WHY MECHATRONICS, INTEGRONICS & ADAPTRONICS?

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Abstract: The paper "Why Mechatronics, Integronics & Adaptronics?" deals with the new concepts, innovative solutions and intelligent constructions of products, systems of products and systems of systems of intelligent products, with applications specific to their real time behaviour, work conditions and environmental conditions in the industry, economy and society.
Keywords: mechatronics, integronics, adaptronics, products, systems and systems of intelligent systems.

1. INTRODUCTION

1.1. What is mechatronics?

Mechatronics is an integrative science, as follows:

- a new generation of multi-purpose and multi-cultural science, whose outcome vector integrates existing discipline with other disciplines such as precision mechanics, electronics and informatics, new scientific areas with other areas present such as special hardware other dedicated hardware, flexible software with other universal adaptive software with other generative models, fuzzy logic models, neural models, other cognitive neural systems / micro-nano-systems and other systems / micro-nanosystems and evolutionary generation and new algorithms superior to other adaptive algorithms, sophisticated neural networks with other superior networks;
- a new integrator field;
- a global and synthesizer concept;
- a multidisciplinary field;
- an intelligent systems engineering;
- advanced design methodology;
- an intelligent technology with fast and efficient effects:
  - improvement of industrial processes / products;
  - promotion of technical solutions for machinery and new equipment;
  - designing new products with new attributes and functions;
  - creation of new working techniques for various interdisciplinary areas;
  - promoting new concepts for achieving intelligent machines; and so on

The concept of mechatronics is expressed as follows (fig. 1 / fig. 2):

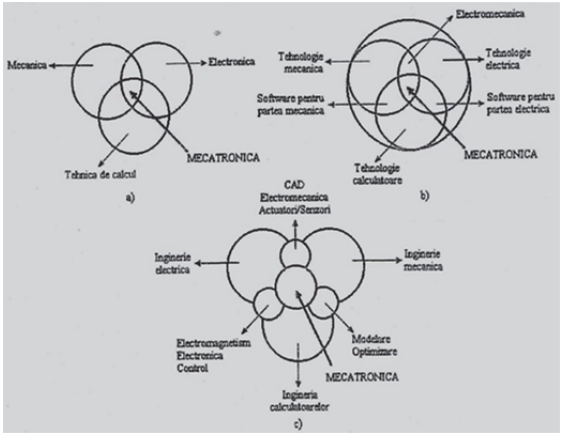


Fig. 1

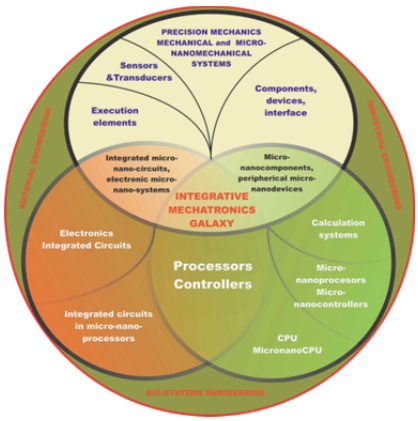


Fig. 2

1.2. What is integronics?

Integronics is an advanced multi-integrative science:

- integrative versatile and poly-cultural science;
- synergistic integration of disciplines with other disciplines, scientific domains with other scientific fields, such as specific hardware / flexible dedicated software for languages universal / particular adaptive modeling, fuzzy logic, technical / human / sociological / psychological / cultures etc, systems and technologies, CAD / CAM concepts, generative/ adaptive algorithms, neural networks, etc ;
- synergistic implementation of micro-nano-mechanical systems / micro-nano-mechanical high precision systems, micro-nanostructures, intelligent computing, electronics / micro-nano-electronics, components / micro-nano-components, logical hardware / micro-nano-hardware and specific software, adaptive and dedicated to management of optimal / adaptive / intelligent and reproducible controllers, independent and functional interactions and technology;
- connection or interface with integrative functions similar to human anatomy and human ones;
- intelligent / computer / information integration;
- integration of intelligent areas;
- a global concept, synthesizer and integrator, scientific and technical sciences, fundamental theoretical sciences, economics, sciences, sociology, educational, psychological sciences and humanities;

The concept of Integronics is expressed as follows (fig. 3):

