ROAN - from analog to digital solutions

Ana Georgescu – IMC 2014 Giron

TG1

Introducing ROAN

The AllSky project, financed by the Romanian Goverment – contract nr 205/2012 through the PNCDI-2 Program of the Minister of Educatian and Research, will develop a complex (video and radio) station for meteors detection. This station will become the basis for a national ALLSKY-type monitorizing network, named ROAN.

Right now, the project has extended financing until June 2016, as a result of the decreasings of 40% in 2013 and 39.8% in 2014 of the financing line of govermental funds, these being transfered to 2016 because of budget reasonings. In the year 2014, the legal aspect of whether or not the station should continue to function after it would be taken over by a non-governmental organization-

The Romanian Astronomy Society was resolved, which would also legally assure the locations for all the 10 main stations (including functioning authorizations).

Having a wide experimental basis, apart from those 10 stations, 25-35 additional ones will be distributed, on custody acords between RAS and certain amateurs or interested parties.

Slide 2

TG1 Tudor Georgescu; 19/09/2014

Allsky 2013-2014
a year of “trial and error”

Marsboard A20 – 10pcs
Raspberry PI B -5pcs
Xilinx Mojo -2pcs
Lattice MachXO2-5pcs

- The objective of developing a functional automatic station in areas with no human presence, where access is almost impossible for 6 months / year, is a maximum request for our technical team and it required redesigning modules several times.
- Version 4b is currently under construction and will have redundant power and communication systems. For version 5, we're preparing to introduce resilience solutions for critical systems and redundant for the sensors and logging modules.
- The main issue that occured while field testing regards the stability of the main router 3G, cold solder which occurs in high temperature variations, the stability of SBC's operating system and especially software designing bugs of the video drivers at the EZ CAP adaptors.

Status

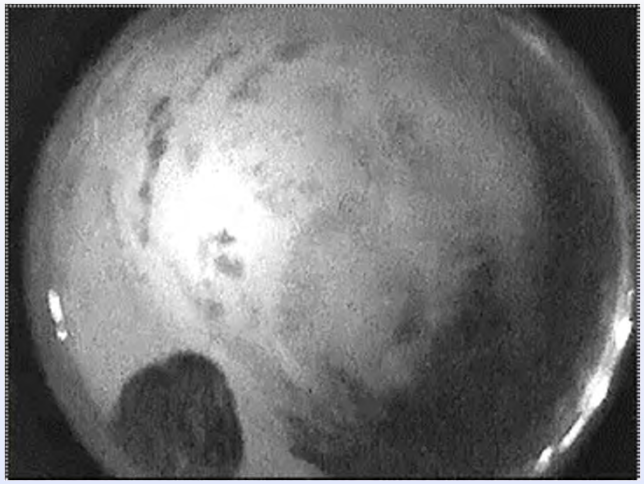
12 types of analogical cameras and
4 digital ones are under stress tests.

The tests that were conducted in the last year regarded the following objectives:

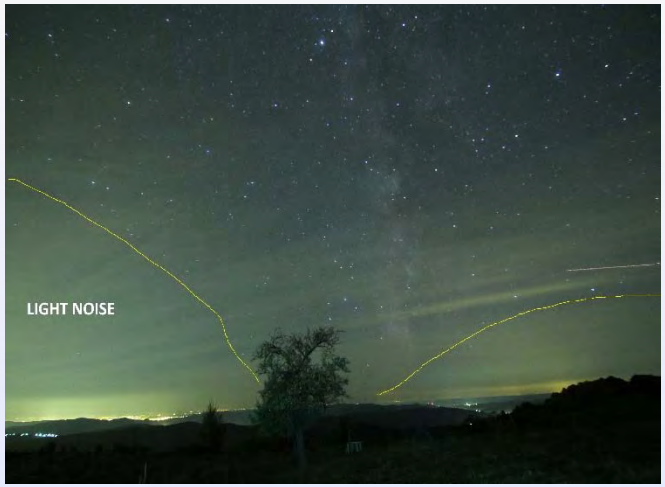
- Defining an optimal video/optic subsystem, that would be electronically viable and would process the images after the capture, so that it would transmit it through mobile networks at a great distance, thus using an ,'off grid'' regim.
- The detection of inflexion points of the real and stable performance of the video sensors and the command and control electronics (the sense-up limit, object's luminosity, the influence of the moon light when it appears on the screen, air traffic, etc.)
- Determinating the influence that outside factors can have on the video substation's performance (changes in temperature, snow, glazed frost, hoar-frost dust, dejection from birds and insects, spider webs, etc)

