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# Development of Nano-Satellite, AEROSAT for Space Education

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**Abstract** : An AEROSAT is a simulation of a real satellite, integrated within the volume and shaped of a frustum structure. The challenge is to fit all the major subsystems found in a satellite, such as power, sensors and a communication system, into this minimal volume. The AEROSAT is then sent to an altitude of a few hundred metres by a drone and its mission begins: to carry out a scientific experiment and achieve a safe landing. AEROSAT offers a unique opportunity for students to have a first practical experience of a real space project. They are responsible for all aspects: selecting the mission objectives, designing the AEROSAT, integrating the components, testing, preparing for launch and then analysing the data. Throughout this process the students: learn by doing, get acquainted with the inquiry-based methodology that is typical of real-life scientific and technical professions and acquire and/or reinforce fundamental Aerodynamics, Physics, and programming curricular concepts.

**Keywords**: Cansat, Nanosatellite, Space Education, Iot Application

## 1. Introduction

Space education has been introduced in many way of technology involvement in past decade [1]. One of the initiatives is called nano-satellite project which a standard soda can size with few electronic component inside and launch into the space. Development of nano-satellite called AEROSAT as shown in figure 1 was introduced in the educational field in order to expose the students to the technology of nano satellite and improve their understanding of the atmospheric elements. Basically, this innovation is divided into two main part which is the AEROSAT and the Ground Station. The AEROSAT is sent to a higher altitude by using a drone and powered by a Lipo 3.7 V battery. The BME680 and GPS in the AEROSAT will collect data of the altitude, pressure, humidity, gas resistance, temperature and location before sending it to the ground by using a transmitter. The Ground Station will receive the data and show it in the serial monitor before transferring it to the Blynk Apps. The Blynk platform will

display the data in the form of parameter which is much easier to understand and compare. Even though there been a lot of programme and competition regarding satellite, but there are still a lot of students that are not aware of it. Therefore, it is designed to increase the understanding of satellite and how to practice the usage of sensors alongside IoT platform in daily life. The Ground Station is equipped with NodeMCU ESP8266 which allow many people to access the data from AEROSAT on Blynk Apps at one time by only sharing the same WiFi connection (Figure 1). This IoT based system has been widely used for many projects such as Servo Motor Monitor [2], Skating Robot [3], Tiny Internet Weather Station [4] and IoT CloudKit [5].



**Figure 1 : AEROSAT and its Ground Station development**

## 2. Materials and Methods

2.1 Materials

The main body part of the AEROSAT is the container that attaches the payload subsystem. The shape of the container is a frustum which has been made by high-quality PETG material by using a 3D Printer. The diameter of the bottom container is 10 cm and its top is 3 cm, plus the height is 8.5 cm. To design its overall system is still quite complicated. It is easier to deal with each subsystem. There are 3 tiers of a PCB attached to each other. The first tier consists of a power supply: Battery Lipo 3.7V, 2 in 1 Step-up and charger, switch button and Arduino Nano (microcontroller). The second tier consists of payload subsystems: GPS NEO 6M V2 and Mini LoRa SX1278 (transceiver module). The third tier consists of BME680 (indicates temperature, pressure, humidity, altitude and gas resistance). Table 1 shows arrangemenr of each tier with components involved in AEROSAT.

**Table 1: Arrangement of each tier with components**

| Tier | Components |
|---|---|
| **The first tier (power supply)** | Battery Lipo 3.7V, 2 in 1 Step-up and charger, switch button and Arduino Nano (microcontroller). |
| **The second tier (payload subsystems)** | GPS NEO 6M V2 and Mini LoRa SX1278 (transceiver module). |
| **The third tier (payload subsystems)** | BME680 (indicates temperature, pressure, humidity, altitude and gas resistance). |

2.2 Methods

The AEROSAT is then sent to an altitude of few meters by drone or dropped from a platform and the objective is to prove the concept and measure the atmospheric pressure, humidity, altitude, change in temperature, Global Positioning System coordinates (GPS), air quality from the atmosphere to ground.