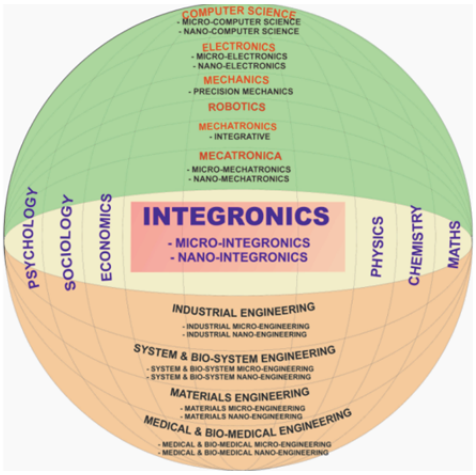


Fig. 3

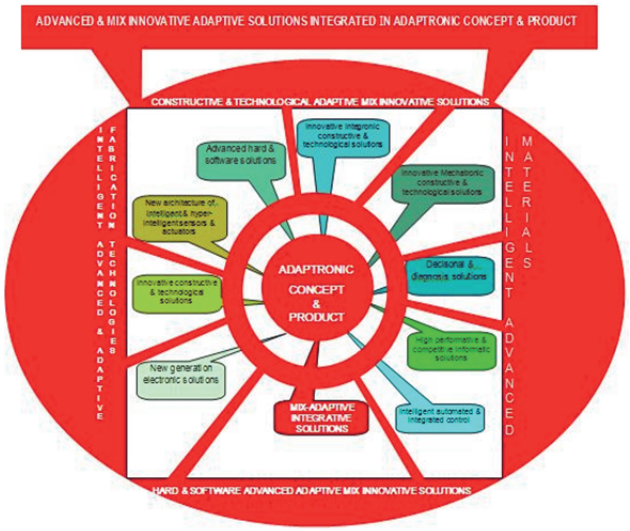
1.3. What is adaptronics?

Adaptronics is a key technology for the future!

Intelligent adaptive Adaptronics is a science, as follows:.

- engineering and multi-disciplinary innovative technology that brings together and integrates new fundamental knowledge of structural mechatronics, generative integronics, materials science and engineering, architecture of actuators and sensors, as well as measurement and automatic control technology and software engineering..
- advanced science that facilitates high performance mechatronic, integronic, and high-tech systems;.
- hyper-advanced field that complements the innovative developments and potential;.
- integrator vector of high-tech strategic industries such as mechatronics industry, aerospace industry, automotive industry, medical technology industry, intelligent measurement engineering, process engineering, etc..
- forefront of supporting high-tech intensive technology transfer and products;.
- key technology for future increasingly becoming an international platform of knowledge and new knowledge;.
- structurally - active applicable to all industries;.
- mix of structures and products;.
- technical and technological dialogue between research and commercial application - development- innovation active exchange of experiences and knowledge transfer..

The concept of Adaptronics is expressed as follows (fig. 4 / fig. 5):



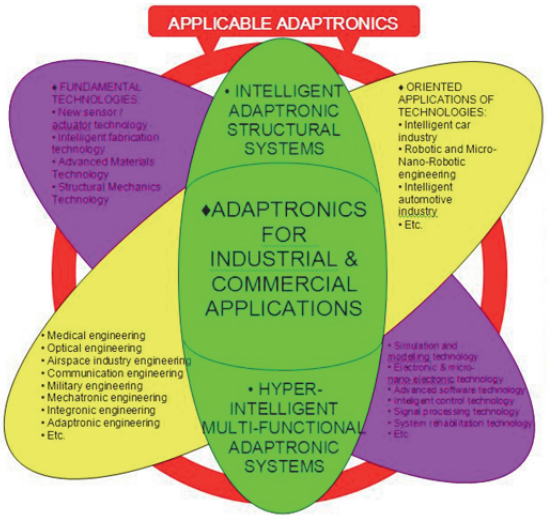


Fig. 4 **Fig. 5**

2. INNOVATIVE VECTOR OF MECHATRONICS AND HEADING FOR THE FUTURE MICRONANOMECHATRONICS

The innovative vector of MECHATRONICS, is in essence, a complex engineering structure synergy in combination and mix integration, engineering / micro-nano engineering, precision mechanics, engineering / micro-nano engineering, electronics and engineering / micro-nano engineering, computer science, all in one building architectural systems with materials engineering / micro-nano-engineering, industrial engineering / micro-nano-engineering , bio-systems engineering / micro-nano-engineering, etc.

Moreover, Mechatronics is defined simply as intelligent machines science and its extension to other areas such as: hydronics, pneutronics, thermotronics, autotronics, agrotronics, etc.

As scope and development at micro-macro and nano-scale, mechatronics is a multidisciplinary engineering, a field of advanced high-tech engineering, perspective / micro-nano engineering intelligent control serving advanced hybrid systems, and as a scientific discipline is a compendium of a mix of various interdisciplinary fields of technical and technological engineering.

In its evolution, as interdisciplinary science, Mechatronics is used in all areas of human life, improving the quality of human life.

In research, Mechatronics - Micro-NanoMecatronics covers a large degree of application areas, such as:

➢ competitive and advanced products; intelligent instrumentation; intelligent manufacturing; integration of computers and intelligent processors; intelligent control of appliances and high - tech process equipment; continuous innovation of mechatronics / micro-nano-mechatronics / nano-mechatronics.

