Ten Years of the HUNVEYOR Educational Space Probe

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***Abstract**: We report about the construction, main system characteristics of the fourth Hungarian University Surveyor, and its impact on the physics education during the last ten years at the Alba Regia University Center, Székesfehérvár.*

***Keywords**: HUNVEYOR, education, space, space probe, physics*

1 Introduction – The HUNVEYOR Project

The name "HUNVEYOR" stands for Hungarian UNiversity SurVEYOR. The project itself is a minimal space probe construction program [1] which was initiated at the Roland Eötvös University, Budapest in 1997. There was built the first Hunveyor instructed by Bérczi. By the time other educational institutions joined to the project [13], so the probe was renamed to HUNVEYOR-1.

The project is part of the paradigm change which happened especially in the physics education in Hungary during the last decades. Namely the manifestation of phenomena do not occur in their clean, but in complex forms, in different interactions. An educational space probe integrates the complex measurements of different physical quantities with the robotics, and has a great pedagogical value. [2,3,4,9, 10]

2 HUNVEYOR-4 at the Óbuda University, Alba Regia University Centre

The Alba Regia Educational Centre of Óbuda University (once called Budapest Polytechnik Kandó Kálmán Faculty of Electrical Engineering, Institute of Computer Engineering) joined to the project was the fourth Institution in 2001, therefore with the name Hunveyor-4. Our realization is based on individual

solutions [5,6]. The project is an educational experiment, and consists of engineering and building the probe itself as well as the science dissemination and public outreach [9].

2.1. Aims

The primary teaching aims of the HUNVEYOR project at our Institute are:

- deepening the physics knowledge of the students
- developing comprehensive approach of complex systems
- forming an attractive, meaningful and long term framework for the research and development carried out by our students
- offering subjects for diploma and other project works
- get acquainted with the latest technologies
- obtaining skills in engineering, organization and realization of products

These goals have not changed over the years, but the HUNVEYOR-4 itself.

2.2. First Steps

The first step of the HUNVEYOR project at our Institute was to gain interest among the students by formulating and posting the project. This was done by constructing and displaying the metal frame of the probe After a while some students participated to the project by mounting a computer main-board into the frame. Because we wanted HUNVEYOR-4 to be open to the public, the students created a web-site for the probe. After these initial steps the next generation of students started creating different instruments and software in order to control and organize the measurements. In the following years the HUNVEYOR-4 was continuously extended and some parts and building blocks are completely redesigned by different students of course, fulfilling the aims of the project.

2.3. General System Overview [9]

The HUNVEYOR-4 consists of

- frame and other mechanical parts
- computers and on-board electronics
- scientific instruments, like sensors etc.
- software control modules and web server

2.3.1. The Frame

Our frame – which is a little bit smaller than the earlier Hunveyors - is a tetrahedral light-weight rigid skeletal structure, made of aluminum. The whole frame consists of about 100 pieces.

2.3.2. The Computers and On-Board Electronics

The electronics of the probe are based upon a PC motherboard mounted into the frame and some special controller boards engineered by the students.

2.3.3. Scientific Instruments

The purpose of a space probe is to collect data and information about its environment, both visually and numerically. Hence the HUNVEYOR-4 has an USB web-camera to look around and a weather station engineered and built by the students. The instrument can measure the temperature, the wind speed (cup anemometer) and direction (weathercock). (Fig. 1.) Furthermore the probe is equipped by a self designed and made LED spectrometer for estimating the soil composition, a semiconductor based particle radiation detector, an air humidity and pressure meter, a noise level meter, a spectral illumination level detector, a back scattering laser light based dust detector, and three vibration detectors, placed on each leg of the HUNVEYOR.

