2020 Future Space Scholars Meet

International Deep Space Development Organization (IDSDO)

“Vulcan” Martian Orbital Settlement Request for Proposals

January 2065

The First Move Proposal

The First Move

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1. Executive Summary

Space station, a critical role in supplying resources and exploration, illuminates our exploring process towards the fascinating universe. In 2065, human focuses on the last and the most essential part in exploring and understanding a familiar yet mysterious planet, migration to Mars. Accordingly, Vulcan space station serves as the first move for this migration process, which supplies fundamental materials for construction in Mars. The proposal focuses on devising a space station which is rational, consistent, integrated, and cost-effective.

Structure and Materials

We aim at devising a space station which is reliable, effective, and cost effective. The moderate design yet achieving the fundamental requires leads to our design. Our design provides required artificial gravity using torus, uses titanium as the main construction material, and utilizes efficient port. The construction of our space station tries to make use of the merits of every step in constructing. Our engines are reliable and rational.

Operation and Safety

In our proposal, electric system is effective, variable, and reliable. The production and storage of electricity is cost-effective and reliable. The air managing system aims at achieving human and production needs and limiting unnecessary distribution. On the other hand, ensuring safety is also a part of air system. Effectiveness and variability make up our water supply system. Therefore, our operation and safety are ensured by the ingenious and rational design.

Residential Area and Community

People are always the most important component in any space station, and human’s psychological and physiological demands are the essential tasks for our residential area

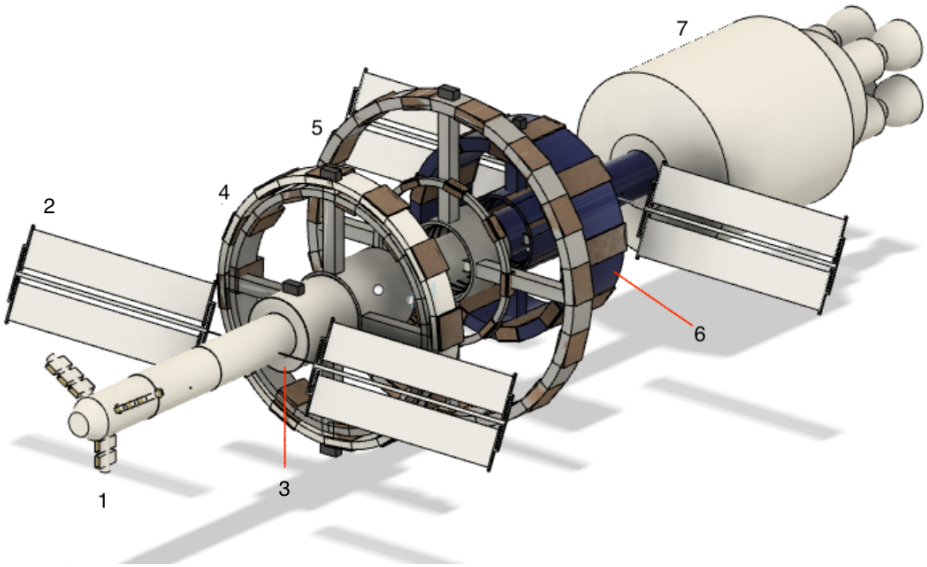
and community design. While achieving fundamental needs of residents, we walk in the customers' shoes: we aims at making people to live a happy life. Utilizing the automation facilities, we make people's life more comfortable and time-saving. Using ingenious design for sport, we help to relieve workers' stresses.

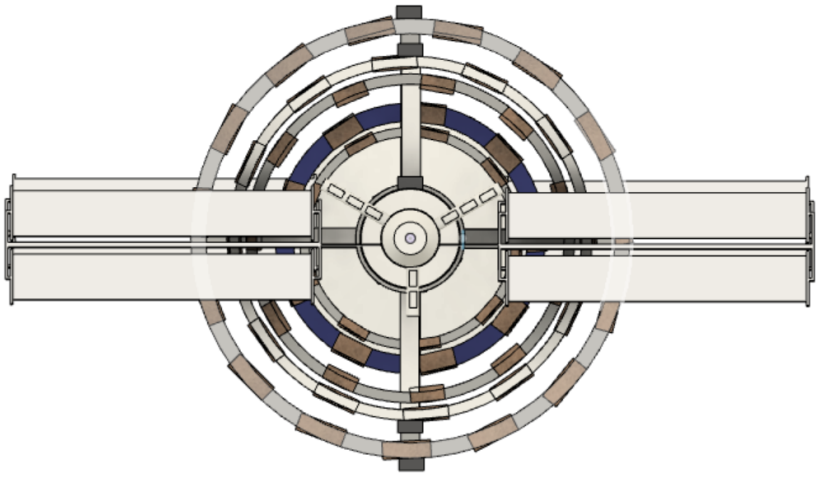
Features

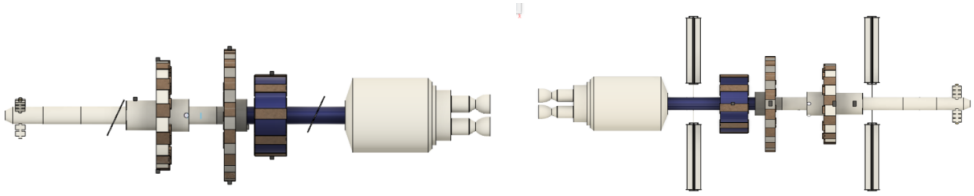
Granted, space farm constitutes a challenge in our design. Therefore, we separate the space farm into two parts, the farm for animals and that for plants. We devise a self-renewal mode between plants and animals, and we utilize different gravity zones to encourage the production ---- that's why we separate the farm. As for industrial production, while providing enough industrial space for different gravitational demands, we design an efficient transporting system which is automatic. Making use of automation facilities is a key feature in our industrial production.

2. Structure and Material

2.1 Overall Design



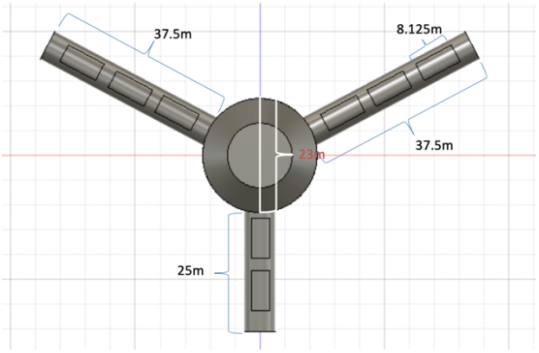




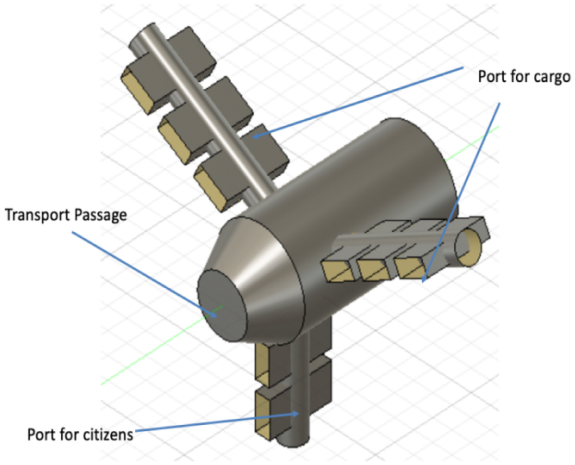
The graph above presents the overall design of the space-settlement, Vulcan. The whole city consists of 7 areas, each of which possesses a different function. The name of these areas and their relative position in the space-settlement is shown in the graph above and this diagram:

1	Port
2	Solar Energy Panels
3	0G Industry area
4	1/6G Plantation & Industry Area
5	1 g industry area & animal farm
6	1/2g Residential area
7	Fuel Tank and Engine

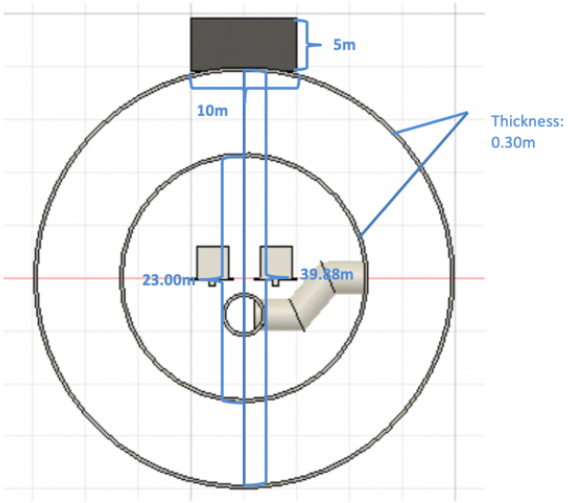
Par1: Port

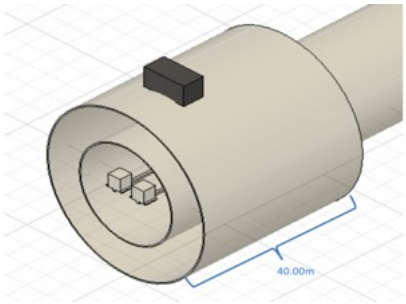


This graph shows the port of Vulcan. The port of the space-settlement is intended to provide berth for spaceships that shuttle between the universe, which may be used to transport the materials that Vulcan needs, or bring people (visitors and crews). There are three small ports, two for cargo and one for citizens. Each of them connects to a 35m long passage which are able to deliver cargos to other functional areas of the city. The port cargo has a total length of 37.5m and contains 6 parking aprons, 3 on each side. The length of the port for citizens is 25m and has 4 parking aprons.



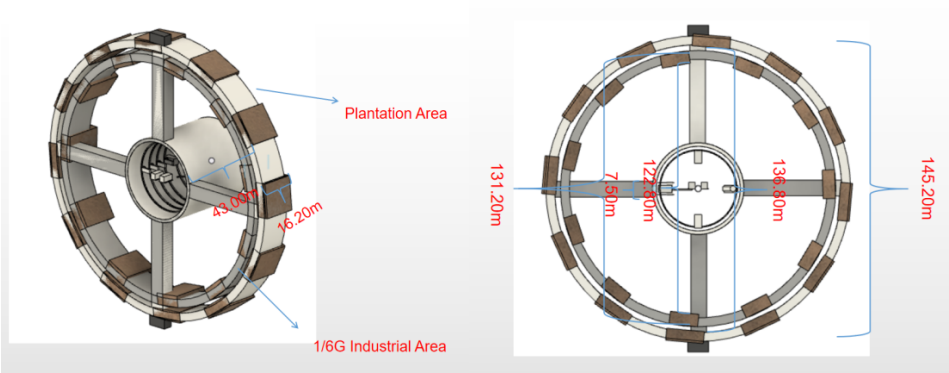
Part2: 0g Industrial Area





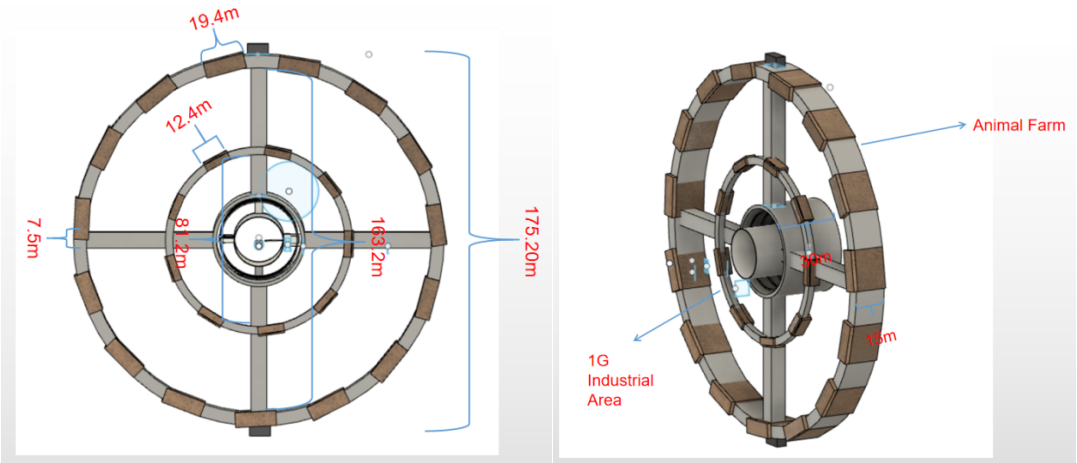
The graph above shows the of the 0g industrial area which is 40m long. The part inside the small circle is Vulcan's main axis. The transport passages and elevators for both cargos and people are placed in the main axis. It has an internal diameter of 23 meters. The area between the small circle and the big circle is the 0g industrial area. The outside circle has an internal diameter of 39.88m. The sickness of both two parts are 0.3m. The black box is the water tank which has a length of 10 meters and a width of 5 meters.

Part3: Industrial Area and Plantation Area(1/6g)



This graph displays the third part of Vulcan. There are two functional area in this picture, 1/6g industrial area and plantation area. The length of the axis of this part is 43m and the thickness of these two annuluses are 16. 2m. The external annulus is the 1/6g industry area whose diameter is 136.8m. The relatively small one is the plantation for cultivating crops. The diameter of the plantation is 122.8m. The smallest ring is the main axis of the space-settlement which connects all 6 parts together. The 7.5m wide bar-types spread in four directions are the connection axis. They link two big annuluses with the main axis to control their motions. The water tanks that provide water for these two areas are placed at the two ends of one connection axis.

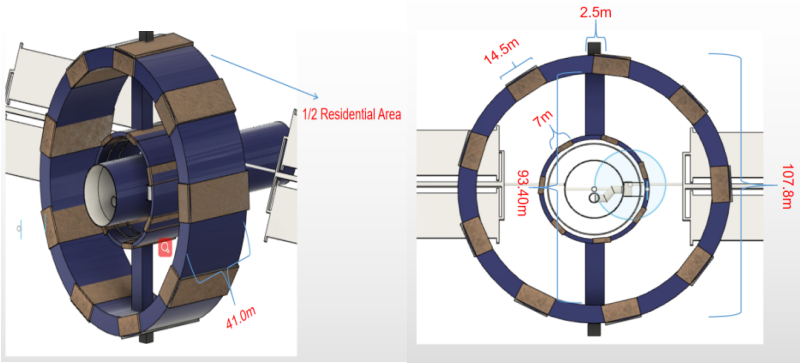
Part4: Industry area & animal farm(1 g)



This graph demonstrates the fourth part of Vulcan. As the previous one, there are two functional area, 1 g industry area and animal farm. The exterior loop is animal farm with diameter of 175.2m. The interior one is the 1g industry area with diameter of 81.2m. The 7.5m wide bar-types spread in four directions are the connection axis. They link two big annuluses with the main axis to control their motions. The water tanks that provide water for these two areas are placed at the two ends of one connection axis.

