

TESTING THE MAIN TASKS OF FIRST MOLDAVIAN SATELLITE IN NEAR SPACE CONDITIONS WITH A HIGH ALTITUDE BALLON

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Abstract: *High-altitude balloons (HABs) are conventionally used to collect flight data, weather data, including pressure, inside and outside temperature, humidity, wind speeds and a lot of data needed by developers up to an altitude of at least 40 km. The scope of this project is to test the ground station systems developed at NCST, create and launch an electronic system for real-time tracking and data monitoring for a HAB. GPS data, inside and outside temperature, pressure, battery status and images captured during the flight are saved to an on-board SD card and sent via 10mWatt transmitter to NCST Ground Stations System. Also was installed an GPS tracker thus, users are able to track the position for balloon recovery. One onboard camera capture still images throughout the three hour flight.*

Introduction

A HAB consists of two systems, as seen in Figure 1. The balloon provides the necessary lift using the buoyancy force of hydrogen or helium. The payload is tied below the balloon, and contains the electronics necessary for taking measurements and communicating with users on the ground.



Fig. 1 A high altitude balloon system

Our primary contribution to HABs is the development of the payload. The project goals are to provide real-time tracking, accurately calculate altitude, stabilize the payload the same way as satellites do in space, capture photos of the flight and transmit real-time video to ground station. This version of HAB payload needs to add stabilization of the payload and to send real-time video with a 5.8GHz transmitter. The Pi in the Sky module must be present as the main electronics part and its task is to send the telemetry in standard mode. The test electronics part must be added to send additional data on another channel. The MTX2 is an FM radio transmitter that features a TCXO (Temperature Compensated Crystal Oscillator) that means that the output frequency is very stable despite

temperature changes. This means that once you tune in to the transmission, you won't need to retune during flight even if the tracker gets very cold.



Fig. 2 PITS+ Board for model A+, B+, V2 B

Further, the choice of antenna requires significant design considerations regarding the tradeoff between omni-direction and unidirectional transmission.

The scope of the project mainly is to test the payload electronics and ground station system developed at National Center for Space Technologies at Technical University of Moldova.

Hardware and Software

The hardware and software requirements for the HAB were decomposed into six tasks: power supply board, communication, localization, sensors, stabilization and image collection. In this project are used as Raspberry as Atmega microcontrollers which communicates between them to perform all.

The power supply allows the PITS, Pi, 5,8GHz Transmitter and Stabilization system to be powered from a 3S lipo battery. For PITS and Pi the battery voltage is converted to 5V and then fed to the Pi which down-converts to 3.3V for the processor and PITS. The 5,8GHz transmitter and Stabilization System are powered through a current sensor to the 3S Lipo because there already are a converter which does the job.

In order to solve the problem with all electronics on board we've developed a software which is uploaded on the main navigation controller and it handles the attitude, sensors and telemetry data, communication, video transmitter and power distribution control.