The new concept of MECHATRONICS, μMECHATRONICS & nMECHATRONICS, features the following main objectives:

• improvement and modernization of processes / products / systems;
• integration of components;
• creating new interdisciplinary techniques;
• creation and production of intelligent and computerized machinery / equipment, oriented to human "simulation"; etc .;
• THE GALAXY OF THE SCIENCE OF «INTEGRATIVE ADAPTIVE MECHATRONICS AND ADAPTABLE TO HUMAN BEINGS»

Overall, THE GALAXY OF THE SCIENCE OF «INTEGRATIVE ADAPTIVE MECHATRONICS AND ADAPTABLE TO HUMAN BEINGS» is dedicated to society by its "hyper-intelligent constructions" in human skills from different backgrounds, thereby improving skills and operations in the "human - machine" combination.

The continuous improvement in the intelligent human - machine interface made possible the development "Integrative Adaptive and Adaptive Mechatronics" in building systems / micro-nanosystems for intelligent education and training of excellence in the field.

The basic idea for "INTEGRATIVE ADAPTIVE AND ADAPTABLE TO HUMAN BEINGS MECHATRONICS", is to develop integrative mechatronic systems / micro-nanosystems integrating functions including changes of the intelligent human - machine interface to improve operational skills and human perfection of skills (fig. 6).

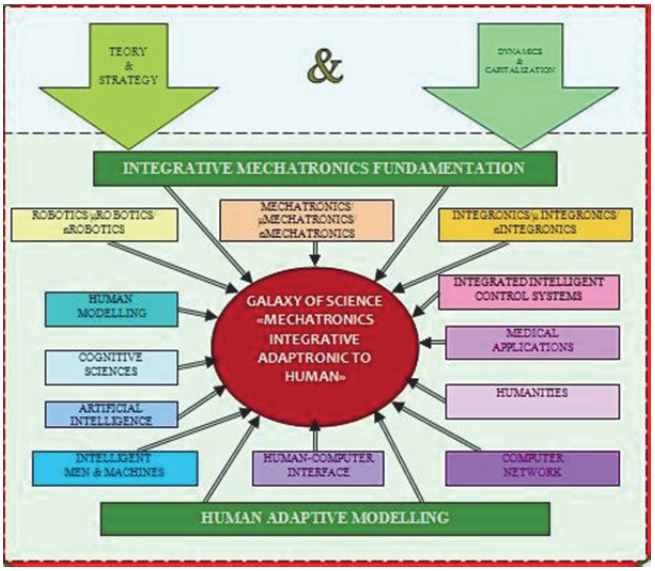


Fig. 6

The scope of " Integrative Adaptive and Adaptable Mechatronics", is primarily dedicated to advanced engineering / micro-nano-engineering control systems / micro-nanosystems.

Education in Integrative Adaptive Mechatronics provides flexibility in thinking and action by addressing mechatronic principles: systemic thinking and training to work in a team.

• *SENSORICS and in the immediate future MICRO-NANO-SENSORICS - part of Mechatronics and MicroNanoMecatronics*

The intelligent field of SENSORICS and in the immediate future MICRO-NANOSENSORICS and in the future of Robotics and Micro-NanoRobotics provides assessment, monitoring and diagnosis of intelligent manufacturing processes. The systemic and structural matrix of the field of Sensorics, Micro-Nano-Sensorics is shown in Figure 7.

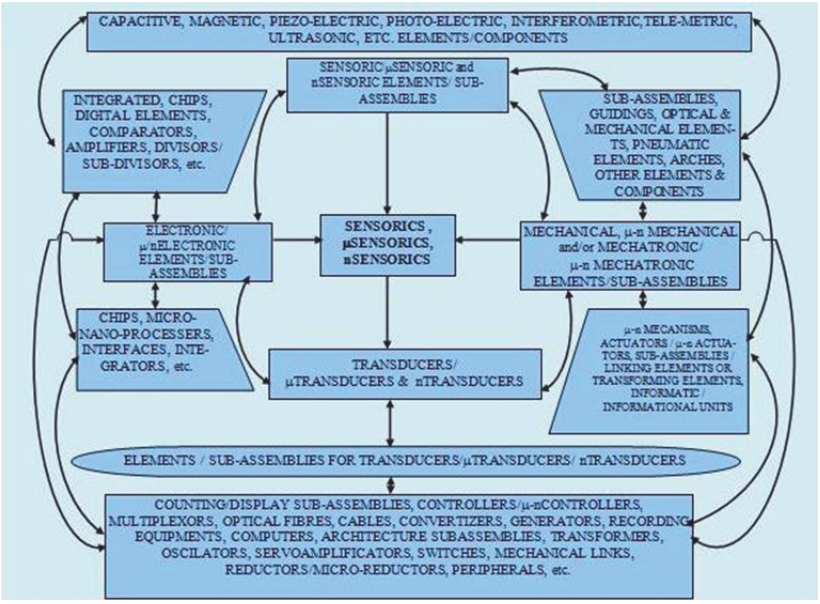


Fig. 7. Systemic and structural matrix.

