ROAN: A calibration unit for a meteor camera

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ROAN's main objective is the deployment of a network of systems (optics and radio) for monitoring meteors. Several steps are included into the deployment of this network such as the development of detectors, stress test of the components and the calibration in the laboratory. The article presents the evolution of the project for the improvement of the technical solution for the calibration in the laboratory.

1 Introduction

Ground-based monitoring of meteors is a permanent activity over the world. The rapid evolution of techniques, miniaturization and sensitivity of detectors in both optical and radio wavelength allow to record a huge number of events each year. The meteor communities in each country developed strategies to set up reliable networks of all-sky detectors in order to obtain homogeneous data-sets of scientific data (Roggemans et al., 2013; Colas et al., 2014; Toth et al., 2014).

Our effort to join the community of meteor observers is called the "*Romanian ALLSKY Network*" (ROAN) and was conceived as a research and development project for 2012–2016 (Georgescu et al., 2014a, 2014b). The main objective of this project is to formalize a technical solution (ALLSKY) for a coherent, automated, multisensory national network, with a 24/24 hour operating time, to detect and to track meteors. This research and development project is leaded by Elcos Project ltd and the consortium also includes teams from the "Politehnica" University of Bucharest, the National Research and Development in Optoelectronics Institute, and the Romanian Space Agency.

Three steps are scheduled for the network implementation of ROAN. In the initial phase, the network will have only one layer, formed exclusively of experimental sensors from the main locations. As the project evolves, some of them will be replaced and transferred, based on custody documents, to legal persons or persons that are interested in hosting the sensors (astroclubs, amateur astronomers, schools, universities, planetariums).

Together with the manufactured and traded sensors from the last phase of the project, the hosted ones will form the second layer (calibrated sensors, but outside the normal control of the project team). Finally, the third step consists in implementing the sensors received from different sources installed in Romania, which are not calibrated, but which can provide data in the format accepted by the main server, and remain online large periods of time.

The locations for the main sensors are chosen following several criteria such as: the number of clear nights per year, according to a systematic study of climatology and nebulosity. Studies concerning this subject for Romania were published recently. The light and radio pollution situation over Romania will be taken into account too. The sensors will be placed to avoid human settlements or proximity of radio and light sources. The second criterion is the presence of a 3G/4G/Wimax network for sending data to the main server. The sensors from the secondary network can be installed in inhabited areas and under the direct supervision of enthusiasts or organizations interested in astronomy. The third touchstone involves the possibility of obtaining authorizations from the local agencies and the land's legal owner in order to install the system.

After finalizing the project in 2016, the management and finances of ROAN will be transferred to a non-governmental organization – The *Romanian Society for Astronomy*, without any charges to this organization.

2 Design and operations of the system

Technical solution

The technical solution, formalized under the acronym ALLSKY, is conceived as being a complex of components containing both optical and radio antennas, electronics and power supply, as well as the capability to transfer data in real-time once the detection occurs. The technical solution for the optical part is now under study. Unlike the 2014 version, the block diagram of the standard model has some changes added, besides the digital APTINA model based camera (*Figure 1*).

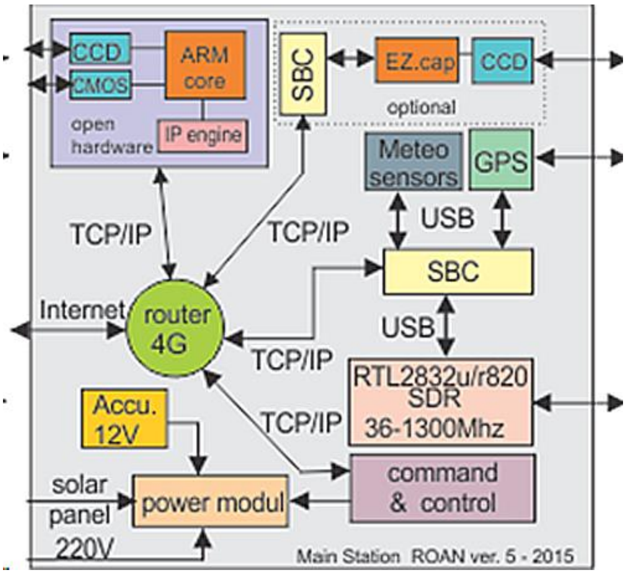

Figure 1 – Revised conceptual scheme. This scheme is based on only two SBC. In fact, the develpment of new SBCs allow enough computing power to use only one of them for radio acquisition, GPS and meteo monitoring.

Optics and detectors

We evaluated the FISH EYE/F2.0 lens into miniature domes found on the market. The lens allows 185 grade FOV and maximum visibility for areas without light pollution. For the sections with light pollution problems, smaller angle lens are being used – for example – FOV of 135° to 20°, thus avoiding nearby light sources to interfere.

A problem of primordial importance for the Fish Eye lenses mounted on the CCTV analog cameras is that the resolution of the classic CCD sensors is too small; the addition of the Full HD resolution CMOS sensors increases the number of pixels and thus the precision of the measurements. In fact, our team has opted for a digital sensor mainly because it provides a high resolution; the alternative being to use multiple cameras at each location, each of them covering a sector of the sky. Thus, we obtain a better solid angle/number of pixels ratio and we maintain a high sensibility, but with huge costs.

Unit for dynamic testing and calibrating All-sky systems

In 2015, a system for dynamic testing and for the calibration of video cameras was designed (*Figure 2*) and built (*Figure 3*). This unit enables the optimization of video cameras. This device is aimed at those systems which use CCD or CMOS sensors with global shuttering for meteor detection.

The system is based on a simulated starry sky and a laser projected on a polygonal rotating mirror (*Figure 4*), having its rotating speed controlled through a microcontroller. In the first step, this technical solution allows to control of the length of the simulated meteor, and to model its intensity and path, as well as the random apparition. The major advantage of this solution is that the project team can work during the day, without being influenced by weather conditions, employee schedule etc.

Under these circumstances, substantial savings have been made, as there is no further need to pay for night shifts or overtime working hours.

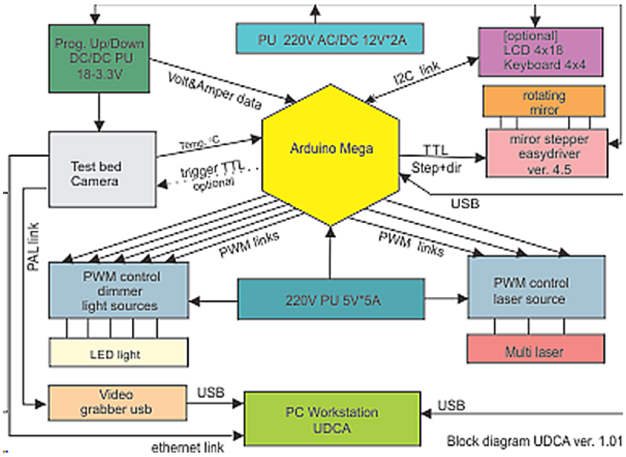

Figure 2 – Conceptual scheme of the unit for dynamic test and callibration of Allsky cameras.

Figure 3 – Picture of the unit of calibration. The front pannel was detached during the picture. The unit concept is that the entire experiment simulates an ideally dark night.

Acknowledgments

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Figure 4 – Record of a simulated meteor inside the calibration unit.

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Ana Georgescu during her lecture (Photo by *Christoph Niederhametner*).