NEW DEVELOPMENTS IN THE HUNVEYOR-HUSAR EDUCATIONAL SPACE PROBE MODEL SYSTEM: HUNBALLOON, HUMBLEWEED, HUSAR SWARM FOR LOOKING AND MOVING AROUND FROM HUNVEYOR BASE ON THE PLANETARY SURFACE (THE TISA-PROGRAM). S. Hegyi[1], Gy. Hudoba[2], I. Nehéz[3], T. Varga[4], S. Kabai[5], Sz. Bérczi[6]. [1]Pécs University, Dept. Informatics and G. Technology, H-7624 Pécs, Ifjúság u. 6. Hungary, (hegyis@ttk.pte.hu) [2]Budapest Polytechnik, Regional Information and Education Center, H-6000, Székesfehérvár, Budai út, Hungary, [3]Nehéz Balloon Project, H-8500 Pápa, Korona u. 13., Hungary (nehezimre@kabelszat2002.hu), [4]VT Patent Kft. H-1111 Budapest, Bertalan u. 20. Hungary, [5]UNICONSTANT, H-4150, Püspökladány, Honvéd u. 3. Hungary. [6]Eötvös University, Institute of Physics, Dept. Materials Physics. H-1117, Budapest, Pázmány P. s. 1/a. Hungary.

Introduction: New developments of the Hunveyor-Husar robot models are summarized. Some new strategies were developed: 1) Hunballon lifts off and sinks down from and to the basis of Hunveyor lander 2) Humbleweed departs from the Hunveyor lander 3) swarm of various Husar rovers work around the Hunveyor to a rolling trip away from the system to report surface conditions in the vicinity of the landing site. The whole system can operate on Earth and on Titan. The activities on Titan were collected into a Titan Investigating Scientific Assemblege (TISA) program.

Benefits and aims: The educational space probe systems have benefits for students from the parallel work of design and construction, and the modelleing of great number of imagined and planned situations [1-2]. Recently the design is helped by several simulative instruments and programs. One of them is the Wolfram Demonstration Project [3-4].

Hunballon lifts off and sinks down: The basic criterium is that we can garantee the Nil-Diffusion covering of several layers of the balloon , with active isolation technology, which results in the possible decrease of gas storing coverings beside keeping or even increasing gas-sealing capacity. Hunballon is a subsystem in the Titan Investigating Scientific Assemblege (TISA) with the following benefits: Lifting up by a wire it can measure atmospheric characteristics (dust, composition, electricity, p and T) at (10-20-50 m). In the higher levels (100-200-400 m) with the atmospheric measurements it can observe by its camera the surface changes, and local and farther changes in the vicinity of the lander.

In a specific Hunveyor-Hunballon mass ratio the Hunballon is capable to transport the Hunveyor itself. Such translating role is a topics for study int he next year works.

Humbleweed departs from the Hunveyor lander: The benefit of the tumbleweed style of operation is that wind moves the rolling structure with instruments inside the outer spherical shell.

The basic unit of the Humbleweed of Fig. 1. is the folding robotic arm with 4 knees as the demonstration: http://demonstrations.wolfram.com/FractalRobotArm/ shows them. The 5 fingers of this arm were omitted, but the arms were multiplied to form a 5-arm-bundle.

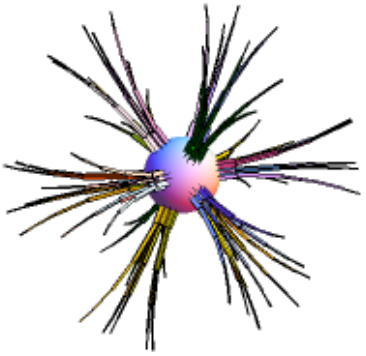

Fig. 1. Starting position of Humbleweed with 12 arm-bushes, 5 arm in each bundles begin to open (Kabai S. *Mathematica*)

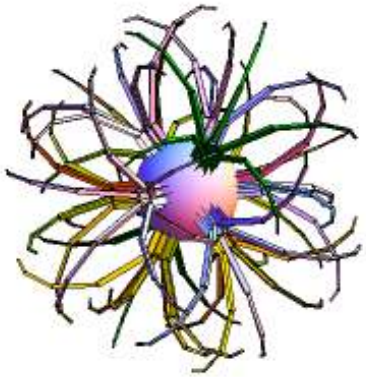

Fig. 2. Opening arm-bushes begin to form a spherical surface to the rolling Humbleweed. (Kabai S. *Mathematica*)

