



Cube Satellite Project (KN-Sat1)

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Abstract: Cube Satellites are small-sized satellites (Nano-Satellites) for educational and research purposes. The concept of an educational Cube Satellite project is a contemporary approach in bringing space science disciplines and programs into universities and institutes. This concept involves undergraduates, postgraduates and researchers in such practical way while they are receiving the theoretical aspects behind designing, integrating, testing and launching the satellites. Adopting the Cube Satellite Project in the University of Khartoum will lead to advancement and in pioneering in Sudan's future space programs.

Keywords: *Cube Satellites – CubeSats - Space science – KN-Sat1 Prototype – Ground Station.*

1. Introduction

In 2010 The Cube Satellite project started in the Faculty of Engineering at the University of Khartoum. The Cube Satellite, known as, "CubeSat" is a small (Nano) Satellite that typically measures about (10x10x10 cm) cube in volume and weighs about 1.33 kilogram. A standard platform was made in accordance to the design and launching for the CubeSats. This platform significantly reduced cost and development time, allowing researchers and students from various universities around the world to break through space with satellites carrying scientific research missions. The CubeSat platform standard came as a collaborative effort between California Polytechnic State University and Stanford in 1999. The first batch of CubeSats was launched in 2003. Nowadays more than 50 CubeSats are in space from more than 30 Universities around the world.

2. Objectives

The objective of the CubeSat project in the University of Khartoum is to educate, train and provide a "hands-on" experience to students, graduates and researchers in space science and engineering and satellite design, development, launching and control in order to break through space technology; providing pioneers in space engineering and sciences to carry on future large scale scientific and commercial satellite projects that serves the nation.

3. Methodology

In order to achieve the CubeSat Project objectives, the following methodology will take place:

- i) A real time satellite tracking ground station will be established in the Faculty of Engineering for research and educational purposes.
- ii) A fully functional CubeSat (KN-Sat1) will be designed, developed, tested and launched by a team of students, graduates and researchers.
- iii) An establishment of a (space laboratory) will take place for space science and engineering researches.
- iv) Training courses and workshops will be held along with the project, to promote capabilities of students and researches from all disciplines and universities in the field of space science and engineering.

4. Results:

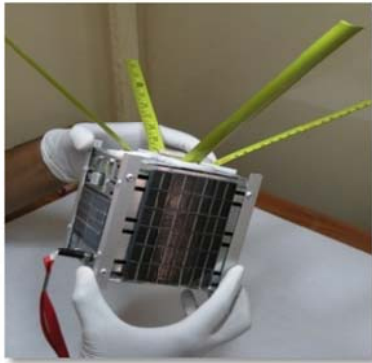
4.1 KN-Sat1 Prototype:

A fully functional Cube Satellite prototype (KN-Sat1p) with all its subsystems; On-Board Computer, Electrical Power System, Antenna and Communication subsystem and Beacon subsystem was designed, built and successfully tested for a launching sequence simulation in real time by the team of four graduates, Abubakr Eltayeb, Hala Othman, Mustafa Atta and Yasir Mohamed. KN-Sat1p successfully transmitted its mission data, telemetry and housekeeping data and proudly was considered the first Sudanese Satellite ever built in the history of Sudan.

KN-Sat1p was built using COTS (Components Off-The-Shelf). Size and volume constraints and thus the power budget limitations, were all challenges considered by the team in realizing the designs of the KN-Sat1p. The final tested design met all pre-set requirements of main mission of the KN-sat1p.

The team successfully tested in real-time the behavior and sequences of operations after launching and deploying the CubeSat into its orbit.

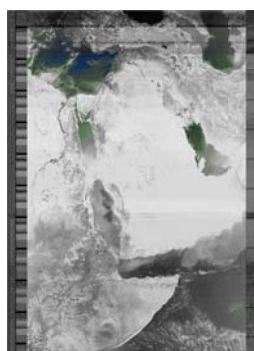
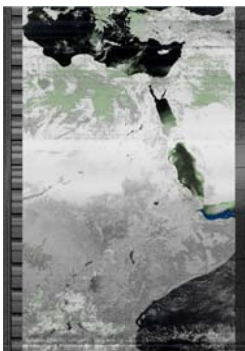
This project allowed the team to take the research to the implementation level and gain the hands-on experience needed. The design followed the CubeSat Standards platform and the data of the experiment was received by the project's ground station.



KN-Sat1p

4.2 The Ground Station (ST2UOK):

A real time satellite tracking ground station was established in the faculty of engineering. It was designed, built, calibrated and operated by the team. The ground station is capable of tracking all other universities CubeSats, as well as other amateur satellites. For example; Oscar satellites, the international space station (ISS) and weather Satellites (NOAA). ST2UOK is capable of receiving and transmitting data signals in the HF, UHF, VHF, L and S bands, providing a wide range scheme of research topics (e.g. Antennas and wave propagation, Transmission lines communications, Transceivers electronic design and Modulation techniques, Computer software design and satellite data analysis, Satellite tracking theory, Satellite communications and Control theory and more.



(NOAA 18 and NOAA 19 images received by ST2UOK)



University of Khartoum Ground Station (ST2UOK)

5. Conclusion and future work:

The Cube Satellite (KN-Sat1) Project is the First Satellite project in Sudan. It is expected to promote space science and engineering among the nation. Students, graduates and researchers who participate in the project will gain and develop the necessary skills and experience needed to succeed in space researches and execution of space projects. The Flight model of KN-SAT1 is now being developed and tested to be ready for a launching opportunity in the near future by a space-launching provider. As this project will continue to grow afterwards and adopt cutting edge concepts in space science and engineering.



Live-testing for KN-Sat1p

6. References

- [1] <http://cubesat.uofk.edu/>
- [2] <http://www.cubesat.org/>