DEVELOPMENT OF A TELEMETRY CANSAT IN 2014

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ABSTRACT:

This paper presents design, electronic system and data processing of an advanced level Telemetry CanSat whose primary purpose is to collect and transmit data from the flight and therefore weather conditions are processed by a ground station in a real time.We used microcontroller, pressureand temperature sensors,humidity sensor, 3-axis accelerometer, small key ring camera, GPS, and 2.45 GHz RF communication module to communicate with Yagi-Uda antenna and ground station's PC. Also 3application programsare developed in this work for data processing and flight control. Those aresoftwareprocessed GPS data analysis, 3D motion tracking with accelerometer and gyroscope, sensor data analysis using Processing and Java. Asystem programming, electronic circuit design and test results are presented in this paper.

Introduction

As participating in CanSat-2014 competition, which organized under the auspices of the prime minister, Link Square's CanSat operation concepts, modules we are used, and heirresponsibilities, their assembly in a main frame, electrical connection, software on computer to evaluate and to handle the obtained data from CanSat. Also overviews are compressed in this documents. Furthermore, each section's assembly, their real physical position, connection are preferred to show on this paper.

Goals in 2014

- With the result of the cooperation of National University of Mongolian's Department of Climate, to determine the main climate parameters as real value of a meteorology's device.
- With the type of sensors of telemetry, to obtain Inertial Measurements Unit's real time value, which can be used to determine small satellite's orientation.
- To calibrate an additional sensor's raw values, then handle its data in microcontroller
- To get handled values of motion sensors to express body's 3D dimension in degrees.
- To approach to the best solution of CanSat's durable frame and structure, find out each compatible positions of elements with the help of AutoCAD program.
- To develop data handling software on computer, which can be easy to understand during the real time.
- Every members of the team should try to include their own values, also to achieve these goals, we have to study independently, figure out the design of CanSat with the team.

