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# Design of an Earth Observation Satellite for supporting disaster Management in Equatorial Region

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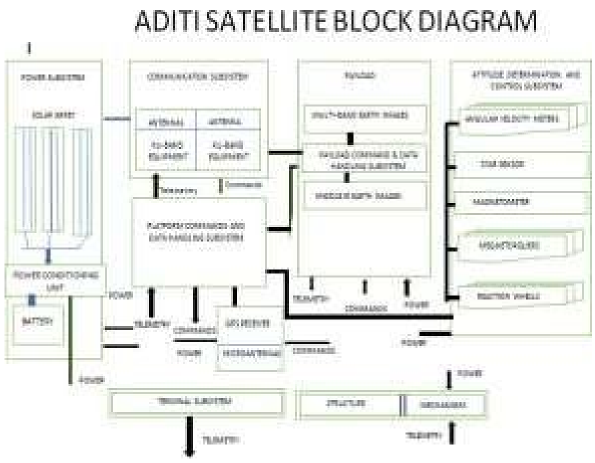
## ABSTRACT

This paper aims to develop a simulated design of an Earth Observing (EO) Satellite named as ADITISAT which supports us in disaster management such as Flood, Earthquake and Tsunami. The proposed system is designed to overcome the thick cloud cover while capturing the earth data. The overall mass of our satellite will be less than 26 kg. The Satellite is designed to cover equatorial region at 23 ° Latitude and longitude. The implementation strategies of our research advocate Attitude Determination and control components, Communication Components, Power management, Solar Panel design, payload calculation and Design of the Satellite etc. The key challenge in ADITISAT is maintaining the mass under the expected mass as well penetrating the thick cloud cover. This Research concept will definitely have lot of scope to convert in to a realone.

## INTRODUCTION

Low Earth Orbit satellites or Earth remote sensing satellites are basically designed for Low Earth orbit, which is to detective disaster satellites but proposed for uses such as environmental monitoring, earthquake etc. IT exhibit how satellite signals are connected to images and walk around the ways in which different scientists use such images. Remote sensing is the science of monitor, make out, and compute objects and regions without direct contact. Sensors are mounted on satellites that orbit Earth. The global coverage with a lowearth orbit be a polar orbit or neighbour too. A low orbit will have an detour of normally 100 minutes and the Earth will turn in the order of its glacial axis with about 25° between subsequent orbits, due to the result that the ground path is change towards west with these 25° in longitude. Maximum are in sun-synchronous orbits.

## PROPOSED DESIGN




## ORBITAL DESIGN

If the altitude is selected as less than 500 km (depending on the satellites ballistic characteristics), the atmospheric drag affects the satellite Position in the orbit. So, it is decided to choose the altitude above 500 kms.

## ORBITAL PARAMETERS

| | |
|---|---|
| Perigee=apogee | = 710 km |
| PerigeeRadii | = Perigee + Radius ofEarth |
| $R_p$ | = 710+6371 |
| $R_p$ | =7081km |
| Apogee Radii | = Apogee + Radii ofearth |
| $R_a$ | = 710+6371 |
| $R_a$ | =7081km |

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**EC ENTRICITY (e)**

$e = (L_a - L_p) / (L_a + L_p)$

$e$=0 (because sun synchronous is a circular orbit)

**MEAN MOTION (MM)**

$$\mu_m = \sqrt{\frac{G_m}{(Sm)_a^3}}$$

$$\mu_m = \sqrt{\frac{398600.4}{(7081)^3}}$$

$$\mu_m = 1.05963\text{x}10^{-3}$$

**ORBITAL PERIOD (T)**

$$T = 2\pi\sqrt{\frac{(Sm)^3}{G_m}}$$

**INCLINATION**

$$i = 98.2°$$

**ATTITUDE AND ORBITAL DETERMINATION CONTROL SYSTEM**

**EXPLANATION OF AOCS PROCEDURE**

The AOCS machine accepts that the tiny satellite has a light mass magnetometer attitude control stand with distant sensing arrangement (payload).Earth surface is measured by interconnected directed sensor data. This prerequisite makes it need to regulate correct sensor pointing data for every dimension. Therefore, the AOCS needs orientation and attitude data, which not alone controls (attitude stability) but also, does the extension of payload sensor quantities.

Mechanisms used for location purpose and the components used by the Attitude Determination and Control System (ADCS). ADCS includes sensors used to determine attitude and attitude rate, such as star trackers sun trackers, and actuators designed to change aspacecraft‟s attitude, like reaction wheels and thrusters.

**REACTION WHEELS**

Diminished reaction wheels provide minor spacecraft with a precision pointing capability. Reaction wheels could provide arbitrary torques limited only by the wheel‟s peak torque and momentum ability. We have decided to use RWP500 reaction wheel for our proposed design because of the following specification.

**MAGNETOMETERS**

Magnetometers deliver a quantity of the local magnetic field, and this measurement can be used to provide both estimations of attitude. Typical application of this magnetometer is space craft attitude determination. It is a ring core-based flux gate type magnetometer that provides 16bit output along each sensitive axis. Magnetic sensor and processing electronics are housed in a compact enclosure.