The selection of video sensors that would offer the best price/performance ratio for a tipical lowcost video/radio station . (<1000Euro)

All of these tests have offered a base of knowledge that helped identify the problems and risks to which our project is exposed. We even observed the aging effect of the plastic from which some of the camera's domes are made in only one year.



Unresolved… YET



•Because we use a single board computer (SBC) which must consume very little energy, for the analog cameras we have to use a digitizing USB EZ-CAP solution, this making it not reliable and less stable, requiring very frequent resets of the system by an independent watchdog. (4 of them broke, out of 15 devices in only 16months).

• In remote areas, birds or insects can leave visible traces on the plexiglass or glass protective dome camera. In densely populated areas such events are less common, but light pollution is more striking.

•For the radio beacon to function with a power greater than 100W CW, an order issued by the Minister of Communications is required, the estimated time for approval being 9 months.

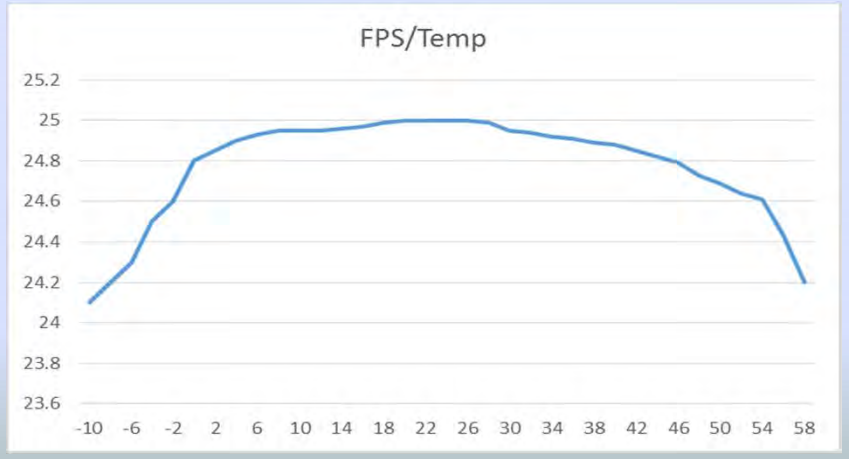
Thermal drifting

The thermal drift in the measuring, reading and/or analogical tunning of the critical parameters has been studied as a part of a degree project from the Politehnica University of Bucharest, which is one of the project's partners, the paper being queued for publishing.

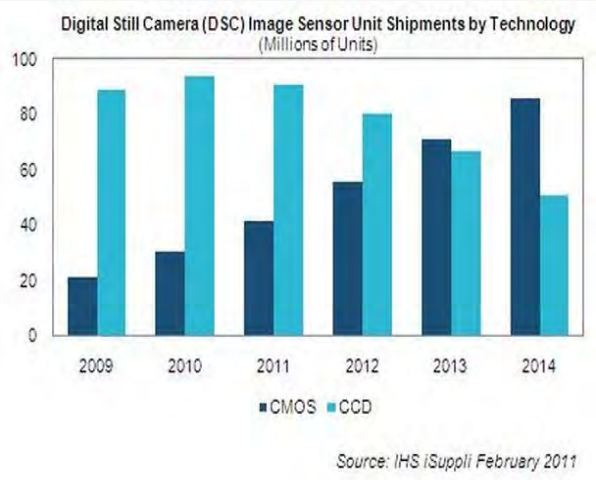
This type of thermical deviation occurs at most CCTV cameras, but it's most common on systems that tend to over-heat while used and that use a single oscillator for all their clock signals.

