PRACTICAL REALIZATION OF ROBOT TECHNOLOGY CONSTRUCTED TO PROMOTE WORK ON THE MOON. A. Kókány[1], P. Pál[2], Cs. Pintér[3], I. Urbán[4], ISTF Ltd. Pécs, ISTF Business Management and Consulting Services Limited Liability Company, (www.istf.hu), H-7632 Pécs, Maléter Pál u. 130, Hungary (kokanya@istf.hu[1] ; palp@istf.hu[2] ; pintercs@istf.hu[3] ; urbani@istf.hu[4]).

The purpose of the present abstract is the practical realization of lunar work in view of Moon environment as well as utilization of our innovations and technologies in robot designing.

Theoretical background of technologies planned to be improved was drafted in the following abstracts: Practical questions of the Lunar Surface. 38th LPSC, #1395. Practical questions and task analysis of realization and operation of a lunar robot for moving lunar surface material. IX SRR.

Principles needed to robot operation: with reference to the above written, performance of the robot reduces to one sixth because of the 1/6 Earth and Moon gravitation difference. [1] We eliminated the gravitation problem by self-weighting of robot weight so there is enough push and pull power to operate the robot.

In the course of the modeling processes based on our principles, we concluded that the construction of the robot has to be altered [2]. The changed main construction parts are the following: we separated the self-weight stowage side and in this way altered the shape of robot. The ballast tank was designed with a ballast unloading appliance. The operation side (equipped with an angle dozer blade) was separated from the self-weighting side because technically the double function cannot operate. It is obvious that in this way the actuation alters. Because of the better weight distribution the robot is equipped with six wheels. As a result of this, we developed the current design. The exact name of the robot is '**MATCI**' **M**oon **A**nt **T**echnology **C**onstruction **I**nstrument. This name reflects that the operation of the robot is adjusted to the extreme lunar conditions.

Main construction parts of the robot: the construction of the robot is an eased structure which has a relatively large stowage and control cell. All of these were designed with appropriate reinforcements and a special light, but high endurable alloy. It is important that the weight of the robot should be as light as possible since it should be put to the Moon. The main parts, the body could be divided into two parts, upper and lower, each of which could be divided into two further parts. The telescopic, specially locking stowage is at the stowage side of the robot. Size, shape and movement of the loading spade are crucial aspects of the project. Finalization of design of loading spade and its arcs was preceded by several computer modeling. The present solution along with the fixing and closing points can manage this multifunctional task. After the self-weighting, operation is ensured by a specially strengthened, in its horizontal plane moveable, light angle dozer blade. Form of place of the angle dozer blade is multifunctional since it is possible to equip other headpieces on the robot according to the type of the work, e.g. clamshell bucket or drill bit. It would be ideal if the machine was able to change the working headpieces without human navigation.

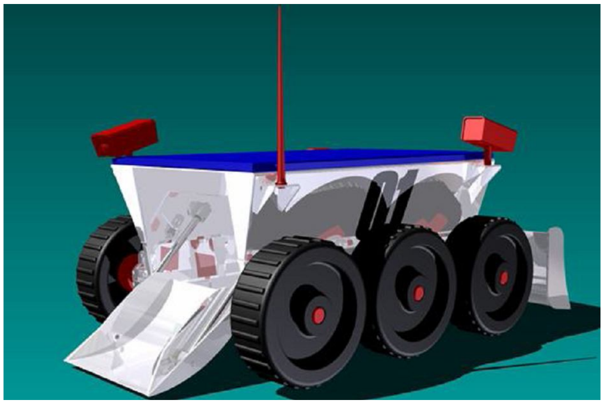

Fig. 1: Loading-side view of robot

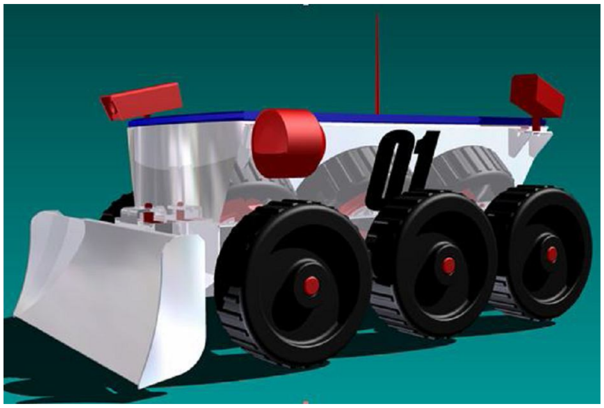

Fig. 2: Angle-dozer-blade-side view of robot

The main structural parts are the six wheels ensuring the movement of the robot. Other elements on the robot body helps communication and navigation as well as to carry out measurements and to collect data.

