Republic of Tunisia
University of Monastir,
Faculty of Sciences of Monastir

The 3rd Mission Idea Contest for Micro/Nano-satellite Utilization

Microélectronique et instrumentation
LR 13ES12

Nanosatellites Monitoring for Human health Control

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Abstract

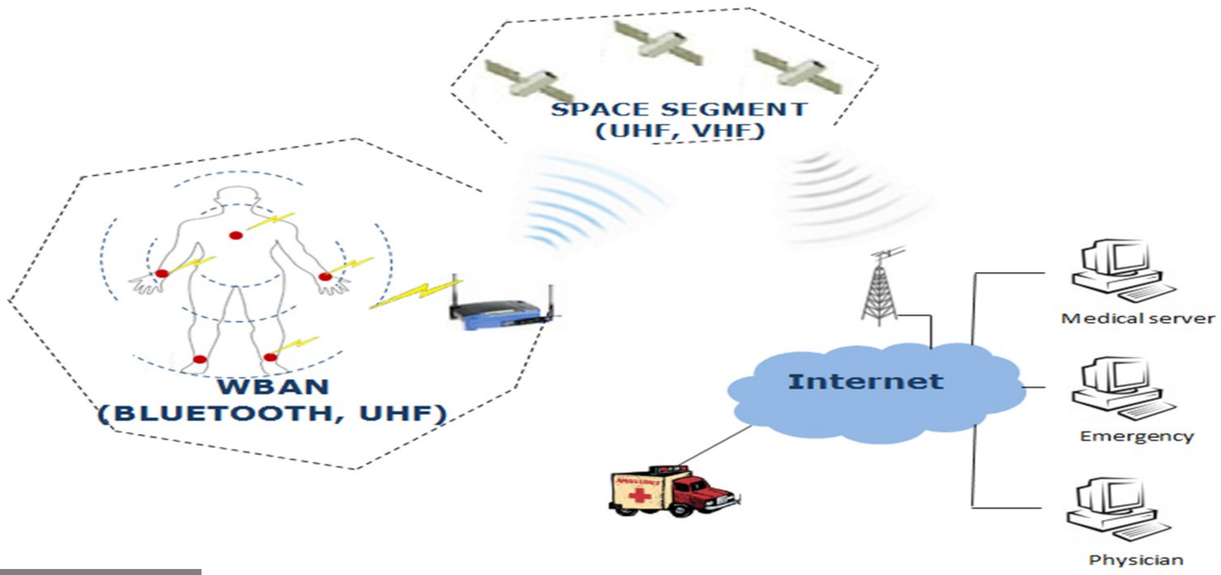
Growth, hypertension, diabetes, irregular heartbeat, COPD (Chronic Obstructive Pulmonary Disease) are examples of such common health problems which requires periodically and continue visits to medical centers for monitoring. The traditional method for analysis is costly for daily control. Therefore, the nanosatellites technology presents an interest solution for wireless health monitoring. It offers the possibility to integrate wireless health system with telemedicine systems which can alert the patients and medical person when they have a serious condition occur. Furthermore, this system can be used for monitoring the patient health in an ambulatory setting such as a diagnostic procedure, optimal chronic disease care and supervised recovery from acute event or surgical.

Mission Objectives

The primary goal of our proposal is to integrate the satellite with new technology in human health monitoring.

1. Integrate a Bridge Bluetooth/UHF as a new technology to communicate with the satellite constellation.
2. Increase the number of world telehealth monitoring through a reliable and autonomous system.
3. Monitor changes in vital signs and provide information to help maintain optimal health.
4. Monitor the health of patients in an ambulatory setting :
   a. Optimal chronic disease care.
   b. Supervising recovery from an acute event or surgical.
5. Integrate the area without infrastructure in telehealth (e.g. MENA region).