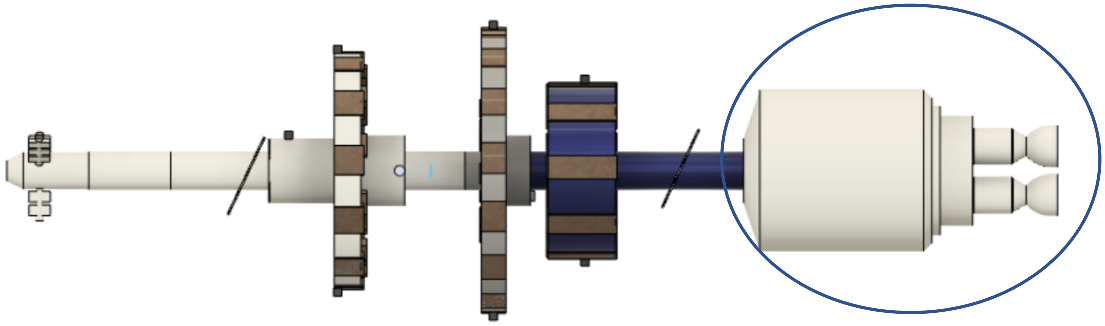
Furthermore, the main axis can help to rotate or stop rotating the whole space settlement. The two annuluses are composed of small sections of area for the convenience of repairing and construction and emergency. In the external loop, the small sections are 19.4m long. In the internal loop, the small sections are 12.4m long.

Part5: Residential Area(1/2 g)



The above graph reveals the fifth part of Vulcan. There is only one functional area which is 1/2 g residential area. The loop for resident has an external diameter of 107.8m and an internal diameter of 93.4m. The 7.5m wide bar-types spread in two directions are the connection axis. They link the annuluses with the main axis to control their motions. The water tanks that provide water for these two areas are placed at the two ends of one connection axis. The separate sections for this area are 14.5m and 7m.

Part6: Fuel Tank and Engines

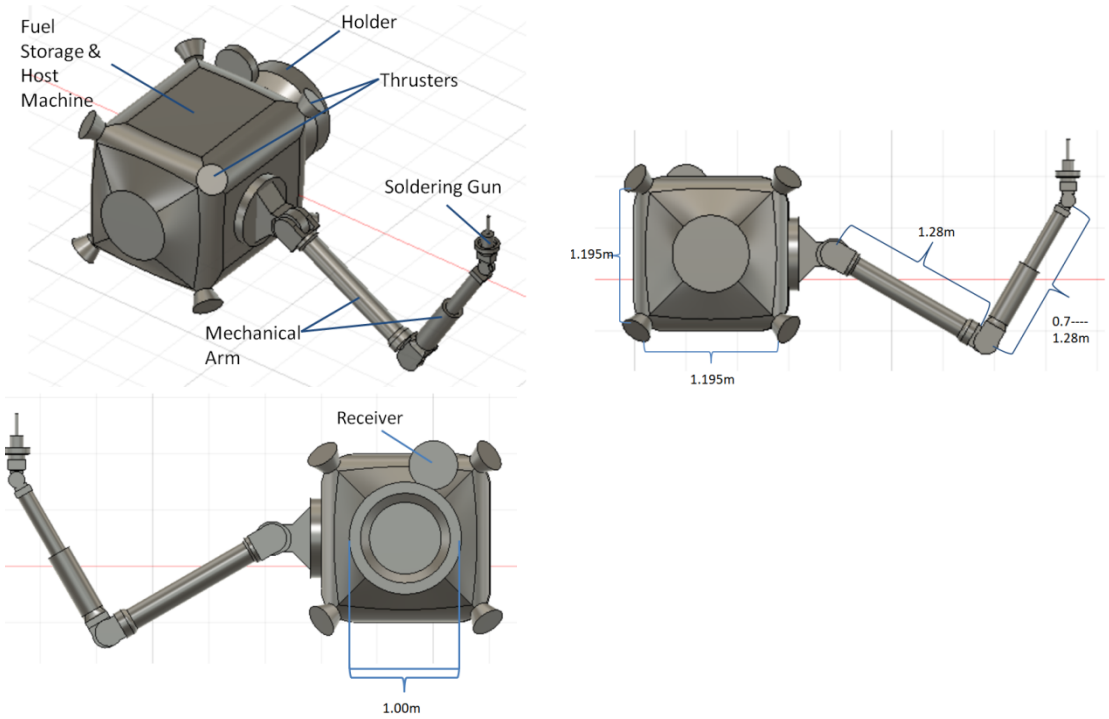


The above graph shows the sixth part of Vulcan which are fuel tank and engines. The fuel tank furnishs the engines with energy resource. Then, the engines provide impulse to the whole space settlement to move.

2.2 Construction Sequence

2.2.1 Constructing Automation Facilities

2.2.1.1 Constructing Robot 1

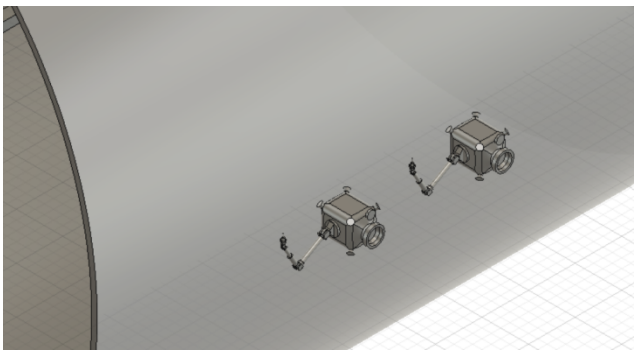


Constructing Robots 1 aims at constructing the exterior parts, constructing interior parts, and transporting related materials while constructing. Utilizing liquid hydrogen as the fuel for thrusters, Constructing Robot 1 attains essential flexibilities regarding movements, which enables it to process both of interior and exterior constructing tasks. The holder of Constructing Robot 1 could be utilized when two, or more if needed, robots cooperate when transporting materials for construction. Mechanical arm and soldering gun help to construct.

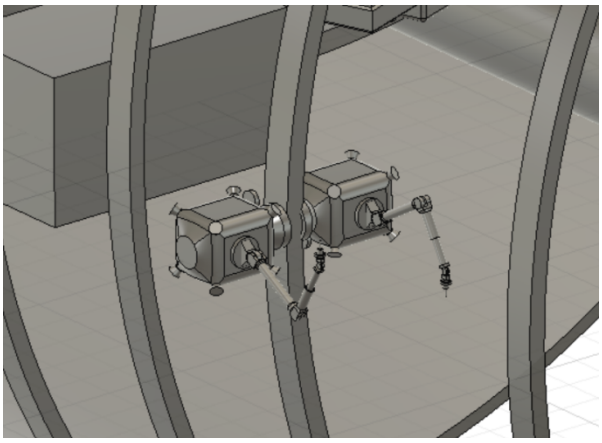
Other than the functions above, this robot can also construct the Constructing Robots 1 and 2. The strategy used would be dispatching 10 Constructing Robots 1 from lunar base (the 10 robots will be constructed in the lunar base) with enough amounts of chips, which have to be produced on earth, to the Vulcan. Then the 10 Constructing Robot 1 would produce the other Constructing Robot 1 until the total number reaches 100.

Moreover, the robot will construct the trail for Constructing Robot 2.

The material of this robot would be titanium and iron, which are abundant in moon. The maximum amount of this robot would be 100.

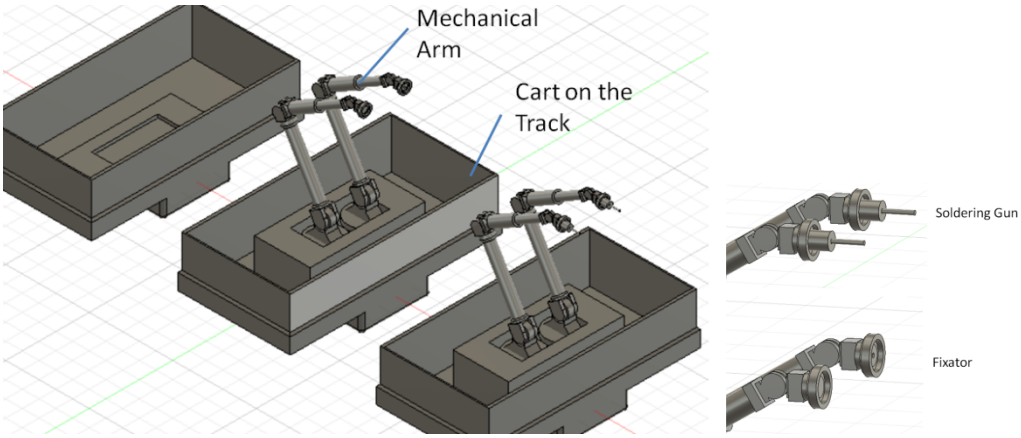


CR1 are constructing the exterior part.



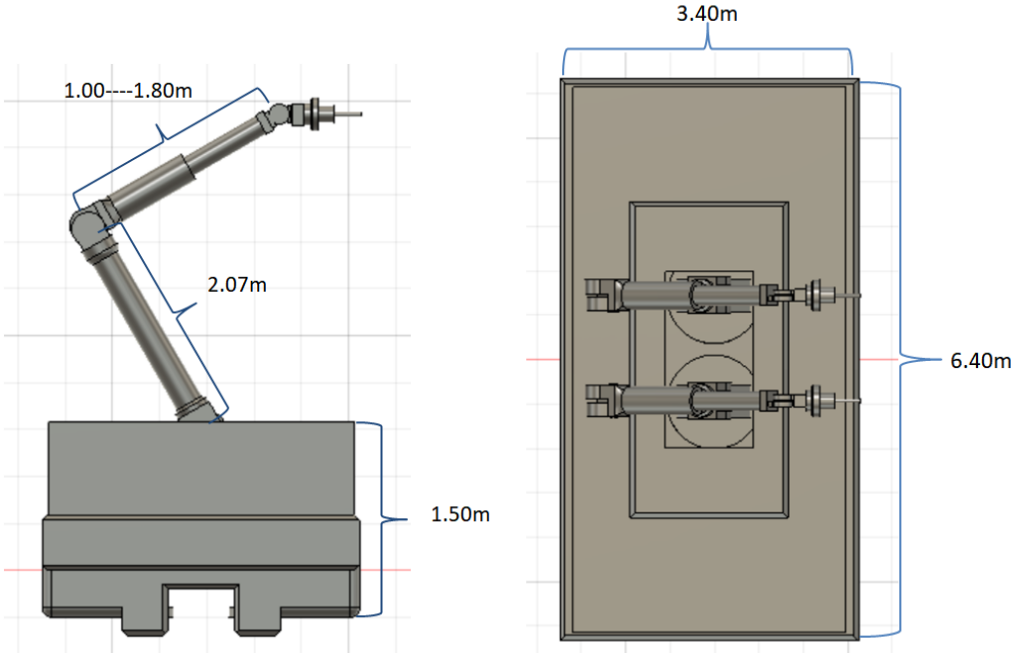
CR1 are cooperating to transport materials

2.2.1.2 Constructing Robot 2



Constructing Robot 2 is responsible for material transporting (from the port to the

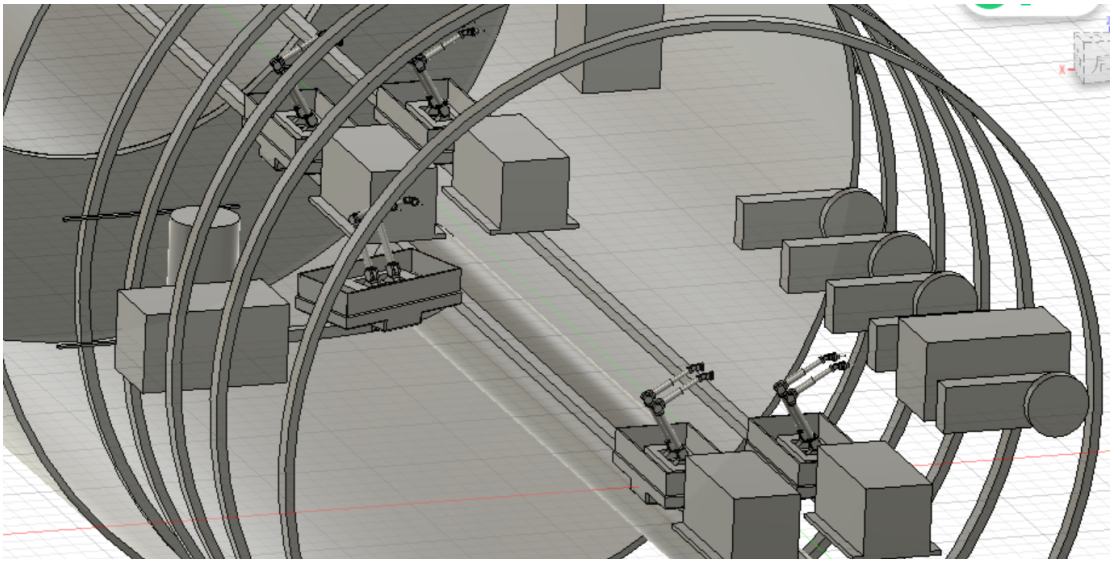
workplace) and exterior construction. Through moving on the trail, or track, Constructing Robot 2 meets the demand to save time. The capacity of the cart is large enough to transport enormous amount of materials, which avoids Constructing Robot 1 to waste liquid hydrogen to save the costs. In addition, this robot is equipped with soldering guns and fixators which are necessary for construction. Plus, the mechanical arms ensure the flexibilities of this robot while constructing.



Other than the functions above, Constructing Robot 2 plays an essential role for dismantling and reproducing. The mechanical arms and the carts are different modules that can be directly equipped to the other robots (transporting cart in 5.3, Constructing Robot 1, mechanical arm in 5.3, etc). Such design could save the time and costs for constructing robot 1 to dismantle and reproduce multiple kinds of robots.

The material of this robot is titanium and iron (same with Constructing Robot 1). The maximum amount of this robot would be 20. The power supply comes from electricity (Vulcan can generate electricity at the same time).

At last, the producing strategy used here is that after laying the track of the central axis of Vulcan, Constructing Robot 1 starts to produce Constructing Robot 2 until the total number of this robot reaches 20 (which require to dismantle 40 CR1).



