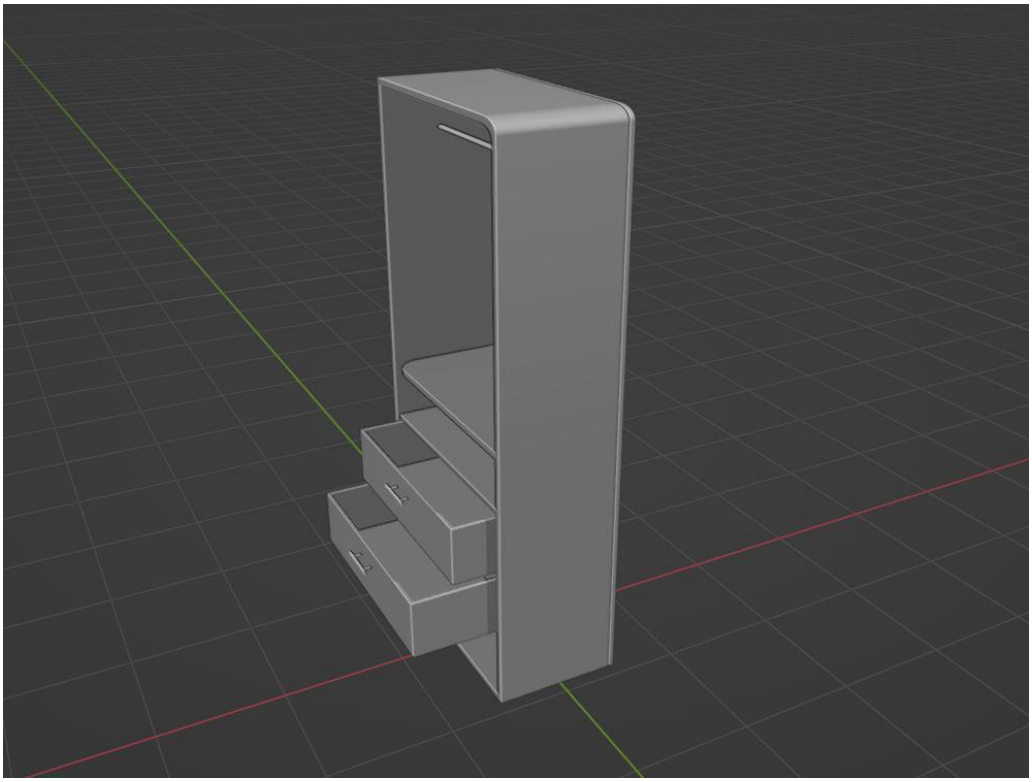

Fig 4.2.41.1 Cabinet Model.

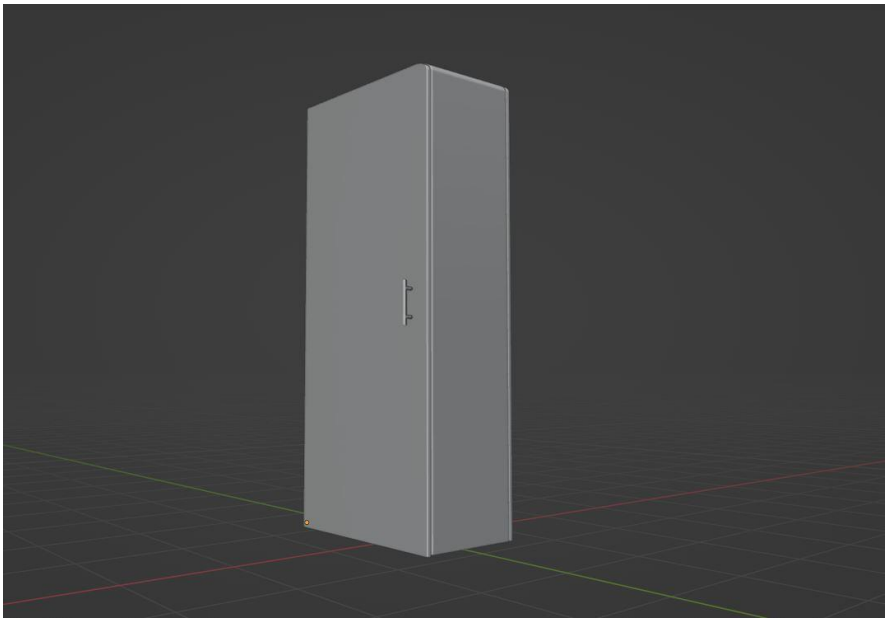

Fig 4.2.41.2 Cabinet Model.

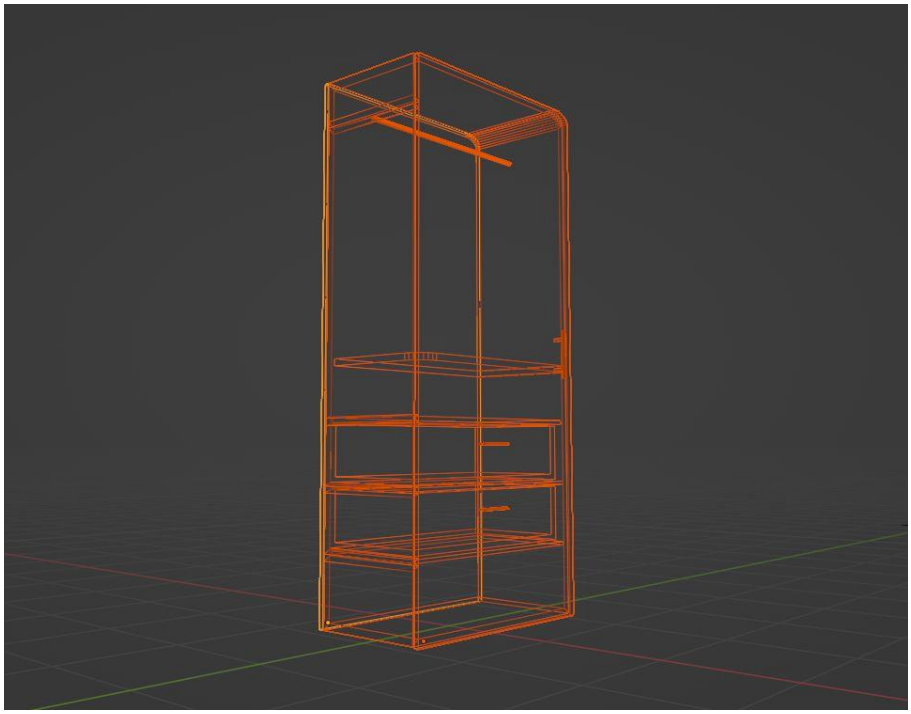

Fig 4.2.41.3 Cabinet Wireframe.

4.2.39 Chair:

Chair is our interior model. Its basic low poly model. It's not a difficult model but also not a easy work. The chair is basically four part of model. We took cube and took the vertex and make it in the shape of chair. Then we used some modifier to make it smooth.

Fig 4.2.39.1 Chair Model.

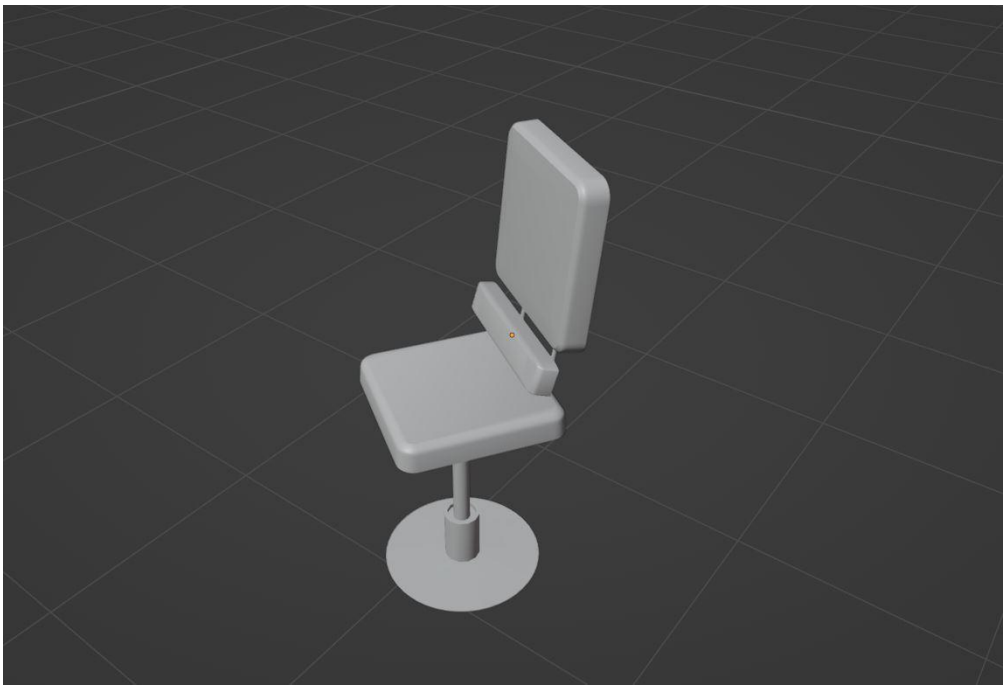

Fig 4.2.39.2 Chair Model.

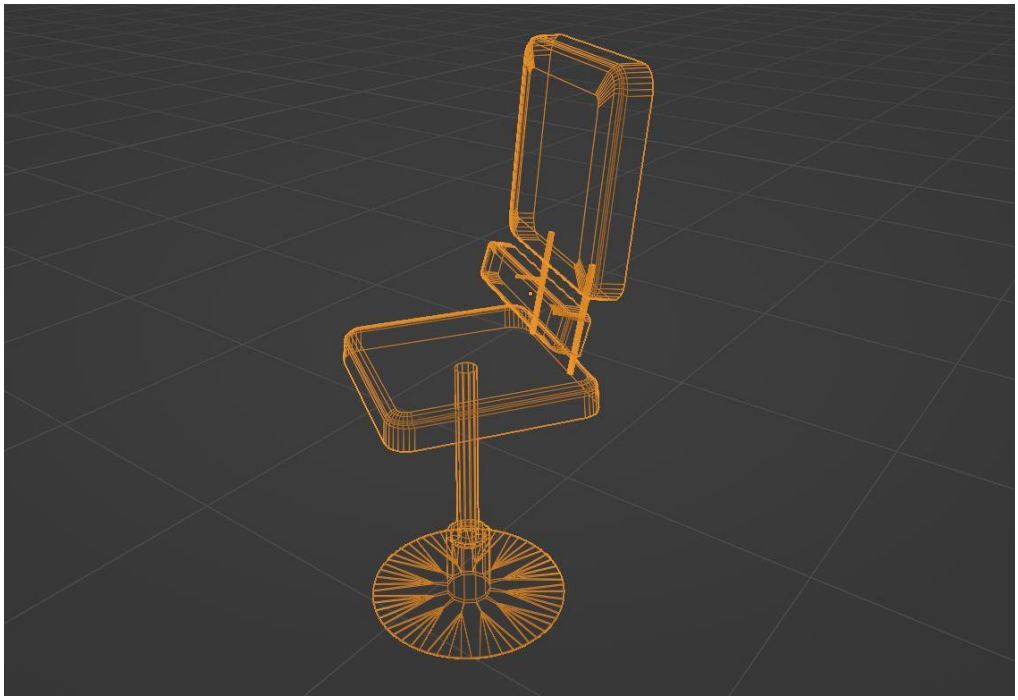

Fig 4.2.39.3 Chair wireframe.

4.2.42 Sofa (Sculpting):

Sofa is our part of interior model. It's a very complex model. We think it keeps low poly but can't. It's a high poly model. Its pretty complex model for us. We used cube to made it. We took a cube and go to the edit mode and take the vertex and shape of a sofa. Then apply some modifier to make it. We use sculpting on it.