• *Robotics and in the immediate future Micro-NanoRobotics - part of Mechatronics and MicroNanoMechatronics*

The field of Robotics and in the immediate future Micro-NanoRobotics is an integrative part of MECHATRONICS and MICRONANOMECHATRONICS and of INTEGRONICS and MICRO-NANO-INTEGRONICS, as the robot is defined as an intelligent mechatronic product defining applications and industrial and human capacities.

The intelligent field of Robotics and in the immediate future Micro-NanoRobotics has evolved from industrial robots manipulators (1965), and service robots for medical / micro-nano-medical scopes (2000), and hyper-intelligent biological robots in the future (2020).

In Figure 8 is shown the systemic and structural matrix of Robotics and in the immediate future, Micro-NanoRobotics.

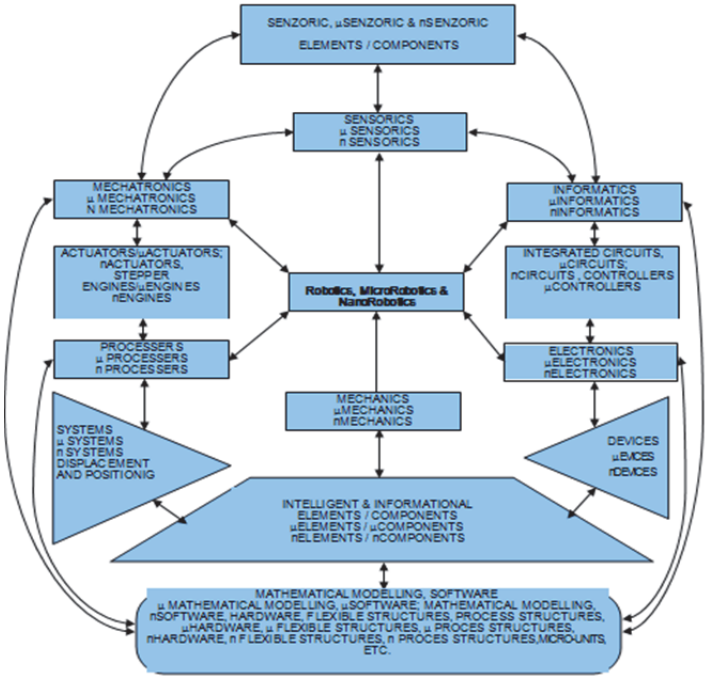


Fig. 8. Systemic and structural matrix of Robotics and in the immediate future, Micro-NanoRobotics.

• *Micro-Electro-Mechanic Systems and in the future Nano--Electro-Mechanic Systems – MEMS & NEMS*

The first vision of MEMS & NEMS was made long ago (1959) by Dr. Richard Feyman, during the control and manipulation of micro-nano-scale objects.

By implementing and evolving micro-nano nanotechnology, much has changed in the structure, architecture and operation, manufacturing and micro-nano-manufacturing for materials, products and systems by:

> New properties on micro-nano-composites and micro-nano-ceramics and other advanced micro-nano-materials meant to improve accuracy, high precision, reliability, dependability, transability and high maintainability;

> High efficiency, capacity, flexibility and integrity.

MEMS & NEMS architecture includes complex integrative and adaptive solutions to new requirements of the structure of intelligent integronic adaptronice mechatronic systems.

3. INNOVATIVE VECTOR OF INTEGRONICS AND HEADING FOR THE FUTURE MICRONANOINTEGRONICS

The Innovative vector of INTEGRONICS is "the perspective of mechatronics mix - completely integronized engineering and a design of integrated systems" cumulating constructive - functional

solutions within decisions similar to the human body, behavior and expression of physical - moral, socio - human, and mental states, etc. and evolving into a global vector of the innovative vision of "Integronics - MicroIntegronics - NanoIntegronics".

Compared to systems theory and cybernetics studying ready-made systems, INTEGRONICS has no concern for how systems are established and developed.

Moreover, INTEGRONICS focuses on new solutions of hyper-integration, such as genetic integration, integration through addiction, integration by choice, etc.

• *Integronics and in the future MicroIntegronics and NanoIntegronics*

New high-tech field of INTEGRONICS and in the future MICROINTEGRONICS AND NANOINTEGRONICS showed the world the concept of synergy of advanced areas of Mechatronics, Micro-Mechatronics and NanoMecatronics of micro- and nano-materials, equipment and Micro – NanoEquipments of process and technologies, micro- and nano-technologies and other scientific fields, biological sciences, social and human sciences, management, etc., all assembled into a neural network and with human-like behavior and functioning.

Projecting the future of this highly advanced hyper-intelligent field involves primarily a predictive projection of innovative research and development of new knowledge, the production of products / systems / technologies and industry-specific services, integronic trades and products and new an intelligent architecture of information society.