CR 2 are transporting and constructing the exterior parts

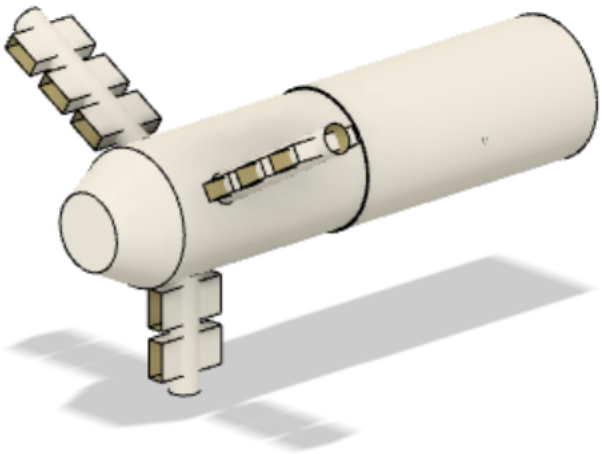
Appendix:

The Reproduction Schedule

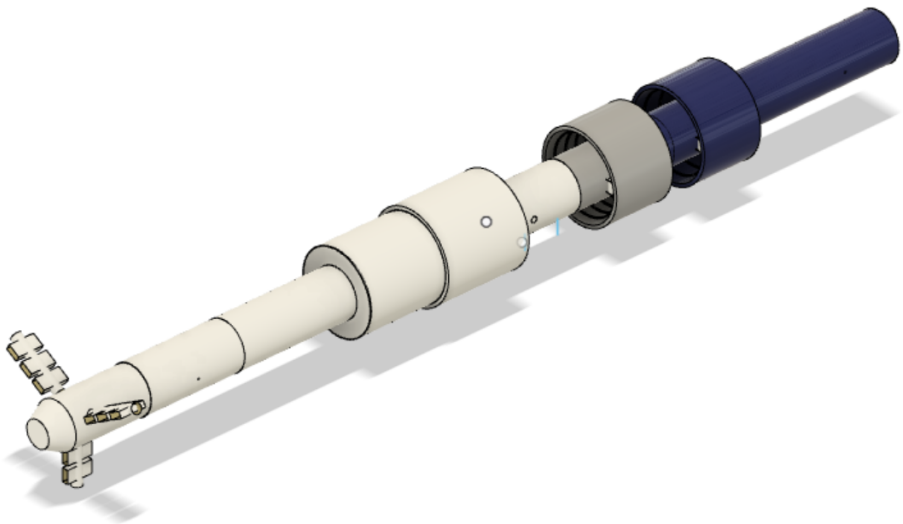
Task	Site	Period
Lunar Mining	Idun Lunar Base	12 months in advance the construction
Chips Transportation (from earth)		
Robot(CR1) Reproduction (one per 5 days)	Idun Lunar Base	15months
Tracks Construction (by CR1)	Vulcan Space Station	10 months
Robot(CR2) Reproduction (one per 5 days)	Vulcan Space Station	2 months
Robot(Transporting Robots in 5.3) Reproduction (one mechanical arm per 5 days, and one cart per 3 days)	Vulcan Space Station	6 months

2.2.2 Construction Sequence

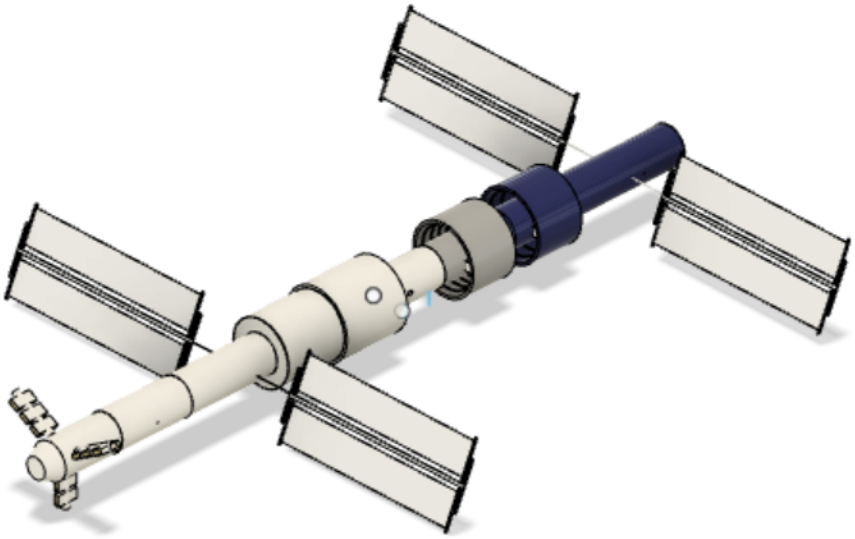
Step1: Port（to transport the materials that Vulcan needs for construction and bring people）



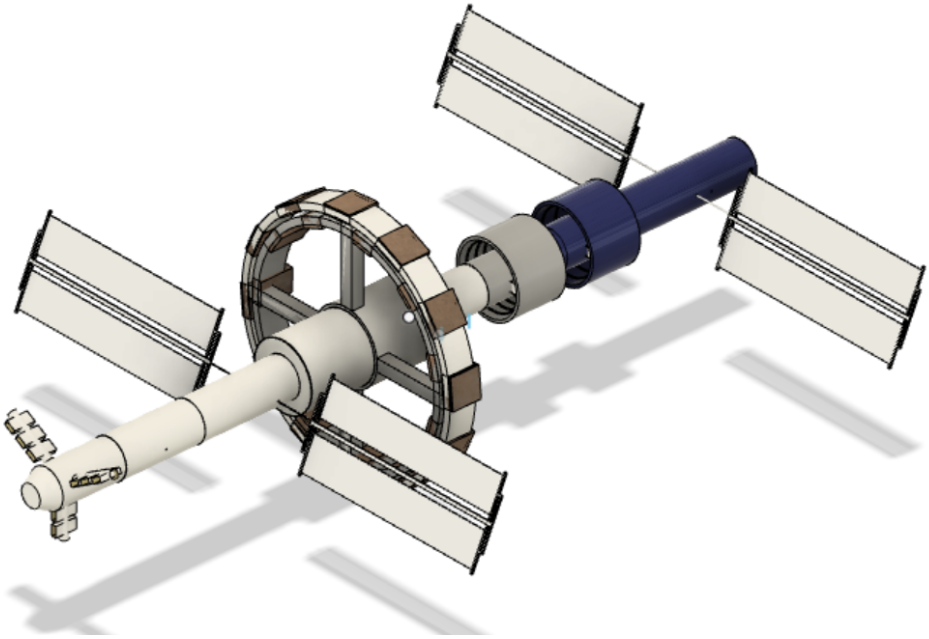
Step2: Main Axis (foundation for following construction)



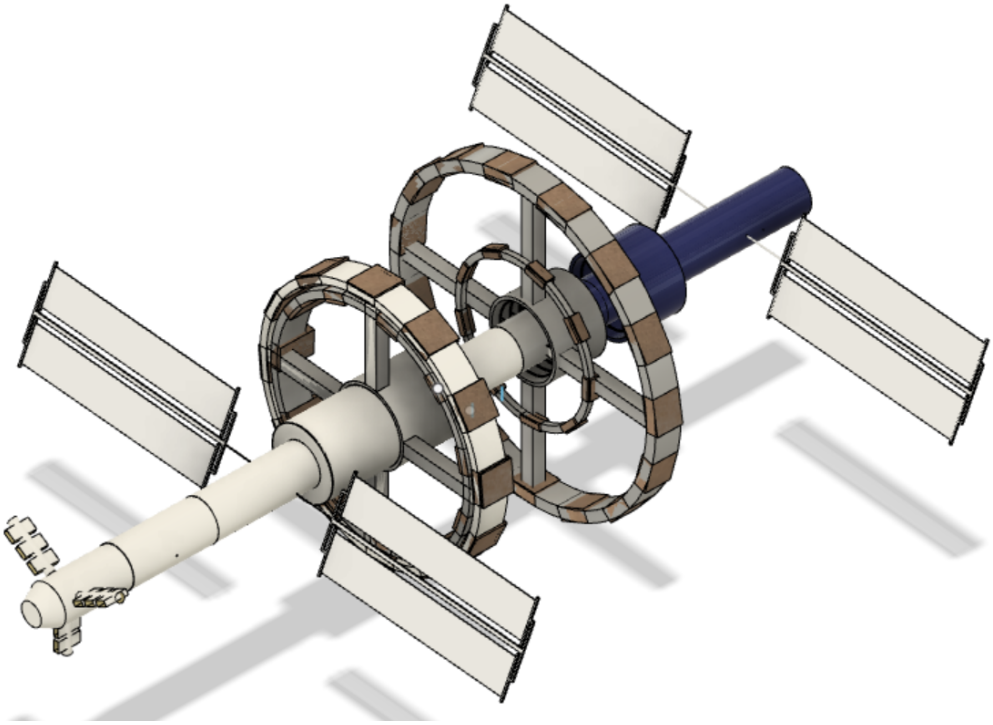
Step3: Solar Panels（provide lots of energy for the project）



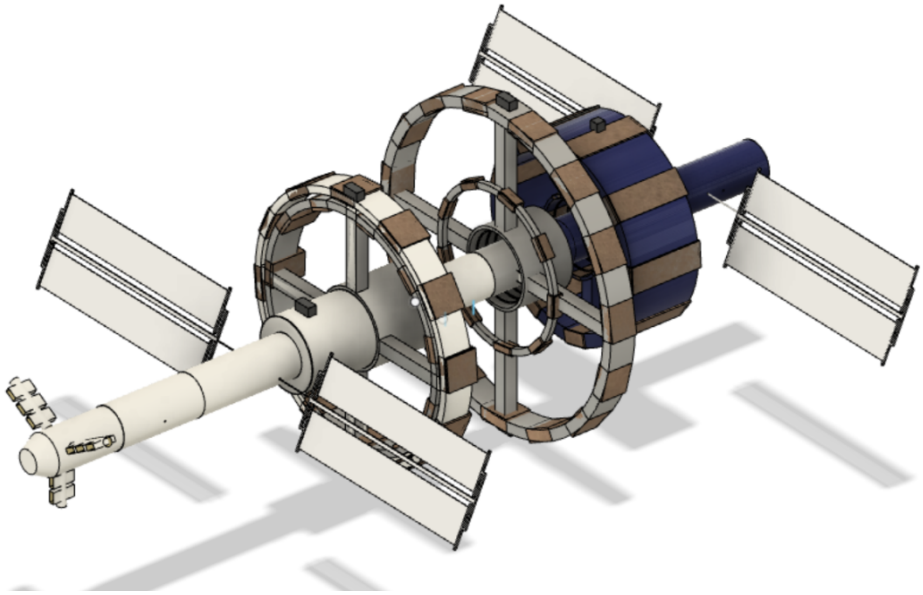
Step4.1: 1/6 Plantation & Industry Area



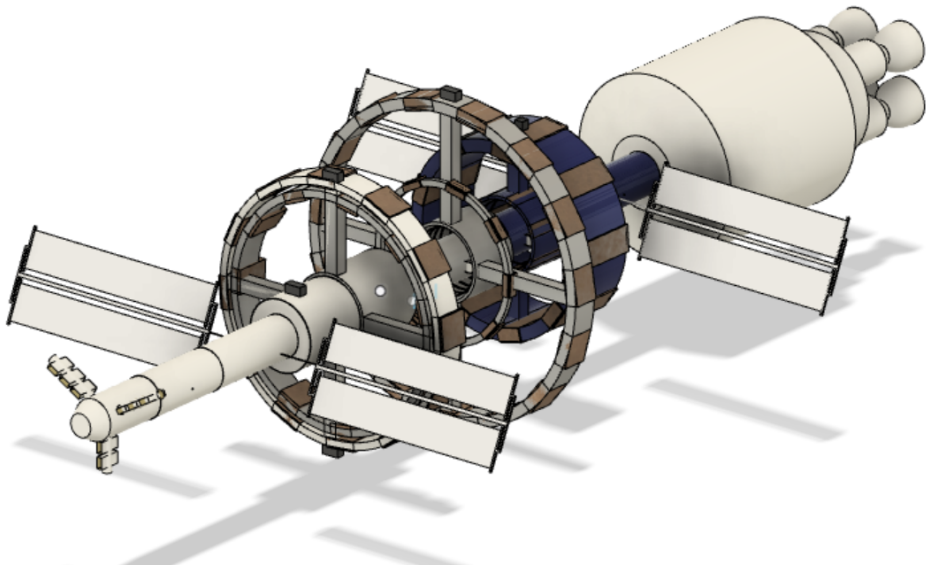
Step4.2: 1G Industry Area & Animal Area



Step4.3: 1/2 Residential Area (Including Water Tank)



Step5: Fuel Tank and Engines



First, our company build a port for transportation. This step is intended to provide a place to land for the material obtained from other planets and workers. After this, we plan to build the main axis of Vulcan. Since the main axis connects all parts of the space-settlement including the engine and solar panels, it is indeed our foundation for the following construction. Solar panels are also important because they can provide lots of energy for the project. Therefore, we need to build the solar panels as soon as possible and the most suitable time would be after we finished main axis. The next steps are the functional areas, residential area, industrial areas, farming areas. There building consequence are shown above. After the construction of the functional area, the last step is the fuel tank and engine. Once the last step is finished, Vulcan is ready to 'set sail'.

2.3 Construction material

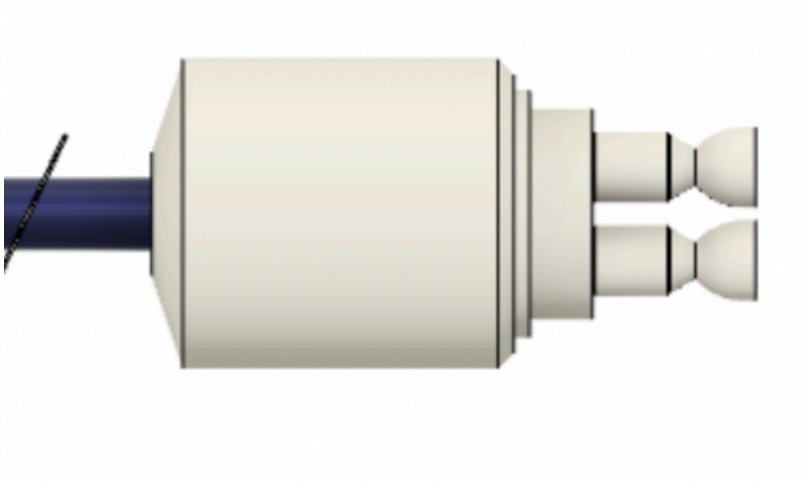
Material Type	Sources	Mass	Density	Note
Aigis	Lunar Bases	2994.304	2.3g/cm3	20cm-thick
Titanium	Lunar bases	84865.95	4.507g/cm3	

We use Aigis for radiation protection. It's easy to obtain a large number of batches within a short time. More than that, Aigis is relatively cheap. It can be applied to

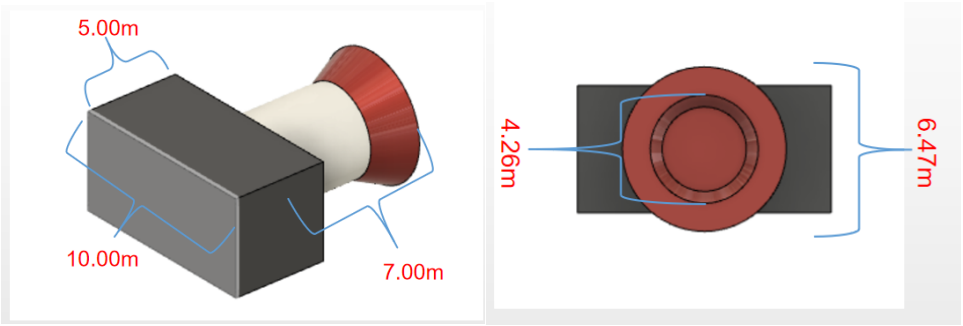
exterior structure of human space infrastructure. With a density of about 2.3g/cm3, it is highly radioprotective. A 20cm-thick layer of Aigis added to the exterior structure of the Lunar Palace can effectively protect humans from primary and secondary cosmic radiation.

Titanium is for the thermal insulation of the space-settlement, On the Moon, titanium is in the form of a magnetic mineral (ilmenite) which can, in theory, be easily separated from the bulk of the lunar ore. In addition, use of titanium for structure would result in significant savings in the total amount of refined material because, although more difficult to form and fabricate, its strength-to-mass ratio is greater than that of the other metals available. Since ilmenite is basically FeTi03, significant amounts of iron and oxygen can be extracted as byproducts.

