PLANETARY GEOLOGY EDUCATION VIA CONSTRUCTION OF A PLANETARY LANDER PROBE. ***Sz. Bérczi[1,2], V. Cech[2], S. Hegyi[3], T. Borbola[2], T. Diósy[2], Z. Köllõ[2], Sz. Tóth[2]*** [1]Eötvös University, Dept. Petrology and Geochemistry, H-1088 Budapest, Múzeum krt 4/a. Hungary, [2]Eötvös University, Dept. G. Technology, H-1088 Budapest, Rákóczi út 5. Hungary (berczi szani@ludens.elte.hu) [3]Janus Pannonius University, Dept. Appl. Math. Informatics, H-7625 Pécs, Ifjúság u. 6. Hungary.

HISTORICAL: Considering traditions Hungary has only one important great old man in space research - Herman Oberth, born in Nagyszeben, (rec. Sibiu) in Transylvania, in 1891, at that time Hungary.

In the last 23 years Eötvös University, Budapest, had courses on Planetology and Cosmopetrography. Recently we began a new strategy in education of this subject, mostly because of the impressions in the International Space Camp, Alabama, attended by one of us (Sz. B.) in 1993. *Teaching is effective, if it is attached with constructive activities and more effective, if space science education is connected to it* [1]. We connected planetary science education with robotics and we are advancing in a program of a Surveyor like planetary lander space-probe construction. In this course parallel with the construction of the lander we study in details the scientific goals to be achieved.

PRINCIPLES: There are two main blocks of principles which give framework to such a program. One is the scientific achievements in planetary geology, i.e. Wilhelms [2], the other is a kind of summary of planetary probe construction and operation, i.e. Nick [3], and also a summary of measurements and results: The Surveyor Investigator Teams [4-5].In this paper we summarize our program, goals and results.

MEASUREMENTS ON THE SURFACE: First stratigraphic works on lunar geology selected and emphasized those principles of terrestrial geology, which can be extended to Solar System scale [6]. Identification of surface rocks were first done by their optical properties and morphologies, but later, the lander space probes showed details of the surface. Characteristics of surface can be done by physical (mechanical, optical or thermal properties, first approx.) measurements of:

- mechanical properties: strength, rigidity, porosity, depth of regolith, depth of surface powder, roughness of the soil and the largest blocks scattered on the surface, i.e. Christensen et al. [7], Choate et al. [8], Scott et al. [9], Scott et al. [10];
- optical properties to be studied by a television camera are: relative albedo, roughness, crater density, smoothness, height of the highest elevation in the vicinity of the lander, average inclination of the landscape, i.e. Shoemaker et al. [11], [12];
- thermal properties are: surface rock temperatures, thermal conductivity, i.e. Lucas et al. [13], Vitkus et al. [14],
- magnetic properties by passive magnet contacts. We intended to supply our space probe with measuring instruments for all these properties. We had a rich literature about earlier works of the Surveyor and Viking missions [4-5], [15].

TWO LEVELS OF CONSTRUCTION: We divided our program to two levels. In the first level we make a lander skeleton with minimal space probe furniture as televison camera with mirror, telescopic arm to mechanic operations, thermal unit for environmental measurements and communication system for these units.

In the second level we specify our space probe to an asteroid to be investigated on the site. We selected 434 Hungaria asteroid being one of the innermost asteroids in the asteroid belt with specific orbital (being one Hirayama-family object) [16]. and surface material characteristics (with connection to E-asteroids and E-chondrites and achondrites) [17-18]. If we are ready with the first level and begin specification, we should like to connect our works to the Discovery program of NASA.

FIRST LEVEL: MINIMAL PROBE: Tetrahedral skeleton as a holding framework was the first unit we built. For a minimal probe personal minimal environmental observing activities were copied: visuality, touch, temperature experience. Televison camera with mirror to "see around", telescopic arm to dig small graben, and a bimetallic temperature measuring instruments can be corresponded to them. We also took passive magnets on legs. Also the first level contains the electronic set to organize parallel measurements but time-parted sign telemetrics. First by cables (Fig.1.b), later separated radio electronic connection (Fig.1.c)was built. This Surveyor-like minimal probe gave us many pleasure during building. The sceleton was made from copper pipes with 15 mm diameter. The first robotics was constructed from the ROBOT EVOLUTION System of a Hungarian Engineer Group in Eger (zero level, Fig.1.a.) It made possible to make working 3 motors, but their electronics was able only separate element operations, therefore first electronic step was to build a parallel system with interfaces (interfaces were developed on Dept. Technology by B. Drommer).

