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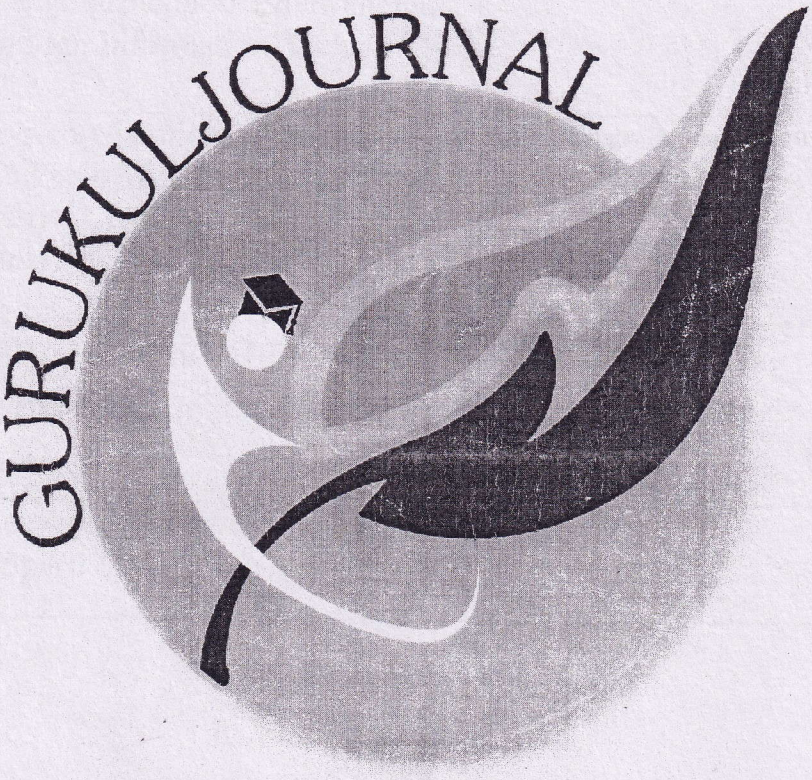

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INDEX

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THE MAJOR ACHIEVEMENTS OF INDIA IN SPACE

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Dr. Vikram Sarabhai is considered to be the father of Indian Space Programme. He had a vision of making India venture into space and play a meaningful role in developing technologies. Ever since 1980, India had managed to make a mark by developing its own satellite.

The Indian Space Research Organisation (ISRO) is one of the largest domestic communications satellite systems in the entire Asia-Pacific. Indian National Satellite System helps in weather forecasting, disaster warning along with providing search and rescue services. ISRO is located in Bengaluru and was established in 1969. Jawahar Lal Nehru along with Vikram Sarabhai had founded INCOSPAR (Indian National Committee for Space Research) in 1962.

'Aim for the moon, even if you miss you'll land among stars. India not only aimed for but also landed on the moon. And not only moon, the journey of India has extrapolated from invading moon to conquering Mars, and the journey still continues for annexing Sun'.

As the nation celebrates seventy years of Independence, the press has been filled with retrospectives, asking the usual decennial question: Has India succeeded or has it failed? The journey of India since Independence has defined the trajectory and shape of our nation today. While India has achieved milestones in every sector, the country has acquired eminence in world-class space science. The India Space Research Organisation (ISRO), with the vision to "harness space technology for national development while pursuing space science research and planetary exploration", was formed in 1969, superseding the erstwhile Indian National Committee for Space Research (INCOSPAR) established in 1962. Since its inception, ISRO has been working continuously in making us proud about its achievements in the field of space.

In the past three decades, ISRO has built an infrastructure sector of space programme construction and operation of satellites and their launch vehicles, ground station and sensors. ISRO has also collaborated with other Indian institutions and over 250 private industries. Both private and public sectors manufacture a variety of equipment and materials light alloy structure

for inter stages, motor cases, liquid thrusters, propellant tanks, gas generation and electronic packages.

India's progress in space has been very systematic starting with experimental satellites like Aryabhatta, Bhaskara, Apple and Rohini. It performed satellite application experiments like Satellite Instructional Television Experiment (SITE), Satellite Telecommunications Experiments Project (STEP) and Apple application programme. The operational space services consist of INSAT system and Indian Remote Sensing Satellites (IRS). ISRO made a modest beginning in launch vehicles like SLV-3 and ASLV. The first development flight of the indigenous Polar Satellite Launch Vehicle (PSLV) was carried out in 1992 which could put a 1,000 kg class remote sensing satellite into 900 km polar Sun-synchronous orbit.

Launched by ISRO in 1983, INSAT is a series of multipurpose geostationary satellites. It helped with telecommunications, broadcasting, meteorology, and search and rescue operations. The satellites built a communication system all across Asia Pacific region. There are nine working satellites in the group. On January 10, 2007, an Indian experiment spacecraft, Space Capsule Recovery Experiment (SRE-I) was launched using the PSLV C7 rocket from Sriharikota. It was launched along with three other satellites to display the ability of recovering an orbiting space capsule.