Figure 1. The camera, the cup anemometer and the weathercock

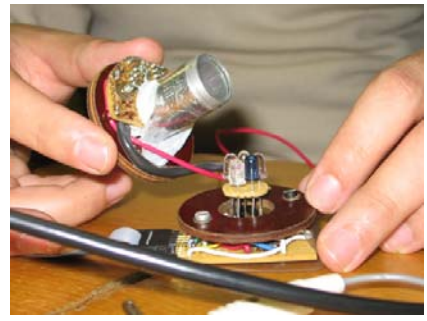

Figure 2. The LED spectrometer..

2.3.4. Software Control Modules, Data Base and Web-server

The HUNVEYOR-4 is operated under a Debian GNU/Linux 3.0 Woody system. Since we planned minimal energy consumption, therefore only the most necessary processes are run. The camera connects by an USB port to the computer. The data are stored in a Postgre SQL data base. The direction and control of the camera movements are solved by the motherboard's parallel port. This server also communicates with the web-server.

2.4. The HUNVEYOR in the Physics Education

How the sensors work, how to calibrate the devices, or even constructing a detector are the places when the students meet with the physics, and consequently drives them towards thorough study on different topics. If someone want to measure different physical quantities, each of them gives much opportunity to meet physics and real world problems to be solved. For example measuring the temperature involves the study of the non-linearity of the device and how recoils the detector to the system to be measured. Dealing with the air pressure involves the study of the air compressed under its own weight, how the pressure changes over the height and how does it modified by the speed of streams. Measuring the noise involves the knowledge of acoustic and the problems of noise pollution. The self designed and built vibration detector uses piezoelectric effect to convert mechanical movement to electrical signal, involving other concepts, such as resonance, dumping, excitation and so on. The semiconductor based LEDs and laser diode direct the student attention toward the solid state physics, like electron-hole recombination, quantum-amplifiers, population inversion or in some case to non-linear phenomenon, like frequency-doubling. Detecting the light comes with the fight against the different kind of noises.

2.5. Experiments

The students tested the space probe inside and outside of the building more or less in normal environmental conditions. In moderate temperature ranges the NTC showed up near linear response, the direction sensing was tested using a fan, moving around the meteorological station. The weathercock is sensitive enough indicating about 0.5 km/hour wind that means the wheel starts turning if you just grab and slowly walk in the room. Testing for higher speed we fixed the unit on to the roof of a car, and obtained data driving from low to moderate speed. Despite of its simplicity, the LED spectrometer produced nice results. We tested different white materials, but the spectrum reveals differences among them (Fig. 3.).

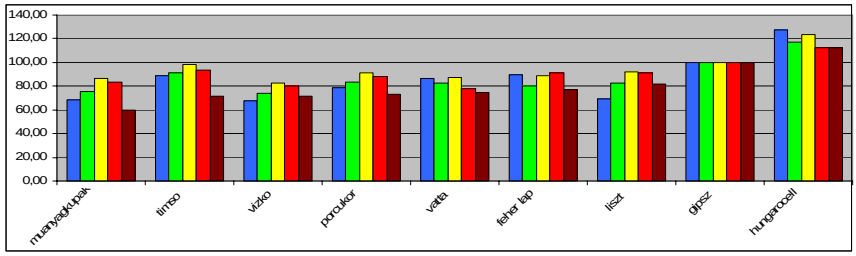

Figure 3. Spectrum collection of different white materials obtained with the LED spectrometer. The blue, green, yellow and red colrs are corresponding to the illuminating LED, the purple is for the IR LED

We also conducted field trips for different planetary analogous terrains across Hungary (Fig. 4).

Figure 4. HUNVEYOR-4 in an Martian analogous terrain (left) and remote communication with the space probe (right)

3 Conclusions

The HUNVEYOR project is much more than mere building a fancy device. The project has a crucial role in the physics education, and has been successfully conducted for years in growing number of educational institutes in Hungary [12], thanks to the publicity and modern technologies. Googling for Hunveyor we have more than 82 thousand results. You can find more information on the Wikipedia [11] and on many other home pages. [12] The project is recognized by the NASA as well, accepting numerous publications. As a result, the project fulfilled its primary aims.

Acknowledgement

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