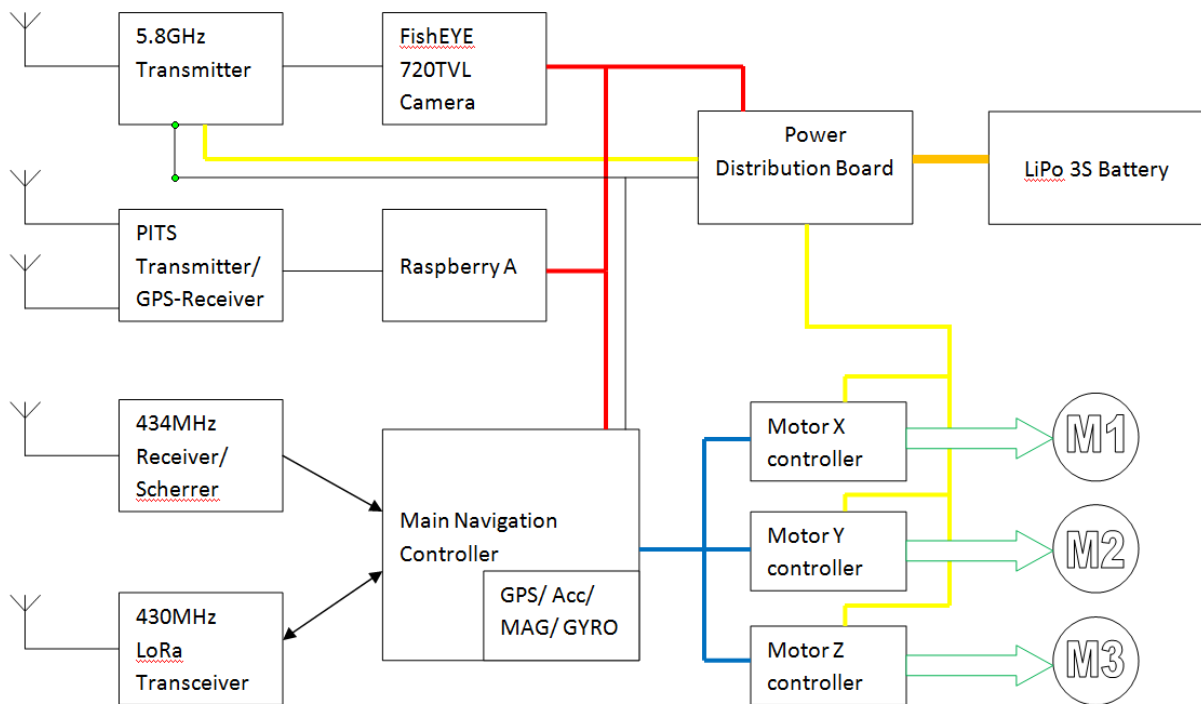


Fig. 3 Diagram of the HAB Payload

Communication

In order to solve the problem of communication with the HAB, we had to write a program to our ground station system that will track the balloon using the data from the on-board GPS. For first information to be received we've developed a mobile station installed on our car, that was the chase car used in our project. the name of the chase car is ER1OR or ER1SC.

The mobile station is equipped with a 3G modem and first data are sent to server so the ground station took these data and start to track the HAB.

The ground station was named and is still named ERITUM, it is our official name that gave authorities.

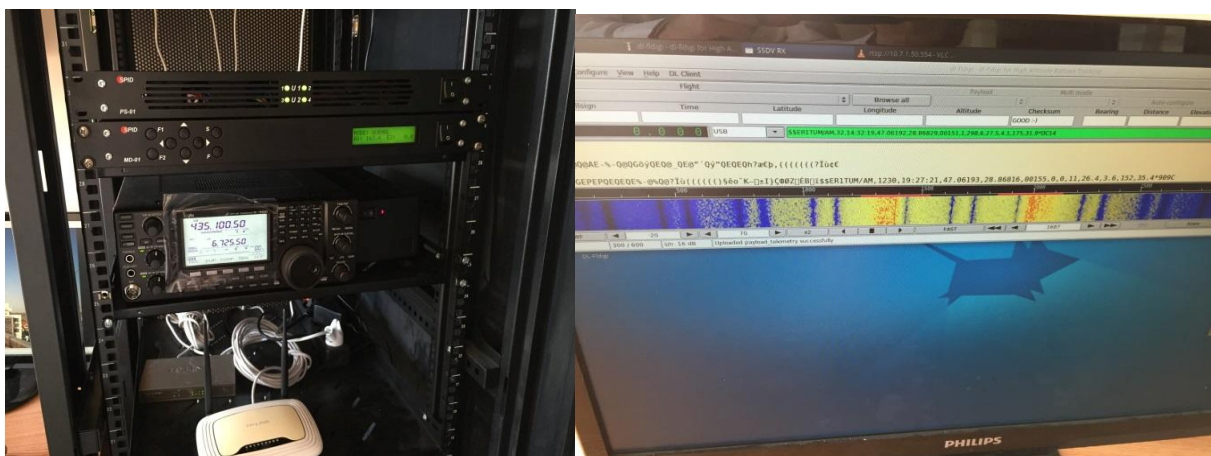


Fig. 4 The ground station and the software that decode information from HAB at NCST

Images are saved on the SD card, and at the same time transmitted to ground station, every image is compressed and the sent. When one image is sent, another image is being sent and the image is a image tooked at the moment when another transmission started.

Prediction

The prediction of the balloon flight in the atmosphere is very important for taking the balloon home after its flight, and is important for authorities to give a NOTAM and to get the permissions for this flight.



Fig. 5 Prediction and preflight tests

Balloon System

Our team use a 500g professional latex weather balloon capable of inflating to 5.8 meters in diameter. When inflated to 2 meters diameter at ground level, the balloon provides 1 kg of lift, and continues to expand before bursting at around 30 km. Inflating required special care, including using latex gloves to prevent transfer of corrosive oils and a soft ground cloth to protect from ground debris. We tied off the balloon using nylon rope.

Conclusions

The launch of a HAB (High Altitude Balloon) only seems to be a simple step in order to take some pictures or flight data from stratosphere, indeed this is a hard work, our team was doing all this work during one year, and we are ready to launch.

Based on last HAB launch we already know about all steps to do with authorities in order to have another success.

Also the changes from the last HAB payload includes only adding new equipment to the payload, the old and tested equipment lasts there for backup the mission in case something goes wrong. I must admit that we have to take this risk and to prepare for everything.

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