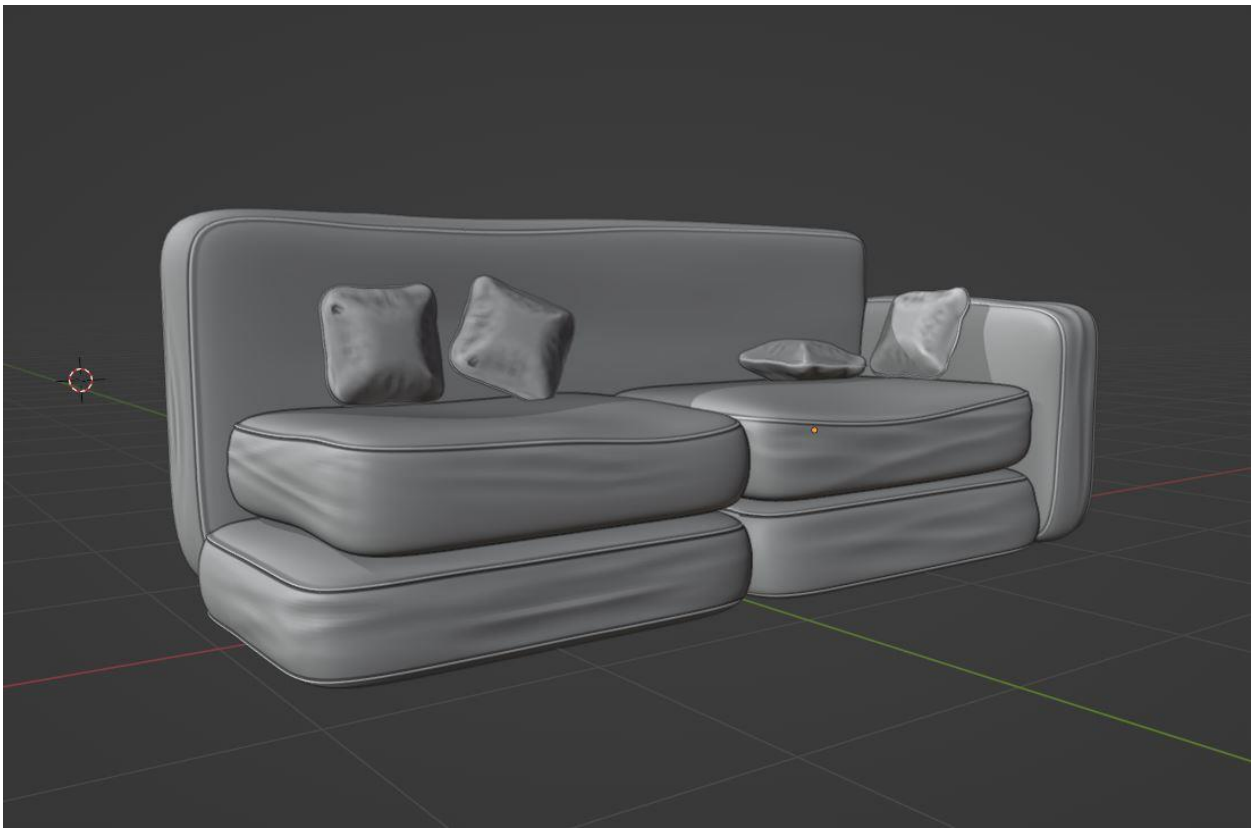

Fig 4.2.42.1 Sofa Model

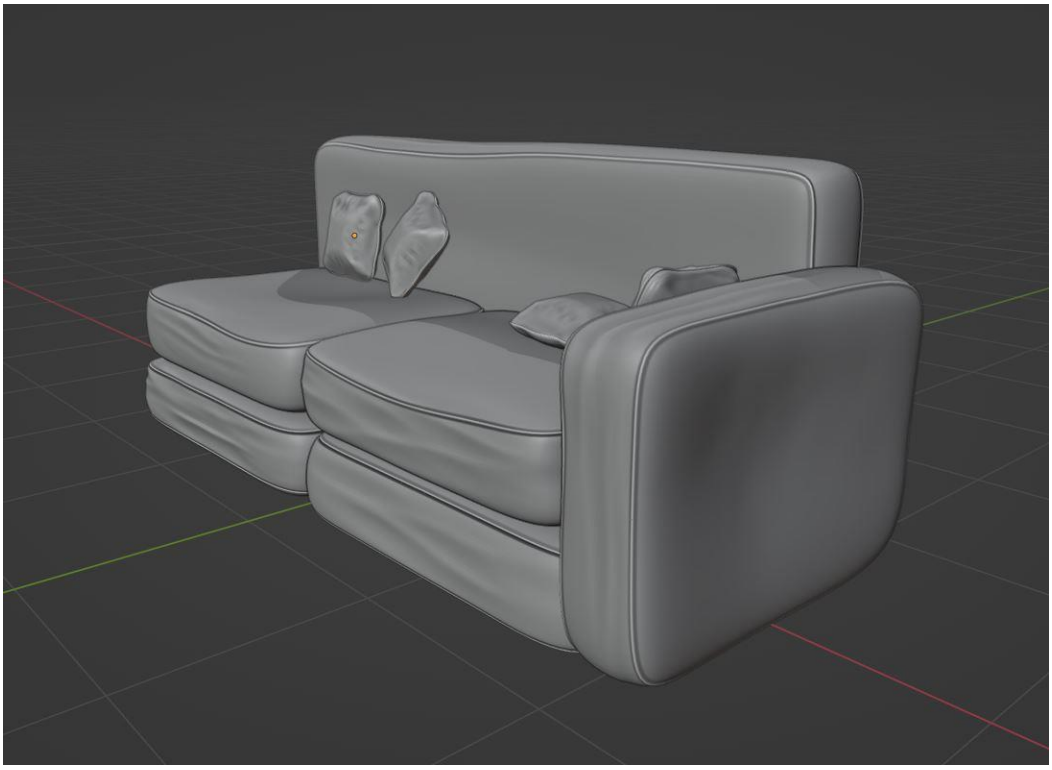

Fig 4.2.42.2 Sofa Model

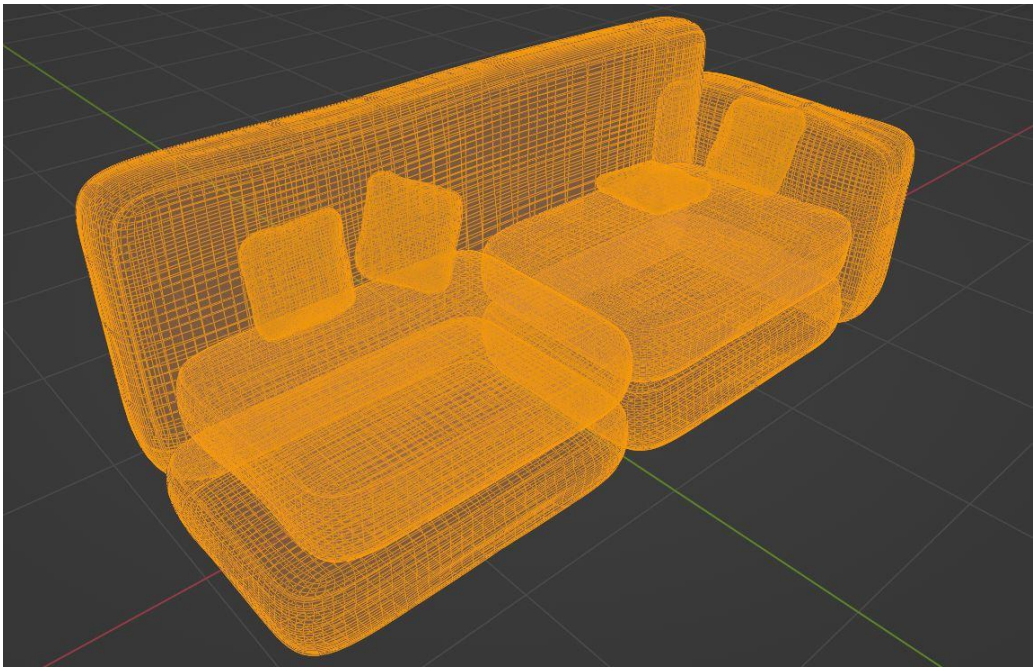

Fig 4.2.42.3 Sofa Wireframe.

4.2.43 TV set:

Tv set is part of our interior model. It’s a low poly model so that our work process pretty harder. We take a cube and make it shape of tv and apply some modifier to smooth it.

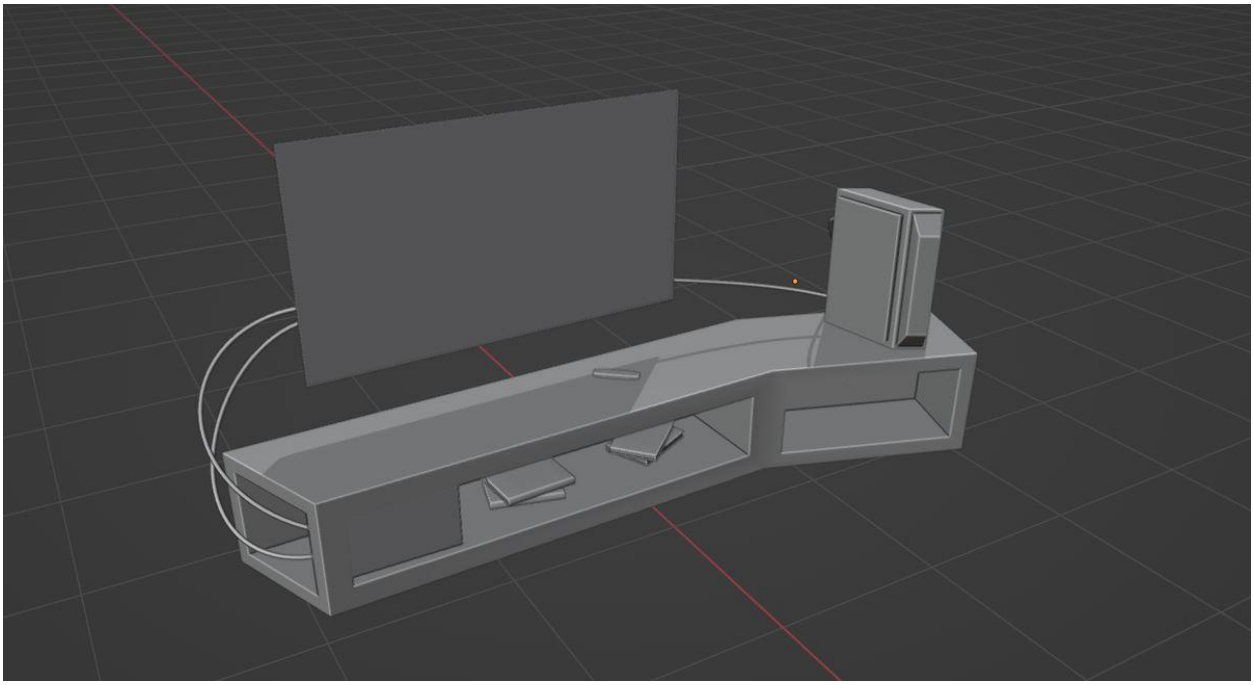

Fig 4.2.43.1 TV set Model

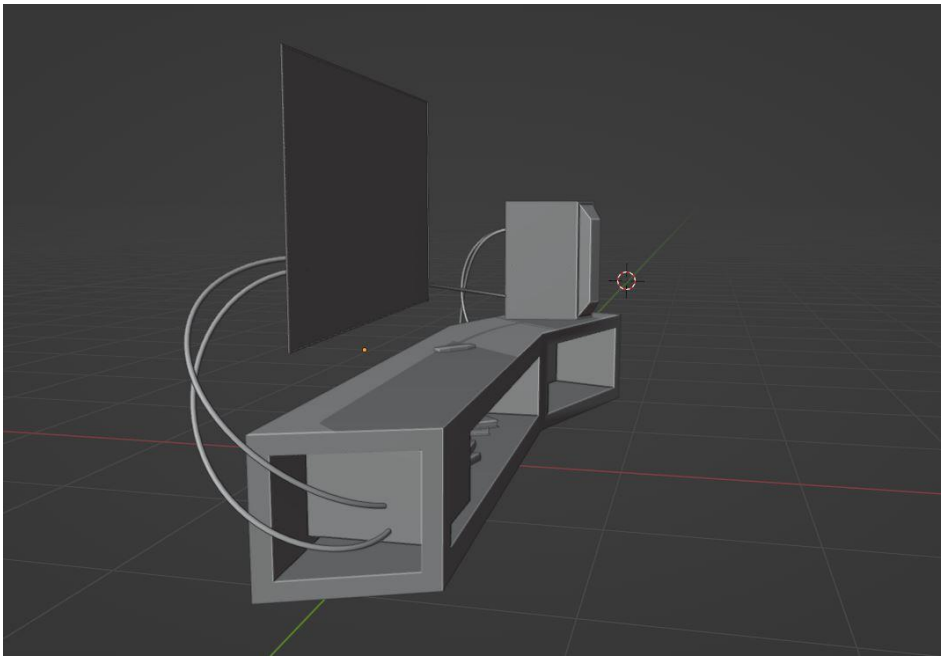

Fig 4.2.43.2 TV set Model

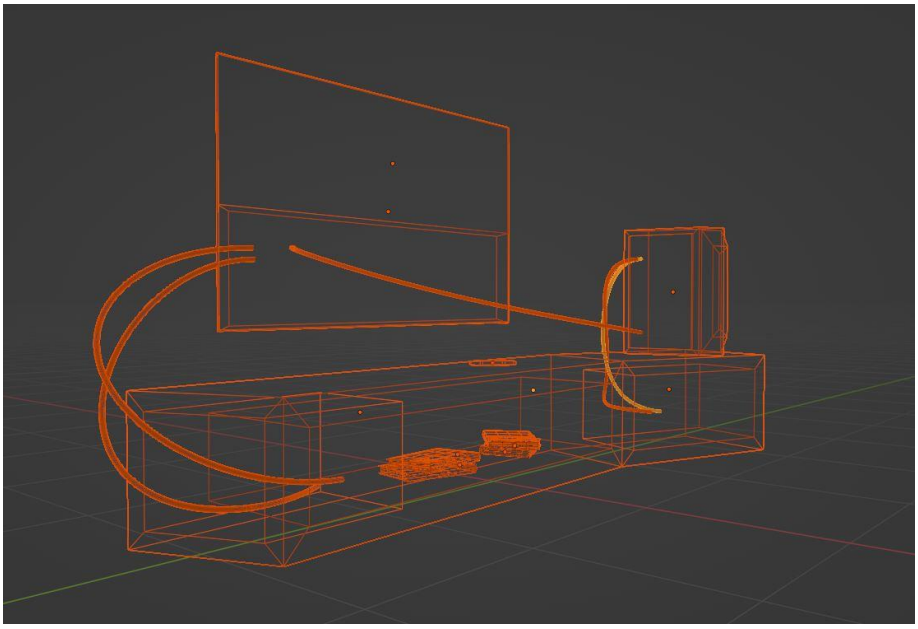

Fig 4.2.43.3 TV set Wireframe.

