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A Review on Cube Satellites

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Abstract: *Hence the CubeSat platform was recommended in 1999-with the first launches in 2003-they have provided affordable access to space for new players. The bulk of CubeSats served educational purposes and research projects for universities. Now, private companies have made the number of CubeSat launches per year rapidly increase. This paper going to discuss various types of CubeSats. Generally, normal satellites are launched which cons more cost for launching and fabrication of satellite, by minimizing the cost of fabrication and launching we replace normal satellites with CubeSat which will give accurate results as normal satellites due to deploy the satellite on earth's lower orbit. Launching the CubeSat into space reduces the clashes between satellites and space junk also. Also easily collected the space debris (if unworked satellites are small satellites means).*

Keywords: *Nano Satellites, Cube Satellites, Arduino.*

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I. INTRODUCTION

A satellite is a device in space that rotates around a bigger object. There are two types of satellites: natural (such as the moon orbiting the Earth) or artificial (such as the Satellites).

A CubeSat is a category of miniaturized satellite-based around an algebraic expression consisting of 10 cm (3.9 in) cubes.[1] CubeSats have a mass of less than or equal to 2 kg (4.4 lb) per unit [2]. CubeSats are set down into orbit by deployers on the ISS or launched as secondary payloads on a launch vehicle.[3] As of August 2021, extremely 1,600 CubeSats had been launched.[4]

In 1999, California Polytechnic State University (Cal Poly) developed the CubeSat specifications to propose the idea to develop the skills necessary for the design, manufacture, and testing of small satellites planned for low Earth orbit (LEO) that perform a number of scientific research functions and explore new space technologies. The academic purpose is the reason for the majority of CubeSat launches until 2013 when more than half of launches were for non-academic purposes, and by 2014 most newly deployed CubeSats were for commercial or amateur projects.[3] Yearly launched and intended CubeSats as of August 2021[5]

The total CubeSatallites had launched as of August 2021[6]

Uses generally involve experiments that can be miniaturized for different purposes such as Earth observation or amateur radio. CubeSats are designed to demonstrate spacecraft technologies planned for small satellites or cost-reducing questionable feasibility of a larger satellite. The unproven experiments conducted by Scientific also find themselves aboard CubeSats because their low cost can justify higher risks. Biological research payloads have been blown several missions, with more planned.[7]Several missions to the Moon and beyond are planning to use CubeSats.[8]The first CubeSats in deep space were floated in the MarCO mission, where two CubeSats were launched towards Mars in May 2018 alongside the successful Intuition mission.[9]

Some CubeSats had also the satellites which are launched as countries' first-ever satellites, being launched by universities, state-owned, or private companies. The browsable Nanosatellite and CubeSat Database list over 3,200 CubeSats that had been and were planned to be launched since 1998.[4]

The CubeSat is divided into five types base on the weight and volume here mentioned in the table no .1.

S.NO	TYPE	WEIGHT	VOLUME/UNITS
1	LARGE	>1000 Kg	-
2	SMALL	500 – 1000 Kg	-
3	MINI	100 – 500 Kg	6U – 12U

4	MICRO	10 – 100 Kg	3U – 6U
5	NANO	<10 Kg	1U - 2U

Table.1. CubeSat Types

1.1. CubeSat Design

Based on table no.1, the CubeSat is divided into five types and each design has different weight constrain and volume constrain. By the volume constrain again the model is shown in Figure no.1. The number of aligned units classifies the size of CubeSats and CubeSat Design Specification is scalable along only one axis to fit the forms of 0.5U, 1U, 1.5U, 2U, or 3U. All these standard sizes of the CubeSat have been built and launched.

CubeSat structures not having the same strength concerns as larger satellites, as having the added benefit of the deployer supporting structurally during launch. Although, some CubeSats will undergo vibration analysis or structural analysis to decide that components unsupported by the P-POD remain structurally sound throughout the launch.

