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Esperanza-Expectation Leads to Inventions in Space

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***Abstract*: The tittle of my project is "ESPERANZA". It is Spanish word, which means "HOPE OR EXPECTATION". The main aim of selecting "Esperanza" as my title is to create a hope in habitats of my settlement to lead a happy long life. "ESPERANZA" also mean "expectation". When we are planning for space colonization, everyone expects a lot about their new settlement. I am sure that the inventions in my settlement reaches the expectations of the people.**

***Keywords*: Solar energy, nuclear energy, Piezoelectricity, Artificial Gravity, Molten salt storage method, Moxie.**

1. Introduction

It has selected Mars Lagrangian point 2, as the best location for our settlement (ESPERANZA) [1]. Lagrangian points are parking places in space where stability is achieved between, in a system of two masses in which one mass is located at centre and other mass around it [2]. The distance between mars and our settlement is the main reason for placing the settlement near Lagrangian point 2 is that it is located in the umbra of mars so that it can be shielded by radiation [3]. The umbra protects our settlement from radiations caused photons (light,X-rays,gamma rays)[4]. It is located on the opposite side of the planet mars between Jupiter and mars [5]. L2 lies a million miles away from the earth but in the opposite direction of the sun [6]. Although L1 point of mars have the same facilities as that of L2, it's radiation shielding is different from that of L2[7]. It is found that the increase in solar radiation pressure at constant oblateness elongates the halo orbits at L1 and the orbits move towards the radiating body [8]. Which in turn results the damaging of orbit near L1[9]. When coming to L2 it moves away from the radiating body [10]. So that no distraction to the orbit and the settlement placed over it [11]. The L3 point is completely hidden behind mars, so there is no chance of solar availability [12]. L4 and L5 are too much away from the mars [13]. There is no chance for communication [14]. And a future implementation project [15].

2. Structural Design

It shapes our buildings, after that they shape us. Structure is the main key concept for the designing of any space settlement. In this settlement I gave accommodation for 5,000 residents. The structure is simple and can catch the sight of viewers. It's made up of central hub, beads, torus and frustum cone. It is shown in fig. 1.

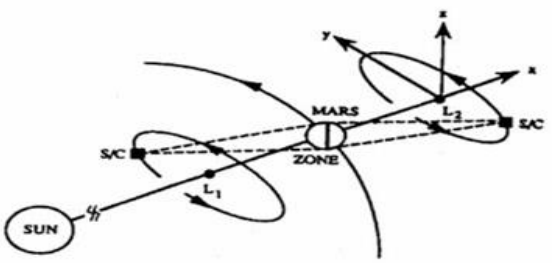

Fig. 1. Sun-Mars L1 and L2 Halo Orbit Constellation

The grouping of these parts in a well-defined manner gives the beautiful outlook to our settlement. Parts Of Esperanza

A. Torus

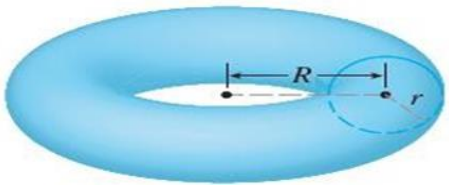

Fig. 2. Structure of Tours

Torus is the space habitat providing housing for nearly 10,000 to 1,50,000 residents. Creating the atmosphere in the space quite It allows to control the radius which is useful in the creation of psedogravity. It contains maximum habitable area. We introduced three tori in the construction of our settlement, in which two are equal in radii and the other is little large compared to both. Four beads are made embedded into the smaller radii torus. It is shown in fig 2.