4. INNOVATIVE VECTOR OF ADAPTRONICS AND HEADING FOR THE FUTURE ADAPTIVE AND ADAPTABLE ADAPTRONICS

Innovative vector of Adaptronics is expressed by the basic objectives and concept of Adaptronics

• The main objectives of Adaptronics

Adopting "Adaptronics" as a new complex intelligent and integrated science as a new high-tech advanced engineering, it is based primarily on Mechatronics and Integronics and MicroNanoMechatronics and MicroNanoIntegronics in the near future, as new areas intelligent role in the extend the functionality of an intelligent and hyper-intelligent structure including even kinematics and dynamics of a point in space, using the replacement or addition of new multi-structural and multifunctional components and sub-systems.

In the context of the adaptronic concept developed, the main objectives of Adaptronics consists of a "continuous interference" in the structure, function and decision information on higher levels and holonic level, a mechanical construction and a mechanical mix and especially their dynamics, defined as a characteristic of global systems, optimizing it, by replacing or complementing structural components with multi-structural elements or multifunctional and adaptive components (with maximum efficiency in sensor-actuator chain) to outline the architecture of mass and space in adaptive and new solutions designed, developed and manufactured.

The main objective of Adaptronics, as a concern, is the introduction of mechatronic and integronic adaptive solutions and tailored for engineering optimization and development of new intelligent products, processes and systems, as a commercial vector is the potential for value creation and stimulating of partners building future markets and as a main goal is to develop innovative new adaptronic concepts, mainly to reduce inner substantial and active vibration and noise in adaptronic systems.

● *Concept of Adaptronics and Applied Adaptronics*

As a technology for the future "Adaptronics / Applied Adaptronics" facilitates both performance and know-how mechatronic and integronic systems and micro-nanosystems and performance and know-how systems and micro-nanosystems and product development of new products and systems and highly competitive systems, partially or fully adaptive and adaptable, being found more and more effective in relevance to most businesses.

Currently, "Adaptronics / Applied Adaptronics" as new concept for the future is the best science and the best area for national and international markets and industries particularly aerospace,

automotive industry, intelligent railway technology industry, shipping industry , medical technology industry, industry acoustic measurement technology industry and integrated automatic intelligent control, mechatronics and measurement integronic industry, mechanical industry, process industry, manipulation and automation of engineering industry production.

● *Concept of the functional adaptronic system*

Based on the creation and adaptronic process of design of products and systems, the system architecture and the functional organization of the adaptronic system must be designed (fig. 9).

The structure of this system functional adaptronic includes:

• Matrix of initial operating parameters - input quantities;

• Concept of intelligent sensor / actuator for capturing technical process signals and / or technological process signals (S / A);

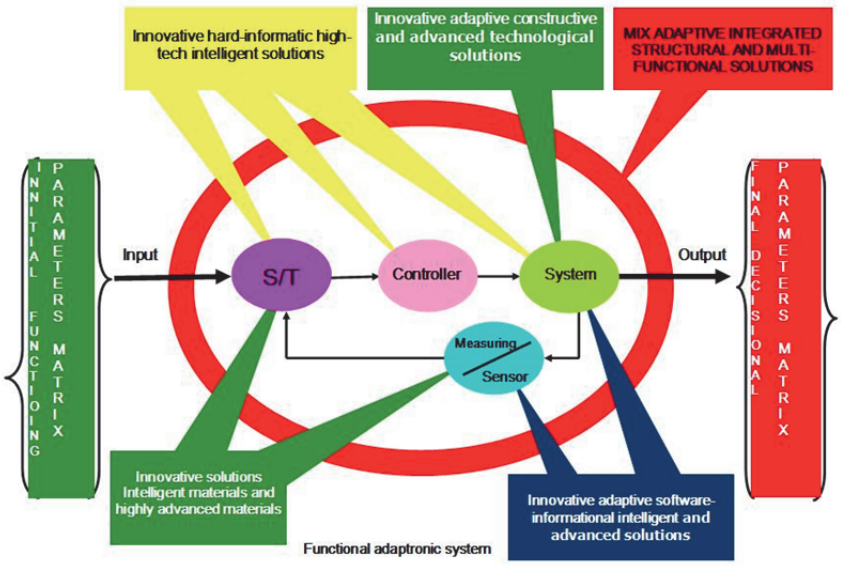


Figure 9

Systems of products and systems of systems of intelligent mechatronic systems for the automotive industry are presented in the figures berlow.

Fig. 10. Tightness control equipment for oil pan S2G- Raw.

Fig. 11. Equipment for tightness control and cylinder cover marking.

Fig. 12. Roller tappet control machine.

