



THE FUTURE OF SPACE EXPLORATION

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ABSTRACT

The space exists as a big playground for future humans not only for exploration but also for energy sources, life chances, tourism as well as military purposes. The race of space exploration is increasing and increasing and is going to be the most advanced race. This paper gives a brief out lines on the new technologies and researches that have been made in the sector of space exploration. Efforts have been made to state the importance of cost effectiveness of these technologies and how these can be a new milestone for the humankind. From space hotels to electromagnetic launchers, every technology projects a new prospect for mankind to reach further out in the space and explore the unknown.

Keywords: Space exploration, Future, Space Tourism, Space Infrastructure, Colonization.

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1. INTRODUCTION

Millions of people are working round the clock on and off the world for decades trying to answer some basic questions. What is lying out there? How do we reach it? And most importantly how will it change the life of mankind on Earth.

Outer Space is one of the most studied subjects by mankind and yet, due to its vastness, is the least discovered one. Ancient people studied astronomy a great deal and inspired the future generation to do the same. People look up to space as one of the biggest mysteries of mankind, may it be the aliens, origin or chances of life.

Humanity has a solid future in space with next generation of seekers already preparing for the journeys in the beyond. The current mode of transport is very expensive with a one way trip to the international space station costing over \$175 million for a single person. The current scenario has limited space explorations to astronauts and cosmonauts sponsored by developed countries only with rockets and space shuttle being highly inefficient and money guzzlers. What if there is a way to change that? What if space is accessible to the common man?

The human tendency is always been to go beyond and eradicate current issues. Many problems can be listed which either are making it hard for space agencies or making a negative impact on nature and humans.

Everyday thousands are working tirelessly trying to answer these questions and are making a small effort to that. A new form of the revolutionary scramjet along with the space elevator can definitely make a effort into reducing the space travel cost and also help reduce the space exploration time which will in turn help in answering many unanswered questions.

Since cosmonaut Yuri Gagarin travel into the space, space exploration has come a long way with launch of unmanned drones to different planets but today still the research of many governments is to send a few people into space and but is not of starting a space tourism sector. What if there is a possibility of space tourism? How will it look like? These can only be answered when space travel becomes affordable for common man and this can only be done by revolutionizing the most important part of the space exploration, ‘ The rocket.’ Well the humankind can definitely start by looking into the alternatives of the current space shuttles. Reusable rockets have reduced the cost but still space is out of reach of most of the mankind. It can only be brought into the reach by reducing the cost by significant amount.

There are many revolutionising modes of space travel that can make it happen, starting with space elevators which have been a vision of many scientists for more than a century. In the late 19th century a Russian scientist envisioned a tower that would able to reach the lower Earth orbit. Recently, with interest in reducing the space travel cost and dependence on shuttles, scientists have reconsidered the concept of Space Elevator. This does not end the ideas that can change the future of space exploration but it’s the tip of the list with many of the others being NASA’s Space Exploration Vehicle (SEV), Solar Sail Technology, Nuclear Powered Spaceships and so on.

The future not only requisites the answers of these questions but also new effective, efficient ways of space probations.

2. LITERARY SURVEY

[1] The paper on HiPER presents that electric propulsion can immerge as a vey important factor in space exploration by reducing the cost multiple times. HiPER is an European union funded project which has shown great potential for development of innovative Electric propulsion system technologies to benefit the mankind in the near future. These systems in their preliminary tests have shown that larger payloads can be send in less time with comparatively less cost. This constitutes the need of development of future electric propulsion systems. [2] Alexander Rudat, MIT, in his paper on the infrastructure systems for future human space exploration has presented a framework in which the advance technology alternatives of the current space infrastructure, which improves the chances of habitation and transportation between planets like Mars and Earth, are described with correct functional mapping. Presented in the paper are the designs and schematics of the formulation of advance models whose sole purpose is to fulfil the need of better infrastructure in space. The scope of this paper includes but not limited to is multiple destinations like Moon, Mars and NEAs. Also, the characteristics of this paper is the use of fundamental functions which allows for a broader spectrum of designs.[3] The paper by scientists of NASA John H. Glenn Research Center, Cleveland, OH 44135 describes the planning and demonstration of a 30kW class solar electric propulsion (SEP) system. NASA embarked on a productive journey to fulfil the needs of critical technologies. The studies of multiple researchers reveal that the solar electric propulsion systems have the potential to be one of the most cost-effective solutions in outer earth orbits and beyond to perform transfers cargoes between interplanetary space stations. These can solve the problem of logistics for the mankind in outer space. The 30kW system