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B. Frustum Cone

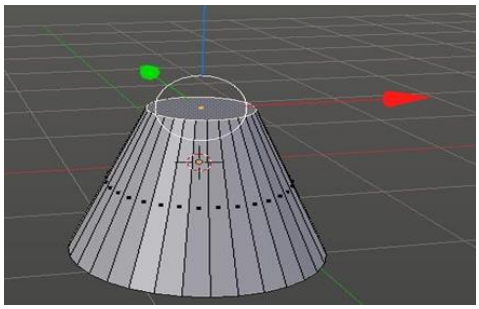

Fig. 3. Structure of Frustum Cone

It is a part of cone formed by slicing (cutting off) the uppermost sharp edge of the cone. In our settlement we placed two frustum cones, one is at the top and other at the bottom. The frustum cone at the top is concerned with the energy whereas frustum cone at bottom is for communication purpose. It is shown in fig 3.

1) Central Hub

It is tube like structure which is stretched from upper portion to lower one. Central Hub is mainly used in transportation.

2) Sphere

We introduced spheres in the upper parts of frustum cone, at the top and the bottom of the central hub, and also embedded into torus of less radii.

3. Overall Structure

1) Artificial Gravity

Artificial Gravity is the key factor which allows ESPERANZA to be stable. Artificial Gravity is produced by rotating our settlement. The rotational frequency should be equal to that of earth. Human body does not cope with rotational frequency greater than 2rpm. So, the rotation of ESPERANZA is fixed to 0.98rpm. it is shown in fig 4.

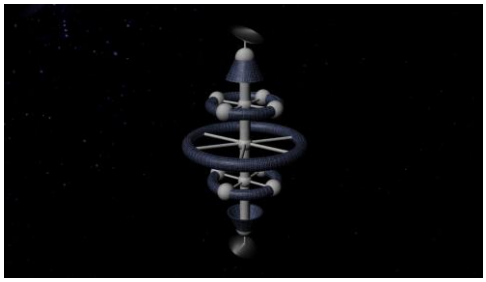

Fig. 4. Shape of ESPERANZA

2) Calculation of Artificial Gravity

Artificial gravity can be calculated by using newton's second law.

$$F = ma \quad (1)$$

$$F = MV^2/r \quad (2)$$

So,

$$Ma=mv^2/ra=v^2/r,\ a =((4pi^2)r)/(t^2) \quad (3)$$

Where a = acceleration due to rotation

r = major radius of the torus

t = Time period for the rotation

The artificial gravity at residential torus will be of 9.856m/s^2. And all remaining places it will be 4.981m/s^2.

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3) Day And Night Cycle

The day and night cycle provisions are maintained same as they are on the earth. The day and night cycle is controlled basic on the concept of "LED BLINKING CONCEPT". If we are able to maintain day and nights as they are on the earth, the people will comfortably enjoy their living atmosphere.

4. Construction

The main work involves in construction of the settlement after planning a design for the settlement.

- Step 1: Construction of central hub is the initial step in the construction of space settlement. It acts as support to the other parts. It takes nearly 1.5 years to complete the construction of central hub.
- Step 2: Construction of beads at the ends of central hub. It takes nearly half year.
- Step 3: Construction of spokes to the central hub in order to accommodate the beads and to support torus. It takes nearly 2 years.
- Step 4: Construction of beads at the ends of the spokes of upper and lower attached spokes. It takes nearly 2 years.
- Step 5: Construction of torus around the beads. It nearly takes 2 years to complete the construction.
- Step 6: The construction of Settlement comes to an end by attaching the frustum cone at the ends of the central hub. Then the frustum cone is attached with beads at its upper ends.

A. Construction Materials

When selecting construction materials on earth we go on seeing which is capable to stand stiff at the time of raining and which can withhold sunlight etc.., But when we come to space settlement, we should keep in mind that we should select a material which can shield the settlement from radiation. So, I am going to utilize graphene, polyethylene, fiber optic, carbon nanotubes, silicon carbide, Ti-Al alloys etc…, in the construction of ESPERANZA.

1) Energy

Energy is the ability to make something happen. Every activity in space settlement either directly or indirectly depend upon energy. Without energy one cannot ponder their life. So, it is very much important when planning to build a space colony to overcome the energy needs over there. In order to fulfill the energy needs in our settlement we opted some techniques.