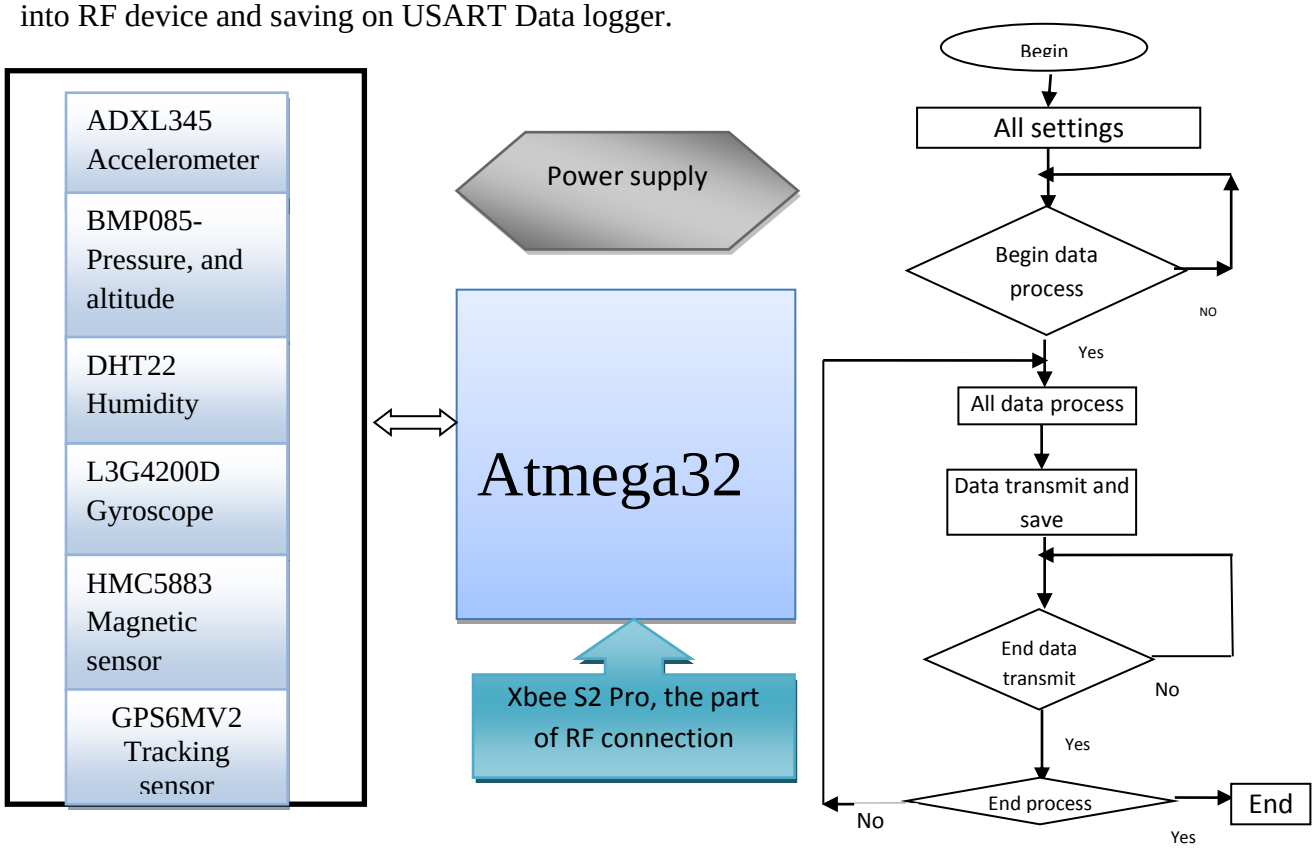
Main Purposes

The purposes of participating in CanSat-2014 in Mongolia are to develop the design of telemetry CanSat we made a year ago, to improve the level of durability, RF connection that is the main

part of CanSat, and the reliable assembly. Instead of simple round shaped board design, to find out the durable case design, which can be a rectangle shaped board design in vertically.

CanSat electronic scheme, diagrams

In CanSat structure, the vital part of CanSat is the center microcontroller unit, which is used to create the interface between sensors, handle raw data in main processor, then transferring data into RF device and saving on USART Data logger.

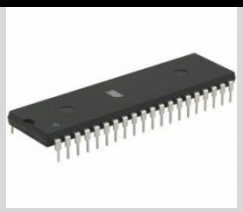
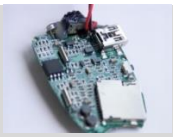
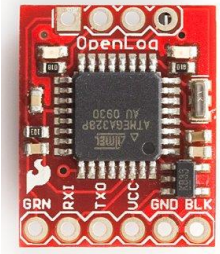


We used the Proteus 7.8 to draw the main electrical connection scheme. Also as a result of working on Altium Designer 11, which is PCB drawing software, drew the real circuit of the main boards, then milled and drilled on CNC machine

Brief information about sensors we used in CanSat

	Name	Picture	Supply Voltage	Resolution	Application	Интерфейс
1	ADXL345		2.0V to 3.6V	13 bit Digital sensor	Calculating body's gravityX, Y,Z axises	I2C interface
2	BST-BMP085-DS000-05		1.8V to 3.8V	16 bit Digital sensor	Air pressure and altitude control	I2C interface
3	DHT22		3.3V to 6V	8 bit Digital sensor	Measuring temperature and humidity	One Wire interface

4	L3G420580 D		2.4V to 3.6V	16 bit Digital sensor	Gyroscope, measuring body's angular moment	I2C interface
5	HMC5883		1.6V to 3.3V	12 bit Digital sensor	Digital Compass using measurement of Earth magnetism	I2C interface

	Module name	Picture	Some performances	Application
1	Atmega32		Supply voltage 4.5V - 5V, 1.1ma 32Kbytes of In-System Self-programmable Flash program memory 1024Bytes EEPROM	1. Making interface between digital sensors 2. First stage data handling on their raw values. 3. Parsing GPS raw values
2	GPS6MV2		Position 2.5m CEP Velocity 0.1m/sec NMEA-0183 V3.01 9600 baud, 8, N, 1 Supply voltage 3V to 5V	Receiving NMEA protocol GPS data in 9600 bit per second
3	XbeeS2B		Supply voltage -3.3V 309mA	RF communication radio module working in range of 2.4Ghz
4	Boost regulator		Boosting input 3.3V to 9V	In operation theory of switching regulator.
5	Camera		- Supply voltage 3.7V, battery power 280mha	Another key ring camera, which is used to taking photo after separation of rocket.
6	Yagi antenna		Yagi-Uda antenna	Receiving CanSat's data with high gains.
7	Battery		3.7V Li-Ion Battery 2800mA/hour	The main supply of CanSat's power.
8	Data logger		Log to low-cost microSD FAT16/32 cards up to 16GB Supply voltage 3.3V - 5V 2400 - 115200 bit per second USART 2mA idle, 6mA at maximum recording rate	Saving data, which are handled and obtained with microcontroller.