The main feature of this is,

- Ring core sensor-based fluxgatemagnetometer
- Closed loopconfiguration
- 16-bit serial digitaloutput
- Single supplyoperation
- Triaxial sensor and Electronics inintegrated housing.

**MAGNETORQUERS**

Magnetorquers are an established technology used in small spacecraft and can provide control torques perpendicular to the local external magnetic field. Magnetorquers are often used in combination with wheels to remove excess momentum. As control torques can only be provided in the plane perpendicular to the local magnetic field, full 3- axis stabilization is ZARM Technik Magnetorquers

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Vol-22- Issue-14-December-2019

## TELEMETRY &TELE-COMMAND LINK

The Telemetry, Tracking and Command (TT&C) Systems of a spacecraft delivers the most energetic telecommunication link between a satellite and ground station. It affords the greatest vital telecommunication link between a satellite and ground station. The TT&C systems run the uplink for command, downlink for observing the several physical condition constraints through telemetry and much needed tracking information for the satellite for monitoring its position in orbit. The link is endowed with using a ground station and on-board tele-command & tracking data receiving systems, on-board decoder and telemetry transmitter. The TT&C link of a satellite is of key reputation, right from the time of its launch to the termination of the mission. The uplink and downlink frequencies could be in VHF/S/X/Ku or Ku bands depending on the mission necessities, structure development status and facilities offered.

Ku band is selected, because it has the feasibility to access the wider bandwidth, number and size of the antenna can be reduced also congestion can be avoided.

## QPSK MODULATION

The Quadrature Phase Shift Keying (QPSK) is chosen for Modulation process. It is two binary codes are represented by four phase (0, 90,180 & 270). Bandwidth is twice efficient than BPSK. Very good noise immunity. On account of compact bandwidth, the information transmission rate of QPSK is greater. Variation in QPSK amplitude is not much; later carrier power almost remains endless. It also has low error probability. Baud rate is half of the bit rate therefore more effective utilization of the available bandwidth of the transmission channel. After QPSK modulation data will be encoded by Forward Error Correction (FEC). We have chosen to integrate COTS communication kit for the telemetry & tracking purpose in oursatellite

## TRANSPONDER

The subsystem, bridges the connecting link between transmitting and receiving antennas of a satellite, is known as Transponder. It is one of the utmost significant parts of space section subsystems. Transponder performs the functions of both transmitter and receiver (Responder) in a satellite. Here, the word „Transponder" is obtained by the combining few letters of two words, Transmitter (Trans) and Responder (ponder).

## POWER SYSTEM DESIGN

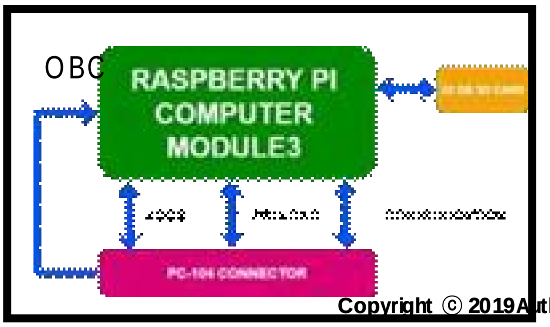
To design a power system to be used in a micro earth observation satellite specifically design for disaster management. The proposed design of satellite illustrates how to overcome the power requirement challenges faced by a micro earth observation satellite. The satellites described in the proposed satellite system should weigh less than50kg.

Based on the power requirements of the sensor and the constant power requirements for the satellite, the solar arrays and batteries for the satellite aresized.

Since the sun synchronous polar orbit is selected, solar panel is more sufficient for power. For the safety plan for a Lithium Ion battery is considered. It is planned to use aluminium material to backend of the solar panel, top with triple junction Ga-As.

## ONBOARD COMPUTERS (OBC)

On Board Computer (OBC) iswell-thought-out to be the brain of the satellite. OBC mustbeplannedinsuchawaythatitshouldcontrolall



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Vol-22- Issue-14-December-2019

the Subsystem.

The primary mission of the satellite is Earth Observation (Disaster management) and data communication to the earth station. This satellite is dispersed into different subsystems like Structural, Power supply, Payload, Attitude Determination and Control, on-board Computer, on-board Communication and Ground station telemetry and trackingsystems.

In addition to all these tasks, the design limitations such as physical size and power consumption must also be considered the Pi/104 extends the CM3‟s interfaces via dual 40-pin connectors that support up to 59x GPIO total. The inner 40-pin connector is pin-compatible with the Raspberry Pi, according to Parker. The outer one implements a homegrown expansion pinout. The Pi/104 is further equipped with a recessed 10/100 Ethernet port , 2xUSB 2.0 host ports, and a Micro-USB OTG port, which provides a third power supply option in addition to the 8-36 V input and the One Bank power inputs. There‟s also an HDMI port and MIPI-DSI display and MIPI-CSI cameraconnectors.

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