Younger Generation Inspiration and Motivation Through Exposure to Space Technology

Secrieru N., Candraman S.
Center of Space Technologies,
Technical University of Moldova,
Chişinău, Rep. of Moldova
nsecrieru@mail.utm.md,
candraman_sergiu@mail.utm.md

Serghei Andronic
Faculty of Engineering and Management in Electronics and Telecommunications,
Technical University of Moldova,
Chişinău, Rep. of Moldova
serghei.andronic@gmail.com

Abstract **- This paper deals with a challenge for the space science - decreasing the number of scientists and engineers. The main objective is to provide the target groups (children, students/young people, students and PhD students), motivation, and opportunities to pursue careers in science and space technology. Specific objectives are to enhance the promotion of research and technological achievements in space science among target groups; closing the gap in education programs used by schools and universities related to space science by creating appropriate content (video lectures, lectures on-line) and implementation of information (competitions, summer schools, workshops); providing opportunities for pupils and students motivated ideas in science and technology design space satellites; creation of courses on web platforms that integrate effectively promoting research, achievements, results dissemination, efficient sharing of resources online education target groups.**

Key words **- computer-aided instruction efficiency, space science providing.**

I. Introduction

Space science is a very strong and vital part of success in providing a knowledge base for many other developments. The technology spin-offs from Space affect industries from medicine to manufacturing. The end user applications affect our lives in every way, from communications at home and work to security, safety, entertainment and travel. The Space Industry covers not just spacecraft but also the manufacturing of the launchers and the ground equipment. Satellites perform many functions autonomously but need to be operated (supervised and controlled) from the ground. Space is perceived differently by different people. To some, Space is about astronauts and robotic craft exploring the universe. In fact Space covers a wide range of activities from commercial communications satellites, through location based services to Science and exploration. Any Space based infrastructure will support a myriad of applications and services. It seems, like ICT, to stimulate (through its disruptive influence) pervasive and continuing improvements in diverse sectors. All of these contribute to and benefit from the Space economy [1-2].

The Centre of Excellence for Space Sciences and Technologies, CNTS-TUM, has been established by a consortium of Technical University of Moldova, academic institutions and some high-tech SMEs in order to take advantage of the benefits of space technologies and applications in Earth observation, meteorology and astrophysics. The goal of the CNTS-TUM is to exclude the lack of scientists, engineers and technicians on the area of space research and development by dissemination of experiences in the space domain to contribute building of long-term partnerships between peoples from different Europe countries to run sustainable outreach activities which can act as catalyzers, motivating pupils and students at different ages and education levels. The RTD activities of CNTS-TUM are focused on medium resolution interactive remote sensing and formation flying missions by involving in these projects a most of students at different ages and education levels. These goals are supported by the concurrent development of micro and nano-satellite platforms an advanced ground control infrastructure and satellite integration facilities as well as a multidisciplinary laboratories for developing and testing of satellite systems and components in simulated space environments. This Centre of Excellence for Space Sciences and Technologies provides the students, early career engineers and enthusiasts with educational resources on many aspects of Space Engineering.

II. Structure of Space Technology Excellence Centre

Centre of Excellence for Spatial Technologies was created to promote this technology labs for students from many specialties from the Technical University of Moldova. Then it was done for other universities, colleges and high schools as a common center with the following structure: Development Laboratory satellite components; Laboratory simulation and testing of the satellite attitude; Center of Excellence Information Technologies and Communications; Laboratory data processing and satellite images; Telemetry ground station communication satellites; Ground station for satellite images receiving; Astronomical observatory.

The Laboratory of satellite components development was the starting point that was founded to promote the concept of space technologies. Here the idea of creating a nanosatellite designed to stimulate the enthusiasm of young people, to encourage them to get acquainted with the most advanced technologies in electronic communications space. Recent laboratory is well equipped with computers and equipment to the design and development of nano-microsatellite components such as electric power systems, on-board computers, data transmission equipment, systems, remote sensing (satellite image capture) as well as structural elements of satellites.

Laboratory data processing and imagery is aimed at familiarizing the students, doctoral students with processing methods and application of these results in various fields.Remote sensed images are generally obtained for different purposes. A peculiarity of images obtained from microsatellites is capture during the satellite's movement. This factor causes geometric distortions as well as radiometric ones. The laboratory of satellite data processing deals with the research on methods of pre-processing of distorted images obtained from microsatellites. There were analyzed and processed concrete examples of images for each type of distortion in software environment based on the methods of processing remote sensed images in spatial domain processing as well as in frequency domain processing and compares its efficiency. Remote sensing brings together a multitude of tools to better analyze the scope and scale of different environmental problems that are an important issue of our country. In order to meet the needs, image processing procedures would make it easier then ever to read, explore, prepare, analyze and share information from imagery.