Compatible physical position of elements on CanSat

Three main board of CanSat:

1. Power Supply's part
2. The main microcontroller's part
3. The part of sensors and recorders

   These three main parts are contained in CanSat physical design. You can see below Figure 2, 3 that show the design of our CanSat, dimensions, their real physical values on AutoCAD 14 software. In another word, these 3D design helped to simulate the position of every elements we've chosen.

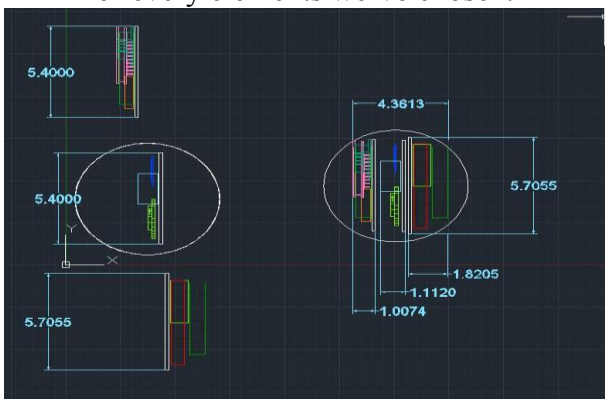


Figure 1

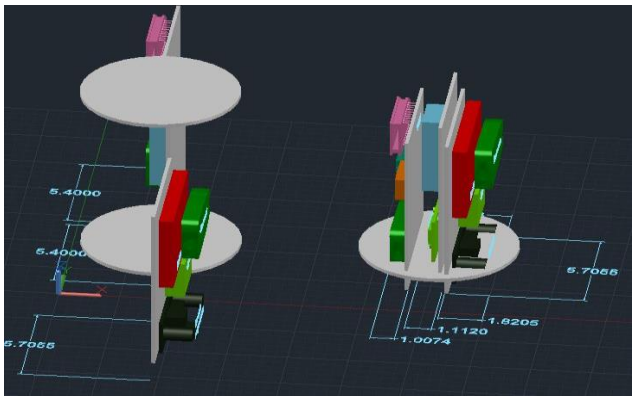


Figure 2

The real view before the main part's assembly:

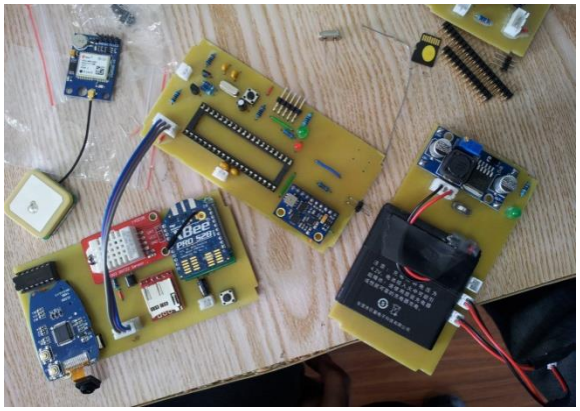


Figure 4. Cansat making

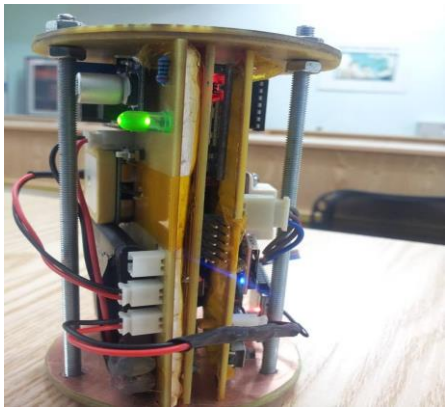


Figure 3. real cansat

Data handling software

a.The interface of JAVA program to distinguish and to save the certain data we received during the real time on computer.

b. The interface of Processing program to show body's orientation in degrees and to draw real time graphics such as the dependences of temperature, humidity, and air pressure to altitude.