Concept of Operations



Satellite Concept

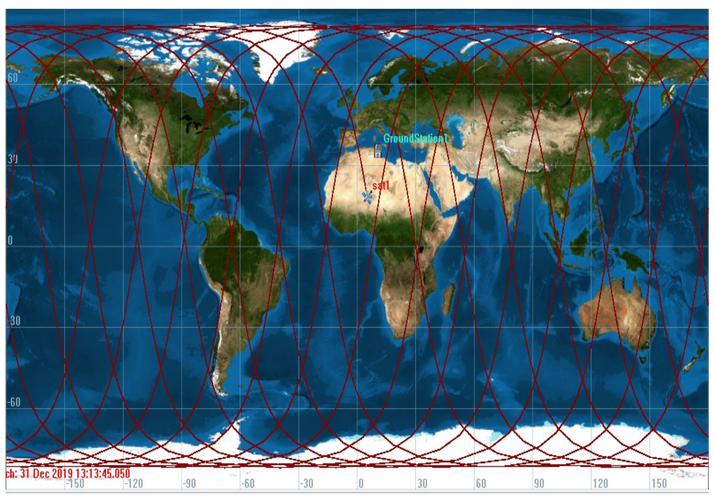
A 1-unit CubeSat envisaged with COTS components. We propose the following architecture which contains the main subsystems of the satellite: a GomSpace NanoMind A712 used to manage data as an On Board Data Handling, a ADCS subsystem to control the stabilization of the satellite and a transmitter/receiver to communicate with the ground station.

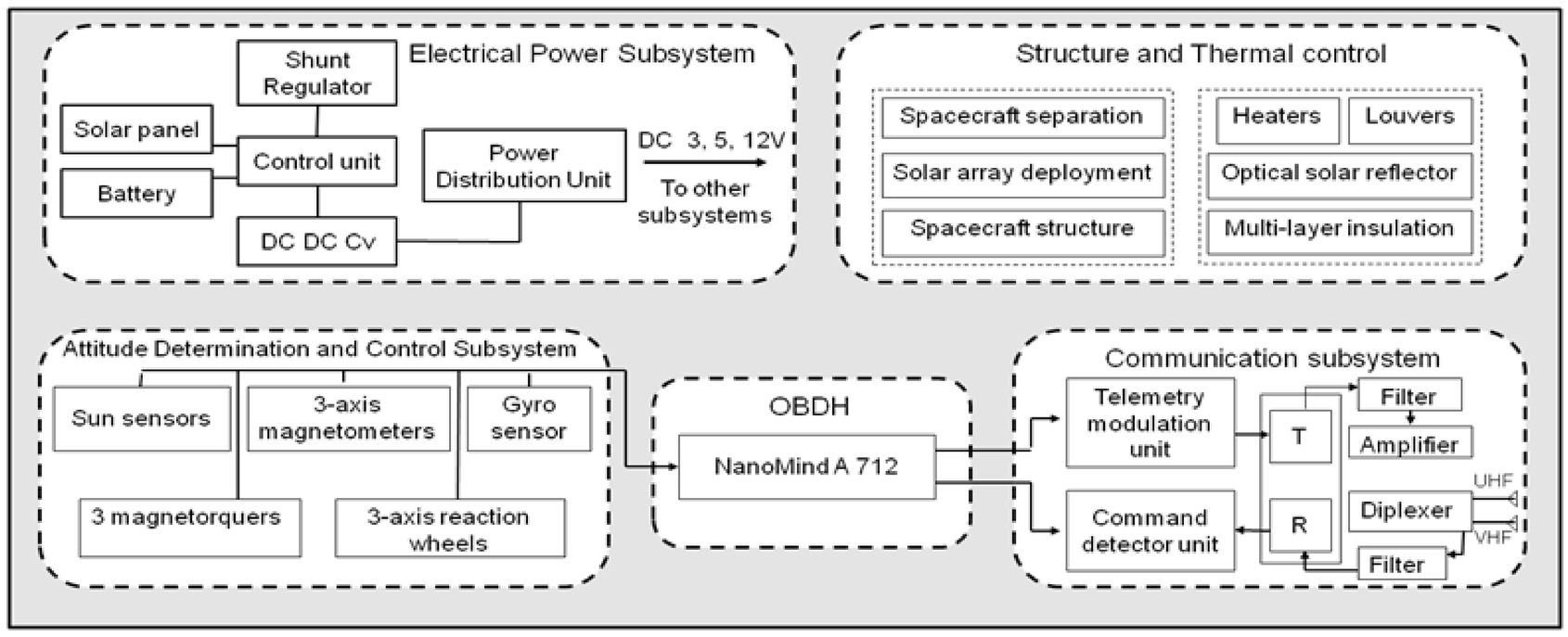
Orbit

In order to cover the entire earth, a circular polar low earth orbit was selected with the following parameters :