4.2.8 Study desk:

Study desk is part of our interiors sector. Its basic low poly model.

We used plan shape for the structure. Then we used some modifier to making this smooth.

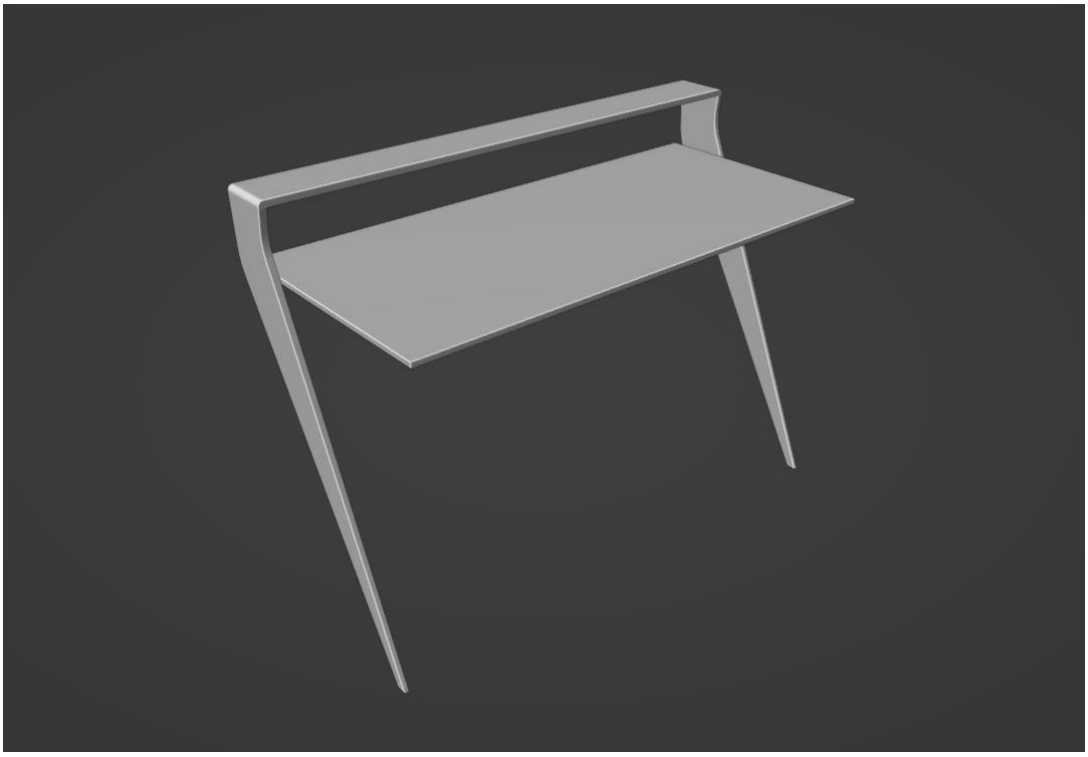

Fig 4.2.8 .1Study desk Model.

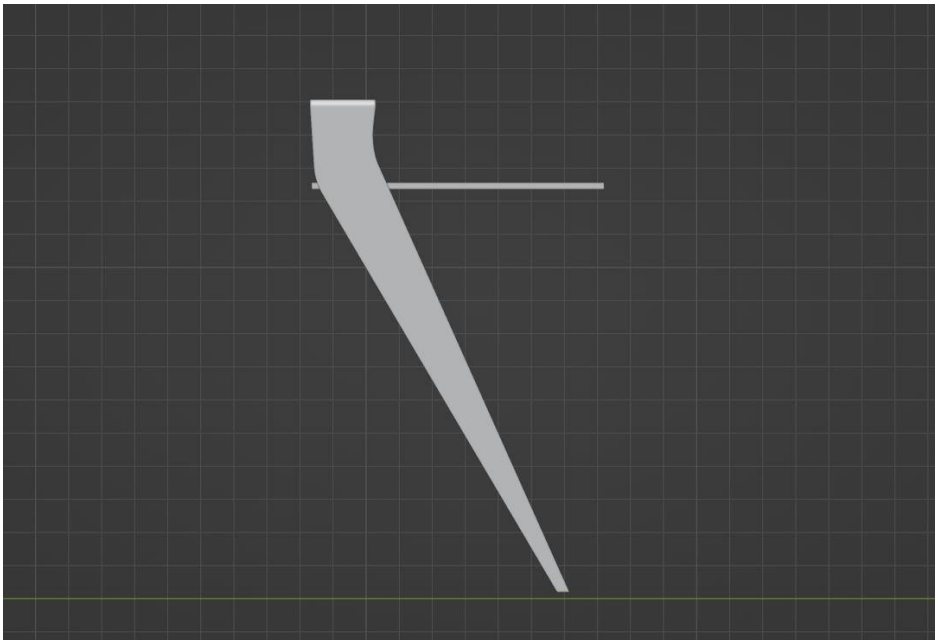

Fig 4.2.8 .2Study desk Model.

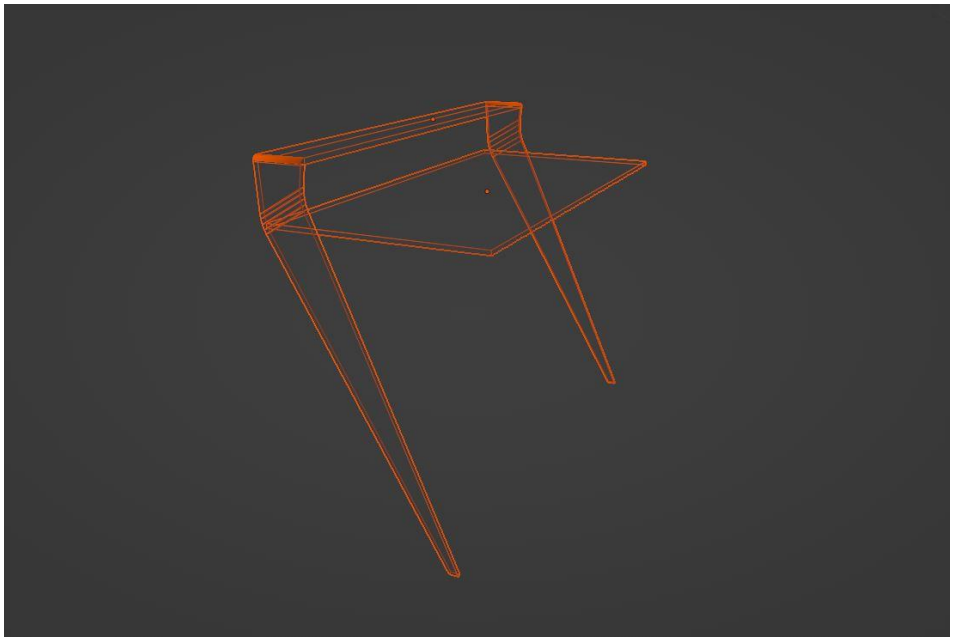

Fig 4.2.8.3Study desk Wireframe.

4.2.45 Pen holder:

It’s also an interior model. Its small but it’s pretty complex model.

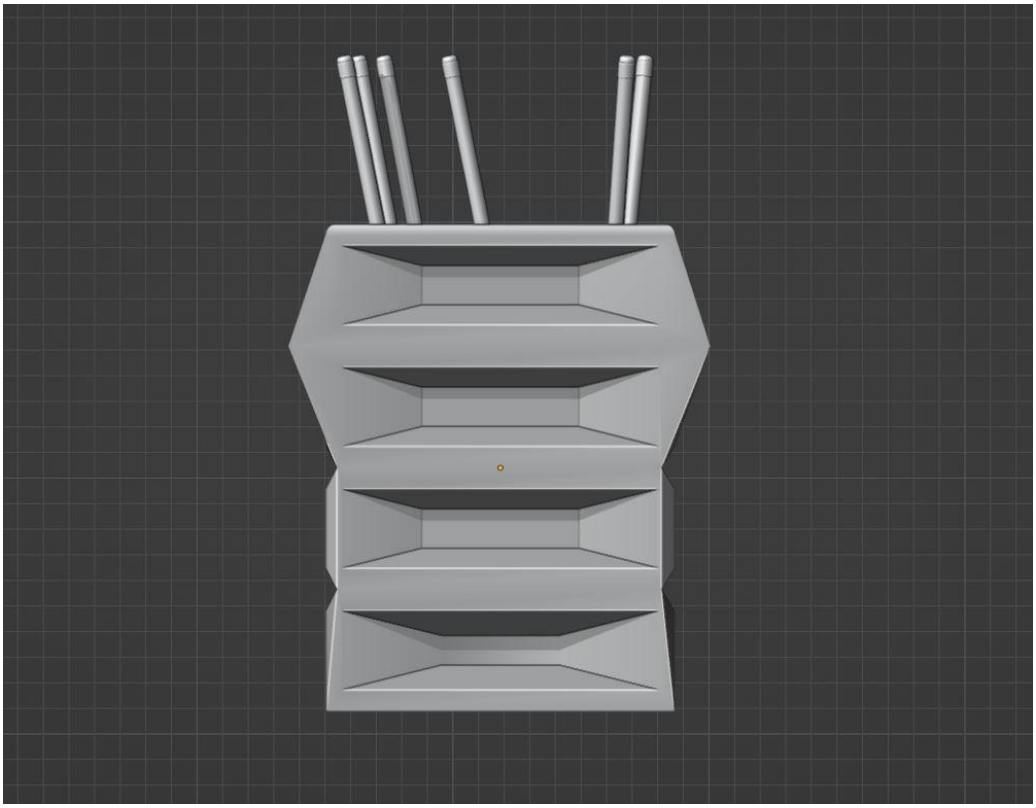

Fig 4.2.45.1 Pen holder Model.

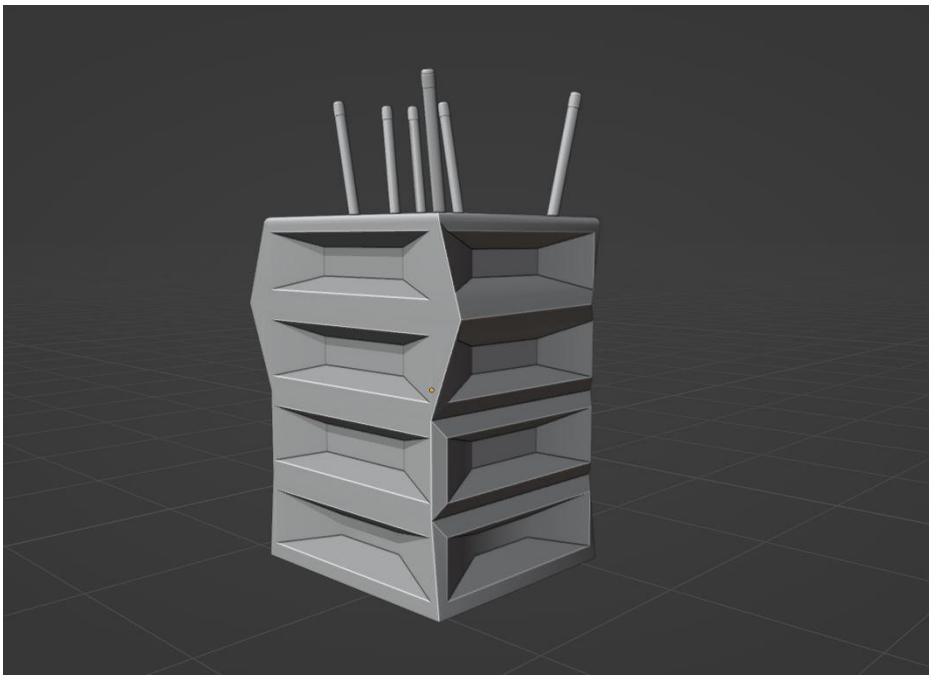

Fig 4.2.45.2 Pen holder Model.

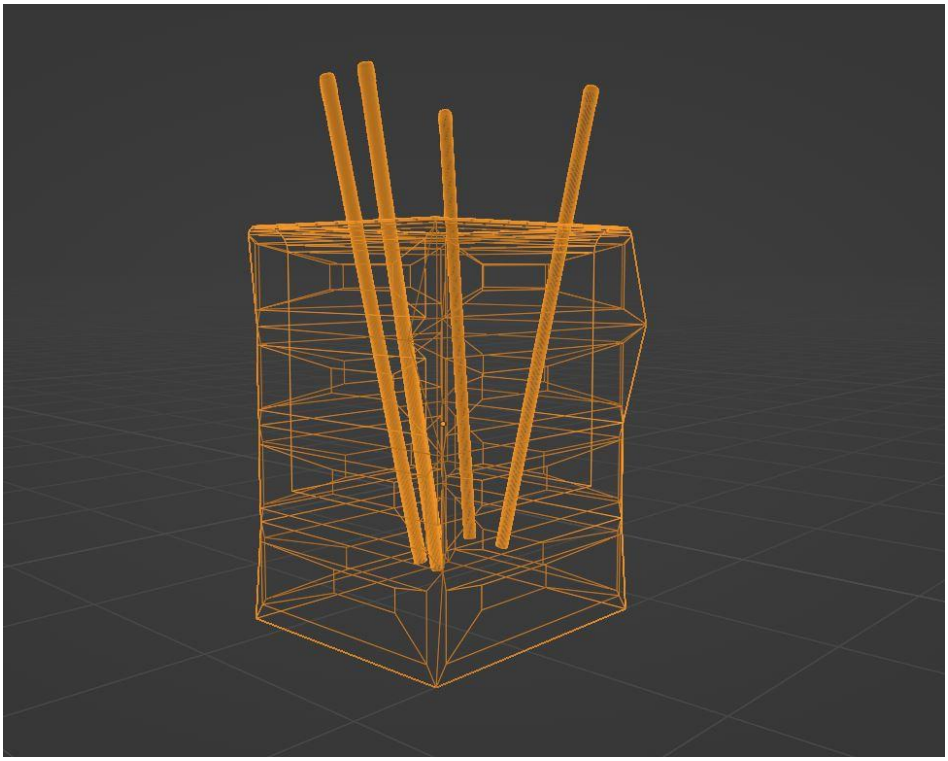

Fig 4.2.45.3 Pen holder Wireframe.