The ground stations for transmitting and receiving of telemetry communication and satellite images represents the terrestrial infrastructure of microsatellite project. This infrastructure is located in the park - museum of technics, which enables all TUM's specialties students to familiarize with these problems. We have developed two distinct nodes: the communication telemetry located in CNTS - TUM with antennas on the roof of the block of trials, and the second node receiving station with digital images is located in a building with a special architecture. This infrastructure is widely used for promoting space technology. Primarily to development and their design involved a large number of students for undergraduate thesis, master, including PhD students. Secondly, it is used to perform practical work and laboratory for smart grid related disciplines radio communications, satellite communications. Control software was developed and parabolic antennas telemetry and graphical interface position monitoring satellites.

The Excellence Center of Information Technologies and Communications was done as a promising infrastructure for hosting a strong cloud computing computer network, research laboratories, simulation and design of various information systems, communications, including satellite data processing, calculations aerodynamics, etc. Everything in this place is a multi-purpose hall for achieving the various academic meetings, inter-university and international. This Center will

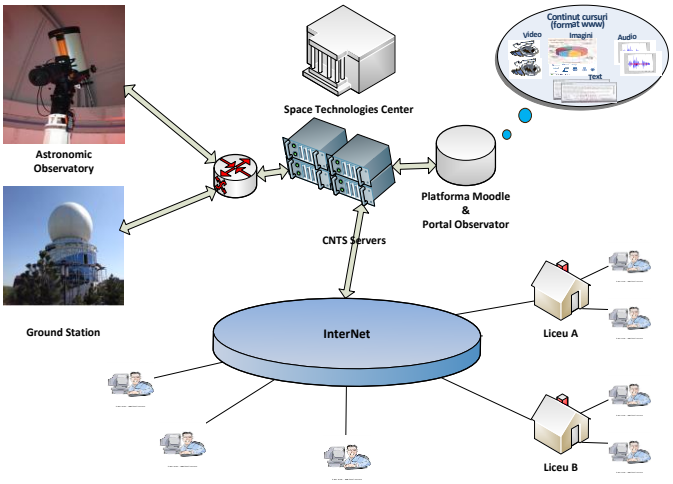

Fig. 1. The CNTS's scheme to promote the space technologies.

conduct lectures, practical work not only TUM professors, but will dominate those invited to promote the most advanced information and communication technologies. A successful collaboration are workshops conducted by IBM Romania, which under the Academic Initiative IBM, are familiar with the type design technologies Model Driven Systems Development with IBM Rational Rhapsody, ILOG OPL - Operations Research, mathematical optimization, mathematical programming, Mathematical Programming (MP) and Constraint Programming (CP), etc., in future the research are expected with the effective participation of students in projects GNSS / LPS based Online Control and Alarm System (GOCA) on base of Mathematical Models and Technical Realization of a Scalable System for Natural and Geotechnical Monitoring Analysis, Numerical modeling in CFD framework with CFD applications in renewable energy conversion systems design, aerodynamics, CFD applications for structure strength, etc [3].

The Astronomical Observatory with CELESTRON telescope. In order to extend the possibilities of space technology promoting the Astronomical Observatory was decided to build as the ground infrastructure component of the Space Technologies Center of Excellence. With the financial support of the Ministry of Education, there was purchased the Astronomic Observatory with remote computer control, based on the telescope of Celestron C14 Edge HD model with CGE-PRO mount, which will be mounted in a specially constructed building located in the Technology Museum Park and connected to the Space Technology Centre, which enables to track the moon, the sun, practically all the planets, various constellations, including objects in low orbit of the Earth, such as the International Space Station orbit LEO satellites, aircraft, and others. The telescope and its infrastructure will be used for educational purposes for the study of planets, sun, moon and other constellations, including astral phenomena and Earth bodies (satellites). Recently, there has been performed some work on the connection of the Astronomic Observatory and Earth Station with the Space Technology Center, a complex

that will facilitate more efficient observation and identification of the astral phenomena and Earth space bodies (satellites).

