CLASSROOM TEACHING OF SPACE TECHNOLOGY AND SIMULATIONS BY THE HUSAR ROVER MODEL.
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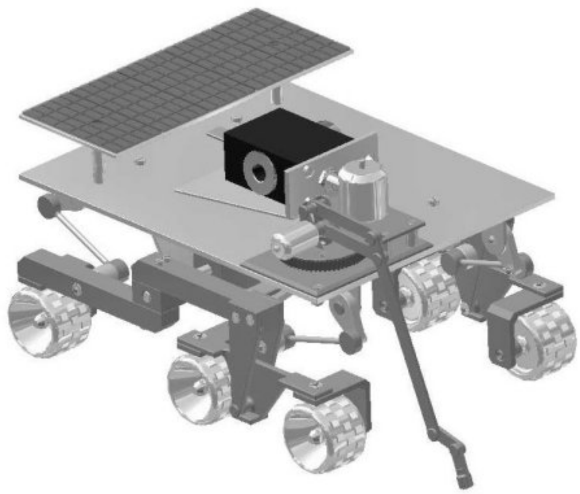
Abstract: We placed instruments onto the HUSAR (**H**ungarian **U**niversity **S**urface **A**nalyser **R**over) of the Hunveyor (**H**ungarian **Un**iversity Sur**veyor**) experimental educational space probe model. Design and construction was parallel topics of our university course of space technology. The complex system and its construction also have been analysed.



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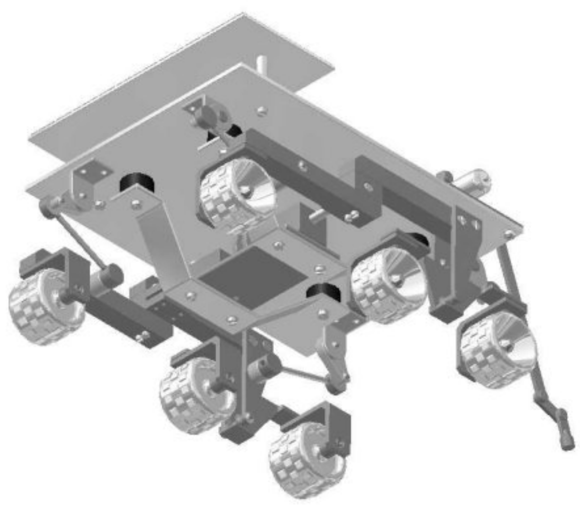

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Fig. 1. Top-side (a) and bottom-side (b) view of the Husar rover of the Pécs University.

Introduction: Observing the success of the Pathfinder (and in these days Spirit MER) we extended the design, construction, manufacturing and simulation activities in our space technology course about Husar rover. Rovers hold similar instruments like landers, however, they are mobile. Such course was also encouraged by Antal Bejczy (NASA, California) who named such activity as telerobotics, or telescience, or teleoperator. He lectured that informatics and robotics is connected by telecommunication and gives a wonderful possibility of this "teleoperation" on an alien planet.

Telerobotics and simulations by construction of the Husar rover in Pécs University: On the Pécs University, (Dept. of Informatics and General Technology) we develop instruments to the Hunveyor-2 university lander type robot [1-5]. In the last years we created a pair for the lander: the Husar rover. They form a minimal space probe pair. We intended to extend educational possibilities by this pair to demonstrate joint working space technical systems. We teach their operation by computer simulation [6]. Telecommunication is also involved by using the internet: the direction of our robots is through the Web. These space robotics activities help to learn the everyday use of technologies, because telerobotics also appeared as tool in medicine, safety-industry, manufacturing, controlls etc. Parallel with the educational demonstrations [7] we study computer helped engineering solution of vision, manipulation, material handling, through the more intelligent programs.

