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DEPLOYMENT OF NANOSAT AT LOW ALTITUDE FOR ATMOSPHERIC PARAMETER ANALYSIS

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ABSTRACT: *Design, development and launch of Nanosat called "SITSAT" using NSLV (Near Space Launch Vehicle) a type of sounding rocket at low altitude is proposed in this paper with the comeback technology. "SITSAT" weighs less than 500g ,carries out the study of UV radiation of range 200-350nm and atmospheric parameters such as temperature, pressure using UV sensor and BMP180 respectively which are embedded in Arduino and data transferring is ensured by LoRa wireless communication module and the data will also be stored locally using SD-card. Navigation is tracked using NEO-6M module which gives the coordinates from which the payload can be recovered safely. Video tracking is done with the on-board camera.*

Keywords: BMP180, NSLV, Comeback technology, LoRa, UV Sensor.

1. INTRODUCTION

Climate action is one of the key elements to acquire a sustainable development. Measuring the above mentioned atmospheric parameters at high altitude gives better prediction. By using nano satellites these parameters are recorded and caneven be calculated. The real time data is quickly available to the users for further analysis. A CANSAT may be a sort of nano satellite, integrated within the quantity and shape of small can. Our challenge is to suit all the main subsystems found in a satellite, like power system, sensors and a communication system into this minimal volume. The CANSAT is then launched to an altitude of a few hundred metres by a rocket and carries out scientific experiment and safe landing is achieved using parachutes. Arduino is an open-source, easy-to-use hardware and software. LoRa SX1278 Ra-02 module is employed as transmitter and receiver for communication from space to the earth station. The recorded data is additionally stored in SD-Card Module. The CANSAT must be developed so as to sustain a while in air at few hundred meters. It uses a 9v power supply. The entire system is meant by ensuring the load less than 500 grams. The modules utilized in the CANSAT systems are sensitive so as to monitor the minimum variation in atmospheric parameters.

2. COMPARSION WITH EXISTING SYSTEM

The system that are prevailing measures the atmospheric pressure and temperature using regular sensors and data is transmitted using YAGI antenna[1].The parameters are analyzed with the assistance of rocket model till the peak of 400 meters within the atmosphere which measures the essential parameters of atmosphere[2].Next stage is to maneuver to an altitude of 600 meters and use of gliders which provides the descent rate faster but in irregular fashion[3]. Then another CANSAT reached to height of 500 to 700 meters which incorporates the altitude, pressure, temperature and position of the CANSAT[4].

The air quality is additionally monitored at 100 meters is performed and this is often analyzed by flying the CANSATwithin the balloon[5]. The atmospheric parameters are studied and data are transmitted using ZigBee module which provides short range transmission and those parameters are studied by launching the CANSAT using balloon[6].

3. OVERVIEW

The primary idea is to measure the atmospheric temperature and pressure with high accuracy and this is often ensured using BMP180 and also the intensity of the ultraviolet rays is additionally calculated by GUVAS12SD.This is done to estimate the sort of UV rays that enter the atmosphere which aims to supply precaution to the environment. The modules used to develop the SITSAT are pressure sensor BMP180, UV sensor GUVAS12SD, GPS module NEO-6M which are embedded within the Arduino. The altitude reached by SITSAT is around 750m using near space launch vehicle [NSLV].The communication is enabled by LoRa SX1278 Ra-02 which is a transceiver and also the results obtained from these components are locally stored using sd-card slot.

4. DESIGN

4.1. BLOCK DIAGRAM REPRESENATION:

The schematic represented in fig 1 shows the flow of information from one module to another. The power supply is given to the Arduino board by 9v DC battery. . Arduino boards are able to read input and turn it into an

output. The boards are equipped with sets of digital and analog input/output pins which will be interfaced to various expansion boards and other circuits. The temperature, pressure within the atmosphere is monitored by BMP180 which gets the input signal from the Arduino and helps to calculate the altitude of the CANSAT reached. The analog UV sensor calculate the intensity and convert it as the output voltage which is governed by ADC present within the Arduino. It helps to indentify the sort of UV rays that enter into the atmosphere. The latitude and longitude helps to spot the location of the CANSAT after reaching ground. The is achieved by NEO-6M module which produces the highly accurate co-ordinates, From this module Latitude and longitude are often obtained by tracing from three satellites itself but altitude are often calculated after tracking quite three satellites .The communication from transmitter in payload to ground station is performed with LoRa SX1278 Ra-02 which provides better transmission of data. The info from sensor are received through arduino and transmitted by LoRa transmitter and received in ground station. The info also are stored in sd-card reader. SQ11 mini Dv camera is employed for on board video .SQ11 includes a built-in lithium-ion battery which has a capability of shooting video with a resolution of 1280X720P for quite hour.