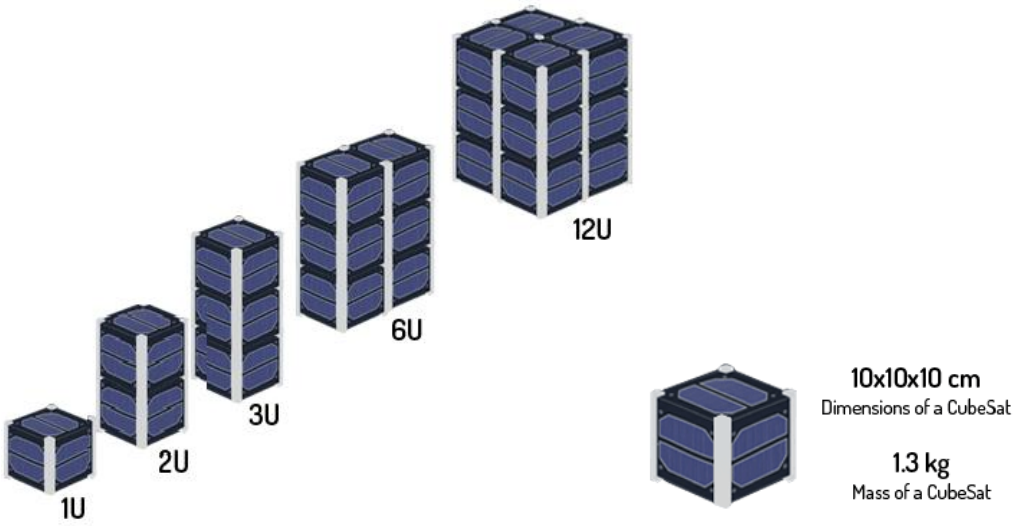

Figure no.1. Standard sizes of CubeSat

1.2. Pros of the CubeSat

- Used in low Earth orbit for applications such as remote sensing or communications.
- The Mini Satellite program also benefits private firms and the government by providing a low-cost way of flying payloads in space.
- All of this occurs while creating important educational opportunities for future leaders of the industry.
- Viable small satellite program is low-cost.
- Cost-efficient.
- Smaller in size.
- Less time to put into orbit.

1.3. Cons of the CubeSat

- Readings that need to take manually by humans cause of the human error.
- Sensing time is very high.
- High installation cost.
- Complex installation.
- Hard to replace any elements.
- Contributes to space debris.
- Its small size can cause feature threats to other working satellites.
- Travels at high velocity projecting the destruction of million-dollar equipment**.**

II. Launch requirements

For the Nano-Satellite discharge, different orbits were chosen. The possibilities were sun-synchronous Earth orbit where the previous CubeSat missions were launched with an altitude of 600 to 850 km and a launch from the ISS. For collecting data on all parts of the Earth's Surface at close quarters it is necessary to adopt a low altitude polar orbit. The sun synchronization occurs when the orbit plane rotates in space at the same rate as the earth Nano Satellites around the sun at one revolution per year or roughly one degree per day.

Sun-Synchronous orbit has an advantage for some Earth viewing missions, in that the Earth is always viewed at one of two times of the day. Since for the Earth observation satellites in Low Earth orbit, the altitude is 550- 950Km then the orbital time of 95-100 min. The spacecraft at low earth orbit will experience the eclipse, the frequency and the duration of which is determined by orbital inclination- for example, in low altitude equatorial orbit the satellite is eclipsed for about 40% of every orbit. Thus, the plane of a Sun-synchronous orbit keeps a constant angle alpha with the Earth-Sun vector. As shown in figure no.2, these orbits are almost polar.

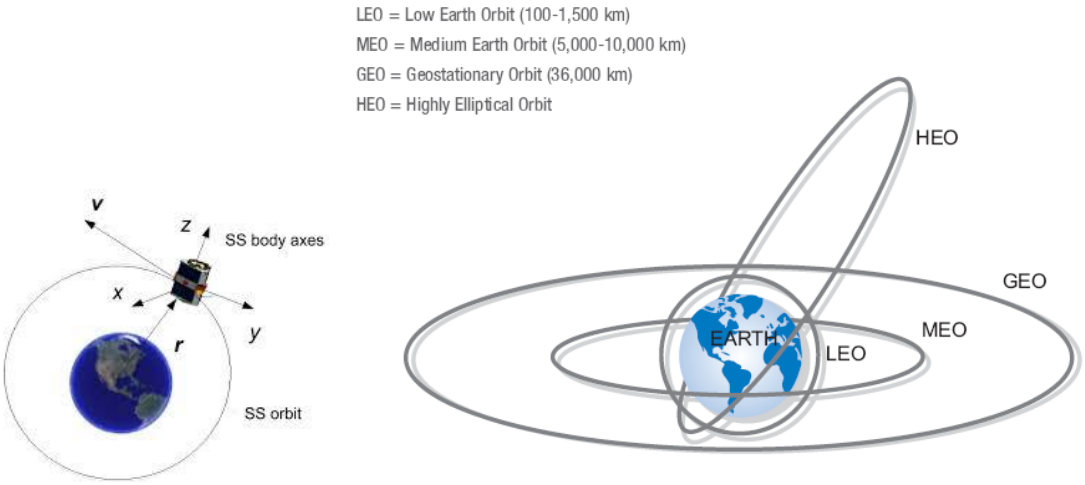

Figure.2. Orbit Structure

2.1 Payload

Payload is the carrying object of an aircraft or launch vehicle. Depending on the characteristic of the flight or mission, the payload of an air vehicle (flight) may consist of cargo, passengers, flight crew, munitions, scientific instruments or experiments, or other equipment.