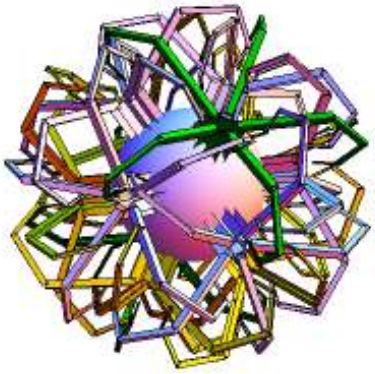

Fig. 3. In the very open position of arms form the rolling surface of the Humbleweed. Instruments are inserted between the arm-bush spaces. (Kabai S. *Mathematica*)

The rolling postions are shown in Fig. 4. of the 12 arm bushes Humbleweeed.

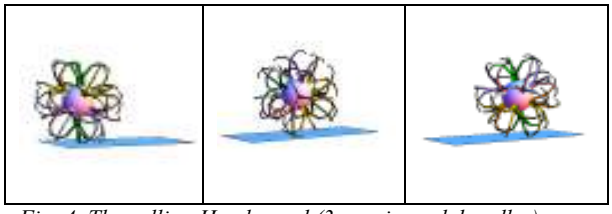

Fig. 4. The rolling Humleweed (3 arm in each bundles).

The basic unit of the Humbleweed of Fig. 1. is the folding robotic arm shown in the demonstration: http://demonstrations.wolfram.com/FractalRobotArm/. The 5 fingers of this arm were omitted, but the arms were multiplied into 5 arms in a bundle [5].

benefit of this type Humbleweed construction is, that in a given position it can be stopped by withdrawing one bush of arms. That direction will cause indenting of the spherical surface. Another solution is a kind of Hoberman sphere mounted on the outer shell of a spherical polyhedron (Fig. 5.) where the opening Nuremberg scissors give the outer sphere of the Humbleweed.

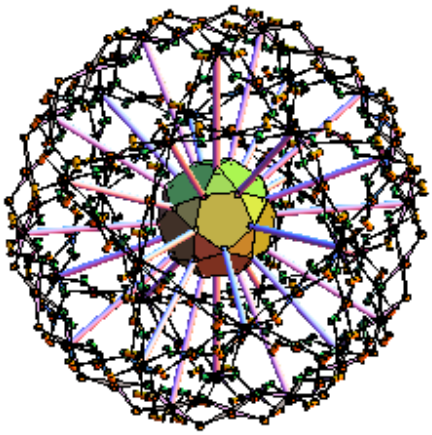

Fig. 5. Other type of Humbleweed with a Hoberman sphere mounted on the outer shell of a spherical polyhedron. http://demonstrations.wolfram.com/HobermanCube/

Swarm of various Husar rovers cooperate in measurements: This system is developed as an educational work at Pécs University, Dept. Informatics and Technology. The students of Technics teachers courses build their own Husar-2 rovers, which are smaller and larger model-cars supported by onboard computer, camera. All Husars in the swarm has specific instrumentation combination (Fig. 6a.) One of them, for example, contains a sensor which monitors a continuous distance reading and returns a corresponding analog voltage with a range of 10cm (4") to 80cm (30"). The sensor package includes a JST 3-pin connector, three pre-crimped wires, and a booklet with detailed information and examples (Fig. 6b.) In this program an DLR (ESA member) developed ASURO rover was also studied, which is similar in many respects to the Husar-2 mini-rovers [7].

Fig. 6. Swarm of various Husar rovers work around the Hunveyor (a). This Husar-2 rover has a GP2D12 sensor to measure distance from rocks. All these are student works [6].

Summary: Several new deveopments of the Hunveyor-Husar university robot system were shown to mark the intensity of interest of students to the preparations to the field work research in planetary geology. Our TISA-program extends the possibilities of the 4 member robotic group of the Hunveyor-Husar-Hunballoon-Humbleweed assemblage when thes are focused to work in Titan surface and atmospheric conditions.

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