has the capabilities to perform high mass transfer without changing the cost effectiveness of the mission. Based multiple scientific researches performed it is clearly that a SEP with higher power system would far more economical and its economic advantages outweighs all the factors.[4] The paper by Mr. Dean Andreadis on Scramjet engines has provided a brief overview on the inner working of the scramjet, it's advantages and most of all it's economic importance. According to Mr. Andreadis, after the successful flight test of the launch of X-43A along with several other full-scale tests of multiple scramjet engine prototypes, the confidence in scramjet based space exploration vehicles has greatly increased. NASA has already put forth many plans to launch multiple vehicles based on scramjet engines by 2025. Under the SED-WR program the U.S. Air force along with Pratt & Whitney, and Boeing's Phantom Works have already started building new space crafts since 2007-08.[5] This research paper describes the processes as well as the basic requirements involved in the a mars rover project. The paper relies upon an ESA project entitled "SPARTAN" which insists on an all-new platform for the next gen mars rovers making them as self-dependent as they can. These rovers are expected to cover more area than their previous counterpart and therefore the time involved in processing and exchanging the data should be reduced, so as to give the rover more accuracy. The blueprint consists of strategically placed cameras, two at a time so as to enable the rover in making detailed 3D portraits of the mars' surface. An experimental prototype was tested and was found to be much precise and reliable one. [6] This research paper describes the upcoming space joyrides and tourism business from the very start to ideas present till date and the future. The idea was born in 1960s. At that time the then Hilton Hotels president Barron Hilton proposed the American Astronautical Society (AAS) on developing space hotels and assured them of backing them by adding the hotels to Hilton franchise. The idea of hotels is not yet accomplished but a lot many companies are working towards it since then. Many a companies like Japanese Rocket Society, Space Transportation Association, NASA, Society Expeditions and many more have made plans, taken public funds and then either abandoned the program or sold themselves. As of today only a handful of companies survive and most notable of them is Virgin Galactic owned by Sir Richard Branson, Philippe Starck, famed space shuttle developer Burt Rutan, and backed up by the ultra-rich Microsoft co-founder Paul Allen who donated \$25 millions to the company. The company has reportedly allocated over \$100 million only on the planning construction of it. Though space tourism is considered to be expensive and dangerous, it would be a phenomenal experience and joyride if it were to be able to take off.[7] This paper speaks of potential of space travel business opposite to prevalent thinking. In the past few years, imperative advances have been taken in understanding this potential. This all started with the space ride for world's first tourists. While a great many people wouldn't like to spend 20 million dollars for a space visit, many would be slanted to purchase a more affordable boarding pass. Indeed, statistical surveying uncovers a craving for a visit to the space among a large number of people from the western countries including U.S. , Canada as well as from the eastern ones like Japan. Different examinations recommend that the space tourism can bloom as a 10- 20 billion USD per annum industry. The most essential prospect for the accomplishment of this industry is the improvement of reusable launch vehicles. Reusable Launch Vehicles (RLVs) speak of a proficient option to the launch vehicles which are used now-a- days to convey payloads to the space. As indicated by a few assessments, RLVs can reduce the shuttle launching expenses by ten times of the current ones. These advantages incorporate decreasing the cost of correspondence and expanding U.S. piece of the overall industry in the business space dispatches area. In excess of twelve organizations worldwide have started take a shot at RLV innovation. Be that as it may, these activities still can't seem to come to fulfillment. Obstructions to RLV improvement incorporate an absence of open acknowledgment of, and bolster for, space travel alongside an awkward, expensive, and unsupportive administrative

