



BARQ SAT

Structure and communication sub-systems



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Abstract: Team 13 responsible for the communication and structure of the CubeSat. In this project, a 1U CubeSat is designed. The CubeSat is named BARQ, and its main function is to take pictures and transmits these pictures to the ground station seeking to contribute on weather prediction. For the communication work, LORA communication module is used as a transmitter in the CubeSat and as a receiver in the ground station where the whole communication system will be controlled by Raspberry PI microcontroller. Moving to the structure, the structure was designed by SolidWorks and simulated by Ansys, as well as the orbit, which was simulated by MATLAB.

Introduction

1- Problem statement

The primary function of a CubeSat is to take pictures from a camera attached on the CubeSat of the earth and send it to ground station and analyze it to predict the weather statue, storm movement and cloud patterns.

2- Constraints

- o Budget: we need to not exceed our 6000 SAR
- o Space environments: Our CubeSat must handle constant velocity and it can handle high and low temperatures.
- o Material: we need to be sure that the material will fit our specifications.
- o Camera Resolution: The 12.5 MP camera's resolution will not produce optimal results.
- o Project Time: The project will be implemented over the course of 12 weeks only.

3- Target Specifications

1. Structure:

- Dimension: 10cm x 10cm x 10 cm (+ 1cm)
- Weight: 150g.
- Material: withstand range temperature -65 °C to 120 °C
- Fixed center of mass.

2. Communication:

- Frequency Range: 433-438 MHz
- Overall Mass: 500 g
- Data Transmission Rate: 8 kb/s.
- Power Consumption: <2W

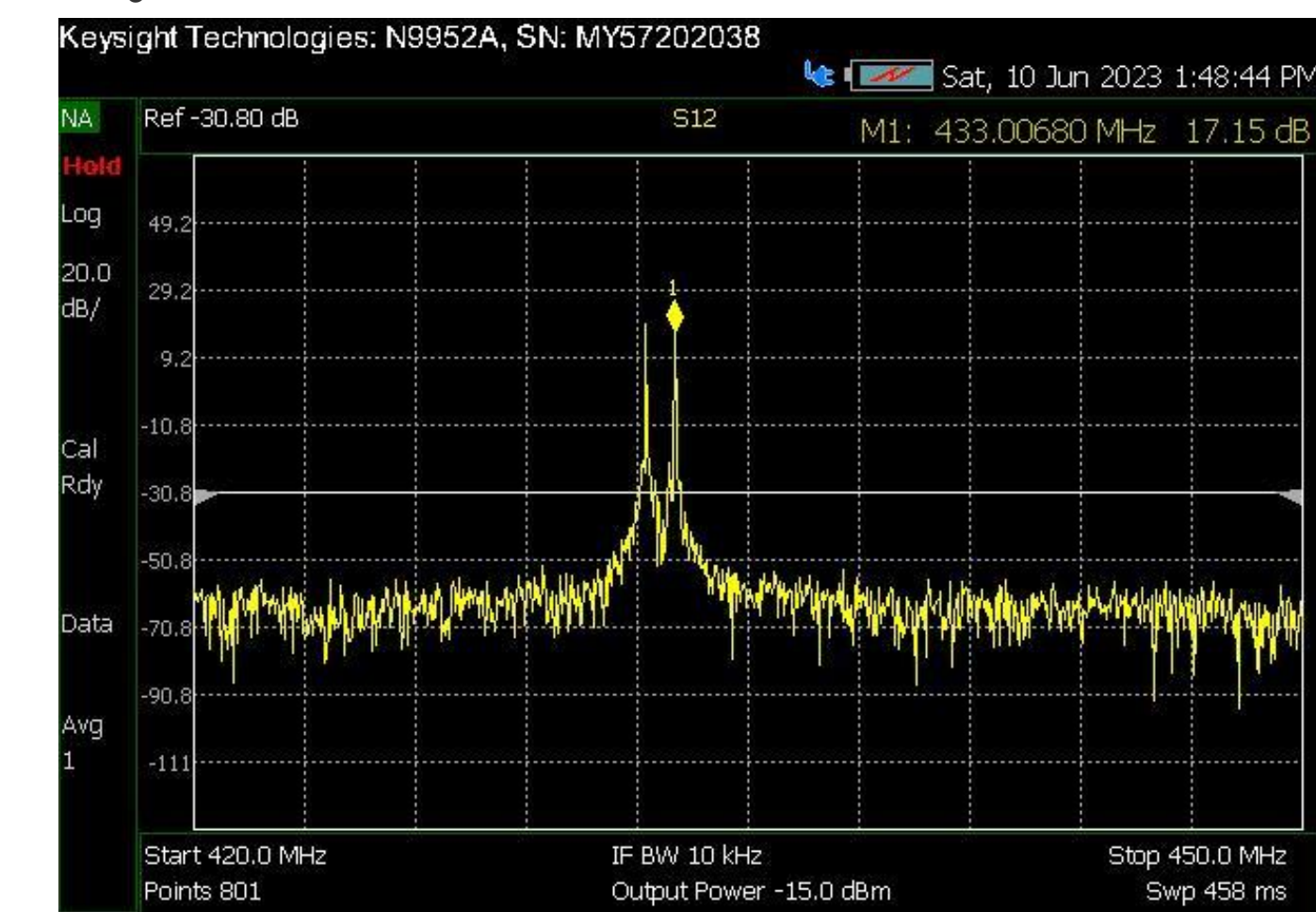
Validation

Proof that specifications were met:

- o Dimension: 10cm x 10cm x 10 cm (+ 1cm)
- o The volume of the structure is 0.0001117 and the density of Aluminum alloy 6061 is 2700 kg/m³ = 0.3 kg.
- o From the property of the Aluminum alloy 6061, it can stand the range of temperature for the lurching orbit at 300 km.
- o As the simulation shows the location center of mass
- o The communication sub-system is equal 146.5 g obtained from the manufacturer data.
- o With the use of image processing methods, a 222 KB photo was transferred in 3.7 minutes. In reality, the specified bit rate was not met, but we were able to find a way to transmit the image in less time while preserving image resolution.

