HUNVEYOR-1 & -2: EXPERIMENTAL UNIVERSITY LANDER DEVELOPMENTS ON THE EÖTVÖS (BUDAPEST) AND JPTE (PÉCS) UNIVERSITIES IN HUNGARY: NEW INSTRUMENT ASSEMBLAGES.

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ABSTRACT

Two Hungarian universities are in competition in developing new instrument-assemblages on their planetary lander type robot, Hunveyor-1 & -2 (**H**ungarian **UN**iversity SUR**VEYOR**). Both groups built new instrumentation, of which we report a) the Hunveyor-1 result of developing a spectrometer, thermometer, drill unit, b) the Hunveyor-2 result of chemical optic-chemical sensor unit, c) Hunveyor-1 Martian desert landscape, d) beginning the Hunveyor type lander construction in a high school in Pécs.

INTRODUCTION

Hunveyor experimental university minimal probe was first constructed to the 1998 LPSC [1] on the Eötvös University, Budapest, (Dept. G. Technology). Next year the same Eötvös University group prepared a rover and internet availability [2]. Also in 1999 we made planetary geology park around Hunveyor-1 [3], and the JPTE Pécs group also begin to build his Hunveyor-2. Since that time the following new developments were carried out: a) soil analyzer measuring unit, (Hunveyor-1), b) optic-chemical sensor unit, (Hunveyor-2), c) Martian desert landscape studies and realization surrounding Hunveyor-1. We worked together with JPTE Pécs University group, in competition who develops more original instrumental assemblages.

SOIL ANALYZER MEASUREMENT ASSEMBLAGE: NEW INSTRUMENTS AND NEW I/O SYSTEM BETWEEN PC AND INSTRUMENTS

The soil analyser unit consists of three new instruments. The increasing number of instruments needed the development of the PC based control system of the lander. This was served by a new I/O card, which connect through control buses to the units by data and address.

Spectrometer: It consists of five photodiodes emitting light in 5 different wavelengths. They begin to emit in a sequential arrangement, the reflected light advances through a phototransistor and an A/D converter to be analysed by the computer on board of Hunveyor. The measurements are in real time processed the result of the analysis appears on the screen.

Temperature measuring sensors: We intend to measure to things. First the temperature of the atmosphere, second the temperature of the soil. To measure the air a sensor is placed on the end of the robotic arm. To measure the soil we placed a sensor into the drill. The sensors send the data through an A/D converter to the computer, which again analyses the data and send it to the control computer.

Drilling to the planetary surface: First it was intended to drill on the NASA Deep Space 2 Mission. There the plan was to drill some 10 centimeters deep into the soil in order to see stratification of the soil. Our Hunveyor drill has a similar aim, but we placed the drill onto the skeleton

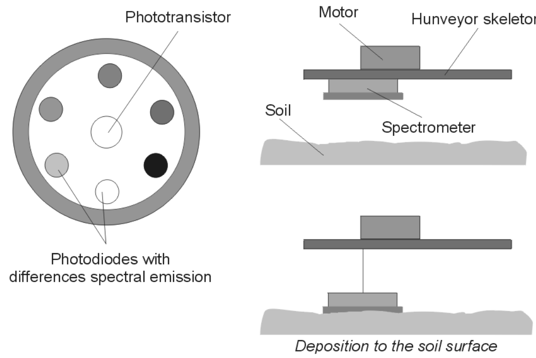

Fig.1. Spectrometer arrangement for Hunveyor-1.

to be more stable and fixed position. Similarly to the Mars Microprobe the drill of the Hunveyor penetrates some 10 centimetres into the loose soil of Mars desert. The drill measures two things: a) the conductivity of the soil, b) the temperature of the soil. Another unit of the Pécs Group builds the chemical sensor unit to measure aqueous and gaseous components in the soil.

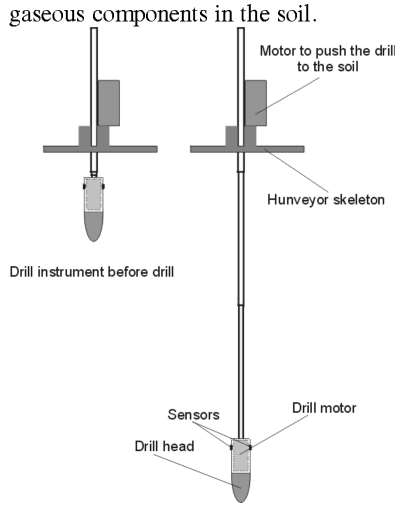

Fig.2. Drill arrangement for Hunveyor-1.

OPTICAL CHEMICAL SENSORS

For medical applications - such as blood gas analysis - sensitive optical chemical sensor devices have been developed [6, 7]. They also can be used for environmental monitoring of dissolved gases, ions or other chemical substances. Fibre optic chemical sensors have small mass, low energy consumption and great variability, therefore multiple number of specific sensors can be mounted on a rover. We focused on gases, such as carbon-dioxide (CO_2), ammonia (NH_3), oxygen (O_2), sulphur-dioxide (SO_2) or hydrogen-sulphide (H_2S). The listed compounds are present in the atmosphere while some of them also may indicate remnants of fossil living tissue [4-6].