2) Solar Energy

Sun is considered to be the ultimate source of energy. As our settlement is planned in space solar energy can utmost fulfill the energy needs. Solar energy can be directly converted to electrical energy by using photo voltaic effect. Most photo voltaic cells are made primarily of silicon. When sunlight hits the photo voltaic cell the energy knocks electrons free of their atoms allowing them to flow through the material. Due to this

flow of electrons electricity is produced.

3) Storage of Solar Energy

Storage of energy at the times of complexity is also a big task. To overcome unexpected energy deficiency in our settlement we are planning for certain techniques to store energy.

4) Molten Salt Storage Technique

When demand is low mirrors reflect sunlight onto tanks of molten salt, heating them almost to 1,000, When demand is high the salt's heat turns water into steam to drive a turbine making electricity. It is shown in fig 5.

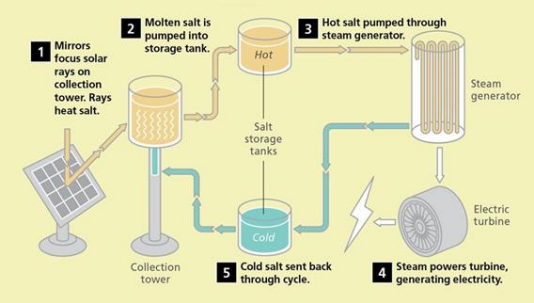

Fig. 5. Flow graph of Molten Salt Storage Technique

5. Nuclear Energy

It can also harness electricity using nuclear reactions. We believe that the nuclear reactions are very harmful. Nuclear fission which involves in splitting of atoms nucleus to half in order to produce energy is harmful. Whereas nuclear fusion which combines nuclei to generate energy is quite safe. An isotope of element helium, helium-03 has two protons and only one neutron. When this is heated at high temperatures and combined with deuterium, the reactions release incredible amounts of energy. Just 2.2 pounds of energy combined with 1.5 pounds of deuterium produces 19 megawatt-years of energy. So, helium-03 is perfectly safe to use and does not cause pollution, does not release radioactive waste and does not poses danger to surroundings.

1) Piezoelectricity

This concept is based on the fact that some metals generate electricity when hit. This is just an idea behind "push to charge". The "push to charge" cell phone would feature in such a way that plastic buttons sit on the top of the hard metal. The bottom most layer is made up of piezoelectric crystals.

2) Working

Each time you press a button the hard metal underneath it would hit the underlying crystal just like hammer. So that it produces a small amount voltage which is nearly equal to 0.5v. It may sound small, but when calculating the voltage for each and every button used in certain message, it is high. We need to admit generating electricity by typing in a keyboard, playing video games etc.

3) Agricultural Practices

Food includes one of the primary needs without which we can not even imagine our life. "It is thus with farming, if you do one thing late, you will be late in all your work". "Investments in Agriculture are the best weapons against hunger and poverty, and they have made life better for billions of people". In this advancing technological world, there are many agricultural practices advanced which can be introduced in our settlement. These Include: -

1. Hydroponics
2. Aeroponics
3. Aerohydroponics
4. Aqaponics
5. Fogponics

6. Hydroponics

The term HYDROPONICS refers to "soil less farming". To keep it short HYDROPONICS is a farming technique in which plants are grown with their roots immersed in a water solution containing necessary minerals. The principal elements that must be provided as dissolved salts in "HYDROPONIC" system are nitrogen, phosphorous, sulfur, potassium, calcium, and magnesium. Crop yields of some plants can be obtained fully equal to those obtained on fertile soils. It is shown in fig 6.