On the ground station, where all the data will be received by the Mini LoRa SX1278 through the serial monitor. In addition, the data also can be read wirelessly through Blynk apps because of the integration between NodeMCU ESP8266 WiFi Module and Mini LoRa SX1278 (Figure 2).
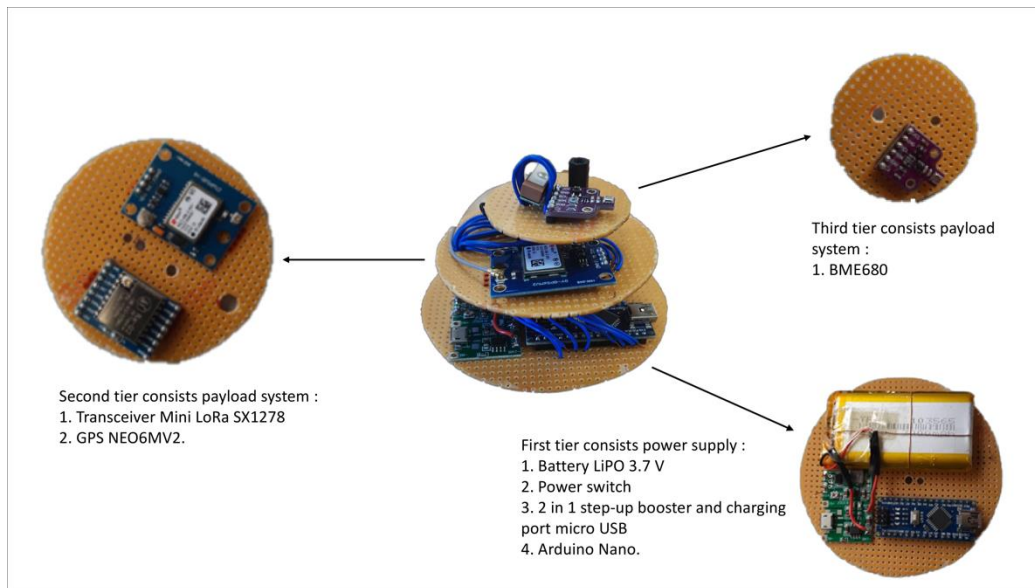


**Figure 2 : The integration of AEROSAT components**

## 3.   Results and Discussion

All components and tiers for AEROSAT and its ground station were successfully integrated and assembled as shown in Figure 3 and Figure 4.  The AEROSAT is sent to a higher altitude by using a drone and then it will be released from a certain altitude. AEROSAT will collect data of the altitude, pressure, humidity, gas resistance, temperature and location. From this, AEROSAT has will transmit the data to the ground station using transceiver module, Mini Lora SX1278. Users can monitor the data and elements via Blynk Apps on a smartphone as shown in Figure 5. Thus, the AEROSAT able to demonstrate the proof of concept and theory of related subject such as Physic and Aerodynamic by measuring atmospheric elements.



**Figure 3 : Intergration of the AEROSAT**
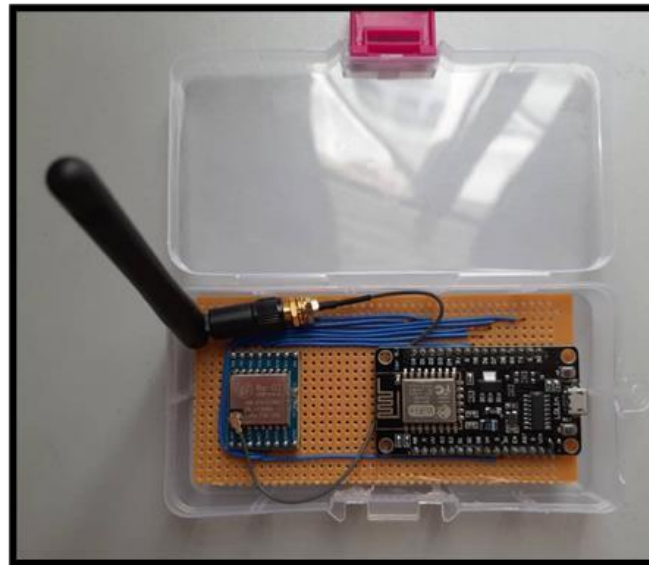
**Figure 4 : Ground station of AEROSAT**



**Figure 5 : The data and elements displayed via Blynk Apps**

## 4. Conclusion

In this project, the AEROSAT was developed to overcome the problem to collect atmospheric data from a higher altitude. With this data, we can analyse the atmospheric elements at a higher altitude and compare them with atmospheric elements on the ground. The performance of the developed innovation has been successfully demonstrated. In addition, a smartphone was used to display the data for better understanding.

**Acknowledgement**

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