administration. In spite of the fact that extraordinary steps have been made in checking open protection from space travel and enhancing the administrative system, more stays to be finished.[8] This research paper explains the mechanism, structure and applications of an electromagnetic launcher designed for NASA-Langley to ease the rocket launching using two different principles of rail gun and coil gun. This system was tested for NASA-Langley by the Centre of Electro mechanics at The University of Texas at Austin. The experiment led to a high energy EML design to accelerate large winged aircrafts up to the escape velocity of earth. This system would use the economical grid power for the basic launch which would be followed by the burning rocket motor in space vacuum where the burning is most efficient. This technology can also be used for the launching of aeroballistics space vehicles with improved designs and efficiency. This can also be the pavement for the horizontal take-off and deep space exploration and even for the disposal of earth's nuclear wastes to the sun. This type of launching system can reduce the cost of personal and priority cargo transfer to space significantly. [9] The ASRG having high conversion efficiency of sterling cycle compared with the radio thermoelectric generators which were used for the precursors of the current space expeditions. Here development status of engineering unit(EU) is discussed for advanced sterling radioisotope generator, which is being performed under the phase 2 of 110W sterling radioisotope generator (SRG110).The use of existing EU will limit the increase in specific power to a lower value than what has been expected. The electrically heated EU ASRG design, making use of the present system. It contains beryllium housing, bulk thermal insulation, an extremely mounted power factor correction controller, gas management valve and the present relief device. The approaches of ASC prevent fault propagation in generator. The electric heat sources at each end of the device are made for general purpose heat sources (GPHS) for progress environmental testing. The ASC designed for the purpose of minimum mass and maximum output. In terms of performance, the ASC operating efficiency and electrical power are dependent of hot and cold side temperature and it gives almost 90% of thermal efficiency. So the objective of these ASRG program is to show highly dependent Stirling system can be built to meet complex space mission.[10] Asset management is a logistical challenge for human space exploration. The appropriate logistic tools are needed to overcome assets related problems especially programs on outside low earth orbit. For example international space station (ISS) faced many difficulties and needed such a management. Actually these databases are in practice of US management information and goods for each human space mission. But the fault of these USS based system is its complexity. These are an empty hole for a common database. So a need of introducing a relational database in ISS maintainability analysis and reliability where data anomalies are causing due to these flatty structure. For reducing complexity of future space program the relational database which is an integrated database frame work to tackle such asset management that is extended from mission planning to execution. This management is a robust method to supply information within a logistic system. These also include documenting and listing the attributes of some 2500 items that are onboard the base. So these is necessary to avoid misalignment of supply chain and information during various stages of the mission.[11] The autonomous system(AS) is a bunch of connected internet protocol that run under the control of one or more network operator through an administrative entity. For space mission human involvement becomes cost prohibited and also not affordable so here comes a topic and future of remote mission assets. The high costs of the satellite missions insisted NASA to start automating many functions reducing human involvement which will also reduce time of response and decision making. Through projects like LOGOS, ANT and ACT, NASA currently focusing on reducing involvement of human controlled system. [12] This paper states the predictive method that is suitable for all, approaches important optimization opportunities, thus supporting related compilation. Then it puts forth an unusual redo collective approach, called optimization-space

exploration (OSE), which is the primary way of approaching towards offensive optimizing compilers focusing mainly on common-purpose architectures. Different from previous frequentative complication tricks and method, the bearing of OSE is finite to particular optimization, architecture realm. Moreover, OSE never sustain the restricted assembled-time cost of other duplicate collective ways. OSE attain this by taking the maximum advantage of existing predictive methods, carefully selecting the search parameters, and using comment to remove the search room at end time. Moreover, OSE recruits a fast unchanged presentation or performance calculator, so avoiding the necessity to run and calculate several advanced modes of the code. At the last, OSE is applicable to the most accomplished part of the programs. Power and the strength of OSE by establishing this type of Intel's offensive advanced production compiler for Itanium. Practical outcome from this model or prototype make sure that OSE can convey important benefits and pase during compiler maintaining time reasonably systematize.

3. FINDINGS

In the stated papers, a clear understanding of topics such as HiPER, infrastructure in space, SEP system, scramjet concept, using robotics in space, space tourism, electromagnetic launcher, ASRG, asset management, autonomous system, compilation describes about how better these technologies can develop opportunities for tourism, have potential to solve and predict problems faced during space exploration or space travel. These all topics subject to reduce cost for a country and can help mankind in solving problems about the current scenario of space exploration. So the common motives of all these papers are to reduce cost, have minimum input and maximum output and to make space exploration more technologically advanced and accessible to the common man.

4. RECOMMENDATIONS & CONCLUSION

In recent times a lot of research has been conducted in the sector of space exploration and during the course of this paper efforts were made to study multiple researches conducted by various alumni of the academia and scientists. The future of space exploration is an important aspect of the times that are to come and the technologies that have been stated in the paper can be stepping stone for mankind in the direction. The researches conducted in this sector are mostly about prototypes and blueprints about plans which will take at least ten more years to come out of the drafting board onto production stage. These projects can be improved and technologies can be advanced to next level along with reduction in cost. There is still lots of scope for research in this sector has space is vast region which has been explored to a very little extent. The next step for mankind is to utilise the full potential of every technologies available to achieve the goal space travel without any limits.

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