The fibre optic chemical sensor device consist of 1) a selective sensing layer placed on one end of an optical fibre

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and 2) of a small instrument, which measures the changes of the optical property of the sensing layer at a given wavelength. Among the variety of optical properties (and methods) available for the detection, the measurement of the reflection or fluorescence of the sensing layer is fairly simple and therefore frequently used. The sensing layer of the sensor contains carrier and dye molecules. The carrier molecule catches selectively the compound of interest, while the dye molecule acts as a transducer: it converts the chemical signal (the presence of the analyte) to optically detectable information (e.g. its colour or fluorescence will be changed).

FIBER OPTIC MEASUREMENTS

The construction of a fibre optic photo/fluorometer can be made very simple (Fig. 3). The light source can be a light emitting diode or a laser diode (LD). The incident beam passes through a splitter (M) and is coupled into the optical fibre (OF) via lenses (L). The light reaches the sensing layer (SL) at the sensor head (SH) through the fibre and is partially absorbed by the dye molecules. In reflection mode the reflected light comes back to the same way and is reflected to the primary silicon detector (D). A second detector is used to monitor the energy of the light source. In fluorescence mode the beam splitter is replaced by a dichroic mirror and a filter is placed between the detector and the mirror for complete separation of the exciting and fluorescent light.

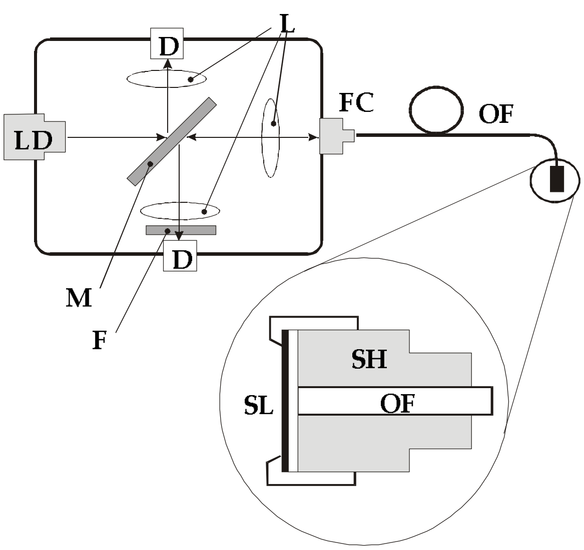

Fig. 3. Fibre optic sensor device for Hunveyor-2.

BENEFITS OF HUNVEYOR: ROBOTICS AND PLANETARY SCIENCE IN HIGH SCHOOLS

Hunveyor experimental lander was also an enthusiastic tool to teach any kind of robotics and measurements on a landscape. Therefore we begin to use it in high school education, to make movements in imagination by robotics in students. The frame of Hunveyor was made in the Angster József High School, Pécs. Teachers and students together developed the two minimal experiments (arm and TV) onto the Hunveyor. They attached classical elementary measurements of temperature, magnetism, and wind marker meteorological instruments to make joyful activities on their imagined space probe, yet in terrestrial station. (International Space Camp program was so realized in the high school education, too [12]).

MARS MICROLANDSCAPE AROUND HUNVEYOR

Last year we arranged Hunveyor as if it were landed on a planetary surface and arranged around it the most important rock types from the Solar System rocky bodies. The list of rocks were given in [2]

Not only the rock types may serve real planetary environment studies on the hypothetical landing site of Hunveyor. This year we arranged desert sand morphology according to the observations and result of Pathfinder. (results reported on XXXth LPSC.) The following surface characteristics were considered: 1) the main wind system above the landing site determines the orientation of the wind-tails [7], 2) the strength of the wind can be deciphered from the deposition of deflation style of the lee-forms [8], 3) the large scale relief was formed both by fluvial and aeolian effects; a larger dune-system was seen both on panorama and orbiter MGS MOC pictures [9], 4) the elongated pits, ventifacts, flutes are the products of the sand transported with earlier strong winds, they also give paleowind orientations [10], 5) impact pits on rocks and broken fresh surfaces of the rocks in the Pathfinder and its rover vicinity witness a kind of erosion modifying the rocky desert landscape [11]. Building these observations into the desert geomorphology around Hunveyor makes the landscape realistic. (All these landscape forms may appear in arctic snowy-desert Antarctic geomorphology.)

SUMMARY

We continued developing instrument assemblage supporting our planetary lander type robots Hunveyor -1 & -2. Our program not only develops experimental practice with instruments and robotics but makes enthusiastic planetary geology education of students and makes possible studying a simulated planetary terrain. [7-11]. Over these benefits our program in the future may: a) help to design new instrumentation, trigger initiatives, make the possibility to realize ideas, b) help in keeping fresh the enthusiasm, constructive activity of students in natural sciences, c) help selection of new constructional units and measurements, e) help forming international university community working together on planetary science [13].

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