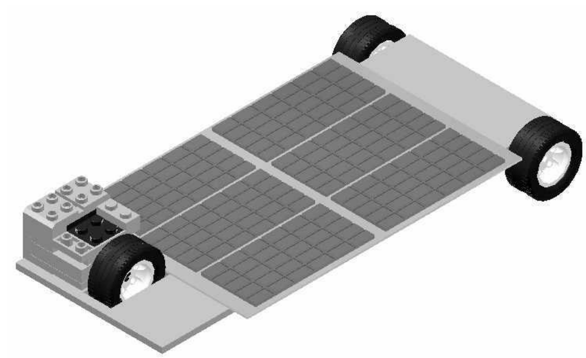

Fig. 2. Small rover from lego elements.

Requirements for rover building: It is exciting in robotic technology that it is cheeper and more safe then human participation. However, mainly this is true only for routine tasks, but not true for repairing. In our university we made various more and more complex rovers with solar cell energy source. They consisted of 4 main units: the basis, the processor; the energy source and mechanics; and the sensors.

Basis: This is the body of the robot. It can be fixed or mobile. The fix one is the Hunveyor (placed on board of the lander), the mobil one is the Husar rover, going to discovering routes on its wheels.

Processor: It is the brain of the robot, which may help decision, if well equipped by such programs.

Energy source and mechanics: It consists of the solar cell and the micromotors, which make moving all effectors (wheels, arms, mobile measuring elements).

Sensors: They contact with the environment by sensing the light, pressure, temperature, etc.

Manufacturing the Hunveyor-Husar robotic pair: There are two levels in education of laboratory work. In the first level elementary measurements are carried out, and in the second level these measuring systems are attached to the Hunveyor-Husar space probe pair. In one model we used Lego elements in Husar construction (Fig. 3.). Studying working strategies we learned much from FIDO modeling. [3-5].

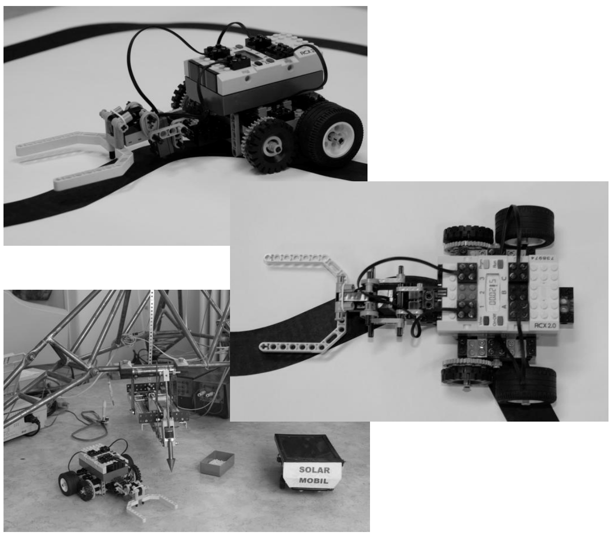

Fig. 3. The Husar rover made of Lego elements.

A self made instrument: optical gas sensor: We developed a fiber optical chemical sensor device capable of measuring several gases (Fig.4.). It consists of a selective sensing layer which was placed on one end of an optical fiber. This is a small instrument, which measures the changes of the optical property of the sensing layer at a given wavelength.
Recently we can measure ammonia (NH_3), sulfur-dioxide (SO_2) and hydrogen-sulfide (H_2S) [8,9]. They are only traces in the Martian atmosphere but may be important on Europe. Ammonia (NH_3) may be the indicator of remnants of fossil living tissues, too [10].

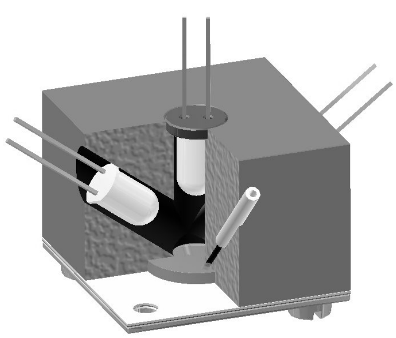

Fig. 4. The optical gas sensor device of Hunveyors.