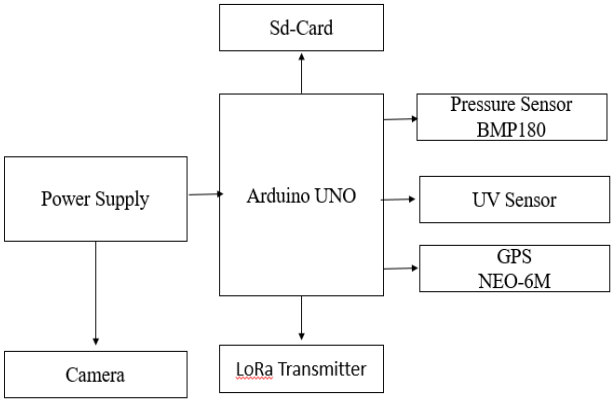


Fig 1. Block diagram of CANSAT

4.2. DESIGN OF CANSAT BODY

CANSAT body is made as light as possible that creates the flight to an extent atlitude. This can be made possible by constructing the body of the CANSAT using balsa of 4mm thickness. The body is formed in the shape of cylindrical whose diameter is 65mm.Series of layers are made as shown in fig2.

Fig 2.CANSAT body

4.3. DESIGN OF ROCKET BODY

Rocket body is vital to lift the whole payload and even be less in weight this is often made by using cardboard material. The weight of the rocket body is minimized and this ensures the flight to higher level. The cardboard is formed to a cylindrical shape with diameter of 75mm and height of 1000mm.The rocketbody is shown in fig3.

Fig. 3 .Rocket body

4.4. DESIGN OF PARACHUTE

Comeback technology is performed by parachute. A parachute is an umbrella-shaped device of light fabric used especially for creating a secure jump from CANSAT. During its descent, due to its weight the gravitation accelerates the CANSAT downwards. Parachute is required to counteract

this force with a drag force caused by air resistance. This negates the acceleration because of gravity and the system descends with a steady velocity called descent velocity. The deployment of the parachute will be relatively violent.. Parachute is made using polythene material which is extremely light and consumes minimal weight within the CANSAT body. The descent rate determines the diameter of the parachute. The diameter of the parachute used for CANSAT body is 50cm. The parachute along with CANSAT body is seen in fig.4.

Fig 4.CANSAT body with parachute

4.5. DESIGN OF NOSECONE*:*

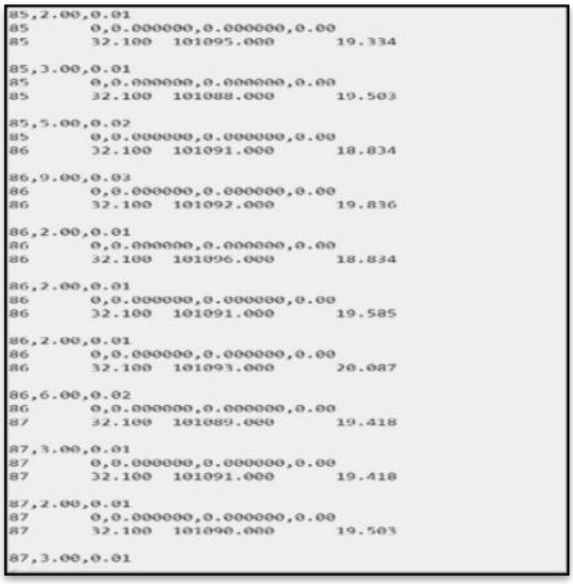
Nosecone is developed using 3D printing using polylactic acid material as shown in fig 5. The diameter of the nosecone is taken to be 75mm with good finishing.

Fig 5.Nosecone

4.6. SOFTWARE DESIGN

(i)Arduino IDE:

Arduino is an open- source electronics platform based on easy-to-use hardware and software. Programs written using Arduino software (IDE) are called sketches. These sketches are written in the text editor and are save with the file extension. These programs can be uploaded into the Arduino board using this software having the facilities of compiling and uploading. This software can be used with any Arduino board. In this system, Arduino IDE helps to upload the program developed using embedded C language into the board for the processing of the system. The results obtained through sd-card slot are shown in fig 6. And transmitted results are received through LoRa which is shown in fig 7.



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85,2.00,0.01
85       0,0.000000,0.000000,0.00
85       32.100   101095.000       19.334

85,3.00,0.01
85       0,0.000000,0.000000,0.00
85       32.100   101088.000       19.503

85,5.00,0.02
85       0,0.000000,0.000000,0.00
86       32.100   101091.000       18.834

86,9.00,0.03
86       0,0.000000,0.000000,0.00
86       32.100   101092.000       19.836

86,2.00,0.01
86       0,0.000000,0.000000,0.00
86       32.100   101096.000       18.834

86,2.00,0.01
86       0,0.000000,0.000000,0.00
86       32.100   101091.000       19.585

86,2.00,0.01
86       0,0.000000,0.000000,0.00
86       32.100   101093.000       20.087