III. Concept, Approach and Implementation of the Project

The purpose of this proposal is to address an emerging challenge for European space science: the existing lack of scientists and engineers. The main objective of IMYGEST project is to offer to four target groups (children, pupils/teenagers, students and PhD students) the motivation and opportunities to follow a career in space science and technologies. The specific objectives are:

- to enhance the promotion of research and technology achievements in space science among target groups;
- to fill the gap in the education programs used by schools and universities related to the space science by creating the necessary content (video lectures, online lectures) and implementing the outreach activities (contests, summer schools, workshops).
- to offer to the motivated pupils and students the research and project ideas and opportunities in space science and satellite design technologies;
- to create a web platform that will integrate effectively the promotion of research achievements, disseminate the project results, efficiently share online educational resources and communicate with the target groups.

In 2009 Technical University of Moldova (TUM) has founded a interdepartmental working group with a long-term objective: designing and launching of the first microsatellite of Republic Moldova. The main goal of this objective was to boost the interest and motivation for the students to pursue the academic and research careers in space technologies. In 2012 there was founded the National Centre for Satellite Technology (NCST) that includes currently 10 professors and 30 Bachelor Degree, Master Degree and Doctoral Degree students. The research and technology developments, as well as educational activities focus on satellite components design and development, ground control, satellite attitude control, image capturing, data transmission and processing, medium resolution interactive remote sensing and formation flying missions, testing of satellite systems and components in simulated space environments, elaboration and implementation of academic programs and courses centered on space technologies. The Centre's infrastructure includes among specialized laboratories, the ground control station equipped with parabolic (4.5 m diameter) and yagi antennas for telemetry, satellite dynamic load and attitude control simulator, astronomy observatory equipped with Celestron 355.6 mm and 127 mm telescopes.

The motivation and opportunities among four target groups (pupils, high school students, university students and PhD students) to follow a career in space science and technologies can be successfully fulfilled by promotion of research and technology achievements in space science and by actively involving the target groups in a real scientific project with a great impact.

In order to boost the interest towards space research and satellite technologies, that in turn will influence positively the overall scientific performance of future and current students, TUM has established NCST with a long-term objective to design and launch the first microsatellite of Republic Moldova, SATUM. All educational and outreach activities will gravitate around two poles: the elaboration of SATUM with ground stations (giving to the involved students the necessary motivation) and the Observatory with a planned Planetarium. Currently, NCST-TUM is in charge with the execution of two national science projects included in the State Program "Elaboration and Design of Microsateliite SATUM, and Ground Control Infrastructure" that is financed by the Government of Republic Moldova through Academy of Sciences of Moldova. Part of the research activities in the framework of the above mentioned projects will be delegated to the participants from the target groups (MSc and PhD students) as topics for their theses. The research outputs of the projects will be shared and used within the activities of this proposal.

In the last decade TUM has observed a slowing interest of pupils and students towards a research or engineering career. In the same time there was noticed an underperformance of current students in engineering and science. Analyzing the reasons for this poor performance, there were identified several key factors including the quality and incompleteness of academic programs, the existing gap in scientific knowledge among school teachers, the lack of information, motivation, environment and opportunities for children and students regarding the science and technology. Space endeavors and related technologies are a constant and strong catalyzer for human scientific development and can be successfully used to attract the interest towards science and engineering of a larger number of people from four target groups at different education levels: children, high school students, students and master degree students, PhD students.

As a global approach project includes raising awareness about space field, generating relevant project ideas and their implementation, creating a favorable environment for personal scientific development among the target groups. The outreach activities are differentiated for each group taking into account their education levels and backgrounds. For the first group, it is intended to draw the attention towards the space science through movies and lectures held at the planned planetarium located in the observatory at NCST-TUM. Furthermore, for those interested there will be available online lectures and contest proposals placed on the planned website platform.

In order to initiate the 2-nd group in the space technology there were planned the online lectures on relevant science areas such as of physics, mathematics and programming, followed by the proposals to use the gained knowledge in practical activities related to aircraft flights and mechanics of celestial bodies, assembling simple Robo-KITs, aircraft and copters KITs and even classroom satellites (CubeSat format). To boost and maintain the motivation there are planned contests and summer schools. The general scope of activities planned for this target group consists in increasing the number of high school students with an interest towards university

education in the specialties related to space science and engineering.

For the current university students, the proposed activities include online and video lectures on advanced topics not covered by standard curriculum such as microcontrollers and electronics used in spacecraft and satellites, satellite design, attitude control and stabilization etc, generating project proposals (including license and Master Degree theses) related to space science and their implementation, summer schools and workshops with invited speakers from the consortium partners. The biggest motivation will be to have the opportunity to participate in the design and elaboration of SATUM. The partners involved in the project will complement each other in creating and implementing the educational content, and sharing their expertise and knowledge.

