NEW EXPERIMENTS (IN METEOROLOGY, AEROSOLS, SOIL MOISTURE AND ICE) ON THE NEW HUNVEYOR EDUCATIONAL PLANETARY LANDERS OF UNIVERSITIES AND COLLEGES IN HUNGARY. ***Gy. Hudoba[1], Zs. I. Kovács[2], A. Pintér[3], T. Földi[4], S. Hegyi[5], Sz. Tóth[6], F. Roskó[6], Sz. Bérczi[7]***. [1]Budapest Polytechnik, Kandó Kálmán College of Engineering, H-8000, Székesfehérvár, Budai út 45, Hungary, [2]Berzsenyi College, Dept. Technology, H-9700 Szombathely, Károlyi G. tér 4, Hungary, [3]High School of Pannonhalma St. Benedict Archabbey, H-9090 Pannonhalma, Vár 1. Hungary, [4]FOELDIX, H-1117 Budapest, Irinyi J. u. 36/b. Hungary, [5]Pécs University, Dept. Informatics and G. Technology, H-7624 Pécs, Ifjúság u. 6. Hungary, [6]eWorld Hungary Kft. H-1026 Budapest, Garas u. 1. Hungary, [7]Eötvös University, Department of General Physics, Cosmic Materials Space Research Group, H-1117, Budapest, Pázmány Péter s. 1/a, Hungary (bercziszani@ludens.elte.hu),

Introduction: Recently 7 Hunveyor are in construction in Hungarian universities and colleges [1]. 3 new one were started last year in high schools. We developed 3 packages of new experiments on various Hunveyors: a) measurements of the main wind parameters, b) measuring the soil ice content and moisture level, and c) bacteria and aerosol collecting package for Martian studies.

Measurements of the main wind parameters on Hunveyor-4: ***Requirements***: The unit should be cheap, reliable, should work in hostile environment, should transmit data about the air temperature, the wind speed and direction changes. Later on should be possible to extend the capability of the unit by additional sensors (like pressure, humidity,), characterizing more precisely the environment of the probe.

Mechanics: The mechanical base, made of stainless steel, is sturdy enough to hold the wheel and weather cook (a composition of stainless steel and aluminum), and resist of gust of wind, humidity and acid rains. The bearing is very precise, originally used in a computer hard drive.

Sensors: After careful consideration the Balluff 516-325-S4-C inductive sensor was chosen, which is water, acid and shock resistant, and has a broad operational range (from –40C^o to +85C^o).

Electronic board: The electronic is based on PIC 16A871 micro-controller, which picks up signals from sensors, and after some data processing sends them to the main computer by RS-232. The data block sent to the PC consists of 3 bytes in the following order: #1 **- temperature**, #2 – **speed**, and #3 – **direction** value.

Fig. 1. Cup anemometer of Hunveyor-4.

The wind-speed measurement: When the bar passes over the sensor, the sensor sends an impulse. The number of the impulses is counting in a register. Each complete turn makes tree counts, up to 255. The micro-controller reads the value from the register in each 2 seconds. At the same time the register is cleared (Fig. 1.).

Determining the wind direction: The weather cook consists of an oar, a vertical positioned aluminum sheet, a finger, which moves over the sensors, a fine bearing and a series of sensors, arranged in a circle (Fig. 2.). The eight sensors mean eight directions and eight bits for the micro-controller as well. The size of the finger was chosen big enough to being detected by two nearby sensors in middle position. With this trick we have increased the angular resolution of the device by a factor of two (Fig. 3.).

Fig. 2. The oar, the finger, the bearing and the sensors.

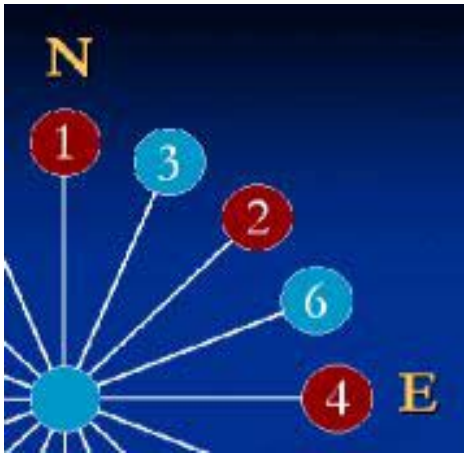

Fig. 3. The red dots show the sensor positions with their decimal value. The blue dots represent the middle positions, when two sensors are activated at the same time. The corresponding value, determined by the micro-controller is the sum of the two active bits.