2.4 Delivering and Orbiting



After the construction of Vulcan, the space-settlement will be launched towards the Mars via Earth-Mars transfer orbit and eventually enter the orbit of Mars after decelerating. Therefore, an engine and a thrust will be necessary. They will be placed at the back of the whole space settlement.



These two pictures are the engine for rotating. They are at the two ends of one connection axis at each annulus.

The equation that we used to calculate the thrust and the weight of the thruster:
thrust=2.8M/1000 (M=the weight of Vulcan without fuel)
weight of the thruster=F/200000*0.095 (F=thrust)
Put the number of M and F, we get that the thrust is 193520N, the thruster weighs 10.2T.

3. Operation and Safety

3.1 Atmosphere Management

District	Composition	Sources
Industrial area	Vacuum, need additional maintenance for spacesuits and so forth.	Artificial intelligence machine for maintenance. Because it is vacuum so that it does not necessarily need any gas sources.
	Air Pressure	Mass
	0.8atm	

District	Composition	Sources
Residential area	78.0%N2 21.425%O2 0.5%CO2 0.075% water vapor	The earth will supply liquid nitrogen and liquid oxygen. Agricultural area will supply oxygen during daytime and carbon dioxide during night. Nitrogen gas can be more beneficial than noble gas because the nitrogen-fixing plants can support the system that the gas level can be biologically maintained by the conversion of nitrogen intro protein.
	Air Pressure	Mass
	0.8atm	106335kg liquid nitrogen 33362kg liquid oxygen 1071kg carbon dioxide 66kg water vapor

District	Composition	Sources
Agricultural area	Initial :78%N2 21%O2 1%CO2	The earth will supply liquid nitrogen, liquid oxygen, and liquid carbon dioxide.
	Later: 83%N2 15%O2 2%CO2	Residential area will supply carbon dioxide Agricultural area itself can supply oxygen. The earth will supply liquid nitrogen.
	Air Pressure	Mass

	0.8atm	

3.2 Electric Power Management System

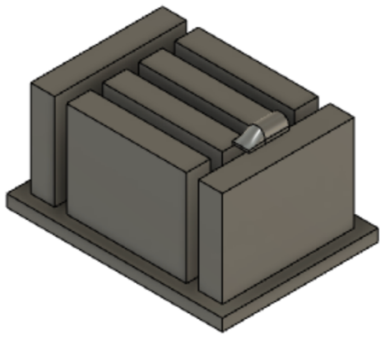
Section	Consumption（kW）
Residential Area	2100
Industry	110230
Agricultural	3280
Emergency	31500
Operation	9000
Sum	156030

In the Domestic, considering the facilities in each room which have relatively high electricity consumption, each room requires 2kW. There are 900 rooms. Also considering the amusement, lighting etc., the totally consumption in Domestic is around 2200kW.

In the Industry, there is a facility which needs at 100MW electricity for smelting and processing. Also considering other facilities, the consumption of Industry is around 120000.

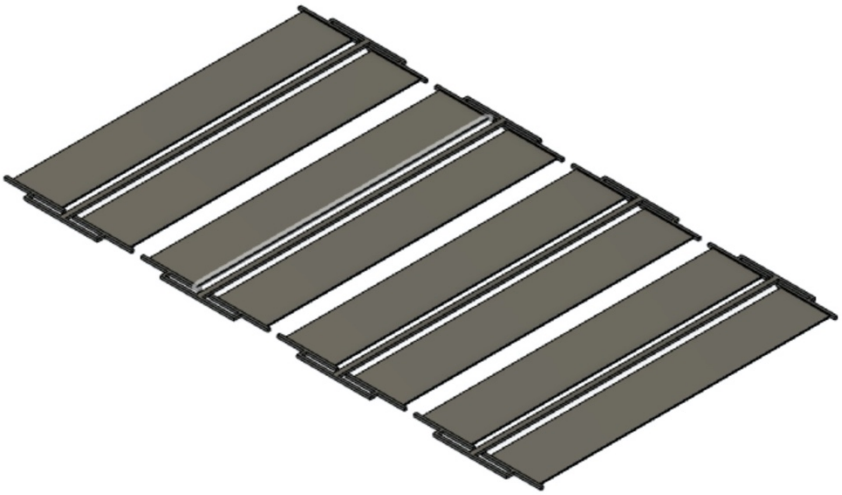
In the agriculture, sunlight is used to fulfill the requirement of plants in order to minimize the electricity consumption. So, the consumption of Agricultural area is watering and operating machines. The agricultural area needs around 3300kW.

In emergency circumstances, only electricity to Domestic are provided with electricity and the planting area of Agricultural. So, around 31628kW is needed in order to last 30 days without any energy resource. Since only Domestic and Agriculture area need energy during emergency, there are batteries in Domestic area in order to reduce the



translating loss.

As electricity is produced instantly when it is needed, the electricity storage facility is unnecessary for daily use. In order to provide enough electricity to the whole spacecraft during emergency, sets of batteries are used as energy resource. In the picture above is a set of batteries.



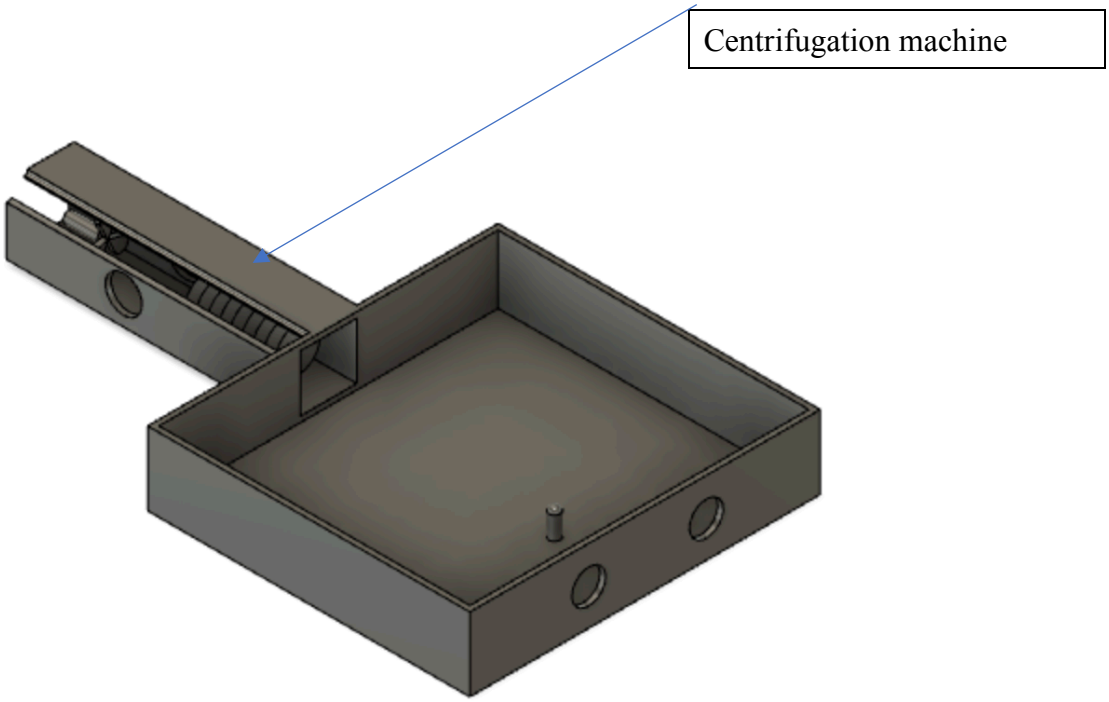
Talking about the way to produce electricity, solar energy is applied as energy resource. The solar panel has about 60% power utilization efficiency. According to the distance of Mars from Sun, we can estimate that the solar panel on Mars can produce 1.3kW per m^2. Then it is able to estimate that the area of solar panel is around 236602m^2

3.3 Water Resources Management System

Section	Water consumption (min) L/day	Water consumption(max)
Human Living (drinking water)	34500	37400
Human Living	434000	473000
Industry	200000	220000
Agricultural	172000	183000
Humidity Maintenance	3700	4500
Sum	844200	1762100

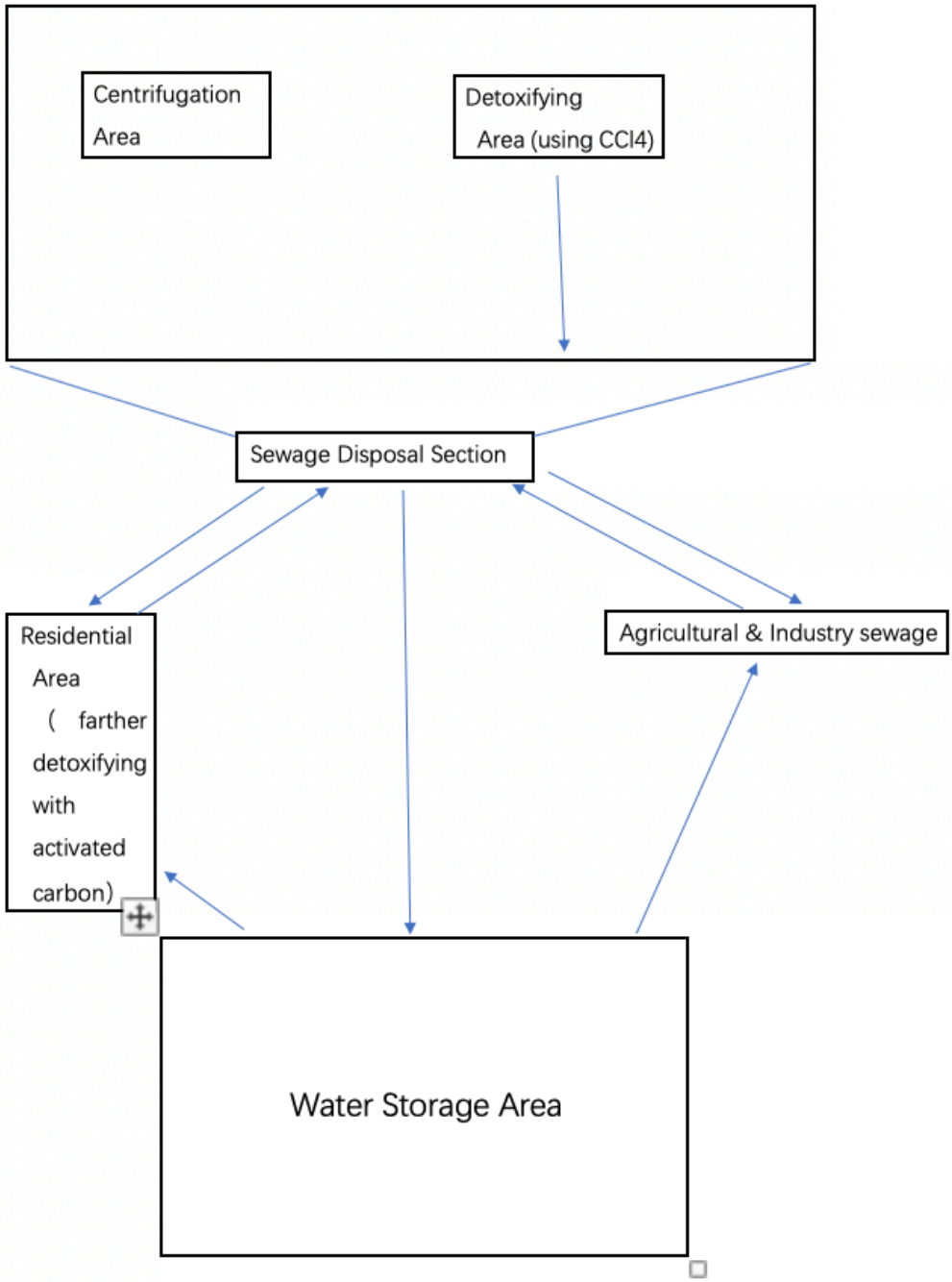
There are water tanks in each area. In the Human living area, the water tank's length is 10m, and the width is 10m, and the height is 5m on the outside of the Human living area. In the Industry area, the water tanks (six) are the same on the outside of the

whole Industry area. The following picture is the Sewage disposal section. As for the source of water, it is from the water ice from lunar. After exploitation of water ice, it will be melted and processed in the industrial area for domestic and industrial use.



The little projection in the detoxifying area can detect the concentration of CCl4. When the CCl4 is not enough, it will add CCl4 into the pool. The holes are heading to different areas with pipes.

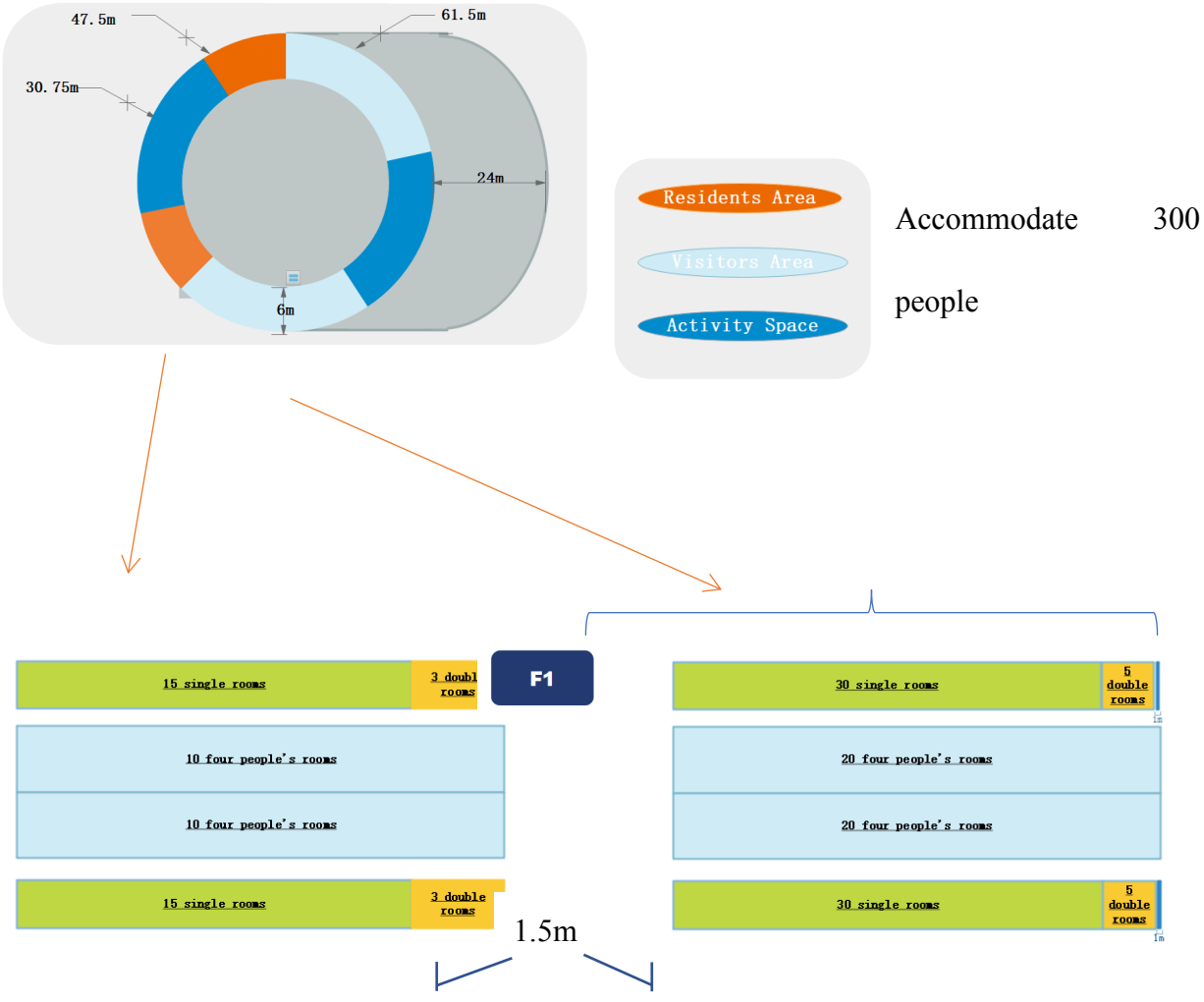
The following picture is the flow chart of the whole water system.