4.2.25 Digital clock:

Digital clock is part of our interiors model. It is small and complex model. We made it with the cube and emission.

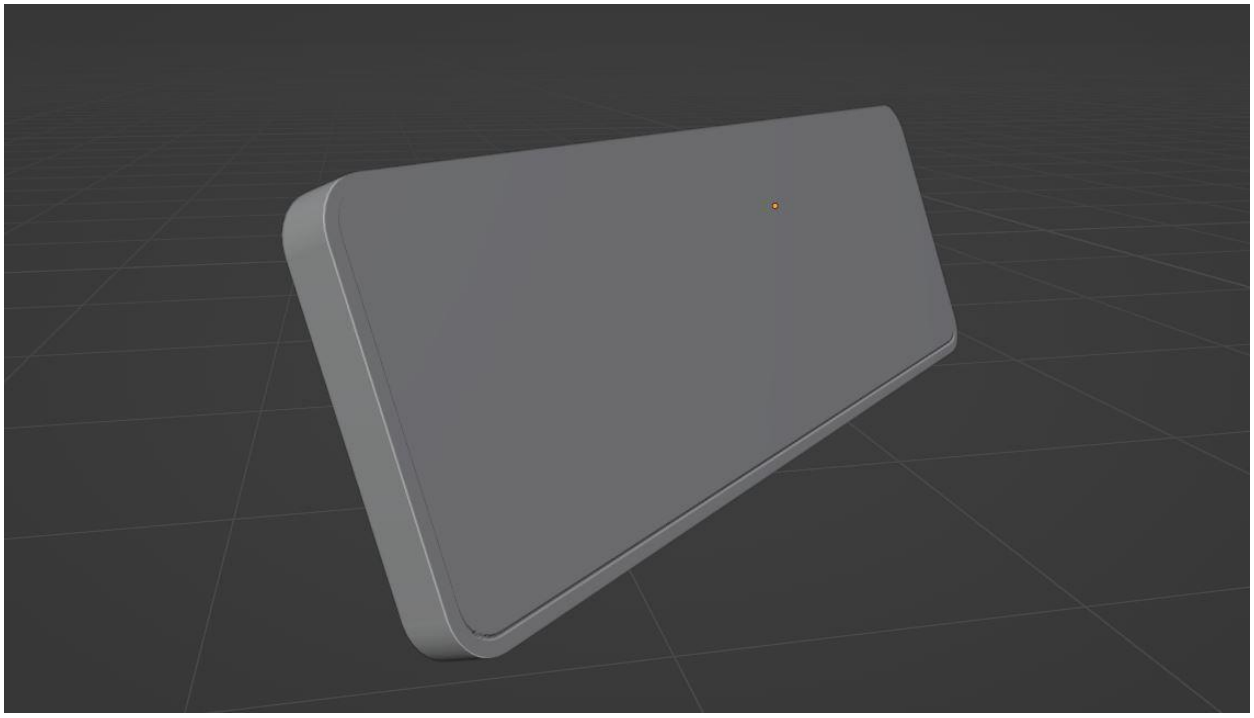

Fig 4.2.25.1 Digital clock Model.

Fig 4.2.25.3 Digital clock Wireframe.

4.3 Texture and UV Unwrap:

Unwarp is one of the most popular method for doing UV of any 3D model. UV means representing a 3d object's face with a flat 2d face. It’s used to texture 3d objects smoothly. This process of creating a UV map is called UV unwrapping. Then the U and V represent two axes of the 2d space.

4.3.1 Building:

Without proper UV Unwrapping its not possible to texture any 3D model, so UV Unwrapping and texturing are very much connected with each other. A building is a rectangular structure so unwrapping was not too complicated but it was not easy as well. First, we unwrapped the building base structure.

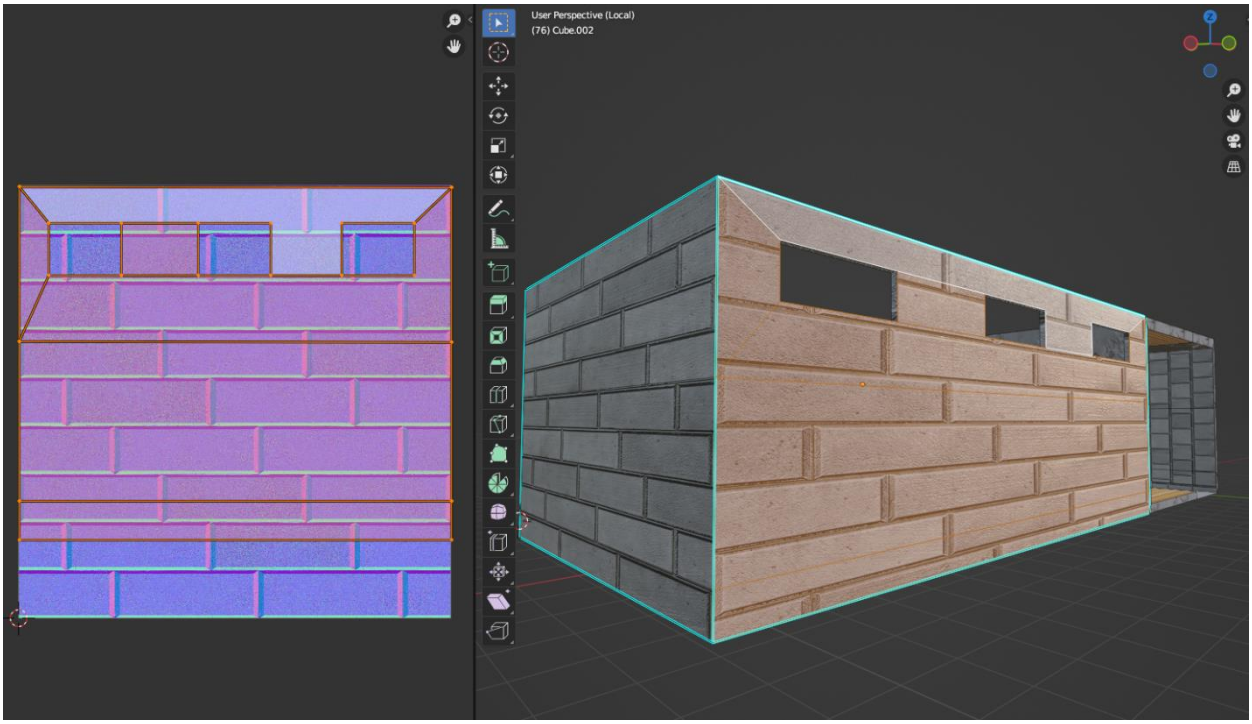

Fig 4.3.1.1 Building unwrapping.

We imported a texture into blender which contains several maps for detailing. Color map, roughness map, normal map, ambient occlusion map, height map, displacement map, metal map etc. We used these maps combined to make the wall of this building more realistic.

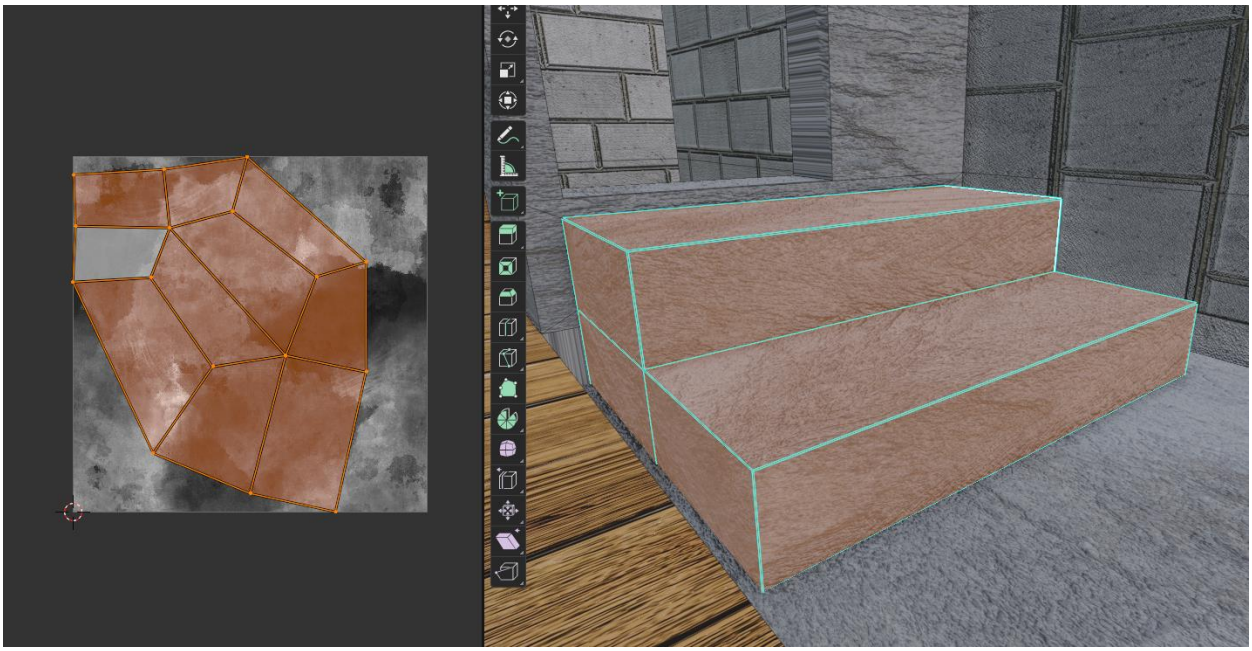

Fig 4.3.1.2 Building unwrapping.

In some cases, we used Smart UV Projection to save our time. Smart UV Projection is not perfect unwrapping but it does the job.

4.3.2 Big Belly Bin:

UV unwrapping is most important role in our project. When we finished our model then the next step is UV unwrapping sector. Without it we cannot apply the texture in any 3d model. It's a part and parcel of a 3d model. The big belly bin is rectangular structure and it's a very difficult task to unwrapping. First, we unwrapped the bin based and we import the texture into the blender which contains several maps for detailing. Color map roughness map, normal map, ambient occlusion map, height map, displacement map, metal map etc.

We used these maps combined to make the wall of this building more realistic

In some cases, we used Smart UV Projection to save our time.

Smart UV Projection is not perfect unwrapping but it does the job

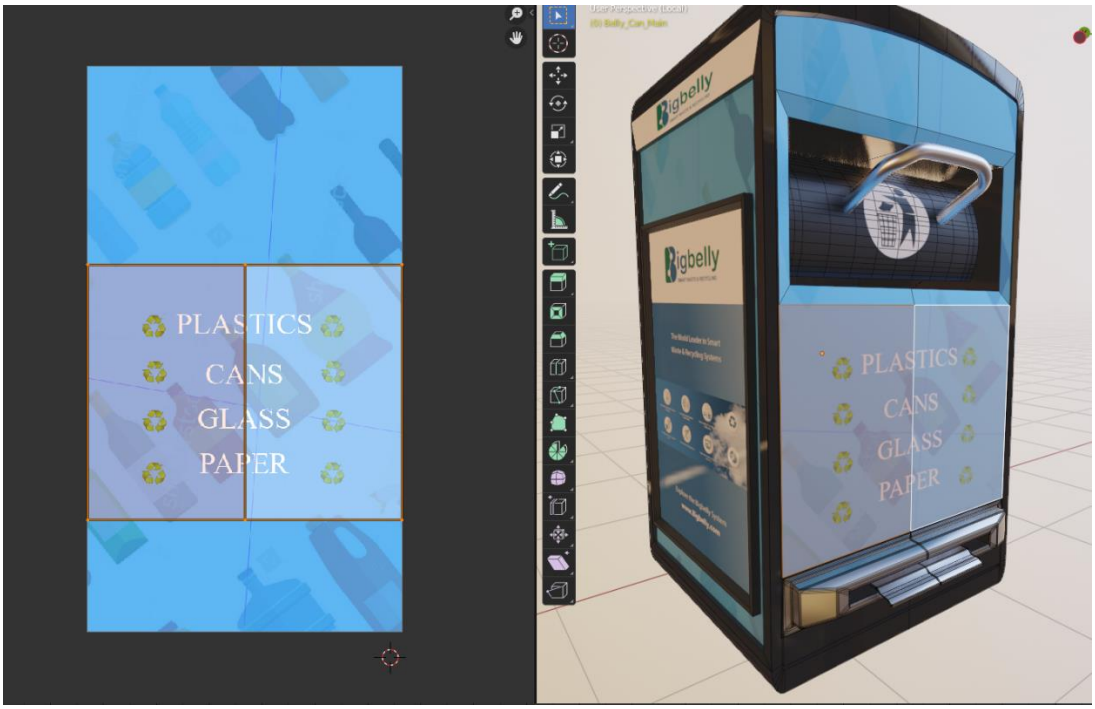

Fig 4.3.2 .1Big Belly Bin unwrapping.