On October 22, 2008, a 312 day unmanned lunar mission, Chandrayaan-1 was launched. It was India's first mission to moon and was a breakthrough in its space mission as it was one of the only six space organizations to attempt this.

On November 5, 2013, ISRO launched the Mars Orbiter Mission. The goal of the mission was to collect more data on the atmosphere of the planet. Three months after this, in December, ISRO launched GSLV-Mk3 that has an Indian made crew capsule which can carry up to three astronauts to space. India will become a part of the exclusive group of space cruising nations which can take humans to space. It is one of the heaviest rockets and is capable of carrying 4 tonnes of load. Now, ISRO is planning to launch GSLV Mk4, the next level of this operation, which would be able to carry 6 tonnes.

The heaviest commercial mission was taken up by ISRO where it launched 1440 kg of payload. Five British satellites were launched as part of the mission using Polar Satellite Launch Vehicle-C28 on July 10, 2015. This commercial installation mission was launched from Sriharikota and included three optical earth observation satellites of 447 kg each along with two auxiliary satellites.

In may 2016, ISRO embarked on the launch business through PSLV-C2 launch, thereby creating a strong impact on the global space market by successfully launching two foreign satellites along with its own ocean monitoring remote sensing satellite. They were launched by the PSLV. ISRO's marketing agency Antrix Corporation has entered the world market with great success. It aims to secure about 20 percent of the global share of remote sensing products. It is gratifying to note that PSLV with certain modifications can put payloads up to 4,000 kg into low earth orbits (LEO's) and up to 800 kg into geo-synchronous transfer orbits (GTO's).

India might have been a slow starter, but it has been an outstanding achiever in the last few years. On February 15, 2017, ISRO created history by lifting off 104 satellites using the Polar Satelliite Launch Vehicle (PSLV), an Indian rocket. The launch took place on the Sriharikota spaceport in Andhra Pradesh and successfully managed to put these satellites into their desired orbit in one go. 101 were foreign satellites out of the 104 launched. It also included the Cartostat-2 series, India's earth observation satellite. According to Aerospace America, Indian remote sensing commercial satellites are among the best in the world. IRS-1C and IRS-ID provide the best high resolution data to the user community anywhere in the world and the data from these satellites are being received and used by several countries including the US, Japan, Germany, South Korea, Thailand and Dubai. India has now established credibility as a space technology vendor. The worl's largestsatellite manufacturer in the US has ordered satellite hardware worth $700,000 from India. India's space technology export earnings have tripled from around Rs. 10 crore to Rs. 30 crore over the past three years.

Coming to the Indian Regional Navigation Satellite System (IRNSS), with the operational name, NAVIC (Navigation with Indian Constellation), these group of seven satellites, which has been planned to be increased to 11, will help India build its own navigation system. The navigation covers an area of 15,000 km aground our country. Two more satellites are present as a standby in the ground station apart from the seven satellites being used for operations. This made India one of the five countries to have its own navigation system in place. The first launch was made in July 1, 2013. In total there were 8 launches, out of which only one was unsuccessful, with the latest one on August 31, 2017.

So far, India has been dependent on Ariane Space, the French space agency, for launching its satellites. But gradually ISRO is trying to make use of its own launching vehicles. Sriharikota's proximity to the equator gives it a better payload advantage for any polar launch.

The flight of INSAT-3B, INSAT-3A, and the GSLV will take ISRO into higher orbit. Once the GSLV is declared operational, India's future INSAT satellites will be launched by this rocket.

Indian space scientists foresee several developments in the new millennium when they can scale new heights. Revolutionary developments in the fields of communication, information, and microelectronics are driving greater convergence and forging new directions for aerospace programmes.

India's experience has clearly shown that the investment is space always pays through remote sensing and telecommunications. By being fully self-reliant in space activities, it is certain that the resulting contribution from the space programme to the Indian GDP will be markedly significant. New capabilities in Earth Observations are planned with the development of Geo imaging Satellite (GISAT) to provide near real-time images of large areas of t he country and hyperspectral imaging systems for natural resources survey and disaster management applications.

Several exciting missions in Space Science and Planetary Exploration have been planned in the near future including Chandrayaan-2, with a lander and a rover intended for in-situ investigations of the Lunar Surface; multi-wavelength Astronomy observatory satellite ASTROSAT-1 for observation of celestial objects covering optical, UV and X-ray bands and India's first spaceborne solar coronagraph mission ADITYA-1 for studies on coronal mass ejections.

ISRO plans to launch a number of new-generation Earth Observation Satellites in the near future. It will also undertake the development of new launch vehicles and spacecraft. ISRO has stated that it will send unmanned mission to Mars and Near-Earth Object. ISRO has planned 58 missions during 2012-17; 33 satellites missions in next two years and 25 launch vehicles missions thereafter, costing Rs. 200 billion ($3 billion).

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