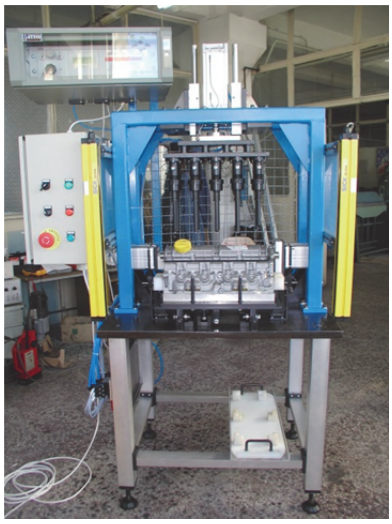


Fig. 13. Tightness control machine for assembled cylinder cover of F8Q engine.

5. NANOMETRIC INTEGRONIC SYSTEMS AND MICRO-SYSTEMS

They are presented in the figures berlow.

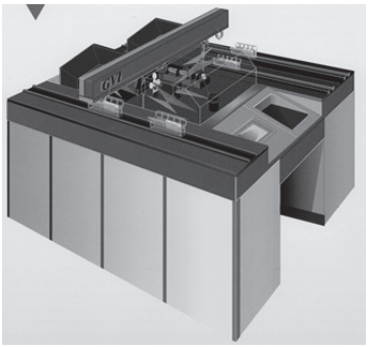


Fig. 14. Integronic micro-system for interferometer inspection.

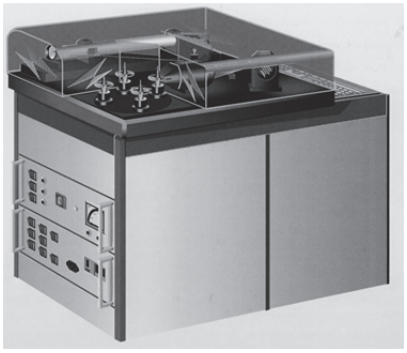


Fig. 15. Integronic micro-system for interferometer inspection, of magnetic surfaces.

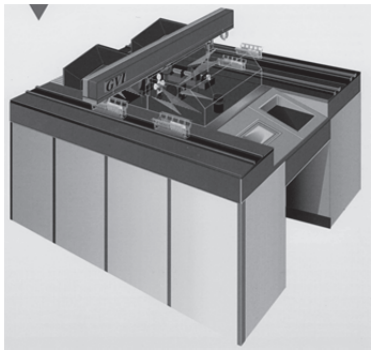


Fig. 16. Integronic micro-system for interferometer inspection.

6. INTELLIGENT ADAPTRONIC SYSTEMS FOR INTELLIGENT REMOTE MONITORING EQUIPMENT AND REMOTE SERVICE FOR THE AUTOMOBILE INDUSTRY-NEW INTELLIGENT TECHNOLOGIES FOR THE FUTURE

● *Remote monitoring and remote service*

The two services that provide benefits through remote access equipments are remote monitoring and remote service, which are modular, flexible and secure, providing an efficient access to remote machines and installations.

Remote monitoring involves linking the process stations located remotely from one or more central control systems. For monitoring and control various public or private networks can be used.

The processing of event-driven type, determined by an event, or cyclical data processing is carried out using special protocols for remote monitoring and allows operating personnel to effectively manage the process as a whole and in detail. One or several software programs are used to connect to the remote control based on GPRS technologies, of more PLC. The technical solution may be used so extensively and only for a few geographically distributed equipment.

Remote service involves the exchange of data via telephone line or via the Internet with equipments and remote systems, such as computers, machinery, and equipment, production lines for error detection, diagnostics, optimization, and maintenance activities, and repair or production optimization. The remote service provides an effective response and customized to diagnose distant geographical systems, or to assist in the completion and implementation of the plan of preventive maintenance.

The two services are bringing significant contributions to minimizing the cost and increase the effectiveness and productivity of industrial activities.

Example 1. *Application running on the PC platform.* On PC computer platform located in the Command Center, the user command is running, necessary for network equipment management systems through which the data traffic is done (commands to equipment systems and responses from them).

The application performs:

(1) connection to PLC network installation wanted through GSM / GPRS network

(2) periodically query the installation for status of equipment from distance

(3) Orders sent by certified personnel for technical assistance service (from Command Center) for telediagnosis phase

Observation: Applications Centre requests have similar format to MODBUS protocol.

The graphical user interface of the software is shown in Figure 17.

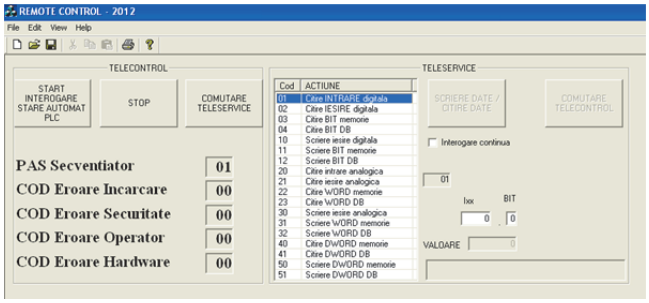


Fig. 17

We have provided two modes, namely telecontrol and teleservice.