At a temperature of -10, the syncro impulse of the video signal vanishes. Through out the tests conducted in the desktop climatic test chambers, it was observed that the camera stops working at a temperature of over 62 C.

For example, for the RA-L005 camera, which has a 0.0001 Lux/F1.2 sensibilty, the graph would be the following one:



For WATEC 902U cameras , the range temperature is even narrower, thus functioning relatively correct up until 51 C, with a shift that adds up to 1.42 FPS. The temperature variations of the camera also affect the performance of the CCD sensor, so that the intern noise variation between winter and summer can gain significant importance in determining the sensibility of the whole video system.



Pro and Cons for the analogic camera

Pro:

- 1. They're cheap
- 2. They can be used for a long time – simple and very stable architecture
- 3. There is a huge installed base that allows the fast finding of a technical support
- 4. They run on really old PC systems or DVR – good for amateurs and enthusiasts

Contra:

- 1. They can generate errors that add up to 7.13% due to thermal deviation and digitizing errors.
- 2. Information about technical performance is presumed constant- and is not in real world.
- 3. Some of the ‚native' high resolution is lost – usually the digitizing is in VGA or PAL
- 4. Low dynamics, and during the digitizing with 8 or 12 bits we lost valuable information.
- 5. Pixel number/field of view is only 1/5 relative at CMOS FullHD sensors
- 6. For main commercial application (CCTV) is already in EOL (End Of Life) stage

Jump to Digital

The leap to digital cameras was speeded up by the launch in 2013 and then in 2014 of an entire population of low light CMOS sensors that can be easy integrated with the low cost ARM and FPGA modules available. Furthermore, some producers already provide developing kits with USB 3.0 for their CMOS sensors.

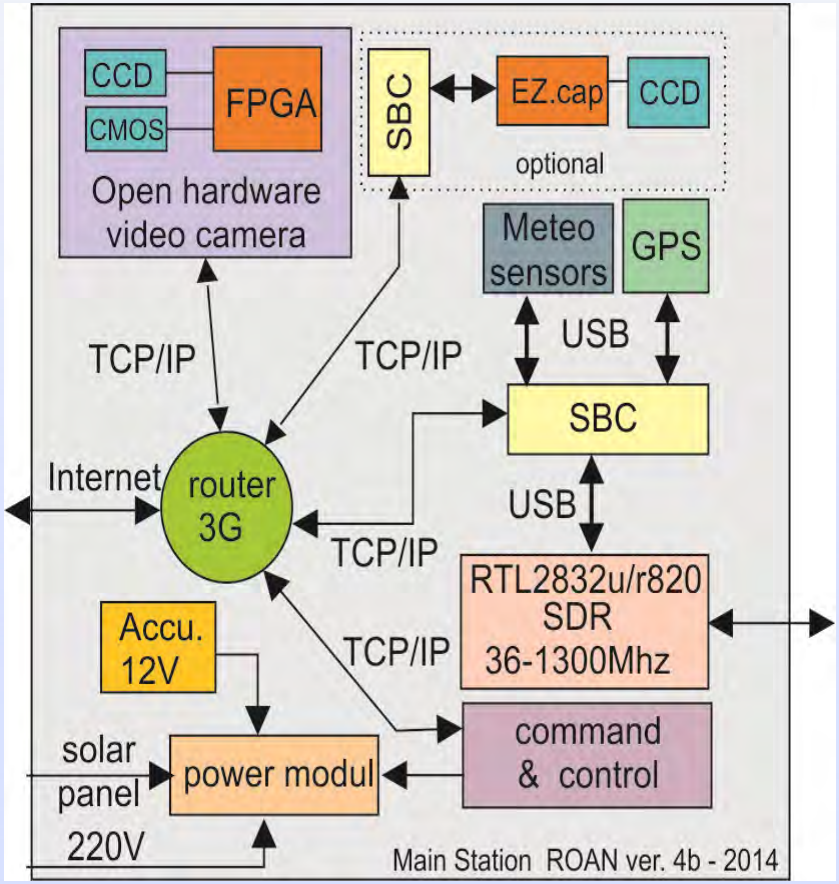
Under these circumstances, we added to the referential system a camera with an EXMOR – Sony IMX136 sensor from SONY and plenty more CMOS cameras with an IP output or USB 3.0.