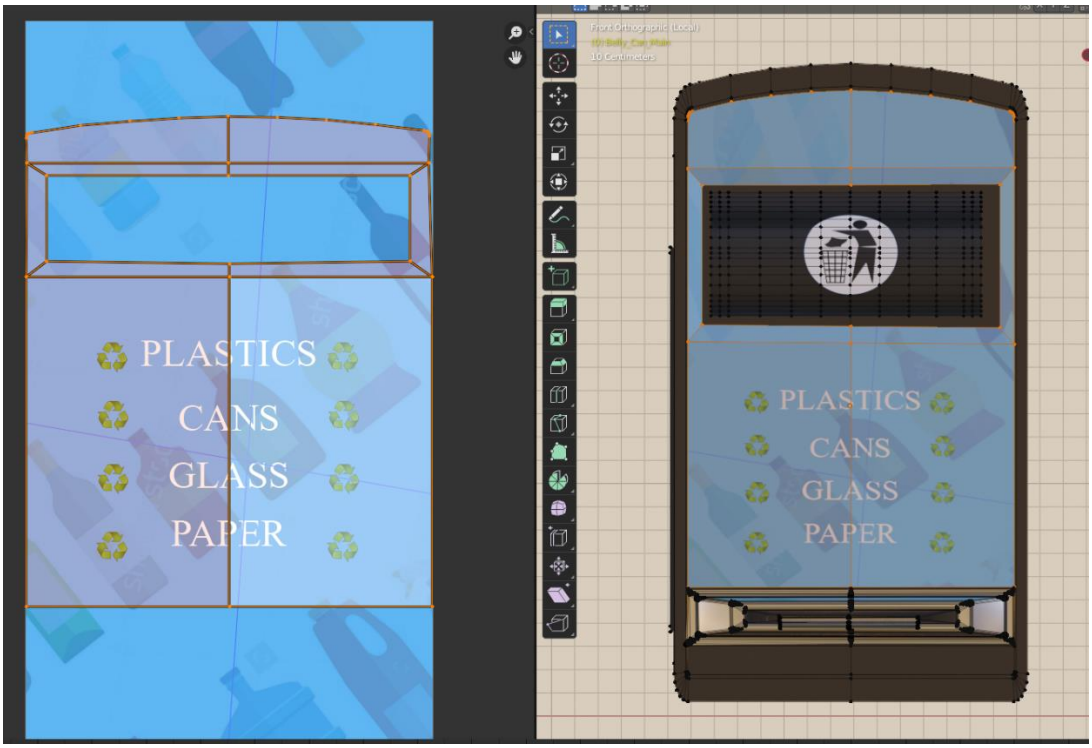

Fig 4.3.2.2Big Belly Bin unwrapping.

4.3.3 Patrol Pump Machine:

Without proper UV Unwrapping it's not possible to texture any 3D model, so UV Unwrapping and texturing are very much connected with each other. The patrol pump Machin is a rectangular structure so unwrapping was not too complicated but it was not easy as well. First, we unwrapped the building base structure

First, we unwrapped the Machin base structure.

We imported a texture into blender which contains several maps for detailing.

Color map, roughness map, normal map, ambient occlusion map, height map, displacement map, metal map etc.

We used these maps combined to make the wall of this building more realistic

In some cases, we used Smart UV Projection to save our time.

Smart UV Projection is not perfect unwrapping but it does the job.

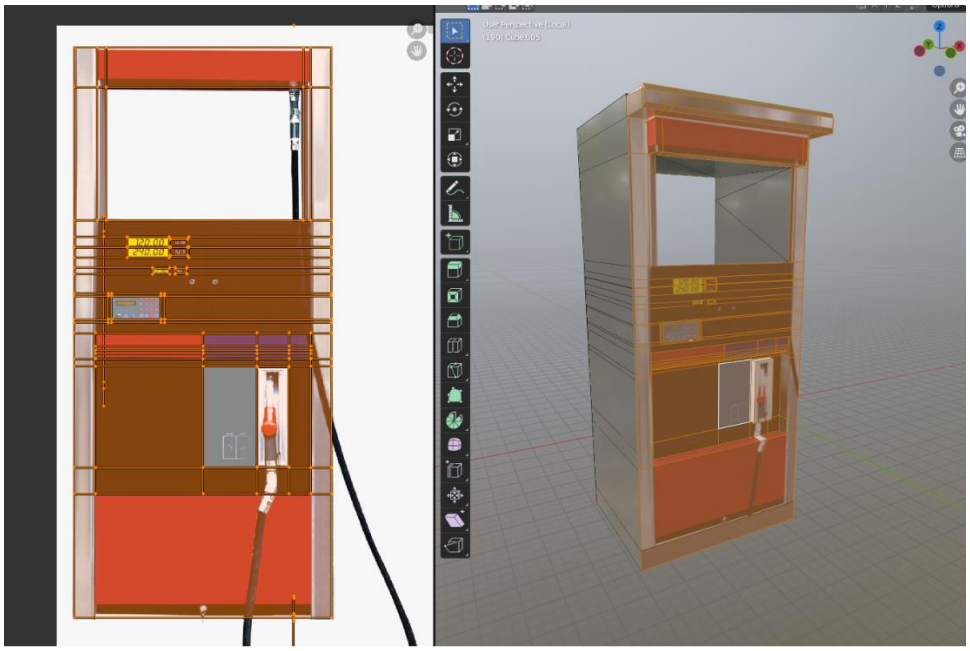

Fig 4.3.3.1Patrol Pump Machine Unwrapping.

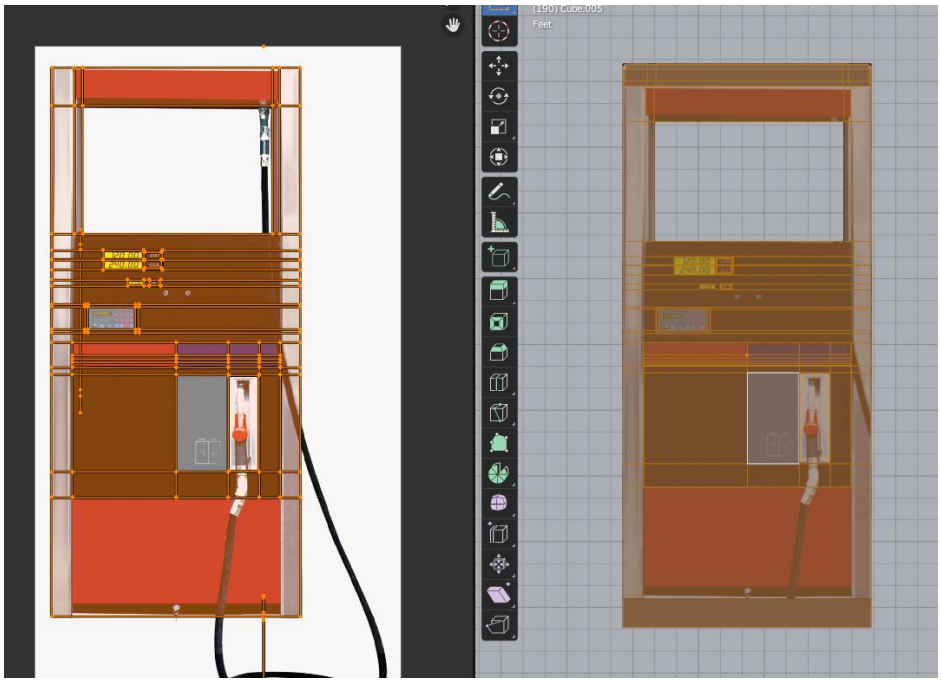

Fig 4.3.3.1Patrol Pump Machine Unwrapping.

4.3.4 Speed camera:

UV unwrapping is most important role in our project. When we finished our model then the next step is UV unwrapping sector. Without it we cannot apply the texture in any 3d model. It's a part and parcel of a 3d model. The speed camera is pretty complex model and its more difficult when we apply the unwrapping and texture. We imported a texture into blender which contains several maps for detailing.

Color map, roughness map, normal map, ambient occlusion map, height map, displacement map, metal map etc. we also used the node system for the texture for better shading in other create materials. Here we show the node system to our project in speed camera.

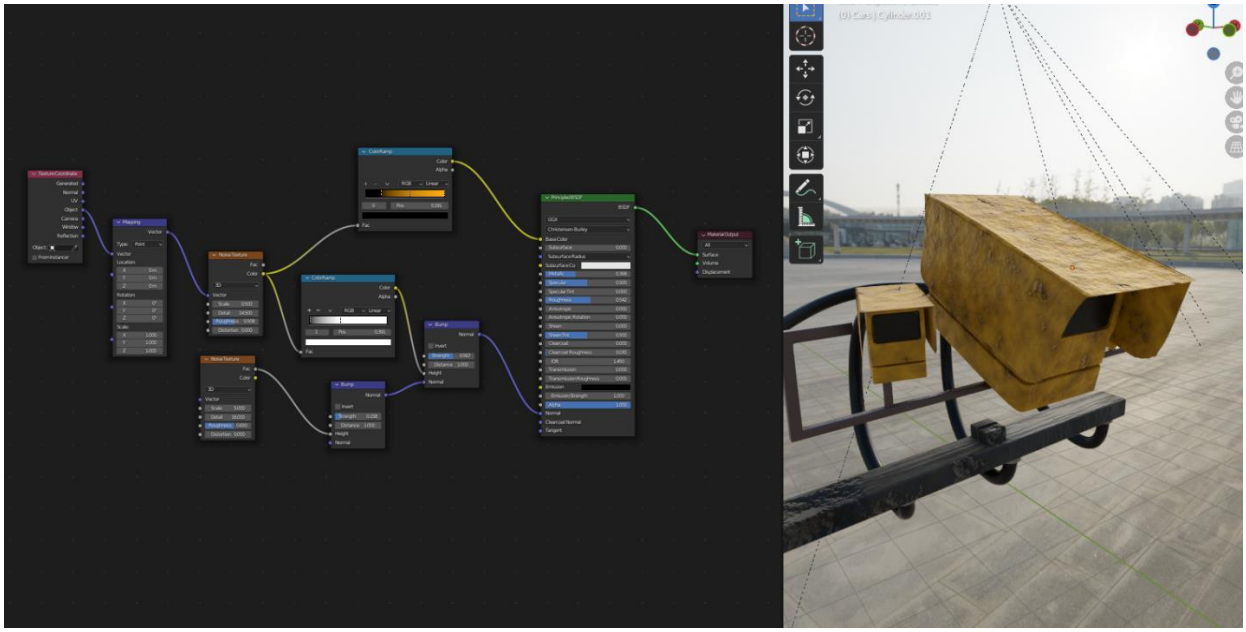

Fig 4.3.4.1Speed camera unwrapping.

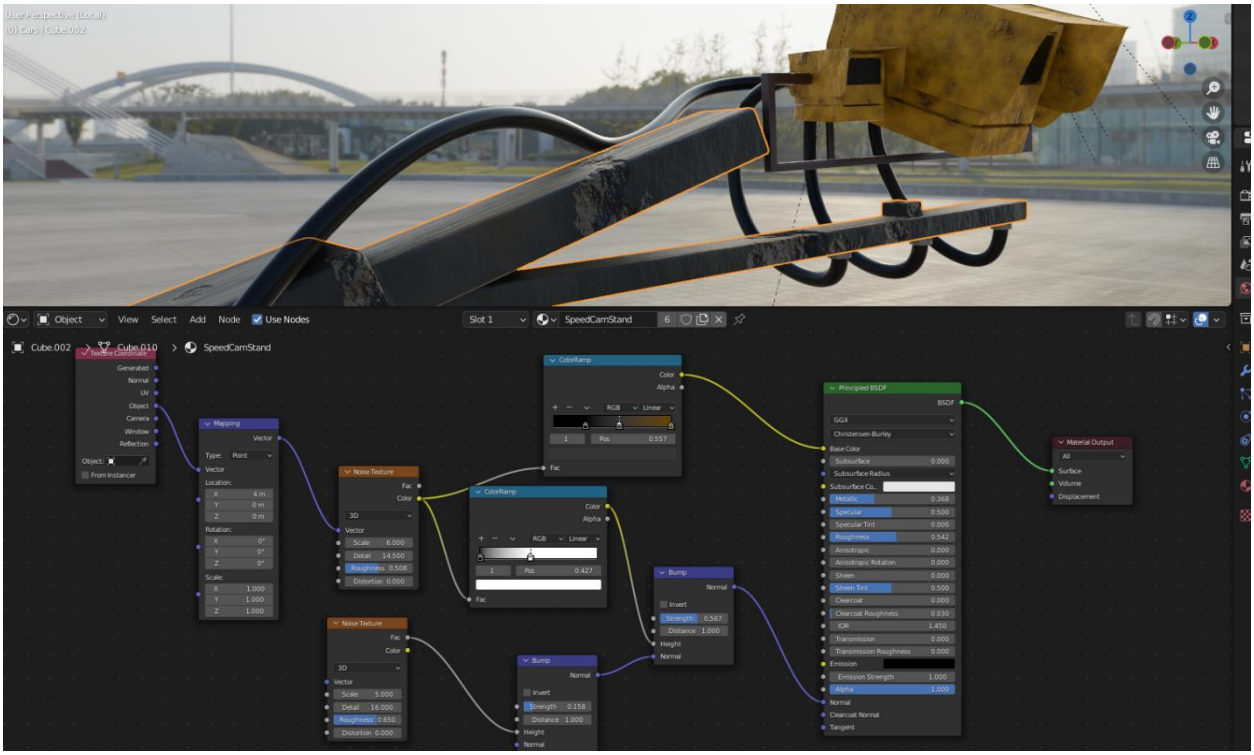

Fig 4.3.4.2 Speed camera unwrapping and node system.