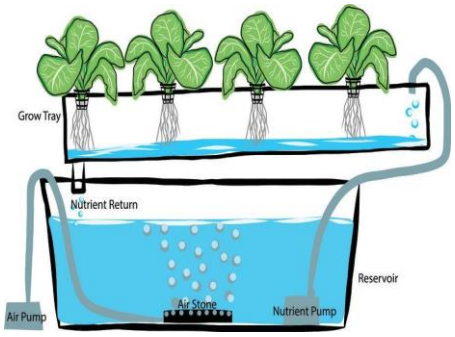

Fig. 6. Hydroponics System

1) Aeroponics

AEROPONICS is a form of HYDROPONICS. Growing plants using AEROPONICS involves hanging the plants grown in net pots in a growing chamber with their roots exposed. A light mist of water and other nutrients is sprayed on the roots regularly to keep the plants alive. Lighting and temperature is controlled in the growing chamber. It is shown in fig 7.

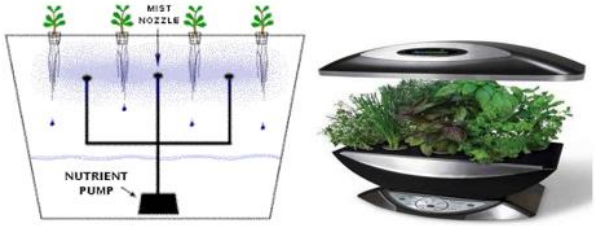

Fig. 7. Aeroponics Process

2) Aero hydroponics

This method is a combination of both AEROPONICS and HYDROPONICS, which is helpful to yield better than both of them. The principle is to grow plants with their root systems exposed to a nutrient mist. As the root system develops into the bottom of a culture bed, they absorb necessary inorganic ions from the continuously flowing nutrient solution in the bottom of a culture bed. Optimum depth of recirculating nutrient solution in the AEROHYDROPONICS was determined to be three to five centimeters.

3) Aquaponics

AQUAPONICS is a combination of both AQUACULTURE and HYDROPONICS. In this method the plants are fed with the aquatic animal waste or discharge. Along with the fish and their waste, microbes play an important role to the nutrition of the plants. These beneficial bacteria gather in the spaces between the roots of the plant and converts the fish waste and the solids into substances the plants can use to grow. Using this we can grow vegetables like Lettuce, kale, watercress, arugula, decorative flowers, mint, herbs, okras, spring onions and leek, radishes, spinach and other small vegetables. Cabbage, tomatoes, cucumbers, beans, broccoli and cauliflower etc. it is shown in fig 8.

Fig. 8. Aquaponics System

4) Fogponics

It is a form of AEROPONICS. Instead, a fog or mist of water and nutrients is pumped into a closed system to supply the roots with the nutrients the plant needs to grow. The theory behind FOGPONICS is that plants are best able to absorb particulate nutrients in the range of 1 to 25 micrometer.

7. AVASA

AVASA is the residential torus of my settlement. As discussed earlier I am planning for accommodation of 5,000 people. The residents of ESPERANZA happily enjoy their life in the torus AVASA.

1) House of Esperanza

House is the heart of life. It is a building for human habitation. The houses of ESPERANZA are designed in such a way that the people enjoy their comfortable life. The overall external design is completely different from that of houses on earth. They are like a dome shaped or in the shape of semi-spherical capsule. The houses are built with piezoelectric material, because it acts as a sensor and can warn people in case of any accident. Interior design is same as it is on earth.

2) Education

Education is nothing but imparting knowledge in any of the field. The students of ESPERANZA are encouraged with their own skills and are trained in their area of interest. Also, the students of ESPERANZA are encouraged in space related activities for their better future.

3) Hospitals

Hospitals are the health care institutions. There will no chance of being sick in Esperanza as we develop eco-friendly environment, even though the hospitals are designed with specialized staff and equipment because the health of each and every resident is concerned.

4) Entertainment

Entertainment is a form of activity that holds attention and interest of people or gives pleasure and delight. The residents of ESPERANZA are gathered together monthly once for a grand party and in every street, fests are going to be conducted in the form of entertainment, in order to free people from their work or other stress.