For a rocket, the payload is a satellite, space probe, or spacecraft carrying humans, animals, or cargo. For a ballistic missile, the payload is the warheads and related systems; their total weight is considered as the throw-weight.

For a satellite, the payload is a sensor used in the satellite like a temperature sensor, heat sensor, Bluetooth sensor, wifi module, camera, etc. The fraction of payload by the total liftoff weight of the air or spacecraft is known as the "payload fraction". When the weight of the payload and fuel are observed together, it is known as the "useful load fraction". In spacecraft, "mass fraction" is generally used, which is the ratio of payload to everything included, (eg. the rocket structure).

III. Observations

Arduino, Esp, Raspberry is an open-source hardware & software company, project, and user community that designs and manufactures single-board microcontroller kits for building digital projects. For constructing the CubeSat these board required for getting data.

3.1 INTEGRATED CODING

The Arduino Integrated Development Environment (IDE) is an application (for Windows, macOS, Linux) that has written functions in C and C++. This application is used to write and upload programs to Arduino compatible boards.

The source code for the IDE is launched under the GNU General Public License, version 2. The Arduino application supports the languages C and C++ using special rules of code structuring. The Arduino IDE application supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, which is compiled and linked with a program stub main () into a workable cyclic executive program with the GNU toolchain.

Figure no.3. Sample for Arduino Code in the application

3.2 SERIAL MONITOR

The Arduino application has a feature that can be helpful in debugging sketches or controlling Arduino from the computer's keyboard. The Serial Monitor is a different pop-up window that acts as a separate terminal that communicates by receiving and sending Serial Data.

The sample of output screen for the satellite module is shown below Figure no.4.

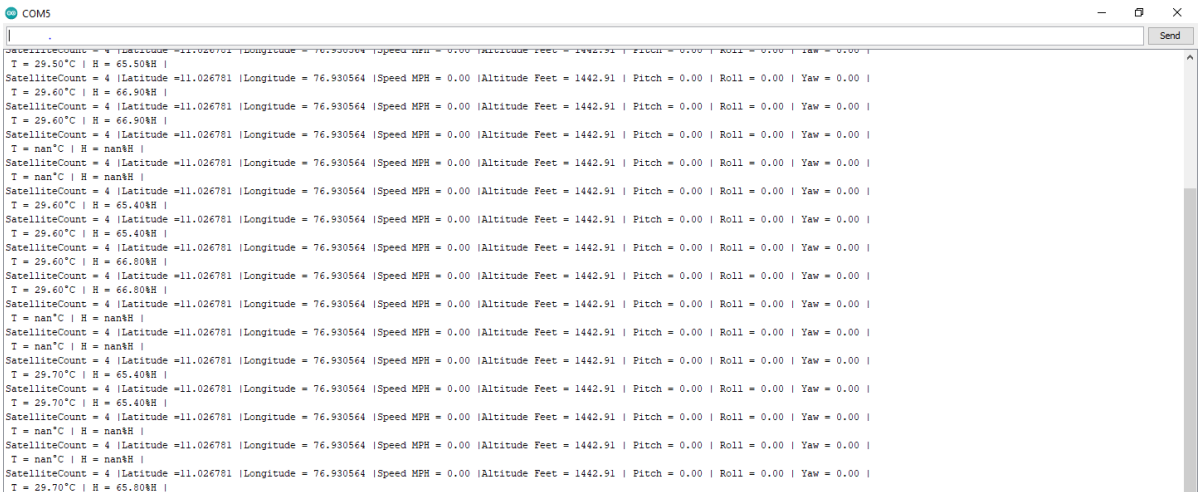

Figure no.4. Sample of CubeSat Data in Arduino application

IV. Future Scope

The future scope of the project is to develop a propulsion unit for this specific nanosatellite module which will utilize the lipo battery power subsystem for the same.

V. Conclusion

This paper discusses a about mini satellites how can be fabricated and procedure for deploying. Aiming to choose the satellite means we can test easily from ground station by conducting various technics (e.g., Rocket launching, Drone launching, Heli launching, parachute launching, Building dropping, etc.). The step-by-step procedure for launching the cube satellite into the space is explained. The design and construction of CubeSat are simple to construct, portable, cost efficient, less power consuming, and reliable. The hardware design and the

data acquisition system are easily demonstrated. and the fabrication of Nano Satellite with proper material Identification is also simple to do.

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