4.3.5 Bus Station:

UV unwrapping is most important role in our project. When we finished our model then the next step is UV unwrapping sector. Without it we cannot apply the texture in any 3d model. It's a part and parcel of a 3d model. The bus station is very complex model and quite difficult to unwrapped. We used node system to texture the model. It's a very useful system in blender. By using this we can maintain the shedding of our model. We can play with this node system to better texture. First, we unwrapped the speed camera structure and apply the texture.

Here we see the system,

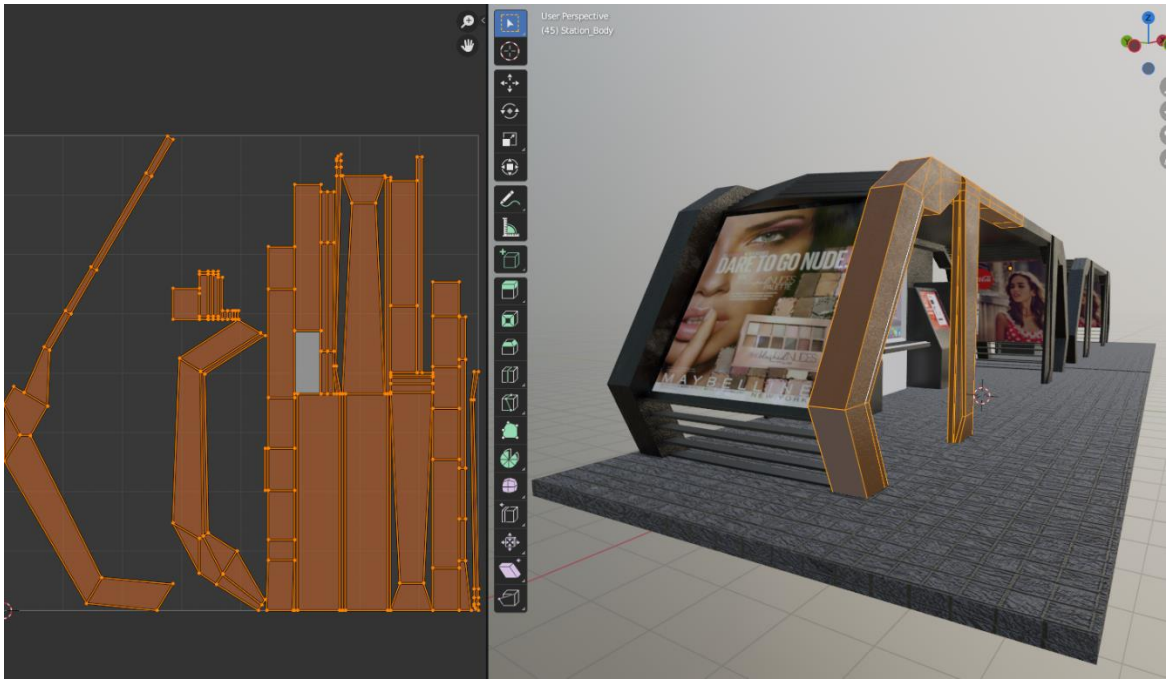

Fig 4.3.5.1 Bus Station unwrapping

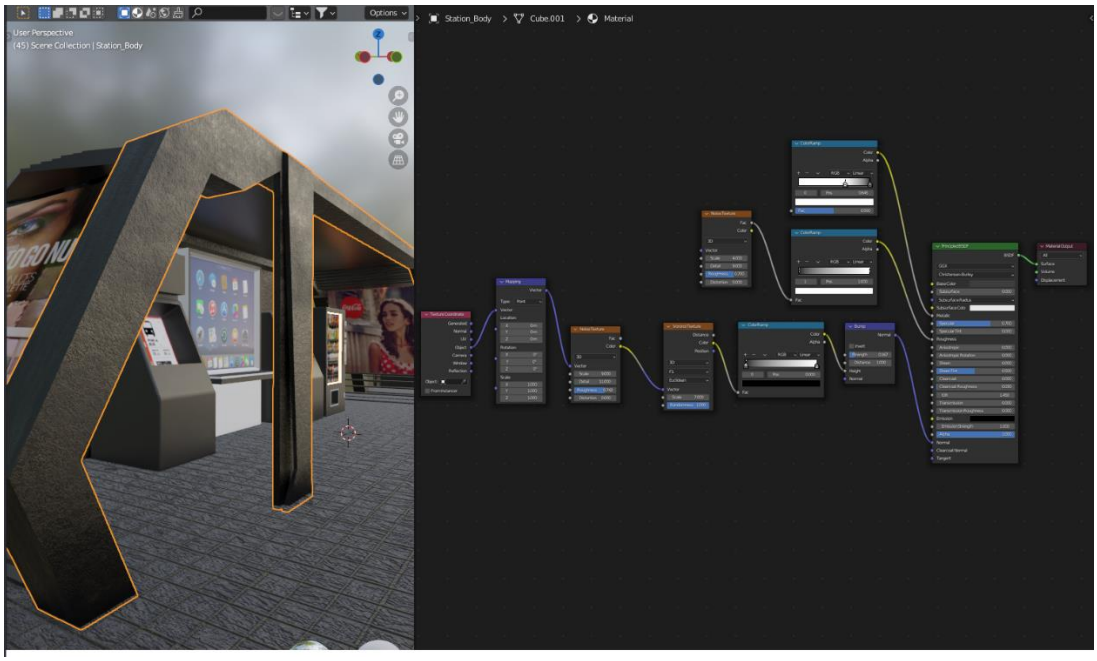

Fig 4.3.5.2 Bus Station unwrapping and texture.

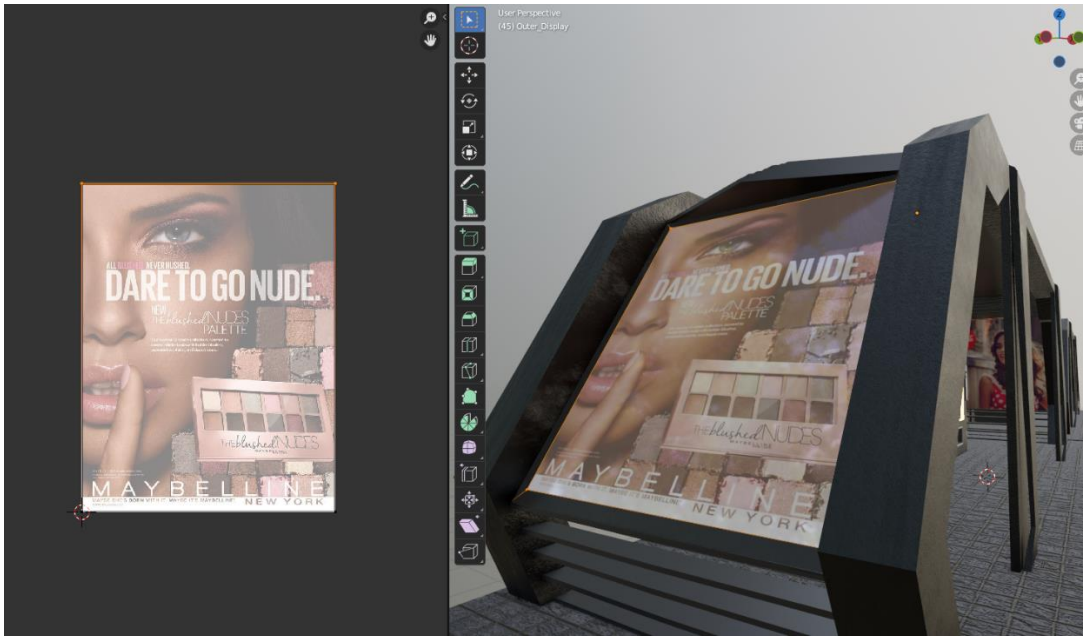

Fig 4.3.5.3 Bus Station unwrapping

Here we see the system,

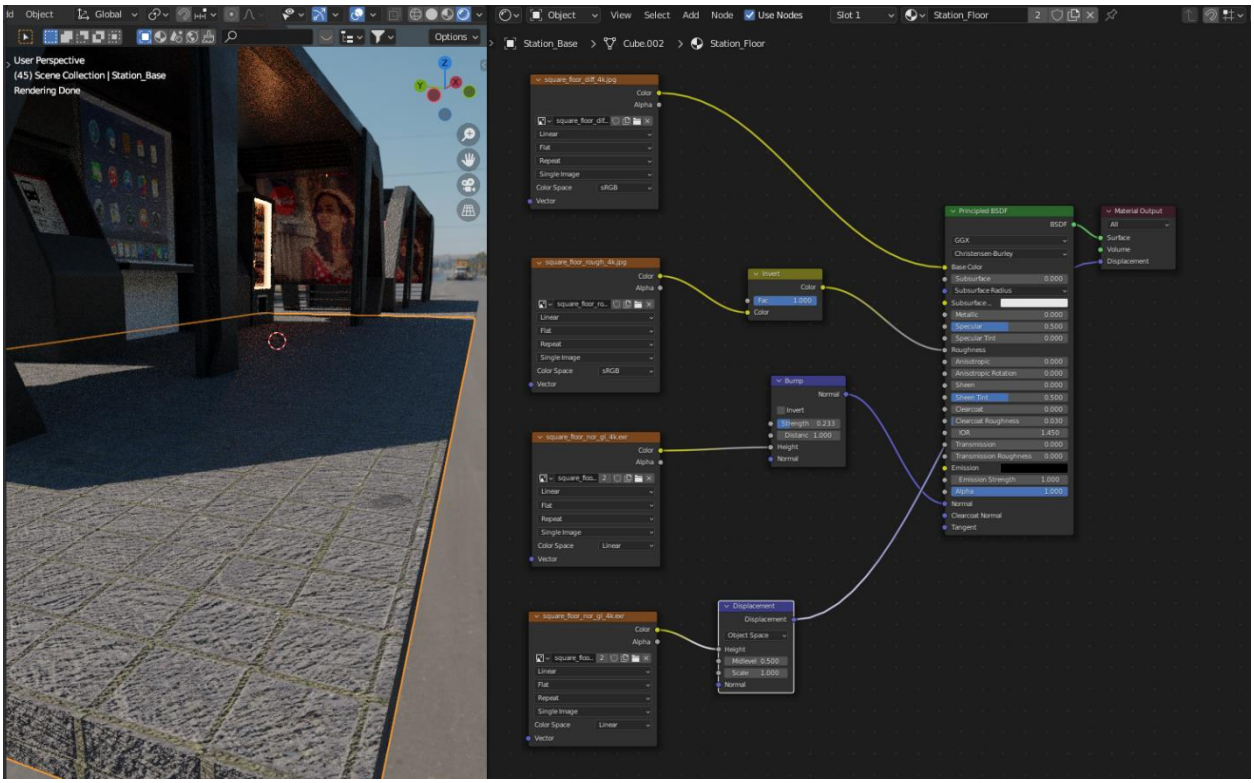

Fig 4.3.5.4 Bus Station Texture.

4.3.6 Vending Machine:

Vending machine is part of a bus station. It's an important part of our bus station. It's a very complex model, and we face many difficulties. After we finished the model we start to UV unwrapped the model and began to texture it. It's a square shape model so first we unwrapped the model then making texture. We used photodramatic on this model.

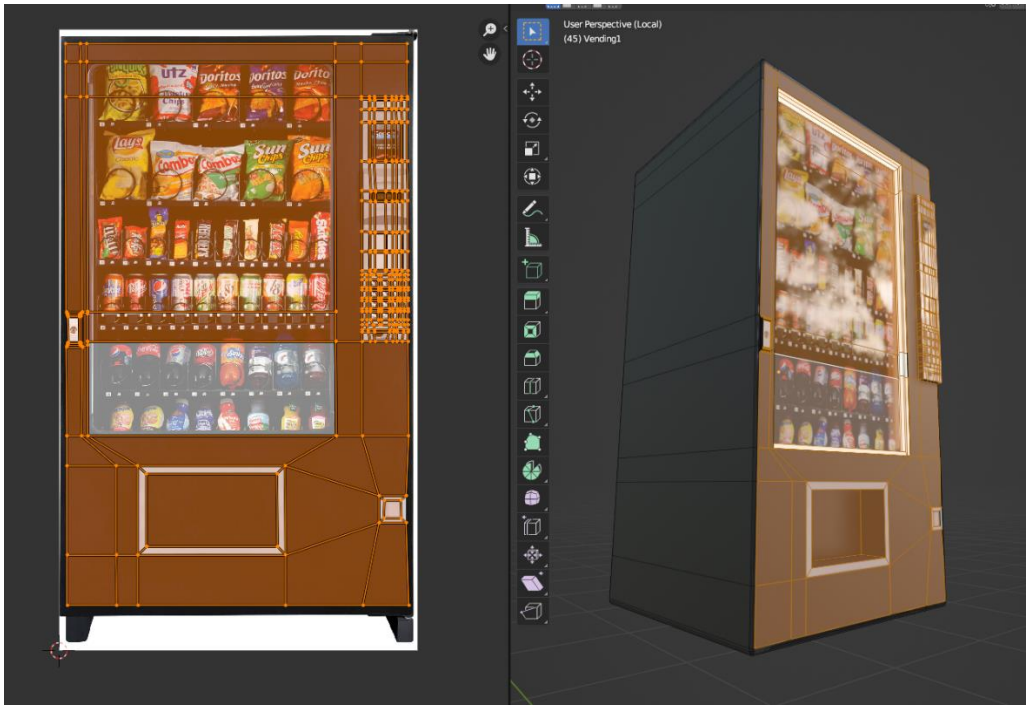

Fig 4.3.6.1 Vending Machine Unwrapping.