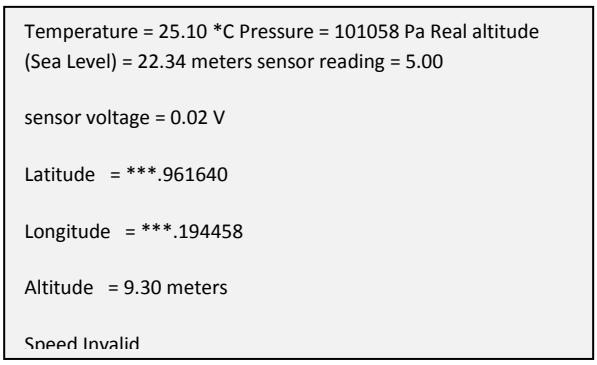
86,6.00,0.02
86       0,0.000000,0.000000,0.00
87       32.100   101089.000       19.418

87,3.00,0.01
87       0,0.000000,0.000000,0.00
87       32.100   101091.000       19.418

87,2.00,0.01
87       0,0.000000,0.000000,0.00
87       32.100   101090.000       19.503

87,3.00,0.01
```

Fig 6. SD card output



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Temperature = 25.10 *C Pressure = 101058 Pa Real altitude
(Sea Level) = 22.34 meters sensor reading = 5.00

sensor voltage = 0.02 V

Latitude   = ***.961640

Longitude  = ***.194458

Altitude   = 9.30 meters

Speed Invalid
```

Fig 7. LoRa output

(ii)Space CAD:

Space cad is a user friendly software tool used to design the rocket body which also tells about the deployment and ejection of CANSAT from a particular altitude. It also tells about the distance of recovery of rocket body. The descend rate, maximum speed and flight time of the CANSAT is also analyzed and calculated.

Fig 8. Side view of rocket body

5. WORKING IMPLEMENTATION

All the sensors are connected to the respective analog and digital pins in the Arduino and the CANSAT module was set and fit in the rocket body. The five phases are rocket was performed. The boost phase is the initial stage which takes places at ground level in which payload and rocket body are ready to fly. The second phase coast is continued and followed by ejection which occurs at 750 meters from ground level. The ejection phase separates the payload and rocket body .Next phase is the descent phase in which the rocket body is recovered using parachute from a distance of 50 meter from the launch distance and the payload descent at a rate of 13m/s and it is recovered using the comeback technology. Finally landing phase takes place from where the payload and the rocket body are recovered. The simulated result is shown in fig 10.

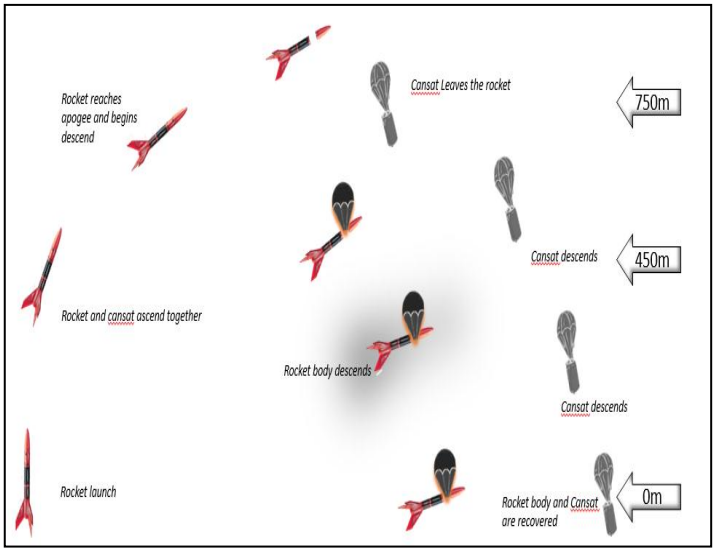

Fig.9.Flow of execution

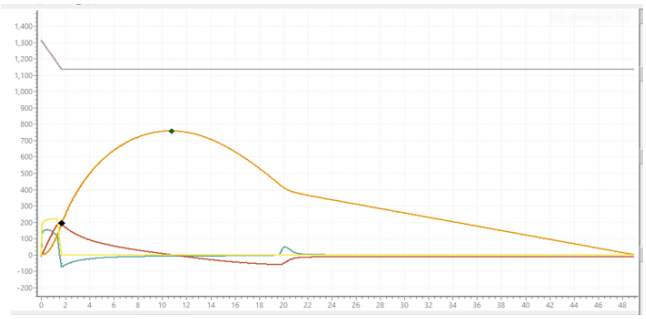

Fig 10. Simulated output of deployment

6. CONCLUSION

The CANSAT is used mainly for analysing weather parameters, for a shorter time withstanding in space. CANSAT is launched using launch vehicle toa height of 750m. The sensors which are interfaced with a CANSAT module continuously sense the data's which is then transmitted to the ground station using LoRa module. The analysed sensor data's are stored in a SD card module. Rocket if powered with Solid engine ($KNO_3 + C_6H_{12}O_6$).The atmosphere parameters are calculated and acknowledged.

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