SECOND LEVEL: 434 HUNGARIA: Specifications to 434 Hungaria minor planet observations needed overview of obtained results. 434 Hungaria is among the 3 most reflective asteroidal bodies [17]. According to the meteorite comparisons E-chondritic and E-achondritic materials are expected on its surface, which may contain metal with Si-content [19-23]. We expect rather sharp color differences of materials on the surface, because of the brigthest nature of the background enstatite containing materials and the probably darker impactors of chondritic or carbonaceous chondritic rocks. Porosity is planned to study by a pneumatic experiment. Outflow of inert gas will be observed and the extension of the powder cloud. Recently this second level of probe construction is in planning state.

SUMMARY: We connected in our educational

program the planetary science with robotics construction of a lander space probe. First level we build a minimal space probe and parallel we study mostly lunar and Martian surface results, and in the second level we specify our lander to an asteroid investigator space probe for visit to 434 Hungaria to study E-type materials asteroid surface.

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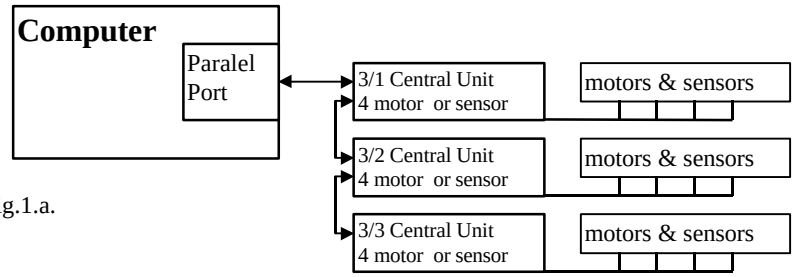
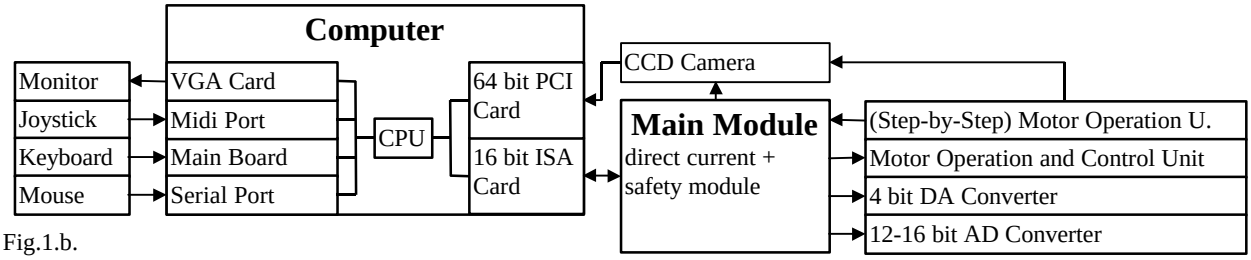


Fig.1.a.



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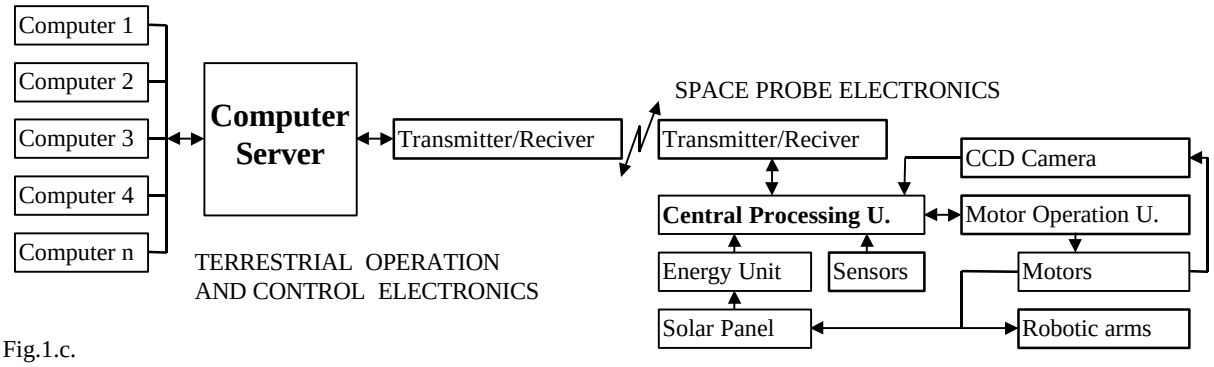

Fig.1.c.