For TELECONTROL working mode:

Pressing the AUTO START QUERY STATUS PLC transmits a frequency of 1 Hz of content query command from the PLC memory address where the five values are required. The message received from PLC values are decoded and transmitted to the display window. Pressing the STOP button stops the automatic transmission of the application to the PLC. Pressing the TELESERVICE button deactivates the three buttons on the left screen and activate the two on the right, belonging to the TELESERVICE working mode.

For TELESERVICE working mode:

> The operator selects from the list the desired function with single or double click of the mouse.

> When reading type functions, operator inputs the required values for memory addresses. The editable field called VALUE is disabled.

> When writing a function type, the operator inputs the required values for memory addresses and the VALUE TO BE TRANSMITTED –the VALUE field is enabled.

> If the repeated value is transmitted to PLC, the continuous Query field is checked.

> The operator presses the WRITE DATA-READ DATA button.

> If Continuous Query option is enabled, it will continuously send the same command to the PLC. If Continuous Query option is not enabled, it will send a command to the PLC once.

As future research work, can be mentioned:

> Development of an application type "Teleservice Center Manager" of INCDMTM;

> Direct connection to any equipment that uses direct PLC Siemens STEP7 development environment;

> Extension of service mobility through implementing application on mobile platforms type PC-based Tablet, Intelligent Phone with Android or WinCE operating systems.

I present, subsequently, the final product: "Experimental software programme specialized for teleservice function of mechatronic products designed and made by INCDMTM".

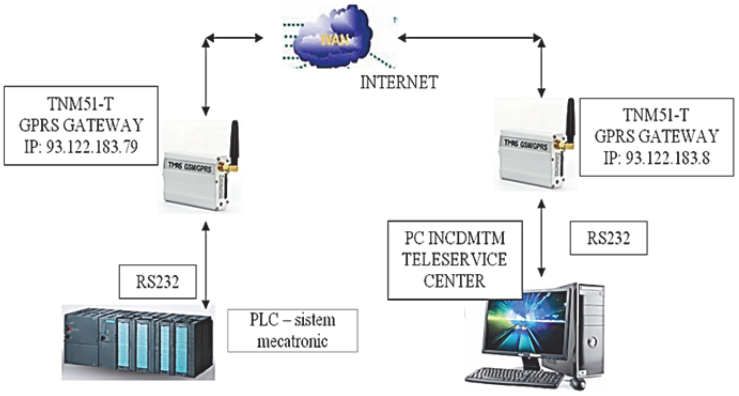


Fig. 18. ME configuration based on two GPRS modems and RS 232 connections.

In this configuration (fig. 19), the link between mechatronic system based on PLC SIEMENS PLC platform (commonly used by INCDMTM mechatronic systems supplied to Renault-Dacia SA) is made using two GPRS GATEWAY modems type TMN-51T, that ensures the data link between PLC and PC by converting GPRS - RS232 (8N1n, 115200bps).

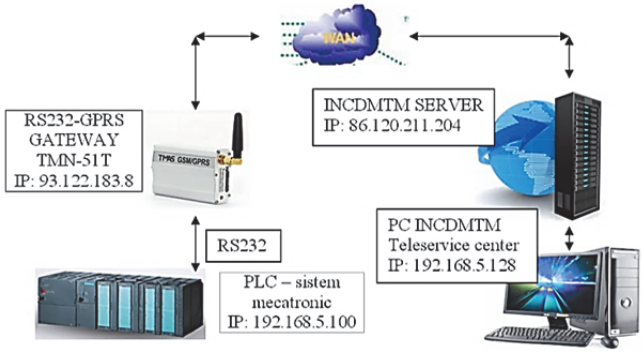


Fig. 19. ME configuration based on a modem and INCDMTM server.

In this configuration (fig. 20), the link between mechatronic system based on PLC SIEMENS PLC platform (commonly used by INCDMTM mechatronic systems supplied to Renault-Dacia SA) is made using a GPRS GATEWAY modem type TMN-51T, that ensures data transfer from the PLC and GPRS packages and converting them to INCDMTM server that communicates with a PC via local network (LAN) of INCDMTM.

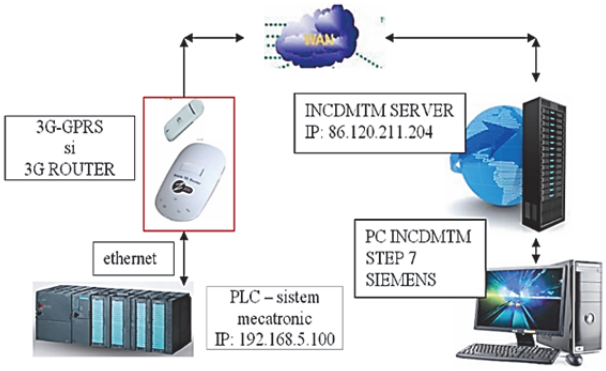


Fig. 20. ME configuration based on 3G router and INCDMTM server.