5) Some Forms of Entertainment Are

1. Music
2. Comedy
3. Drama
4. Dance
5. Movie Mania
6. Circus
7. Street Performances
8. Yoga etc.

B. Business and Trading

It is an activity which involves people in any of the work. It is the useful for the people to earn for life. Here in our settlement, we are going to implement some business forms like:

1. Service Business
2. Merchandising Business
3. Manufacturing Business

1) Service Business

This type of business includes schools, repair shops, saloon, accounting firms and law firms. The products here have no physical form.

2) Merchandising Business

It is just like a “Buy and Sell” policy. Ex: -grocery shops, stores etc.

3) Manufacturing Business

In this type of business products are bought with the intention of utilization for making new products. The goods after Manufacturing will be sold to customers.

C. Trade

It is nothing but transfer of goods from one person to another person. Markets are built at each and every city as the medium of trading.

D. Human Factors

Human Factors are the basic needs required by the people living in the settlement. These include water, oxygen, Food, Transportation.

8. Oxygen Production

1) Using Electrolysis Process

Oxygen and hydrogen can be alone created from water using semiconductor material and sunlight. This process is known as “Electrolysis”. Electricity is made to pass through water containing. soluble electrolyte. This process breaks down water into oxygen and hydrogen and are released separately at the two electrodes.

2) Oxygen Production Through Moxie

Moxie will take the carbon dioxide present in the Martian atmosphere, which is made up of one carbon atom and two oxygen atoms, and isolate one of the oxygen atoms. The two oxygen atoms will then combine together to form O2. The MOXIE checks for the purity of the oxygen and thenreleases it to the atmosphere. Moxie has the ability purify oxygen up-to 99.6%. Carbon Monoxide which is one of the products of the reaction again combine with very small amount of residual oxygen and again transforms to carbon dioxide.

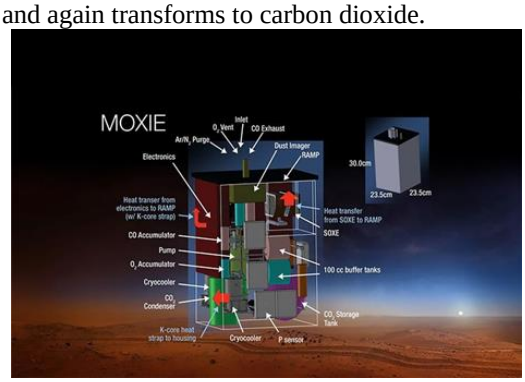

Fig. 10. Moxie Process

9. Water Production

1) Absorption Method

This method is a chemical reaction using lithium hydroxide (Li OH). It is an exothermic reaction of lithium hydroxide and carbon dioxide to create lithium carbonate (Li2CO3) and water (H2O). The Carbon dioxide required in this process is abundantly available on mars and Lithium is extracted from the asteroids.

2) Space Suit

Space suit is the most important thing when we need to travel in the outer space. As ESPERANZA is radiation free, we need to wear space suit when we are outside of the settlement. A special space suit will be designed which will have the following layers in it,

1. Liquid cooling and ventilation garment
2. Extra vehicular visor assembly
3. T V Camera
4. Helmet
5. Hard upper torso
6. Lights
7. Drink Bag
8. Oxygen Control actuator etc.

3) Asteroid Mining

Asteroid mining is the main key factor which effects the allover development of the space colony. As we are away from the earth, it needs to fulfill all the basic needs to the people of our settlement. That can be reached only through Asteroid Mining.

4) Types Of Asteroids

There are different types of Asteroids, they are

- C-type: - Carbonaceous chondrite meteorites
- S-type: - Stony Meteorites
- M-type: - Iron Meteorites
- D-type: - HED Meteorites

B. There are many techniques to get minerals from asteroids

1) Detection of Minerals

In order to mine any asteroid, we need to detect whether the asteroid contains the available minerals. In order to be clarified with this we are going to implement "gamma-ray spectroscope". This tool is used to detect the type of mineral the asteroid is associated with the asteroid. A "gamma ray spectroscope" records the intensity and wavelength of the gamma rays coming from a surface. This spectrum can be analyzed to determine the concentration of the number of important, rock-forming elements including oxygen, magnesium, silicon and iron etc.