Components	Operating Time (Min)	Current (mA)	Voltage (V)	Power (W)	Power per Hour (W/h)
Raspberry Pi	20	380.0	4.45	1.690	0.564
Camera	0.5	Stand by	0.01	2.8	0.00014
		Operating	38.0		0.00089
LoRa E49 Transmitter	10	Stand by	0.0007	2.6	0.000001
		Transmitting	75.0	0.195	0.0325
Total Power consumption					1.991 W
Power consumption per Hour					0.597 W/h

- o f_c is verified using Spectrum Analyzer

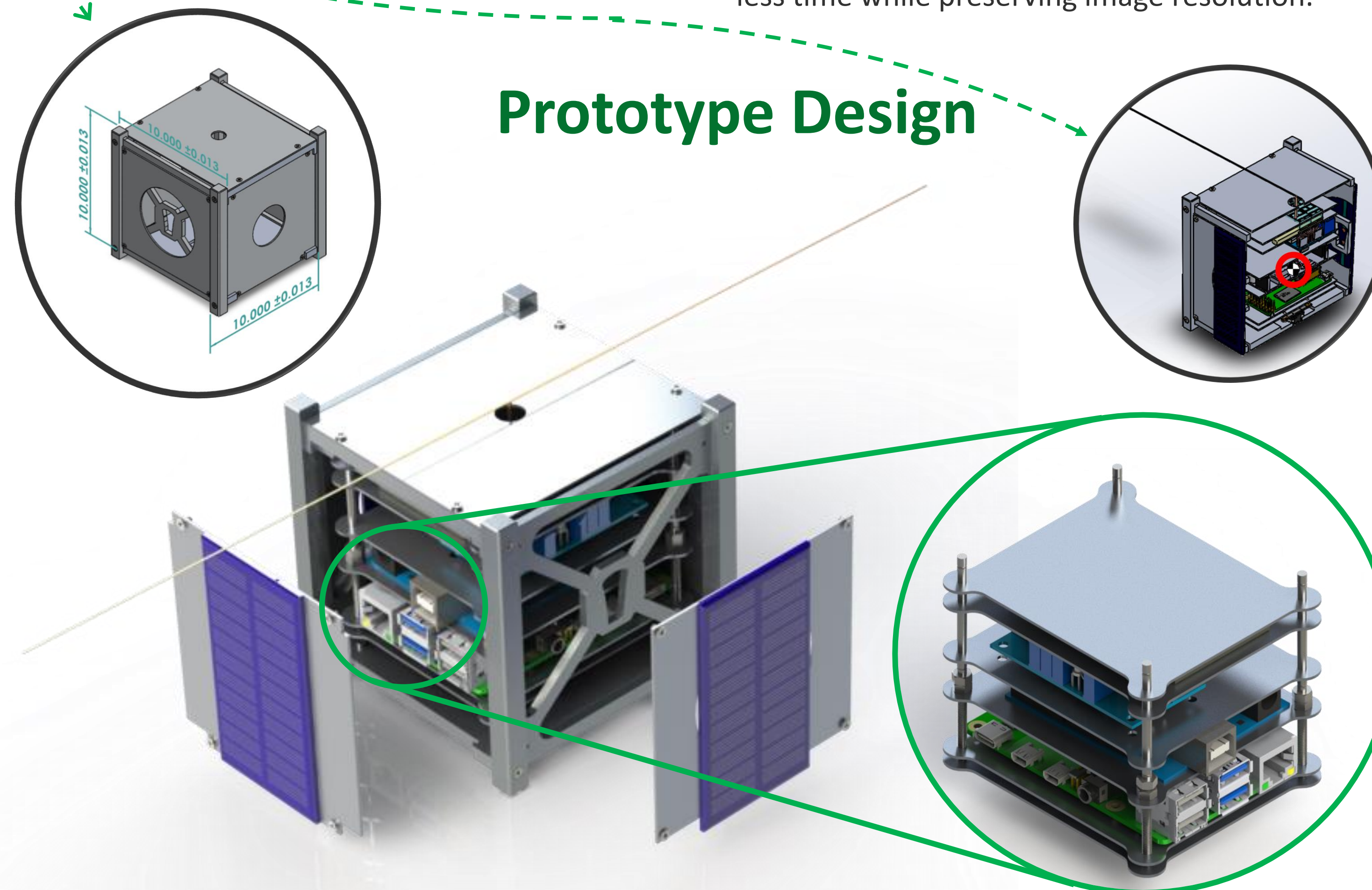


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Components	Module Name	Mass (g)
Microcontroller	Raspberry Pi Model 4B	46.0
Transmitter	LoRa E49	8.0
Wires	Jumper Wires	23.0
Camera	Pi Camera V2	3.0
Antenna	433MHz Dipole antenna	16.5
Others	Board, screws, wires....etc.	50.0
Overall Mass		146.5 g

Conclusion

We can better understand and predict weather patterns by utilizing cutting-edge technologies like CubeSats, which is crucial for preventing accidents and safeguarding life and property. We are enthusiastic to continue investigating its capabilities and making contributions to the development of this important sector since we think that our CubeSat project has the potential to have a big impact on the field of weather forecasting.



Prototype Design