Fig 4.3.6.2 Vending Machine Unwrapping.

4.3.7 Bed Sheet:

Bed sheet is one of the interior models. It's a pretty complex model. We used in that cloth simulation. Without proper UV Unwrapping it's not possible to texture any 3D model,
so, UV Unwrapping and texturing are very much connected with each other. We imported a texture into blender which contains several maps for detailing.

Color map, roughness map, normal map, ambient occlusion map, height map, displacement map, metal map etc.

We used these maps combined to make the wall of this building more realistic

In some cases, we used Smart UV Projection to save our time.

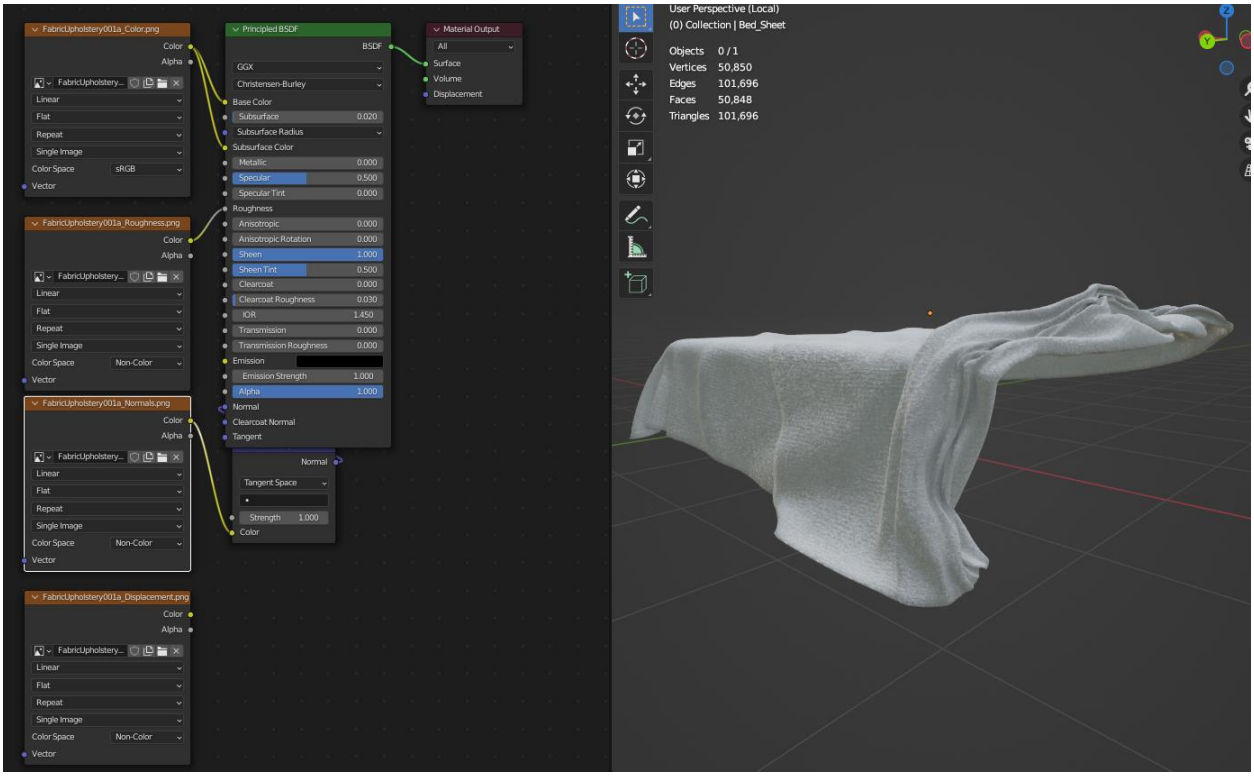

Fig 4.3.7.1 Bed Sheet unwarping.

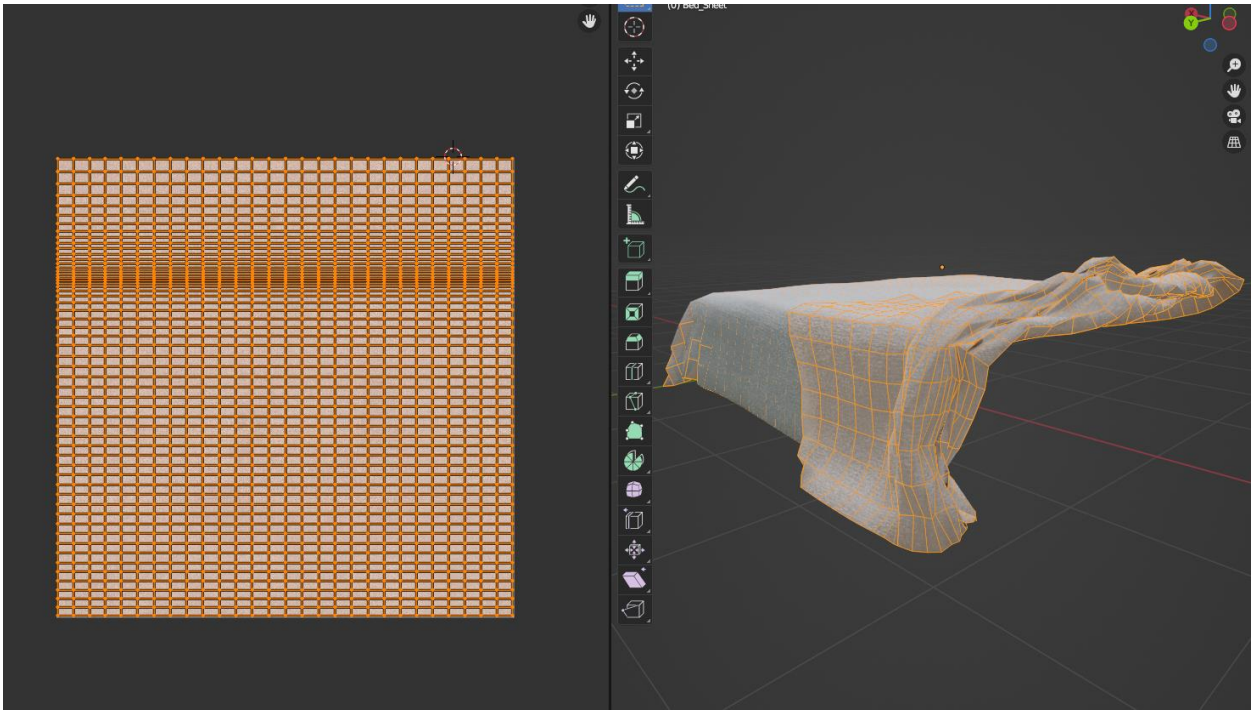

Fig 4.3.7.2 Bed Sheet unwarping.

4.3.8 Road:

Rode is our traffic side model. It's a simple model but we have to faces many problems on this. After finished the model we start unwrapped the model and began to texture. Without proper UV Unwrapping it's not possible to texture any 3D model,

So, UV Unwrapping and texturing are very much connected with each other.

We created the texture into blender which contains several nodes for detailing.

Color map, roughness map, normal map, ambient occlusion map, height map, displacement map, metal map etc. we used their node system texture. It's a complex system and we control shading.

Fig 4.3.8.1 Road Texture.

4.5 Animation:

When images of figures are manipulated to appear to the human eye as though they're moving it's called Animation. Its an important part of 3d modeling. We used the keyframe animation technique to animate our models of different scenarios. Also, we animated scenes from different point of views following the shot division techniques. In several times we used auto keyframe mode to save time though manually adding keyframes is much more reliable than auto keyframe mode. We had to calculate how much frames we need to create and eye soothing animation which saves frames but also keeps the peace of eyes. We fixed 30 frames per second for our every animation scene.

4.5.1 Smart Speed Detector Camera:

Smart speed detector camera is a part of our road animation but we animated the camera to specifically show some features of the speed detector camera. We used close up shot from the shot division to show the texture details.

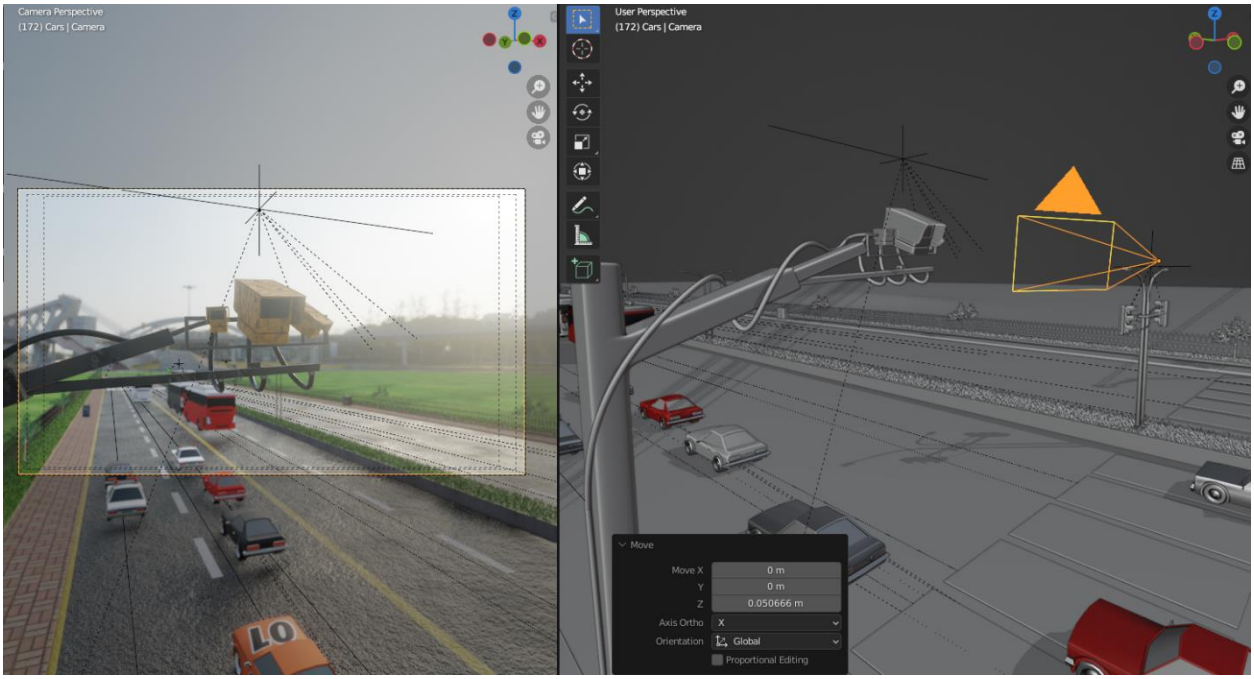

Fig 4.5.1.1 Smart Speed Detector Camera Animation.

Blender offers a splendid feature “Camera Depth of Field” this feature allows us to focus on one single object even while moving the camera around. We used depth of field to focus on the Smart Speed Detector Camera. As this model is one of our smart features we showcased this by focusing on it. We did the same for the traffic lights. We kept the focus to show the features. We did an emission animation on the traffic lights to show how it changes when someone is on the road and it turns red.

Fig 4.5.1.2 Smart Speed Detector Camera Animation.

4.5.2 Smart Parking System:

For Smart Parking System we had to animate the whole model to show how it works. A chain is easy to model by using simple tools but when we thought that we need to animate the chains it became very complex and we couldn't find any solutions about how a chain could move in a particular path and doesn't change its form. Which should have been not that complex but it did because we used array modifier to create a whole bunch of chain segments into a proper working chain. So, when we tried to move the chain through the path the chain become unstable and impossible to animate.

Then we started from the beginning and this time we used curves instead of path to follow. Then the chains become much more stable and possible to animate.

After that we synchronized those chambers with the chain by creating another curve. Then a new problem appeared which is, the chambers were following the curve but by following the curve, axis deformation started. The chambers were stuck to the curve at a single axis. Then we had to find a new way to resolve this issue.