2) Extraction Process

After the detection process the next step involved is extraction of the detected minerals. We implemented a method of "OPTICAL MINING".

3) Optical Mining

This method is best applicable for c-type asteroids only. Optical mining is a method of extracting carbonaceous chondrite asteroid surfaces and driving water and some volatiles, without the use of complex robotics. In the optical mining, highly concentrated sunlight is projected on the surface of asteroid using a system of optically sophisticated system of reflective non-imaging optics. As we are planning for a space colony delivering incredible heat energy to the surface of the asteroid is not such a complex task. So I thought of implementing this method for asteroid mining.

4) Robotics

The branch of Robotics has brought revolutionary change in the development of human life. Robotics is a trending topic in the present society. The robots are used in each and every field of present society. In ESPERANZA I thought of implementing robot named "DARPA".This is a humanoid robot designed by the NASA Agency. We will be designing some other robots as the time goes on.

Fig. 11. DARPA

5) Solid waste Management

Solid waste management is one of the advancing factors that can be useful to create a healthy atmosphere in the settlement.

1. Create a clean and healthy atmosphere in our settlement.
2. Get useful factors by refining and reusing the waste.

The second one will be somehow helpful for us.

6) Solid waste management techniques

The space junk can be converted to usable products by using "Heat Melt Capacitor". The space junk can also be converted as methane gas which can be further used as rocket propellant. Using steam reformer method, we can convert junk to rocket

propellant. This method uses both steam and a little amount of oxygen through which it forms a chemical reaction with the junk and produce hydrogen, carbon dioxide and methane.

The human waste can be reused into many ways by using different refining techniques. It can be transformed to

1. Generate electricity
2. As fertilizer to crops.
3. Produce hydrogen gas.

By using appropriate management technologies, we get a lot of useful resources from the space and waste(junk) also.

7) Transportation

When we are planning for a space settlement, one of the main concepts will be the ways of transportation. We need to plan for two types of transportation i.e, to travel from one place to another place inside the settlement and to travel from earth to the settlement.

8) External Transportation

External communication is planned by using space ships which are designed by using fiber Bragg grating sensor technology. These can be warned with a indication in spite of any change in the external structure of the space ships. The variation in the wavelength intimates us about the danger occurred to the space ship. So that we can be prevented from the danger.

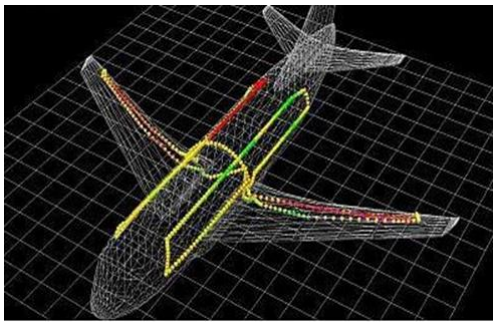

Fig. 12. Outer layer of Craft

9) Internal Transportation

Internal transportation is to travel from one place to another inside the settlement. This can be implemented as pollution free methods by using bicycles for smaller distances. Vehicles will be provided to the residents of ESPERANZA to travel long distances. This can be done by giving the help desk numbers to the residents. They can book their vehicles when they are needed. Another factor used for transportation is space car. This is maintained by the residents of Esperanza of their own. This space car is fixed to a certain speed limit and is layered with a sensor to find any obstacle in its way up to particular distance. So that the people can enjoy their journey and can be safe.

10. Conclusion

Since NASA operates within budget constraints. This emphasis on one particular scientific objective necessarily comes at the expense of others. The complex is considered the question of whether NASA's priorities are too heavily skewed toward life-related investigations. The committee decided, however that this is not the case. The emphasis on life is well justified; the life -related investigations that are planned range over so much of Mars science that they will result in board and comprehensive gains in our knowledge.

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