Centrifugation Area
Detoxifying Area (using CCl4)
Sewage Disposal Section
Residential Area (farther detoxifying with activated carbon)
Agricultural & Industry sewage
Water Storage Area

4. Human Factors and Health

4.1 Residential Space Design

According to the proportion of the population in Mars space station and economic situation of Vulcan, it is divided into two separate parts for residents and visitors. In order to assist easily fit into the settlement life, there are two floors with three meters high each floor (Same set in each floor). Because residents get used to live in low-rise apartments or buildings on earth. In each area, there are two same units which are isolated by leisure area between them. One unit accommodate 300 residents or 600 visitors.

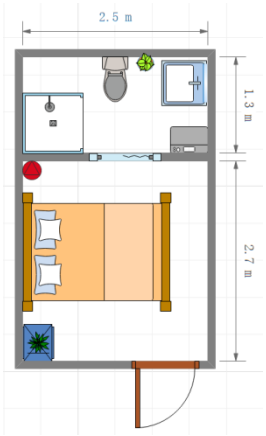


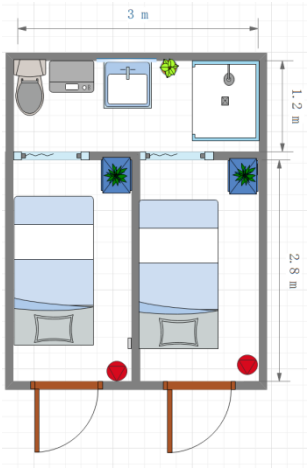
In the middle of each unit, 20 of four people's room arrange in two rows. Single rooms and double rooms distribute on both sides. Plus, we blank 1 meter wide surplus of visitors' area that connects to leisure area. With the existence of 1.5meters wide main roads, people can easily via any place. (The white area)

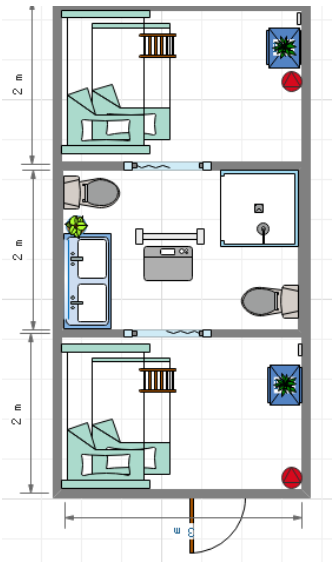
We will supply astronauts with three types of living house types in each unit but with different areas. All people are capable to find satisfactory homes for their respective demands and their

favors. The bed can be folded and left enough space for work. Cabinet near the bed contains folding chairs and a table using.TV equips with virtual reality glasses, so visitors are capable to watch movies at home.

Residents:







The Gross Area:10 ㎡

Group-oriented:

a couple

The Gross Area:12 ㎡

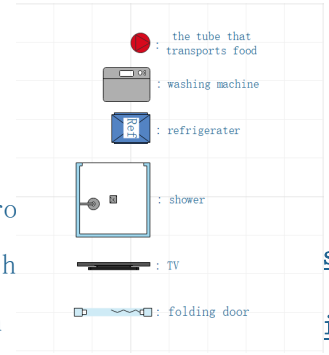
Group-oriented: single ro

designed for people who h

special requirement such

creating a private space. Two

persons will share a washroom



s Area:18 ㎡

ented:

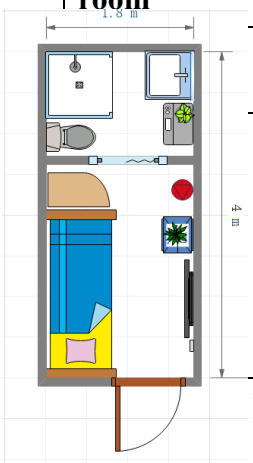
The forth-people residence is

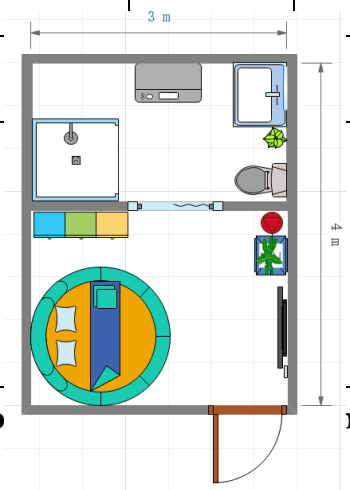
designed for single man and

Visitors:

House Type (residents)	Propor of room(n	The Gross Area: 12 ㎡ Group-oriented: a couple		The Gross Area: 21 ㎡ Group-oriented: four people	
Single room	6				
Double room	10	6	60	12	120
Four people's room	18	20	360	40	720

The Gross Area: 7.2 ㎡



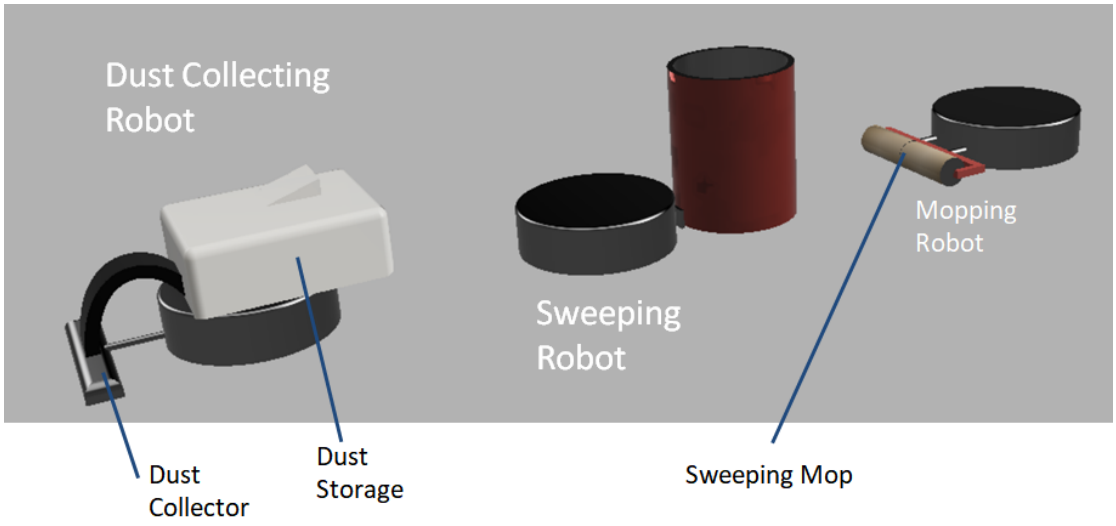


Visitors	Propo of room(m^2)	floor	ortio floor (m^2)	ea	n unit(m^2)
Single room	7.2	60	432	120	864

Double room	12	10	120	20	240
Four people's room	21	40	840	80	1680
Amount					2784

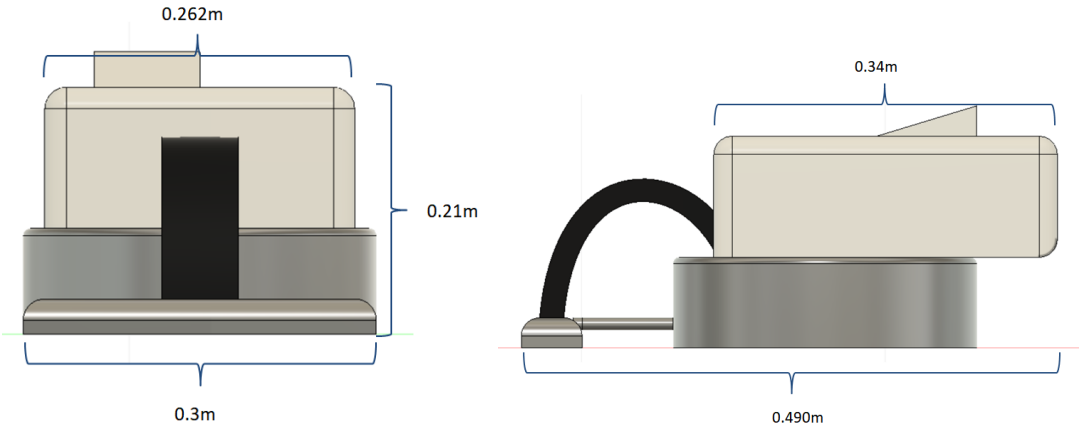
4.2 Residential Automation Facilities

4.2.1 Cleaning Robots

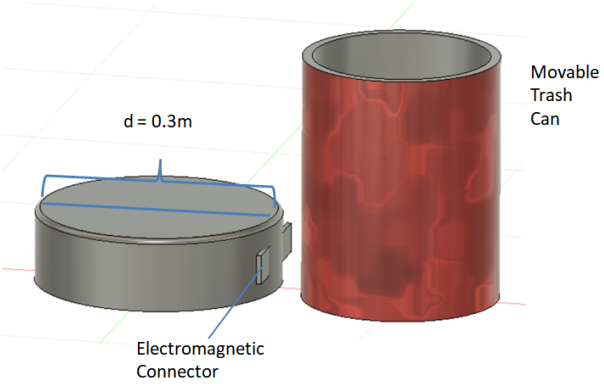


The First kind of robot used for cleaning for every residents in Vulcan. In the Vulcan, sanitation is essential for everyone, and people, accordingly, would spend lots of time repeatedly to keep the room tidy. In order to save the time of people for more important work, cleaning robots' roles are self-evident.

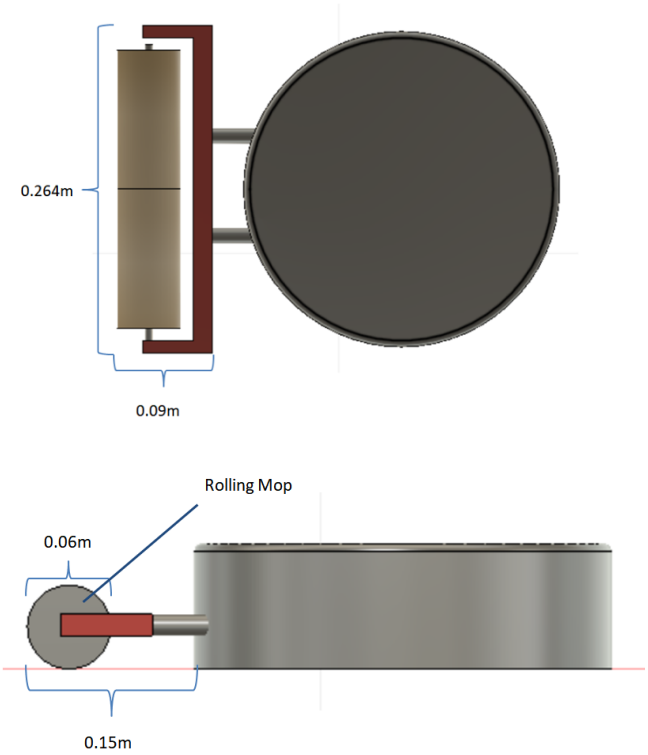
The Cleaning robots are actually the different matches of different modules. To be specific, sweeping robots could achieve the functions of mopping and collecting dusts by equipping accordingly modules as shown in the dimensional graphs. Note that the different equipments are exchangeable, which endows cleaning robots much higher flexibilities and every robots could be used effectively.



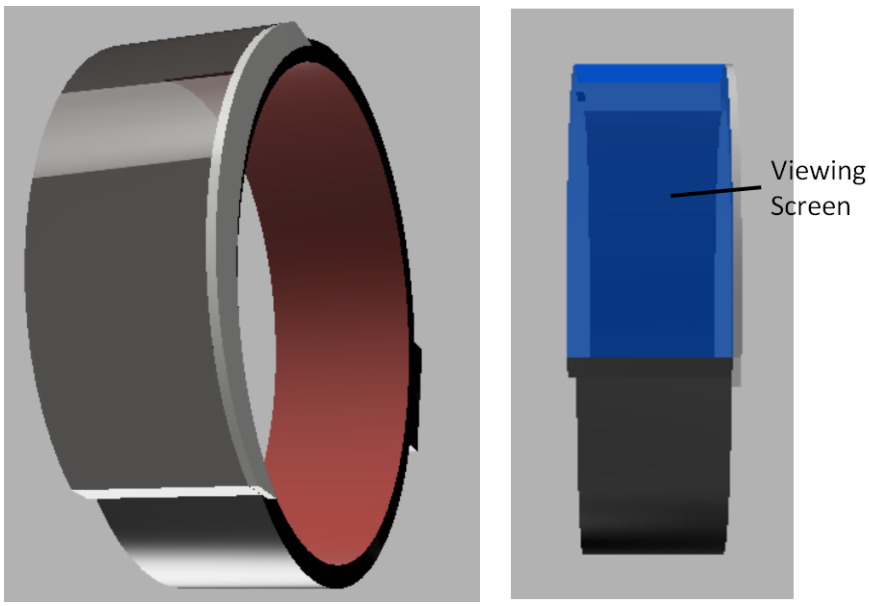
Moreover, inconsideration of the time spent on taking away wastes, every sweeping robot attains the electromagnetic connector to take away the trash cans.