Regarding the PhD students, it is necessary to prepare intriguing research topics, provide an adequate environment, equipment and assistance and offer the possibility of bringing their ideas to life. The partners also can be involved in co-advising joint Doctoral Degree theses.

All information about recent developments of space science and technology, online and video lectures, contest conditions, assistance will be integrated on the to be developed website platform that will allow effectively and efficiently share resources, communicate with target groups, disseminate results and distribute the project information to the press and the public.

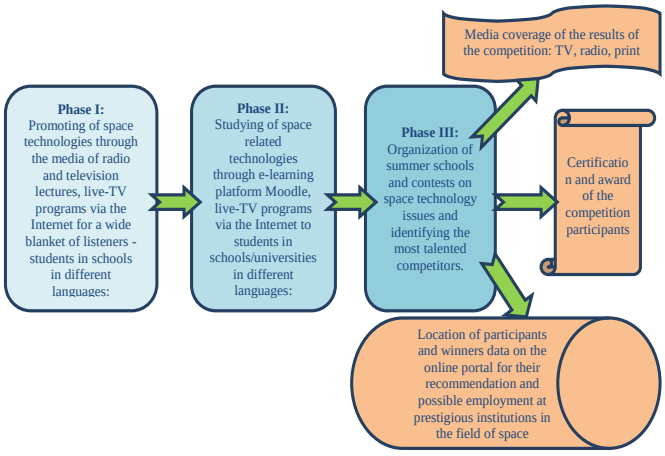

Fig. 2 The scheme to promote the space technologies for the I level - pupils in schools and level II - students from universities.

In order to achieve the main goal of this proposal - excluding the lack of scientists, engineers and technicians on the area of space research and development by dissemination of experiences in the space domain and to contribute to building of long-term partnerships between peoples from different Europe countries there are planned activities that can act as catalyzers in motivating pupils and students at different ages and education levels: **Phase I:** Promoting of space technologies through the media of radio and television lectures, live-TV programs via the Internet for a wide blanket of listeners - students in schools in different languages: Romanian, English, Spanish and Russian as possible. **Phase II:** Studying of space related technologies through e-learning platform Moodle, live-TV programs via the Internet to students in schools/universities in different languages: Romanian, English, Spanish and Russian as possible [5-6]. **Phase III:** Organization of summer schools, workshops and contests on space technology issues and identifying the most talented competitors. Training cycle ends with a media coverage as party competition and awarding participants. An important point is to create a "database" of participants with recommendations for their admission at prestigious institutions and/or companies engaged in space research and technology development.

REFERENCES

[1] European Space Education Resource Office. –In: http://www.esa.int/Education

[2] ESA at the forefront of space education. - In: http://www.esa.int/Education

[3] Bostan, Ion, Cantzer,Valeriu, Secrieru, Nicolae, Bodean, Ghenadie, Candraman, Sergiu. Research, Design And Manufacture of Functional Components of The Microsatellite "Republic of Moldova" - In: Wissenschaftliches Kommunikations und Sicherheitskolloquium, –Siegen, 2014

[4] Todos, P., Secrieru, N., Guvir, S. Architecture of interuniversity's digital network in applied Science themes and economics in Moldova «CRUNT» - In: The 9th International Scientific Conference eLearning and software for Education, Bucharest, April 25-26, 2013, *pp.333-338.*

[5] Secrieru Nicolae, Chilimari Dumitru. Architecture advantiges of interuniversity's digital network in applied science themes and economics in Moldova «CRUNT» - In: Crunt 2014: Bunele Practici de Instruire Online. Culegere de articole, 24 -27 septembrie 2014, Chișinău: UTM, ISBN 978-9975-80-827-9. p. 58-63.

[6] Secrieru Nicolae, Candraman Sergiu. Inspiration and motivation for the younger generations through exposure to space technology. - In: Crunt 2014: Bunele Practici de Instruire Online. Culegere de articole, 24 -27 septembrie 2014, Chișinău: UTM, ISBN 978-9975-80-827-9. p. 72-77.

[7] Satellite Communication. – In: http://elearning.utm.md/moodle/course/view.php?id=3

[8] Space technologies practics with a nanosatellite. In: http://elearning.utm.md/moodle/course/view.php?id=256