SOLAR PANEL AND ELECTRIC POWER SYSTEM OF HUNVEYOR-2 UNIVERSITY LANDER: EXPERIMENTS FOR VARIOUS PLANETARY INSOLATIONS. ***Hegyi, S.***[1]***, Horváth, Cs.***[1]***, Németh, I.***[1]***, Keresztesi, M.***[1]***, Hegyi, Á.***[1]***, Kovács, Zs.***[2]***, Diósy, T.***[3]***, Kabai, S.***[4]***, Bérczi, Sz.***[3] [1]Pécs University, Faculty of Science, Dept. Informatics and G. Technology, H-7624 Pécs, Ifjúság u. 6. Hungary, [2]Berzsenyi Dániel College, Dept. Technology, H-9700 Szombathely, Károlyi G. tér 4. Hungary, [3]Eötvös University, Faculty of Science, Department G. Physics, Cosmic Materials Space Research Group, H-1117 Budapest, Pázmány Péter sétány 1/a. Hungary, [3]UNICONSTANT, H-4150 Püspökladány, Honvéd u. 3. Hungary. (hegyis@ttk.pte.hu, bercziszani@ludens.elte.hu)

Abstract: Constructing the Hunveyor-2 experimental university lander we developed the electric power system by using solar panel and battery. Motions of the solar panel were directed in a local horizontal coordinate system by light sensors and with programming for search of maximum flux. We described the system in an Atlas of Hunveyor construction [1].

Introduction: Surveyor lunar landers were the chosen ideal for our Hunveyor robotics [2-6], [7-9]. There on the top of the central rod a solar panel and an antenna can be found. Our power system of solar panel with the charging and accumulator units on the Hunveyor-2 lander of Pécs University, Hungary

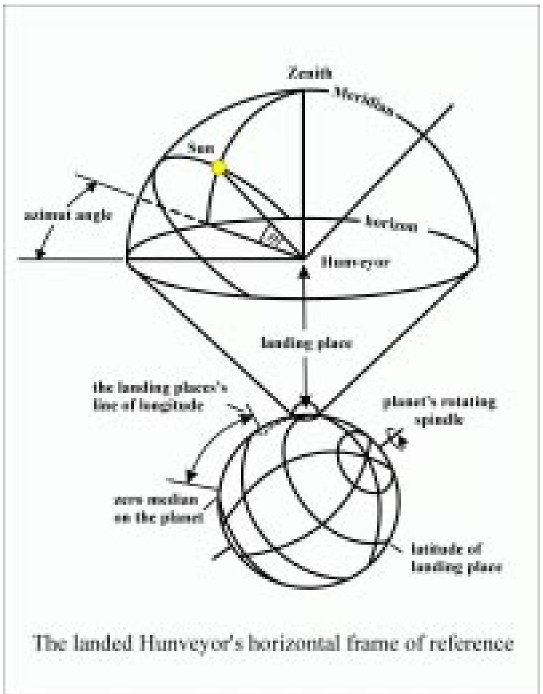

Fig. 1. Horizontal koordinates of the Hunveyor on Mars.

are shown in two parts: 1) the orientation system and 2) in the electric charging system. Different planetary solar irradiation cases were also studied.

Orientation of the panel: Maximal flux, optimal charging of accumulators and the largest efficiency of continuous power production of a panel has if the plane of the solar panel is perpendicular to the direction of the Sun. We wrote a program for the computer on board which keeps on the solar panel in this (almost) maximal flux direction continuously. The position of the lander on an Earthlike body is shown on Fig. 1.

Two light sensors are used in orientation. They "see" perpendicular to the plane of the table. One of the sensors has wide angle (90 degrees) range, the other has narrow (5 degrees) range. When Sunrise begins the wide range sensor send a signal to the computer and the orientation procedure begins.

The positioning of the table is carried out in two steps. In the first step the longitude of the rising Sun is determined. With 1 degree steps the table is turned around and the narrow range sensor measures the produced voltage. It stops at the highes flux position. In the second step the latitude of the Sun is measured. With 1 degree tilting steps the narrow range sensor measures the flux and stops at the highest value. Then the solar panel keep on staying in this position till the produced voltage decreses to the 90 % of the earlier maximum. At this point the orientation system looks for the Sun again.