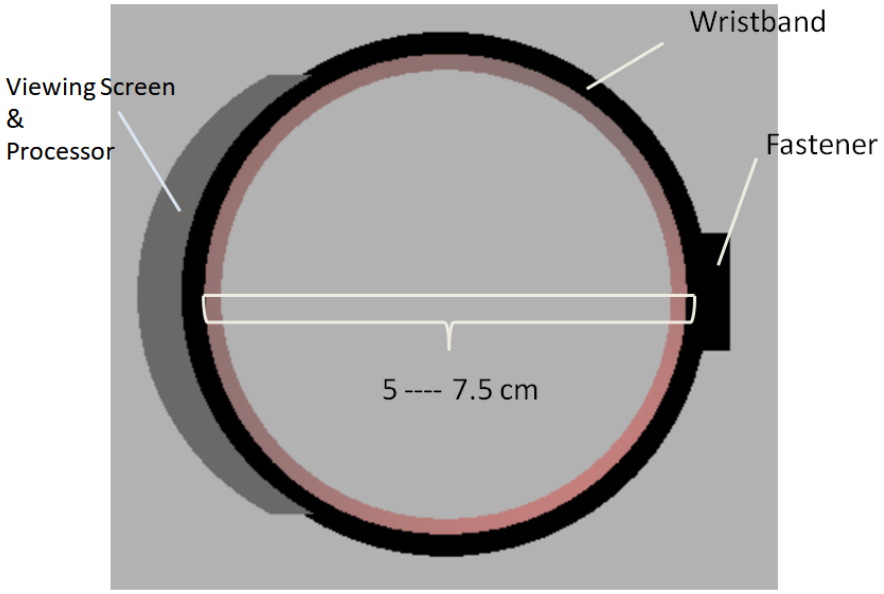


The main material would be plastic. The total amount of robots is 70. The power supply comes from electricity



4.2.2 Smart Watch





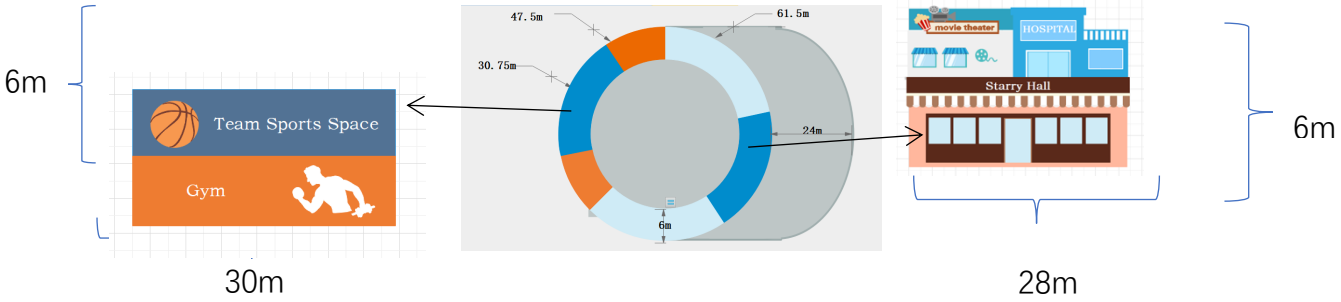
In fact, in our daily life, we may waste time everywhere, even though this is not conspicuous. Therefore, a smart watch, help people to organize their routine tasks to minimize their wasting time, would be an effective way.

Smart watch actually represents a whole automatic system of user's routine tasks. Smart watch is related to the washing machine (set the washing time in advance), cleaning robots (set the cleaning time to be during users' working times), and calorifier.

The material of this wearable device is rubber and plastic. The total amount is 600. The power supply comes from electricity.

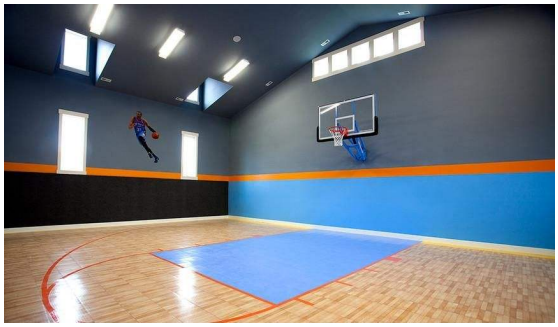
4.3 Activity Space

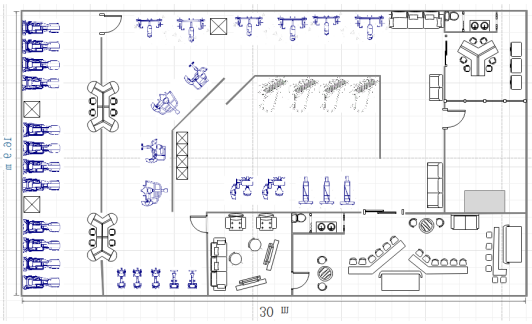
In order to keep residents and visitors' physically and mentally fit, and stimulate community vitality, we have multifunctional gym and the cinema in leisure area. For instance, individuals would like to play golf game through VR technology in the gym; people can choose their favorite movies by using Automatic Speech Recognition technology (ASR) after 3 seconds and so on. Moreover, we set two rows beside activity space for the sake of valuable space. People who live in this area can be satisfied by convenient social demands.



4.3.1 Gym &Team sports space

The top space is used for a special team sport. The game is quite similar to basketball, which means that there are two teams trying to throw one ball into the other team's basket. However, the basket is higher as people can jump higher under 1/2g. Another rule of this game is that when the ball can only touch players' hands, and if it is touched by other parts, the team will lose 1 point each time. The second space is a gym, we provide different types of equipment for astronauts. The entertainment area includes the VR equipment which provide the tourists a simulated golf game and skiing adventures. The leisure area provides the tourists some snacks and beverages. It includes the facilities of treadmill and climbing machine offering the residents to make aerobic exercise to improve their cardiopulmonary abilities.





The running machine is specially designed for astronomers. Because of the special gravity in the space station, astronomers need to exercise for at least two hours every day to prevent osteoporosis. To run in the space station, astronomers need to fix themselves on the machine by elastic bands. The bands provide the tension which imitates the gravity they need. Also, the machines are motorized instead of electric. The electric running machines we have on the earth may cause electromagnetic interference and are more difficult to control in the space.

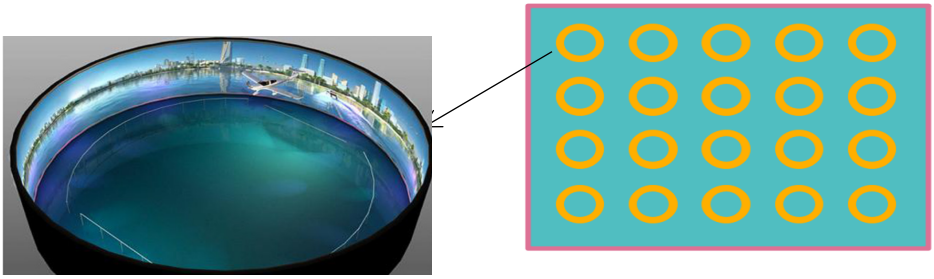
4.3.2 Starry Hall

Starry Hall is located above the hospital and the gym in the residential area, occupying 738m^2. Its location renders the entire entertainment area to be connected. Users are able to take their friends and family to dine among stars here. To spread the panorama of the starry space around users, the restaurant is expanded in an arc-shaped. With windows facing the starry space, users are able to closely appreciate celestial bodies such as asteroids or comets that are passing them. Like any other restaurants on earth, open area, individual closed cubes as well as bar counters are all equipped, ensuring users' need for privacy and entertainment. Furthermore, combining with the "Earth's style" trim, users are able appreciate the astonishing view while feeling at home.

4.3.3 Cinema:

Panoramic ring screen and comfortable massage armchairs are perfect combination in cinema especially when watching whatever you want. Imagine the sense of watching

Interstellar near the Mars. Audience will sit in a loop as yellow ring showed in the picture to enjoy their good time. Each movie will equip scent capsules, and audience needs to open the right one, following hints. Our scent capsules are a fancy tool for experience same scent within the movie. For example, you can smell fragrant Jasmine, and also sniff appetizing pizza off. Furthermore, we provide five different types of popcorn and a variety of drinks at shop.



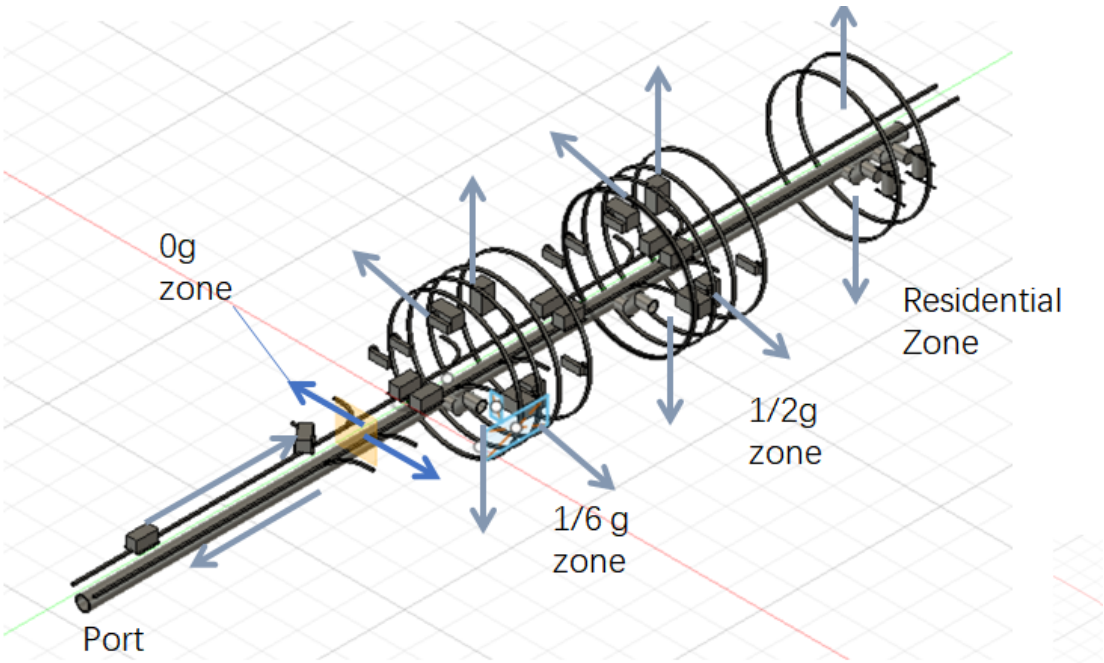
Vertical View

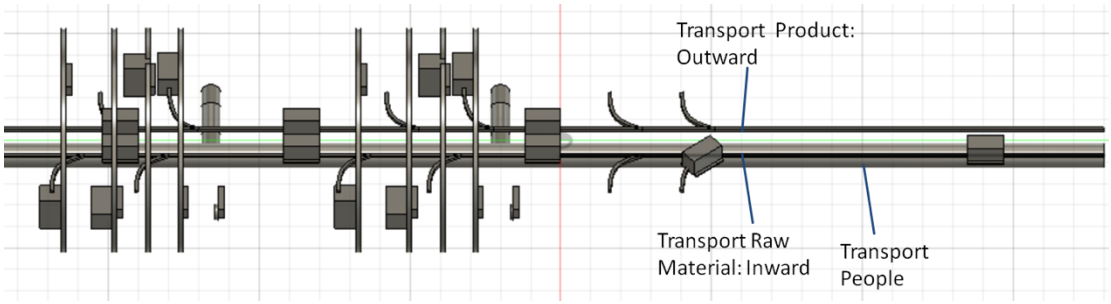
4.3.4 Space hospital

Several historical data demonstrate that during the initial stage at the space station, some astronauts suffer from space motion sickness that cannot be treated easily. In the light of necessary demands of health of astronauts, we design a hospital equipping with medical instruments and hiring professional experts for them. During the process of fitting in space environment, astronauts and human visitors feel faint and nausea even in 1/2 gravity. To solve this problem, we design a kind of capsule and ear patch that filled with unguent to reduce uneasiness. Particularly, we add traditional Chinese herbal medicine mixing with citrus, mint and ginger slice into the capsule, and whenever astronauts or visitors need them, they can get from the hospital. Thanks to special gravity, strong radiation, and strong magnetic field, we are able to provide complete physical inspection to all of the astronauts. Due to the increased intensity of mental work and the use of computers, people's activity time is reduced, and more and more people suffer from lumbar, cervical and leg diseases. Space hospital will have unique effects in treating various orthopedic and neurological diseases. The patient receives medication and massage therapy in the space hospital, which allows each diseased joint to rest and relax without any stress, making it easy for the medication to work directly. In addition, the intense irradiation of various cosmic rays made the muscle and bone segment lesions get a good recovery.

5. Industrial Development

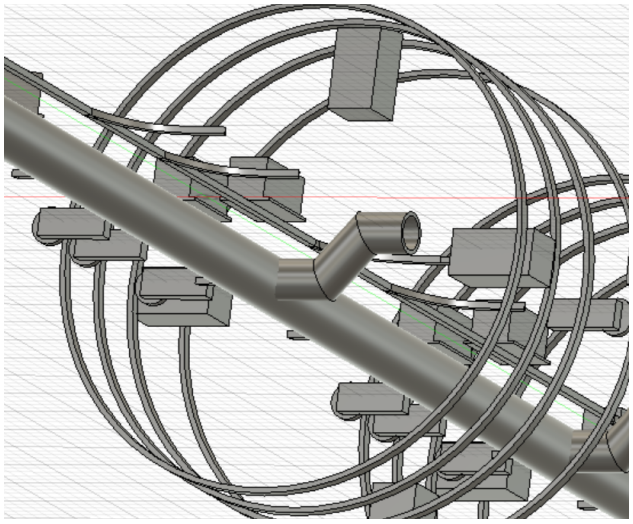
5.1 Traffic Line Chart





The graphs above is the interior scene of Vulcan, and the arrow points out the flow of people, raw materials, and products between factories, port, and residential zone.

The graph following shows the spinning elevator which helps people to transport between central axis and the torus.



5.2 Design of the Space Farm

Extra expansion

The agriculture part for nurturing the crops will be divided into three parts:

Field A

Field B

Hennery

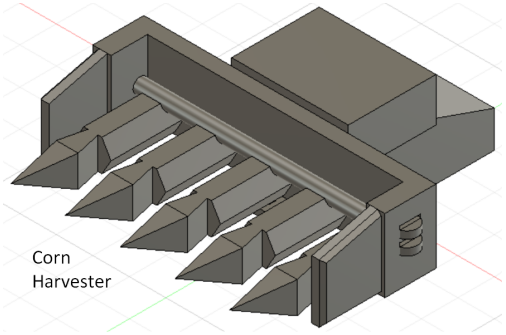
For Field A and Field B, the bottom will be fulfilled with nutrient solution with internal cycling for adding extra minerals and other necessary fertilizer in the system, which fertilize the crops. Plus, for Field B which will grow the wheat, we'll utilize the technology of vertical farming, which efficiently reduce the cost and maximizes the space efficiency. Artificial lightning will keep adding into the two fields, which extra red-and-blue lights to maximize the efficiency of photosynthesis. The crops will be harvested by designed harvesters without the demand of staff. We'll process the left straws into fodder to the chickens.

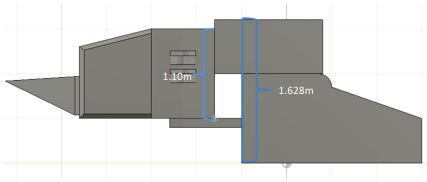
For the hennery, we'll take the common manners on earth to raising the chickens. Additionally, the feathers of the slaughtered chickens will be utilized into filling the beddings in the dormitories like pillows or quilts, and another utilization of the feathers is to process organic fertilizers filling into the fields.

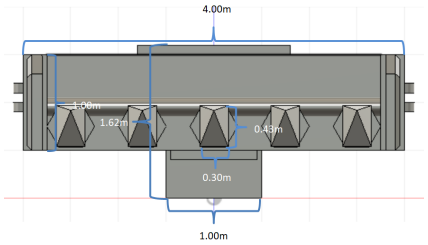
Extra. We'll utilize 1000m^2 in field B to grow the spinach, for its high nutrient value.