Inner body structure: as it was mentioned above, the lower part of the body can be divided into two parts, the bigger one is the ballast itself. In the bottom of the ballast, there are two special size and slope hydraulic unloading doors. Essential feature of the unloading system is the fast and total ballast removal during slow movement. The fullness of the ballast body is measured by weight detecting sensors. The operation of the door system can be easily managed with low energy consumption. Energy cells, which ensure refilling, are placed in the smaller cell in the bottom; this is hermetically closed, so lunar powder cannot harm the system. The main controlling electronic parts of the robot are also placed here. Suspensions of the six wheels fit individually to the underbody. Upper part of the body follows the shape and inner layout of the lower body. The outside cover of the upper body is a solar cell; underneath, in a separated and closed place there are the measuring electronics and the solar cell control panel.

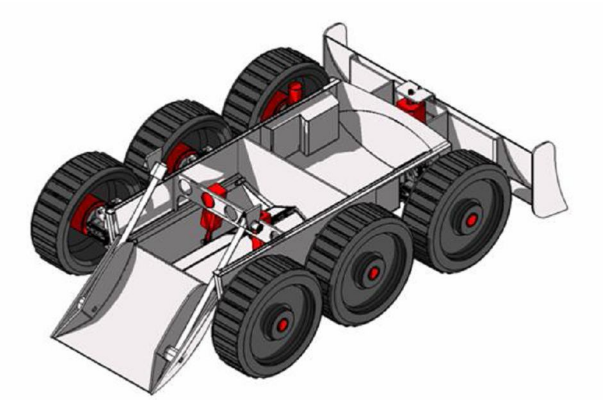

Fig. 3: Inner body structure of robot

Actuation, suspension and control: the computer model was analyzed in different terrain conditions using animation where the four and six wheel versions were tested also. Through analyses, we tried to simulate such lunar terrain conditions where the working ability remains effective. We concluded that the most appropriate is the six wheel version. Wheels have direct actuation, mainly because of the working ability, maneuver ability and avoidance of obstruction. The angle-dozer-blade-side two front wheels can be controlled by precision pacer engines. The version, where each of the six wheels can be controlled and the maneuver ability is even better and sidewise movement is possible, is under testing. Direct actuation, built into the axle-box, and precision steering wheel movements are held by an extraordinarily strong swivel joint suspension system, which provides total stability to the robot. The telescope, built into the suspension, as well as torsional spring, built on the outer side of the suspension, facilitates easy movement on folds. Rounded shape of the bottom part of the body and suspension help to avoid stoppages.

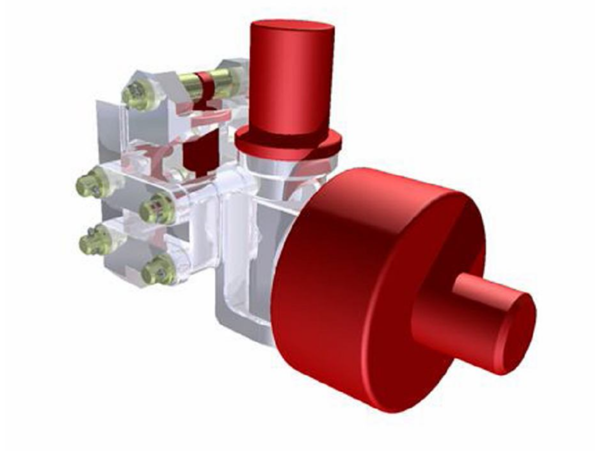

Fig. 4: Actuation of robot

Development targets: our goal is to build different energy production and energy storage methods into the robot which have high operation reliability and durability. Design and further development of the angle-dozer-blade-side commutable adapter system. During continuous development of the robot structure, the main considerations are to apply as few as possible moving parts, using transparent and easy methods. We intend to equip measuring devices into the robot according to the different needs. Along with PinterWorks' [3a, 3b] technological background, practical realization of robot models is carried out on the basis of our own construction plans. The prototype, which has the appropriate technologies and features, is chosen. Testing the prototype in different simulated lunar conditions is also among our goals. Continuous publication of research results.

References:

[1] A. Kókány et al.: Practical questions of the moving of lunar soil materials on the conditions of the Lunar surface. 38th LPSC, #1395; [2] A. Kókány, P. Pál, I. Urbán, et al.: Practical questions and task analysis of realization and operation of a lunar robot for moving lunar surface material. (2007): Space Resources Roundtable IX; [3a] PinterWorks' home page (www.pintermuvek.hu); [3b] Space electronic tap, personal dose meter for NASA astronauts.

Note: Editor of abstract pictures is Gy. Imrek (2009).