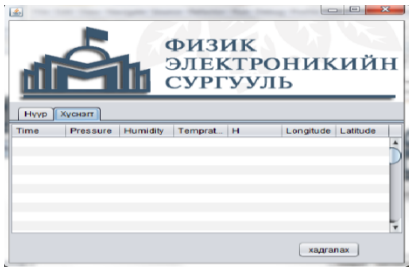


Figure 6. Software interface

Figure 5. Software interface

Results after launch progress.

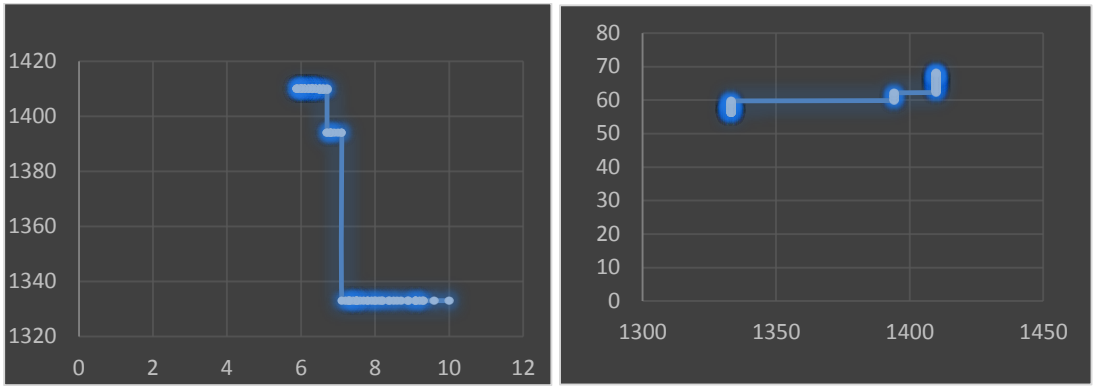


Figure 6. Figure of dependence between air temperature or humidity and altitude given by GPS

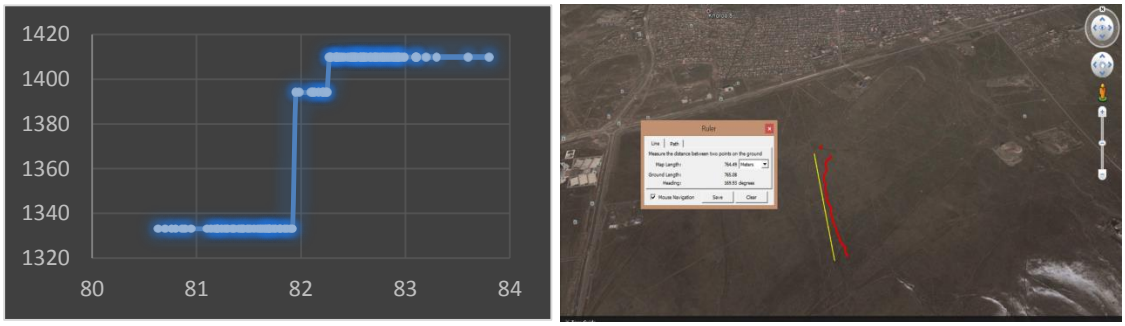


Figure 7. Figure of dependence between air pressure and altitude given by GPS, gps location

Conclusion

During the period of the second CanSat-2014 competition in Mongolia, we developed the CanSat with well performances such as durable, wide range communication subsystem, high sensible sensors, compatible 8 bit microcontroller etc.,. The great importance to achieve to stand on this stage was a type of teamwork organization supporting every member's participation and doing task independently but a little bit suggestion in every problems we faced.

After this competition, we have:

- ✓ Used sensor and their data processing with dedicated purpose.
- ✓ Studied how to reduce measurement error and used digital filter to comply it.
- ✓ Studied how to improve data transmisiion and their relation and used it.
- ✓ Developed related software using Python.
- ✓ On Java, developed data handling software, which works for showing table and figure of the test result.
- ✓ On Processing, developed data handling software, which works for showing table, orientation in degrees, and figure of the test result.