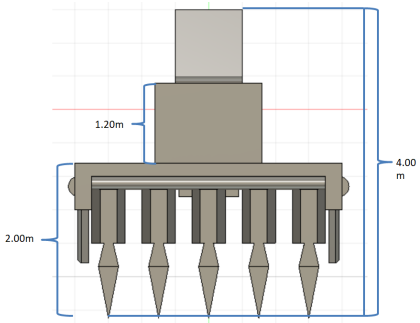
The agricultural robots are attached below.

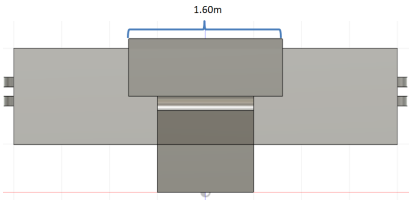
1. Harvest robot



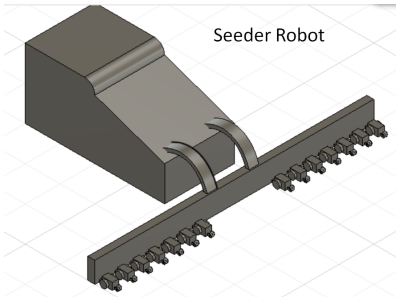


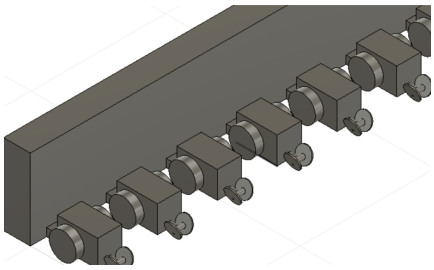


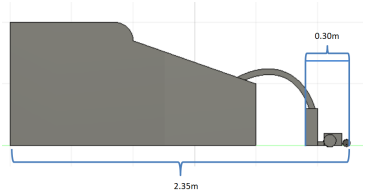


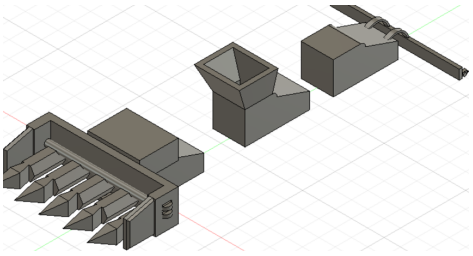


2. Seeding robot





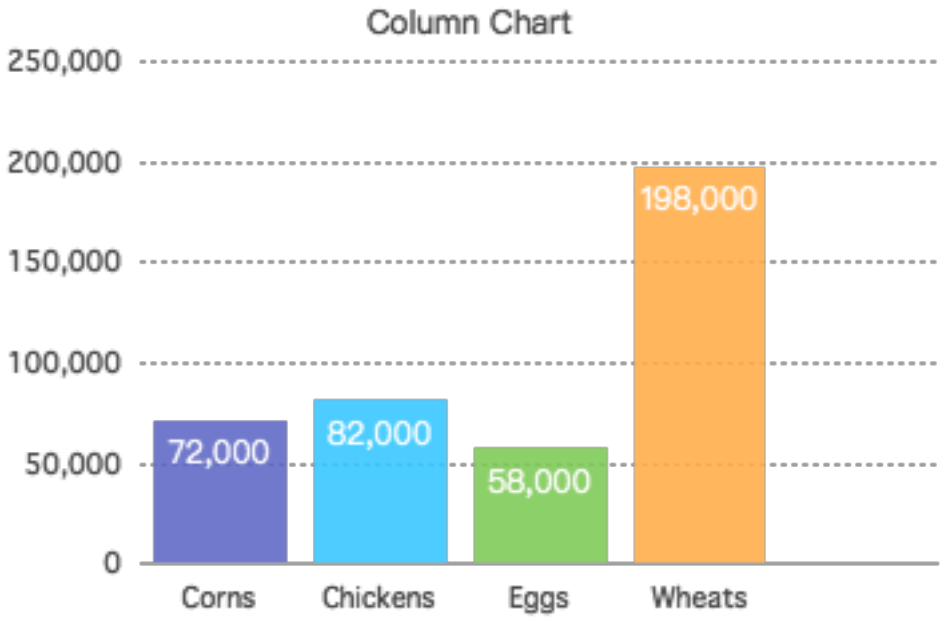




Approximation of the area:
6000m^2 for corns (9000m^3)
5000m^2 for wheats (7500m^3)
640m^2 for chicken (640m^2 * 0.8m * 3 = 1536m^3)
1000m^2 for spinach (1500m^3)

Agricultural Apportion

AGRICULTURAL PRODUCTS	ANNUAL YIELD(KG)
Corns	72,000
Chickens	82,000
Eggs	58,000
Wheats	198,000
Spinachs	27,000



Chicken's table of nutrients

热量	167 千卡	硫胺素	0.05 毫克	钙	9 毫克
蛋白质	19.3 克	核黄素	0.09 毫克	镁	19 毫克
脂肪	9.4 克	烟酸	5.6 毫克	铁	1.4 毫克
碳水化合物	1.3 克	维生素C	0 毫克	锰	0.03 毫克
膳食纤维	0 克	维生素E	0.67 毫克	锌	1.09 毫克
维生素A	48 微克	胆固醇	106 毫克	铜	0.07 毫克
胡罗卜素	1 微克	钾	251 毫克	磷	156 毫克
视黄醇	69 微克	钠	63.3 毫克	硒	11.75 微克

Corn's table of nutrients/100g

成分	含量	成分	含量
蛋白质/g	4.0	热量/kcal	112
脂肪/g	1.2	镁/mg	32
碳水化合物/g	22.8	铁/mg	1.1
不溶性膳食纤维/g	2.9	锌	0.9
维生素 C/mg	16	钾	238
维生素 E/mg	0.46	铜	0.1
维生素 B1/mg	0.2	磷	117
维生素 B2/mg	0.1	钠	1.1
烟酸/mg	1.8	硒/ug	1.6

Wheat's table of nutrients/100g

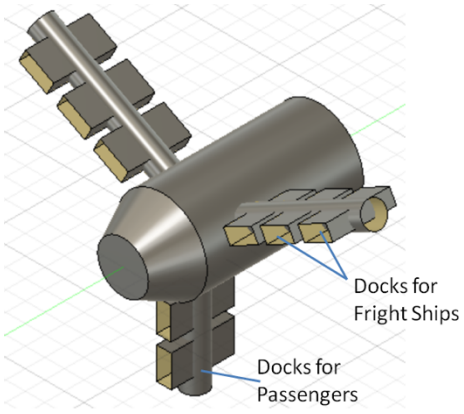
	小麦
蛋白质（g）	9.4
糖类（g）	75
油脂（g）	1.4
维生素 A（μg）	11
维生素 C（mg）	0
钙（mg）	25
铁（mg）	0.6
锌（mg）	0.2

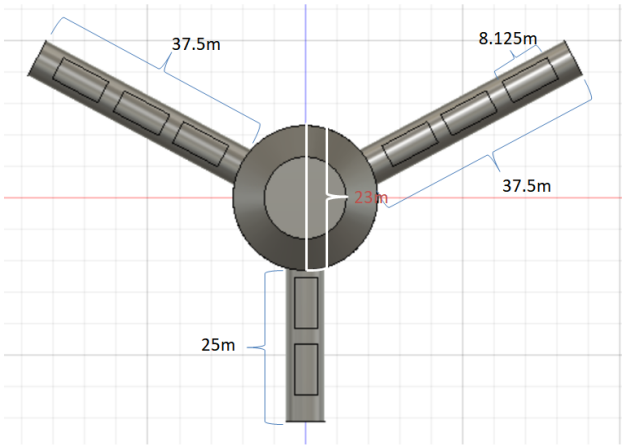
Spinach's table of nutrients/100g

热量	283 千卡	硫胺素	0.2 毫克	钙	411 毫克
蛋白质	6.4 克	核黄素	0.18 毫克	镁	183 毫克
脂肪	0.6 克	烟酸	3.9 毫克	铁	25.9 毫克
碳水化合物	63 克	维生素C	82 毫克	锰	1.61 毫克
膳食纤维	12.7 克	维生素E	7.73 毫克	锌	3.91 毫克
维生素A	598 微克	胆固醇	0 毫克	铜	2.08 毫克
胡罗卜素	8.1 微克	钾	919 毫克	磷	222 毫克
视黄醇	9.2 微克	钠	242 毫克	硒	7.02 微克

5.3 Port Design

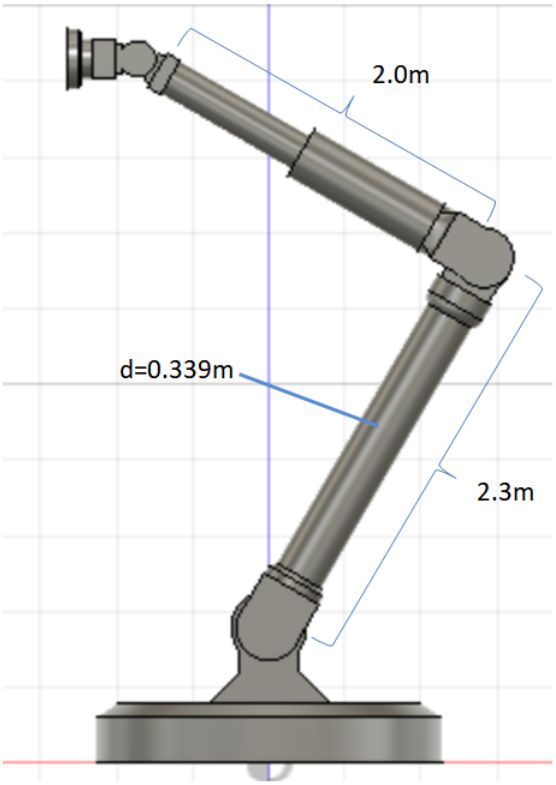
5.3.1 Port





The port is designed based on the principle of making it easy to dock. This design, accordingly, effectively utilized space to achieve the goal while avoiding unnecessary costs.

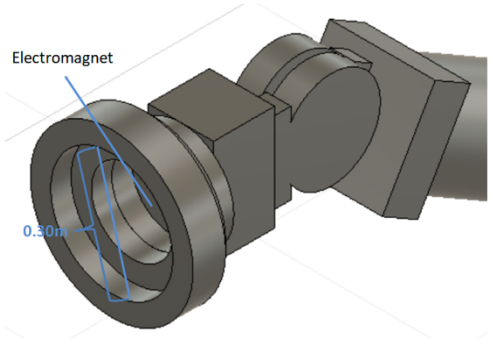
5.3.2 Mechanical Arm



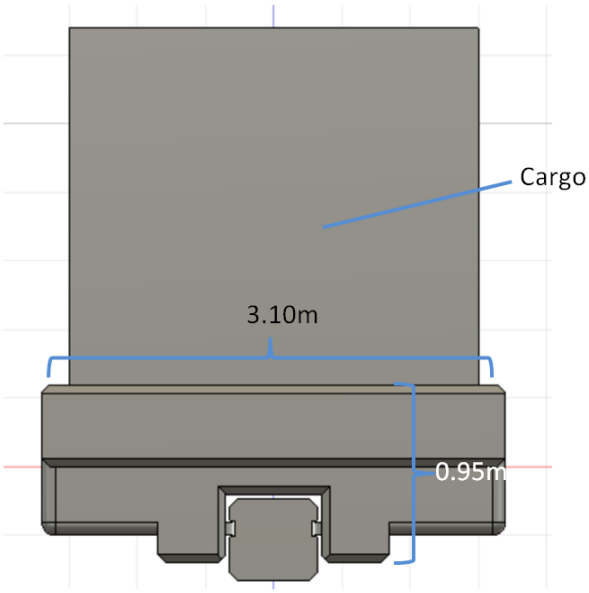
Mechanical arm aims at efficiently drawing freights out of fright shapes and put freights on the carts. Mechanical arms ensure the freights could be passed quickly, and therefore saves lots of time.

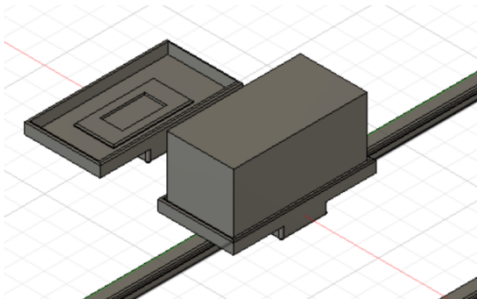
The connector is made of electromagnet, which would be matched with designed fright containers. Electromagnet ensure the steadiness while make it faster to draw and drop.

The mechanical arm is made of titanium, and it consumes electricity. The total amount is 34. The same design, or module, is shared with other automatic facilities, which makes it faster and cheaper, by utilizing constructing robots, to produce such mechanical arms.



5.3.3 Cart

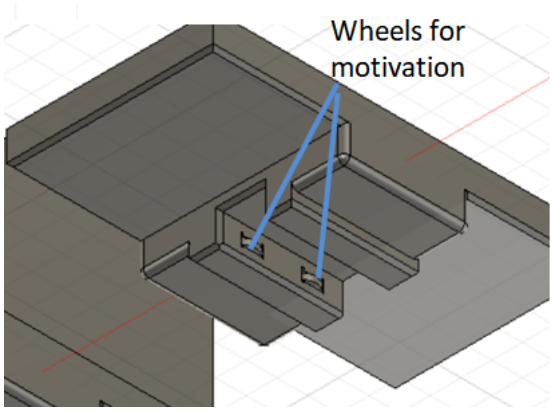




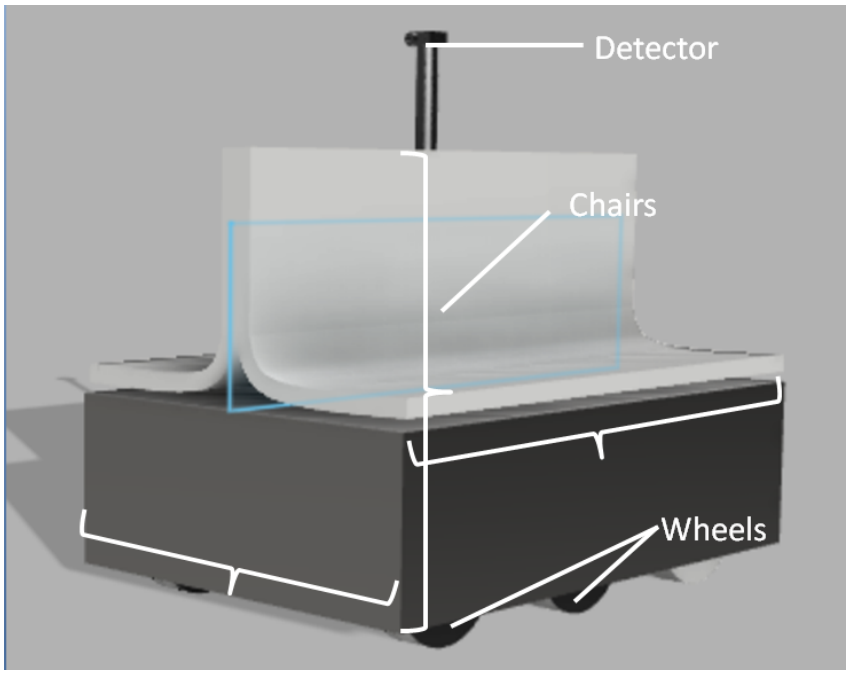
The cart runs on the tracks (as shown in 5.1), and the track is previously used as the tool for constructing. The cart attains the electromagnet at the center, which ensures the steadiness while transporting the freight. Moreover, the cart and track ensure the efficiency of the transportation of freights.