- ε = 0
- a = 600 Km
- i = 98°
- RAAN = 306.14°
- TA = 54.8°

9 satellites form a constellation for this mission are distributed in three orbital plans (3 satellites per plan).





Cost

In order to reduce the cost, we propose an initial version of our mission for simply demonstration composed by three cubesats and one ground station.

Constellation	$215,910.00
Launch	$300,000.00
Testing	$300,000.00
Ground Station	$50,000.00
Bridge Bluetooth-UHF	Developed in laboratory
Operaton Cost	$100,000.00
Total	$965,910.00

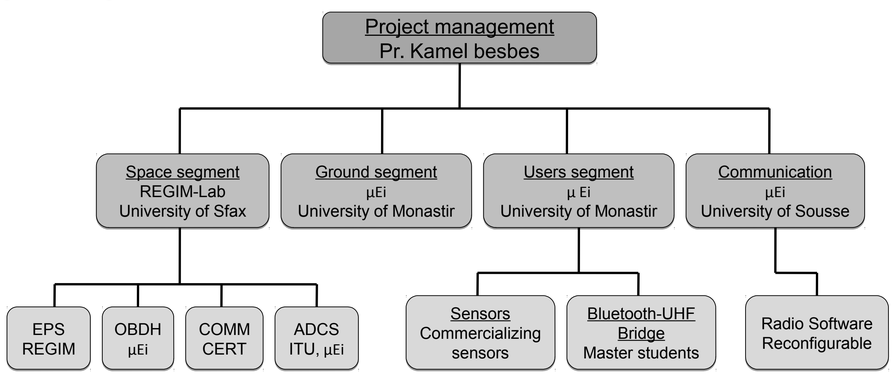
Conceptual design	Jan 2015-june 2015
Engineering model	Jan 2016
Flight model	2017
Constellation	2018
Constellation launch	2019

Specifications of satellite

	Mass and peak power		Mass (g)	Peak power (w)	Qty	Cost $
Satellite Bus	ADCS	Attitude determination and control (3-axis magnetometer, gyro and reaction wheels, sun sensor, 3magnetorquers).	336	1.670	1	27,890.00
	OBDH	(GomSpace NanoMind A712)	50	0.564	1	4,750.00
	COMM	Communication subsystem (ISIS TRXUV VHF/UHF transceiver)	85	1.55	1	9,850.00
		Deployable antenna system for cubesats.	100	2.0	1	6,100.00
	EPS	1U cubesat EPS with integrated battery	163	0.1	1	4,250.00
	STTC	Structure and thermal control (ISIS 1U CubeSat structure)	213	-	1	2,150.00
Power	Solar panel	Clyde space 1U slide solar panel w/MTQ	60	-	6	16,800.00
	Battery	10whr integrated battery	Integrated on EPS			

Implementation Plan

Microelectronic and instrumentation is an established nanosatellite research laboratory in Tunisia. The following figure presents the hierarchy of our mission implementation including the project manager, PhD, master and engineering students.



Risk :

1. Funding for the satellite development and the launch.
2. The failure and interference of transmit signals from the bridge bluetooth-UHF.
3. The indifference to this system by medical centers and the limited number of participate patients.

References :

[1] http://mobihealthnews.com/19963/report-about-300k-patients-were-remotely-monitored-in-2012.
[2] R. Jafari, A. Encarnacao et al. Wireless Sensor Networks for Health Monitoring, ACM/IEEE International Conference on Mobile and ubiquitous systems, pp.479-481, 2005.