In this configuration, the link between mechatronic system based on PLC SIEMENS PLC platform (commonly used by INCDMTM mechatronic systems supplied to Renault-Dacia SA) is made using a wireless Internet modem HSUPA USB Dongle, a 3G router that ensures data transfer from the PLC and GPRS packages and converting them to INCDMTM server that communicates with a PC via local network (LAN) of INCDMTM.

Figure 21 presents an example of PC executable program of remote monitoring, with process variables.

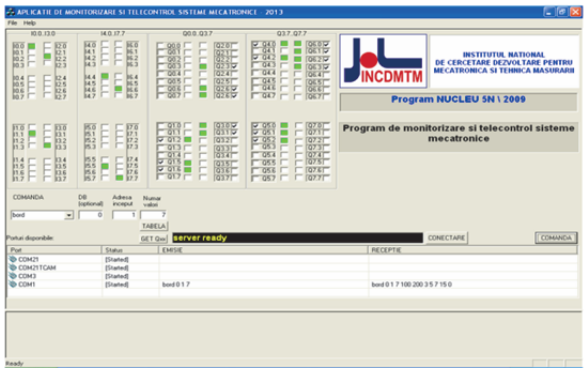


Fig. 21. PC executable program example of remote monitoring with process variables.

Figure 22 presents a browser accessed by selecting a specific example of mechatronic system monitored.

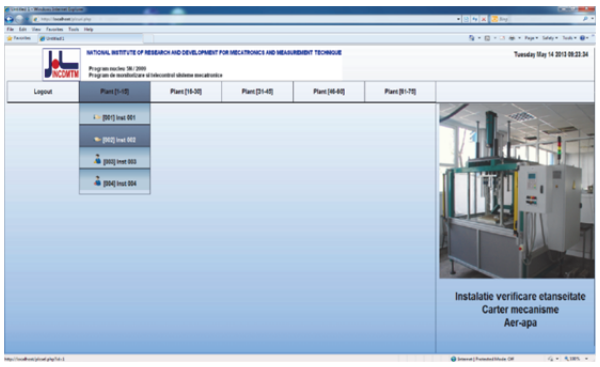


Fig. 22. Program browser accessed example of selecting a particular mechatronic system monitored.

Figure 23 shows a block diagram of a complex mechatronic system of measurement system performing dimensional inspection and marking for the automotive industry.

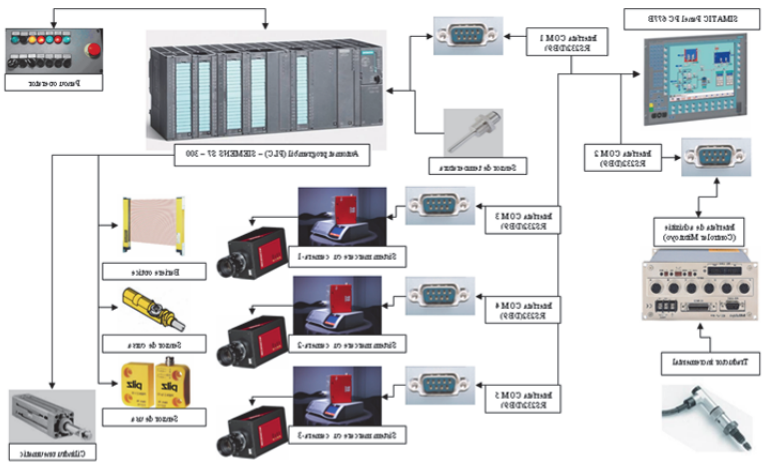


Fig. 23. Block diagram of an intelligent mechatronic system

Telecontrol and teleservice industry for intelligent equipment for automotives are a must for ensuring operating parameters at nominal values by:

- minimizing troubleshooting time and costs;
- rapid identification of errors;
- developing preventive strategies in the maintenance process

8. CONCLUSIONS

Intelligent specialized areas of Mechatronics, Integronics and Adaptronics and Mechatronic, Integronic and Adaptronic products, systems of systems of and Mechatronic, Integronic and Adaptronic products are key technologies for the future in the future.

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DE CE MECATRONICA, INTEGRONICA & ADAPTRONICA ?

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Rezumat: Lucrarea "De ce Mecatronica, Integronica şi Adaptronica ?" tratează noile concepte, soluţii inovative şi construcţii inteligente de produse, sisteme de produse şi sisteme de sisteme de produse inteligente cu aplicaţii specifice comportării acestora în timp real la, condiţiile de lucru şi de mediu din industrie, economie şi societate.