In a planetary surface perspective all such steps can be best seen in a horizontal coordinate system placed on the surface of Mars. (There are many similarities to the Earth in axis tilt and the length of the day.) Students know this horizontal coordinate system from astronomy, it is that of the parallactic arrangement for telescopes.

Mechanics of solar panel movements: The Hunveyor's solar panel is placed on a rotating table. The moving elements orienting the solar panel to maximal flux dierction are shown on Fig. 2.

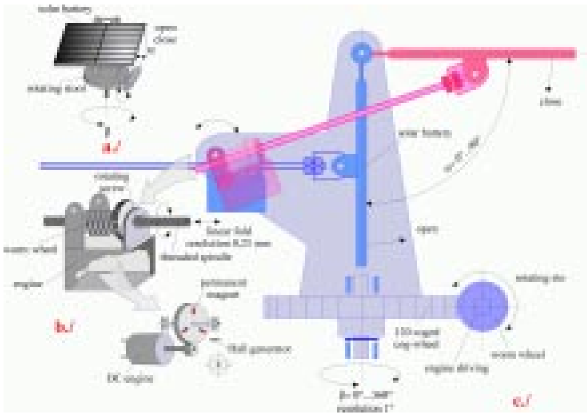

Fig. 2. Mechanical arrangement of the solar panel of Hunveyor-2 with the driving motors.

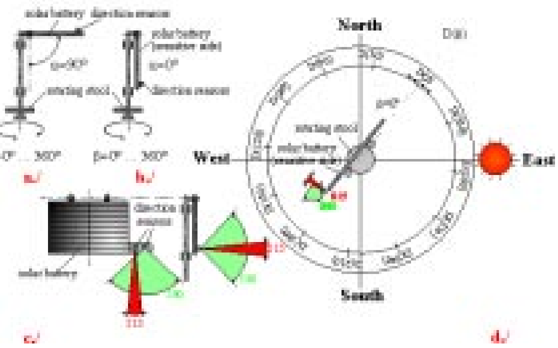

Fig. 3. Orientation of rotating table with the wide and the narrow range sensors.

The charging system: In our model the current produced by the solar panel is 0.5 Ampere, but the instruments need 2 Ampere. Therefore we charge a Cd-Ni accumulator (with 9 cells and with 4 Amper.hour capacity) with the solar panel. In our system for the 2 hours working of the instruments (also considering the efficiency of the charging) we have to continuously .

charging the accumulator for 12 hours.

The charging system is shown in Fig. 4. Here we can see that the accumulator gets DC not directly from the solar panel, but through a charger unit, which has control functions. Charger unit measures the voltage of the accumulator, and stop charging when voltage overrun 13,7 threshold voltage. Charger switches on the board computer, too

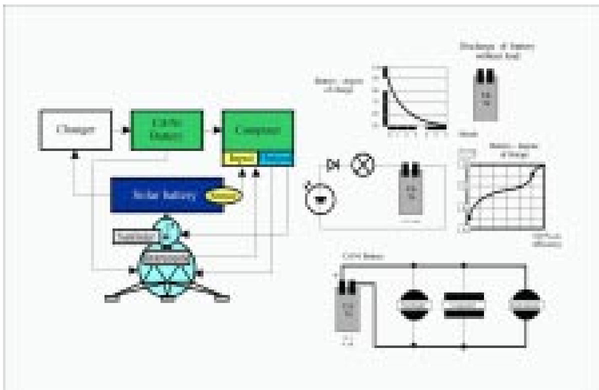

Fig. 4. The block-diagram of the Hunveyor-2 power system. (left) and the charging plots of the accumulator.

Experiments: Two kinds of tests were carried out with the solar panel system. One was modelling the conditions of two main types of planetary bodies: one with rotational axis almost perpendicular to ecliptic: (Jovian satellites case and our Moon) and the tilted rotational axis (over Earth) is Mars. The other test was the alternative use of instruments (priority order was defined: computer, camera, robitic arm) with simulated cloud cover conditions. Step by step Hunveyor sytem this way becomes a kind of planetary lander simulator, and serves as an example for other space science simulators, also bacoming popular in science museums, too.

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