Measuring the temperature: For the temperature measurement we use a single negative temperature coefficient (NTC) thermistor, driven by a current generator. With

changing temperature the voltage drop on the NTC will change due to the resistance change of the thermistor. The voltage drop and its change are measured by the analog/digital converter, incorporated into the microcontroller. The 1.5 mA, produced by the current generator, is small enough to causing unwanted reaction to the ambient temperature to be measured.

Fig. 5. The Hunveyor-4 with the EMU on the top of it. As can be seen, there is a moderate wind at the campus of the Institute in Székesfehérvár.

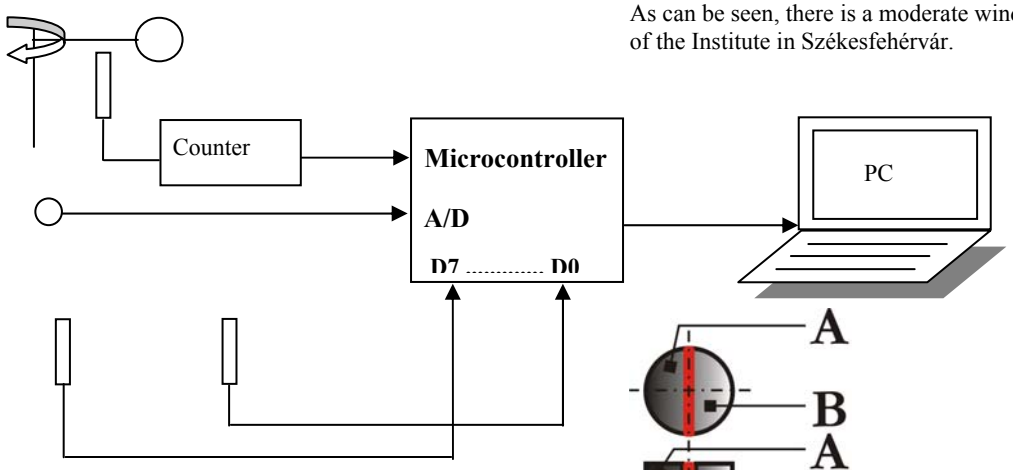

Fig. 4. The schematics of the Environmental Measurement Unit of Hunveyor-4.

Testing and measurements: We tested the EMU inside and outside of the building more or less in normal environment so far, because testing in extreme conditions would be too expensive for our Institute. The data acquisition program running on the computer is designed to store and use correction values for extended range. In moderate temperatures the NTC showed up near linear response. The direction sensing was tested using a fan, moving around the meteorological station. The trickiest part of the calibration was the speed measurement. The device 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.

Measuring soil ice level and content: According to the observations of Mars Odyssey the upper layers of the soil on Mars contains more or less ice. The Hunveyor-3 group focused works in constructing experiment unit to measure the water ice content of the soil. On the basis of earlier Hunveyor-2 soil hardness measuring this unit was developed in a form of a special drilling spindle which can be heated. The principle of the measurements is: heating the soil gradually at 4 levels (A-D) and the resistance of the soil is measured at various levels. (Fig. 6.)

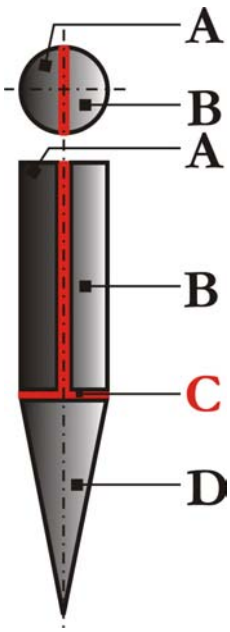

Fig. 6. The soil-ice measuring spindle of Hunveyor-3.

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