Tests have showed that the new CMOS solutions are near comparable with the sensibility of CCD line products and have the advantage that can be integrated easier with IP systems or USB 3.0. But the costs of these sensors exceed by a lot the budget level fixed at the beginning.

So, a solution that should be considered is the development inside the project of a modular camera that would use a SBC+ FPGA for most operations and of an adapting module with LVDS interface, that would assure the interconnection with the Sony or Panasonic sensors.

News 2014:

Open Hardware Camera



- Due to tehnological changes, but also problems that emerged at the same time with the EZ-Cap, our techincal team has decided to remodel the ROAN station and eliminate external digitization of the video signal.

•The new solution (an intermediate one) will allow the use of CCD sensors or CMOS, connected directly to a Mixt format circuit. This circuit is actually an FPGA MachXO2 and a microcontroller type ARM7 A20.

•The old SBC+EZ-CAP architecture can be still optionally used, being cheaper, but for the new developments we will use the new architecture.

•The Open Hardware Camera is a concept which offers an open architecture and which allows us to develop a solution based on the experience of a large number of experienced people.

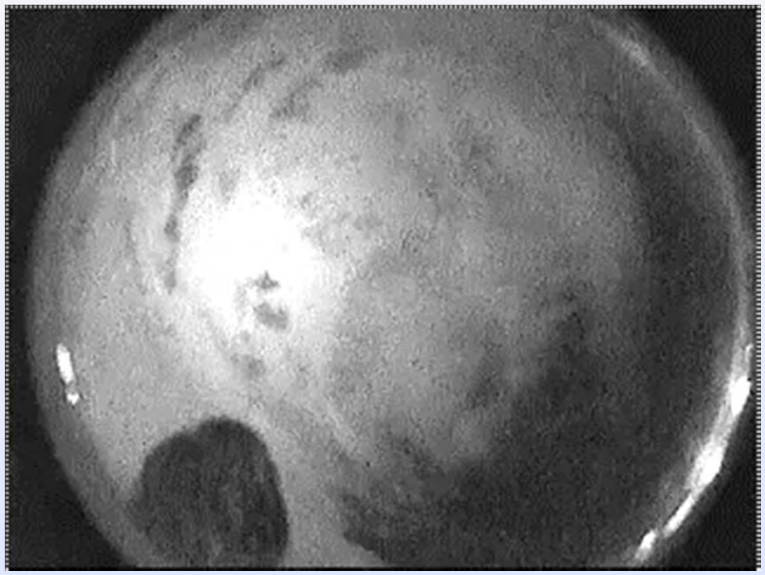
Team leaders

Scientific director – Dr. Mirel Birlan – IMCCE France

Scientific team leaders:

- Dr. Ing. Dan Savastru- National Institute for Research and Development in Optoelectronics (INOE 2000)
- Prof. dr. ing. Buiu Catalin- The Faculty of Automatic Control and Computer Science -University Politehnica of Bucuresti
- Dr. ing. Claudiu Dragasanu – Romanian Space Agency
- Prof. dr. ing. Octavian Ghita– Elcos Proiect srl

❖ Communication officer – std. Ana Georgescu – ICHB Bucharest



Questions ?

More Q&As at the poster session !