The cart is made of titanium, and the total amount is 10. The power supply comes from electricity.

The cart shares the similar design, or module, with the other automatic facilities. This module design make it easier for constructing robots to save time and costs.



5.3.4 Human Transporting Car



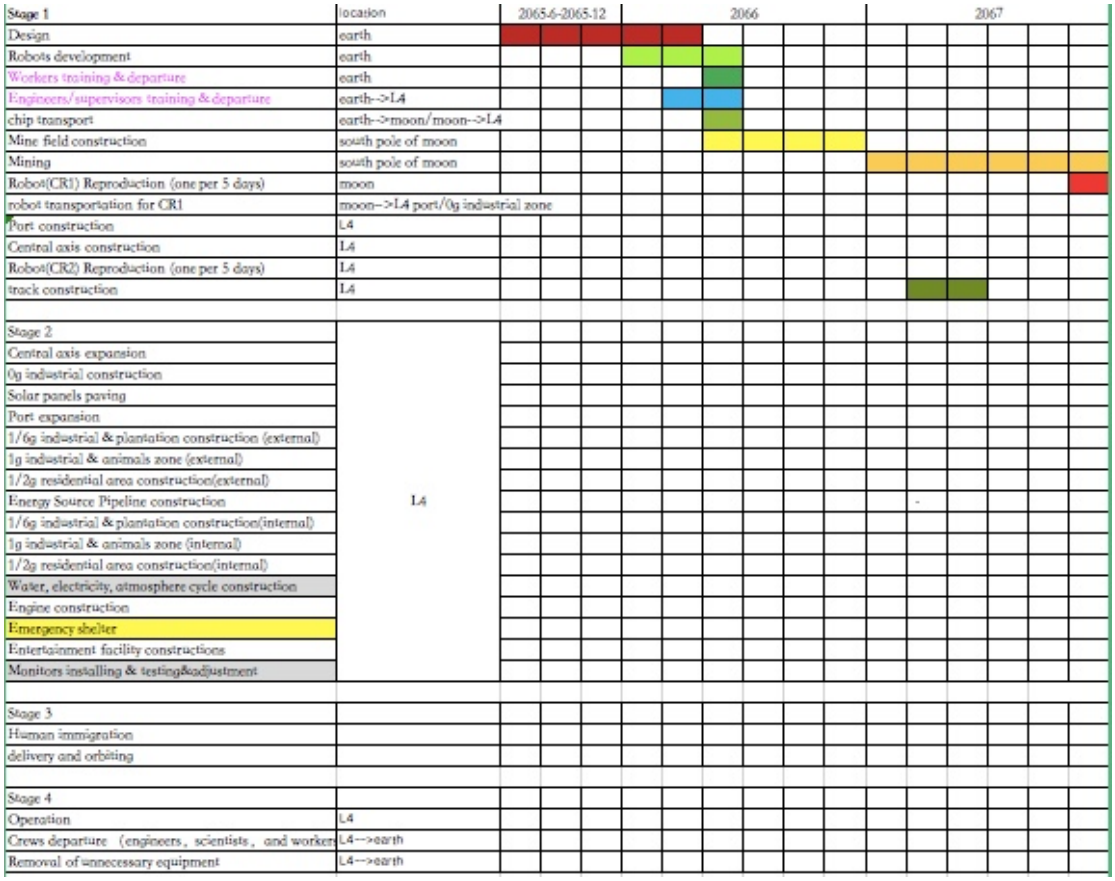
In the tube for human transportation, this car plays a big role in ensuring human commuting efficiency. The bottom of the car attains electromagnetic, which would be attracted by the wall of the tube. For people who don't know how to swim in 0g, this car dissolves that problem.

The car is made of plastic and titanium. The total amount would only be 5, and the

power supply comes from electricity.

6. Schedule and Cost

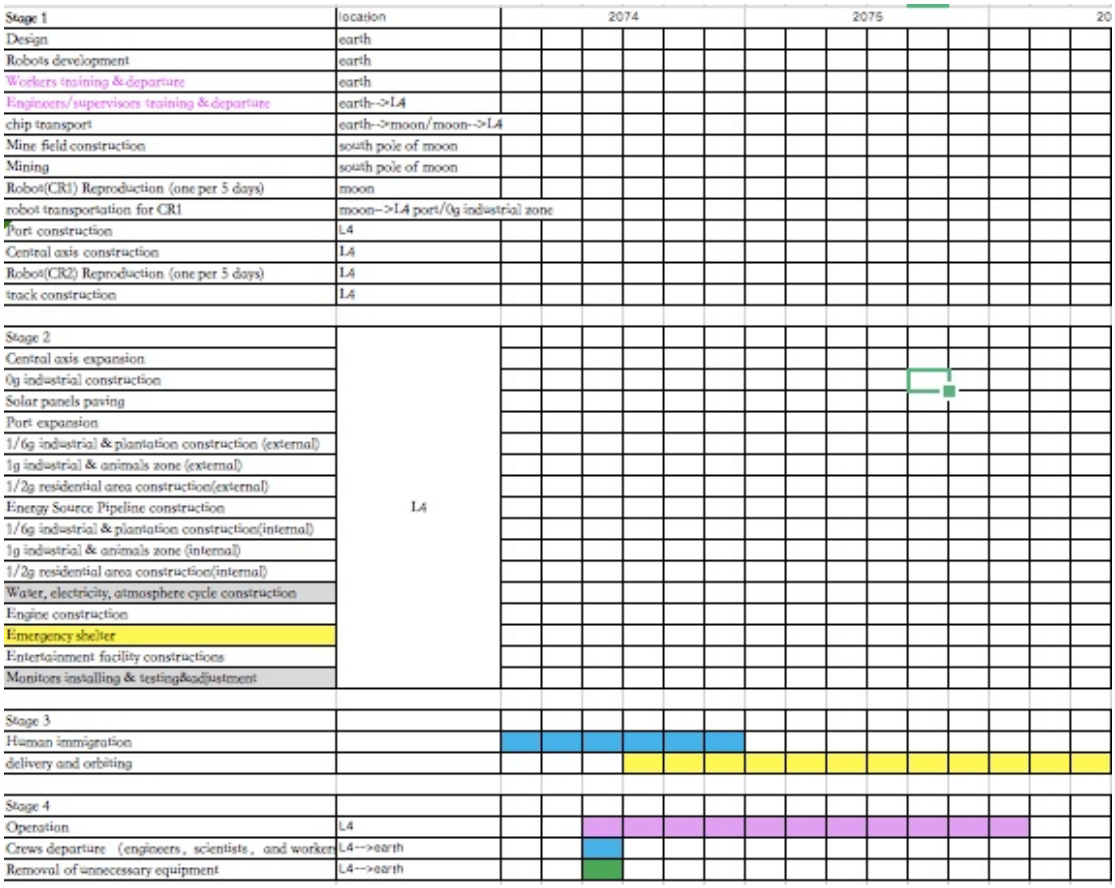
6.1 Construction Schedule



Stage 1	location	2068						2069					
Design	earth												
Robots development	earth												
Workers training & departure	earth												
Engineers/supervisors training & departure	earth->L4												
chip transport	earth->moon/moon->L4												
Mine field construction	south pole of moon												
Mining	south pole of moon												
Robot(CR1) Reproduction (one per 5 days)	moon												
robot transportation for CR1	moon->L4 port/0g industrial zone												
Port construction	L4												
Central axis construction	L4												
Robot(CR2) Reproduction (one per 5 days)	L4												
track construction	L4												
Stage 2													
Central axis expansion													
0g industrial construction													
Solar panels paving													
Port expansion													
1/6g industrial & plantation construction (external)													
1g industrial & animals zone (external)													
1/2g residential area construction(external)													
Energy Source Pipeline construction	L4												
1/6g industrial & plantation construction(internal)													
1g industrial & animals zone (internal)													
1/2g residential area construction(internal)													
Water, electricity, atmosphere cycle construction													
Engine construction													
Emergency shelter													
Entertainment facility constructions													
Monitors installing & testing&adjustment													
Stage 3													
Human immigration													
delivery and orbiting													
Stage 4													
Operation	L4												
Crews departure (engineers, scientists, and workers	L4-->earth												
Removal of unnecessary equipment	L4-->earth												

Stage 1	location	2070						2071					
Design	earth												
Robots development	earth												
Workers training & departure	earth												
Engineers/supervisors training & departure	earth->L4												
chip transport	earth->moon/moon->L4												
Mine field construction	south pole of moon												
Mining	south pole of moon												
Robot(CR1) Reproduction (one per 5 days)	moon												
robot transportation for CR1	moon->L4 port/0g industrial zone												
Port construction	L4												
Central axis construction	L4												
Robot(CR2) Reproduction (one per 5 days)	L4												
track construction	L4												
Stage 2													
Central axis expansion													
0g industrial construction													
Solar panels paving													
Port expansion													
1/6g industrial & plantation construction (external)													
1g industrial & animals zone (external)													
1/2g residential area construction(external)													
Energy Source Pipeline construction	L4												
1/6g industrial & plantation construction(internal)													
1g industrial & animals zone (internal)													
1/2g residential area construction(internal)													
Water, electricity, atmosphere cycle construction													
Engine construction													
Emergency shelter													
Entertainment facility constructions													
Monitors installing & testing&adjustment													
Stage 3													
Human immigration													
delivery and orbiting													
Stage 4													
Operation	L4												
Crews departure (engineers, scientists, and workers	L4-->earth												
Removal of unnecessary equipment	L4-->earth												

Stage 1	location	2072						2073					
Design	earth												
Robots development	earth												
Workers training & departure	earth												
Engineers/supervisors training & departure	earth->L4												
chip transport	earth->moon/moon->L4												
Mine field construction	south pole of moon												
Mining	south pole of moon												
Robot(CR1) Reproduction (one per 5 days)	moon												
robot transportation for CR1	moon->L4 port/0g industrial zone												
Port construction	L4												
Central axis construction	L4												
Robot(CR2) Reproduction (one per 5 days)	L4												
track construction	L4												
Stage 2													
Central axis expansion													
0g industrial construction													
Solar panels paving													
Port expansion													
1/6g industrial & plantation construction (external)													
1g industrial & animals zone (external)													
1/2g residential area construction(external)													
Energy Source Pipeline construction	L4												
1/6g industrial & plantation construction(internal)													
1g industrial & animals zone (internal)													
1/2g residential area construction(internal)													
Water, electricity, atmosphere cycle construction													
Engine construction													
Emergency shelter													
Entertainment facility constructions													
Monitors installing & testing&adjustment													
Stage 3													
Human immigration													
delivery and orbiting													
Stage 4													
Operation	L4												
Crews departure (engineers, scientists, and workers	L4-->earth												
Removal of unnecessary equipment	L4-->earth												



Stage 1	location	2074						2075								20
Design	earth															
Robots development	earth															
Workers training & departure	earth															
Engineers/supervisors training & departure	earth-->L4															
chip transport	earth-->moon/moon-->L4															
Mine field construction	south pole of moon															
Mining	south pole of moon															
Robot(CR1) Reproduction (one per 5 days)	moon															
robot transportation for CR1	moon-->L4 port/0g industrial zone															
Port construction	L4															
Central axis construction	L4															
Robot(CR2) Reproduction (one per 5 days)	L4															
track construction	L4															
Stage 2																
Central axis expansion																
0g industrial construction																
Solar panels paving																
Port expansion																
1/6g industrial & plantation construction (external)																
1g industrial & animals zone (external)																
1/2g residential area construction(external)																
Energy Source Pipeline construction	L4															
1/6g industrial & plantation construction(internal)																
1g industrial & animals zone (internal)																
1/2g residential area construction(internal)																
Water, electricity, atmosphere cycle construction																
Engine construction																
Emergency shelter																
Entertainment facility constructions																
Monitors installing & testing&adjustment																
Stage 3																
Human immigration																
delivery and orbiting																
Stage 4																
Operation	L4															
Crews departure （engineers，scientists，and workers	L4-->earth															
Removal of unnecessary equipment	L4-->earth															

6.2 Cost and Cost Estimates

6.2.1 Cost estimation

		The First Move		Unit : RMB
OPcost 粗略估算				
	项目（每年）	cost 估计	项目（永久）	cost 估计
3.1 大气	maintenance	0.0002B	transportation （without the air cycle at the start）	0.9B
			construction	0.0003B
3.2 电	maintenance	0.0001B	construction	0.75B
	lighting	0.003B		

5.2 农业	machine maintenance	0.03B	seed transportation	0.8B
	operation	0.005B	machine construction	0.1B
3.3 水	purification of water	0.003B	facilities construction	0.08B
	maintenance	0.0002B		
	moisturing	0.00034B		
SUM		2.67214B		
Structure				
Exterior maintenance	0.6B	Titannium	4.507g/ cm^3	-9.00367296B
1/6g maintenance	0.086B	Aigim	2.3g/ cm^3	-16.91489036B
Tunnel	0.05B	Silicon	2.33g/cm^3	0.0155B
SUM			density	17.04660964B
Human Factor				
Walls				0.78071166B
Bathroom			mirrors	0.0007008B
	Individual room	0.003B	wash basins	0.001752B
			shower rooms	0.01782B
	Decoration	0.0005B	toilets	0.0242B
			plants	0.000588B
			washing machines	0.01022B
Bedroom			beds	0.01467B
	Greenary	0.0005B	doors	0.02376B
	Waste management	0.001B	televisions	0.02952B
			refrigerators	0.0123B
	Double room	0.0044B	food tubes	0.00016B

	clinic	0.0002B	restaurant	0.0017B
Entertainments	sports	0.00008B	gym	0.038B
			cinema	0.01B
Personnel	workers	0.03B	engineers&scientists	0.1B
SUM				0.96400246B
Automation				
	Illumination	0.007B	Robot arm	0.00369B
			Constructing robot	0.03B
			Wearable devices (Smart watch)	0.0003B
			Cleaning Robot	0.00014B
	Temperature regulating	0.00005B	Transport robot	0.009B
SUM				0.04319B
Industry				
5.1 & 5.2	Power transmission	0.007B	Orbit	0.146B
Total sum		0.3B		

6.2.2 Possible Commercial Profit

Unit: billion RMB

ITEMS	proccessed Martian material	raw Martian material	Fuel supplement for passing spacecraft	
Profit	1B	0.1 B	0.06B	

ITEMS	broadcasting life in space on TV on earth	advertisement fee	profit from the restaurant	selling space photographs(to scientists, photographers and collectors etc.)
profit	0.006B	0.009B	0.002B	0.0008B
ITEMS	“Home Call”fee (fee for making holographic phone calls to earth)	fitment fee(including gym, cinemas, individual rooms etc.)	security&ensurance fee	allowing, charging and melon cutting for TV works to be filmed;
profit	0.0003B	0. 029B	0.006B	1.2B
TOTAL SUM	2.4131 B			

6.2.3 profit cycle

2065	-0.0003B
2066	-0.00035B
2067	-0.0039B
2068	-0.00021B
2069	0.0002B
2070	0.0003B
2071	0.0006B
2072	0.30B
2073	0.2B
2074	0.9B
2075	1.3 B