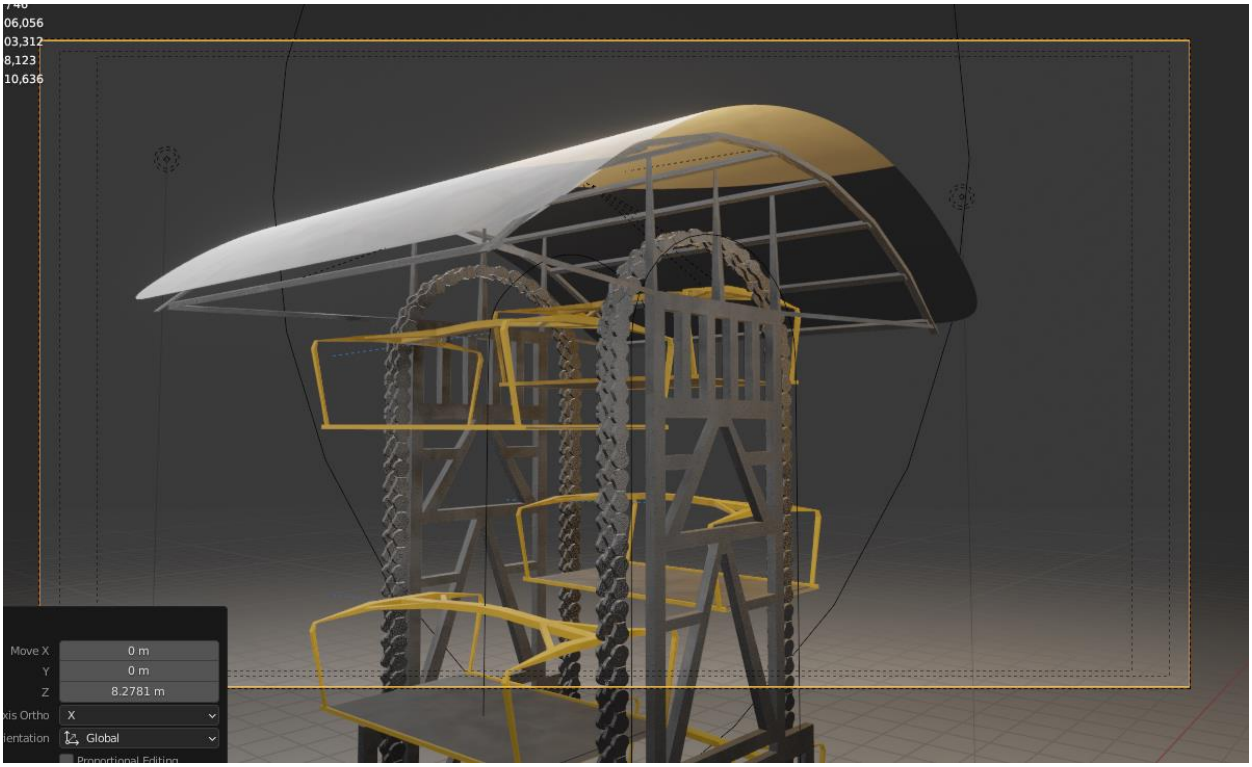

Fig 4.5.2.1 Smart Parking System Animation.

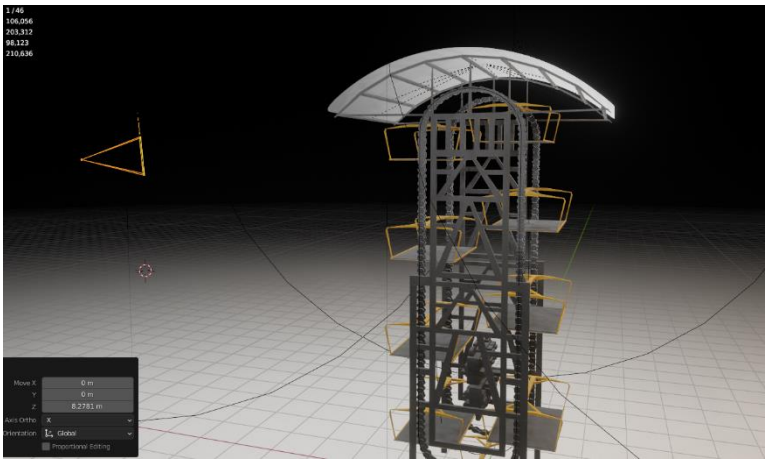

Fig 4.5.2.2 Smart Parking System Animation.

We used simple camera animation to show all the features. The safe areas determine how much are is safe to use for the animation.

4.5.3 Trash Burner:

Trash burner is part of our waste management sector. After finished our model then we apply texture and after that we work on the animation. This part is difficult for us to animate this seen. We use various kinds of shot division for better view. First, we take the key farm and set the frame and animated this.

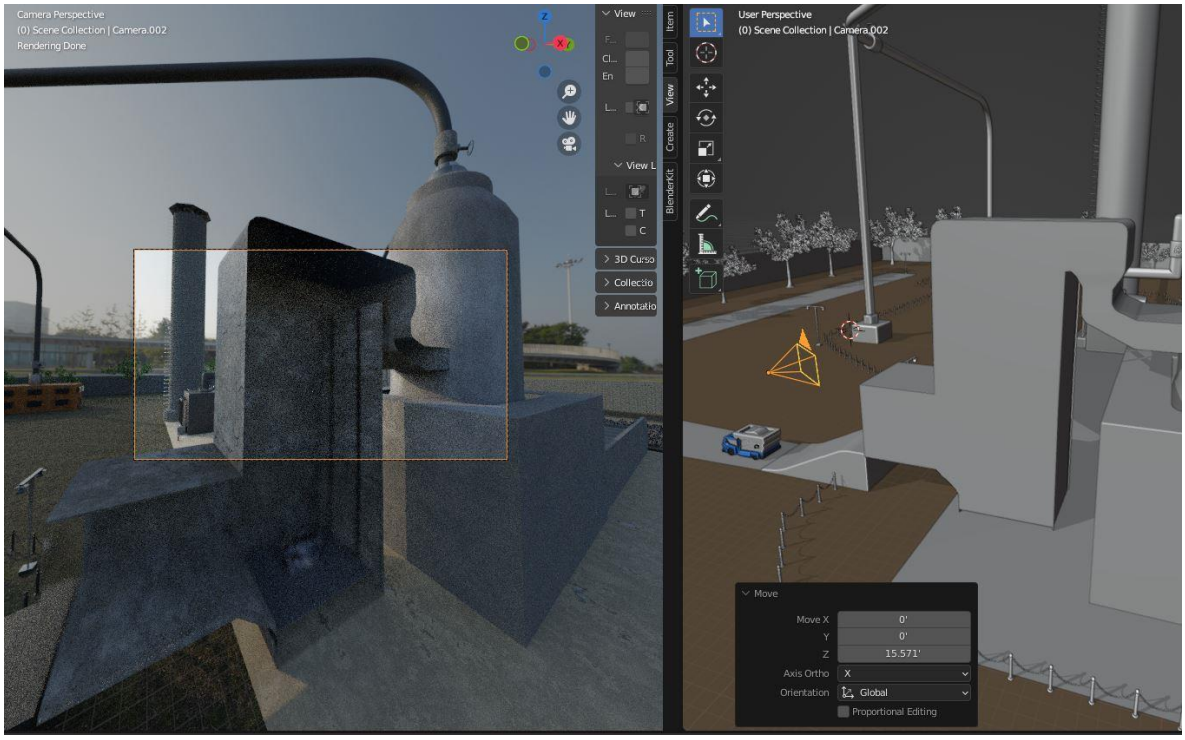

Fig 4.5.3.1 Trash Burner Animation.

4.5.4Ash Conveyor Belt:

Ash conveyor belt is part of our waste management sector. After finished our model then we apply texture and after that we work on the animation. This part is difficult for us to animate this seen. We use various kinds of shot division for better view. First, we take the key farm and set the frame and animated this.

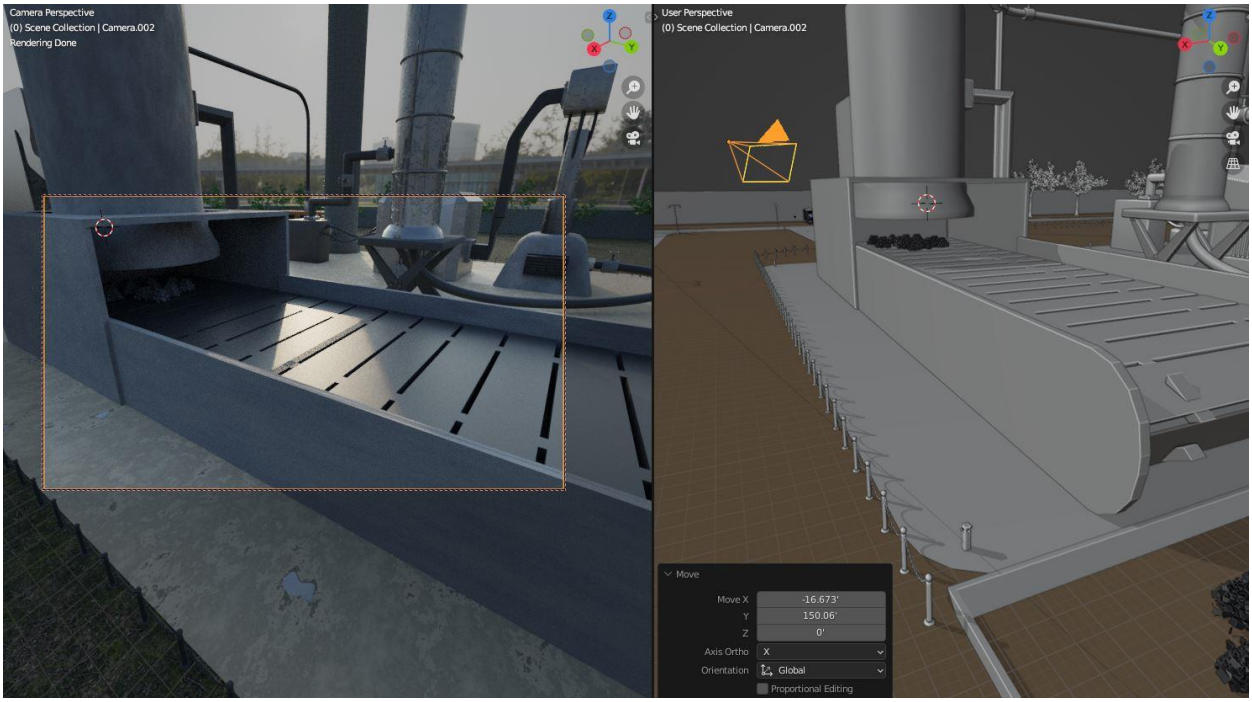

Fig 4.5.4.1 Ash Conveyor Belt Animation.

4.6 Rendering:

Rendering or picture synthesis is the manner of producing a photorealistic or non-photorealistic picture from a 2D or 3-d version by laptop software. The ensuing picture is called the render. Multiple fashions may be described in a scene record containing gadgets in a strictly described language or statistics structure. The scene record incorporates geometry, viewpoint, texture, lighting, and shading records describing the digital scene. The statistics contained with inside the scene record are then exceeded to a rendering software to be processed and output to a virtual picture or raster pix picture record. The term "rendering" is similar to the idea of an artist`s effect on a scene.

4.6.1 Waste Management:

Ash conveyor belt is part of our waste management sector. After finished our model then we apply texture and after that we work on the animation. This part is difficult for us to animate this seen. We use various kinds of shot division for better view. First, we take the key farm and set the frame and animated this. And then we start the rendering process, it took many times for better quality. We render it on Cycles X

Fig 4.6.1.1 Waste Management Render.

CHAPTER 5

5.1 Limitations:

"The successful man will profit from his mistakes & try again in a different way -Dale Carnegie". As Dale Carnegie said we learn from our mistakes and use it as profit to make those mistakes into success.

Turning a smart city concept into 3d visualization has lots of limitations. We had to overcome sophisticated and complex limitations. Such as, proper implementation of the smart city features according to the perspective of Bangladesh. Our project is based on smart city features so we had to design a very complex structure of a city which contains smart city features but in the perspective of Bangladesh, that means we had to analyze and improvise each of our decisions.

3d visualizing a city is a big project for our limited experience and we struggled to build up the whole project.

5.2 Challenges:

There are some challenges that we faced during the process of making this project. The first challenge that we faced was when we realized that this is a large project and even if we are a team of five members, not everyone's expertise is at the same section of 3d visualization.

The next challenge was distance between group members, some of us was at home town when the project was beginning. Then we resolved this issue by getting everyone together but it killed a lot of time. Some of us has medium configuration, which made the whole process slower than we expected and also affected our render time.

Every 3d designer faces a common problem of crashing the software and we are no different. We used a lot of 3rd party addons which costed us the stability of the software.

Blender is a free open source 3d software which run by donations. So, the support system is not as rich as other 3d software, so we did not get proper support when we needed. We had to learn various software to create the whole project.

In some cases, we had to compromise the quality of our render to meet the deadline. Because render time is a large issue when it comes to time management of a large project like this.

Conclusion

The human mind is full of illusions. As ***Eckhart Tolle*** said, ***"All problems are illusions of the mind".*** At the very beginning of this project there was so many issues that occurred to our mind. We were devasted inside thinking that how are we going to fix all of these problems. But after a few days we turned our problems into learning opportunities. We learnt so many new software and how to use them. We learnt so many new modeling techniques. UV unwrapping, shader editing, texturing with nodes, curve editor, mesh conversion, creating textures in photoshop rendering with Cycles, Evee, & CyclesX.

By modeling various kinds of objects, we gathered new experiences throughout the process. Rendering settings are different in every scene. So, we had to evolve from same settings every render to different render settings based on different taste of scene and products.

The exterior and interior projects helped us to learn industry level modeling of architectural structures. We researched so many references to make it to the perfection.

We are satisfied with the choice we made with project instead of internship because we had the freedom of learning anything we want anything we choose and we think we used the time to learn and create something good under proper supervision from our beloved teacher.

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