Summary: We develop a robot pair for demonstration and education of robotics and science. In this work new perspectives are: teaching by physics and other science of materials and processes in unusual conditions, teaching through using communication line and informatics, teaching new strategies in a complex activity, thinking with complex technologies (Fig.5.). Teaching of this style uses crossroads of geophysics, astronomy, geoinformatics, natural resources research and robotics, environmental satellite technology, extra speed informatical data-analysis. By construction of the Hunveyor-Husar system our research groups on Pécs University and Eötvös University can be partner in environmental studies, too.

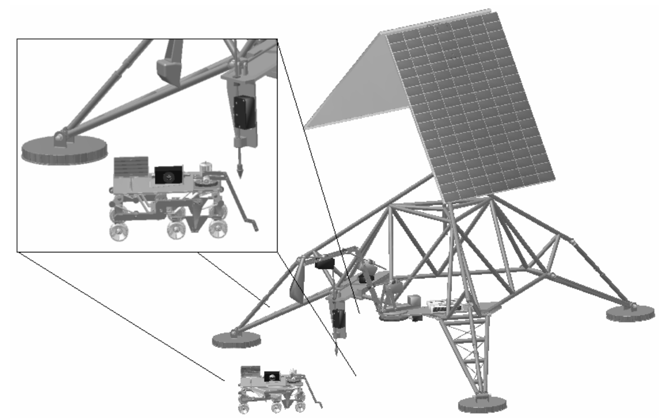

Fig. 5. The educational demonstration of the Hunveyor / Husar pair.

References: [1] Bérczi Sz., Cech V., Hegyi S., Sz. Fabriczy A., Lukács B. (1998): *LPSC XXIX*, 1371; [2] Bérczi Sz., Cech V., Hegyi S., Borbola T., Diósy T., Köllõ Z., Tóth Sz. (1998): *LPSC XXIX*, 1267; [3] Arvidson, R.; Backes, P.; Baumgartner, E.; Blaney, D.; Dorsky, L.; Haldemann, A.; Lindemann, R.; Schenker, P.; Squyres, S. (1999): FIDO: Field Test Rover for 2003 and 2005 Mars Sample Return Missions. XXXI LPSC, #1201, LPI, Houston; [4] Arvidson, R. E.; Squyres, S. W.; Baumgartner, E. T.; Blaney, D. L.; Haldemann, A. F.; Klingelhöfer, G. (2000):FIDO Rover Trials, Silver Lake, California, in Preparation for the Mars Sample Return Mission. XXXI LPSC, #1085; LPI, Houston; [5] Seelos, F. P., IV; Arvidson, R. E.; Squyres, S. W.; Baumgartner, E. T.; Schenker, P. S.; Jolliff, B. L.; Niebur, C. S.; Larsen, K. W.; Snider, N. O. (2001): FIDO Prototype Mars Rover Field Trials, May 2000, Black Rock Summit, Nevada. XXXII LPSC, #1884, LPI, Houston; [6] Sz. Bérczi, S. Hegyi, Zs. Kovács, E. Hudoba, A. Horváth, S. Kabai, A. Fabriczy, T. Földi (2003): Space Simulators in Space Science Education in Hungary (2.): Hunveyor Orientations and Astronomical Observations on Martian Surface. In *LPSC XXXIV*, Abstract #1166, Lunar and Planetary Institute, Houston (CD-ROM). [7] S. Hegyi, Sz. Bérczi, Zs. Kovács, T. Földi, S. Kabai, V. Sándor, V. Cech, F. Roskó (2001): Antarctica, Mars, Moon: Comparative planetary surface geology and on its experiments and modelling via robotics by Hunveyor experimental lander. *MAPS,* **36**, Supplement, p.A77 [8] Wolfbeis, O.S., Kovács B., Goswami K., Klainer, S.M. (1998) *Mikrochim. Acta,* **129**, 181-188. [9] Mohr, G.J., Werner, T., Oehme, I., Preininger, C., Klimant, I., Kovács B., Wolfbeis, O.S. (1997) *Advanced Materials*, **9**, No. 14. 1108. [10] Bérczi Sz., Lukács B. (1997) LPSC XXVIII, 97-98.