The Scientific Bulletin of VALAHIA University
MATERIALS and MECHANICS –Vol. 18, No. 18

DOI 10.2478/bsmm-2022-0009

PROGRESSIVE CONCEPTIONS OF THE FUTURE IN CYBER-MIX MECHATRONICS INDUSTRY AND CLAYTRONICS ENGINEERING (I)

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Abstract: *This scientific paper presents the progressive conceptions of the future from Mechatronics to Cyber-Mechatronics and from Mechatronics Systems to Cyber-Mechatronics Systems, highlighting the scientific and technological advances in the mentioned fields, the new and complex innovative concepts of science and Mechatronics and Cyber-Mechatronics engineering and the constructive and applied architectures of the Mechatronics and Cyber-Mechatronics Systems, which will develop and merge the Physical World (Mechatronics) with the virtual world.*

Keywords: *Progressive concepts, Mechatronics, Cyber-Mixmechatronics, Mechatronic Systems, Cyber-Mechatronics Systems, Claytronics systems.*

1. INTRODUCTION

A new functional structural concept of intelligent control can be developed in complex and multi-complex holonic infrastructures adaptive to industrial and metrological processes [1, 2], to cover the "industrial and technological islands" according to the mechanisms of quality and performance standards of intelligent productions.

2. PROGRESSIVE CONCEPTIONS SCIENTIFIC CYBER-MIXMECHATRONICS IN THE FUTURE

It summarizes the scientific cyber-mixmechatronic scientific concepts of complex intelligent cyber-mixmechatronic 3D electronic control systems, in 3D probe holders, with 3D probe holders, for measurement, integrated control and other intelligent industrial services, with telemonitoring and remote control, intelligent robotics and technology and multi-applicability, followed by the keywords of innovative hoarding [2, 3]:

a) - The new concept of integrated 3D intelligent cyber-mixmecatronic system with two 3D gripper holders for adaptive measurement and control (see fig. 1).

This new concept of intelligent 3D mixed-mechatronic system for adaptive measurement and control, includes a multi-complex structure, architecture, as follows:

- the mass support subsystem for the cyber-mixmechatronic system;
- 3D intelligent cyber-mixmechatronic equipment for adaptive measurement and control;

Figure 1. The new concept of intelligent 3D mechatronic mix system for adaptive measurement and control

- a PC central unit with complex architecture;
- control unit and control of 3D intelligent cyber-mixmechatronic equipment;
- barrier system with sensors for the protection of the workspace of the cyber-mixmecatronic system;
- an electronic unit for digital display of adaptive measurement and control process data;
- grippers subsystems-port 3D electronic probes for contacting the measuring points and adaptive control of the parts to be checked
- parts to be checked (landmarks in the automotive industry);
- a package of specialized software for adaptive measurement and control processes.

Thus, these advanced complex and multi-complex advanced adaptive cyber-mixmechatronic systems can be conceived, designed and implemented in “cyber-mixmechatronic islands” type in general constructions and in repetitive “tree” type structures that express all areas and spaces of industrial smart production.

b) - The new concept of cyber-mixmechatronic system of robotics and intelligent technology with remote monitoring and remote control (fig. 2).

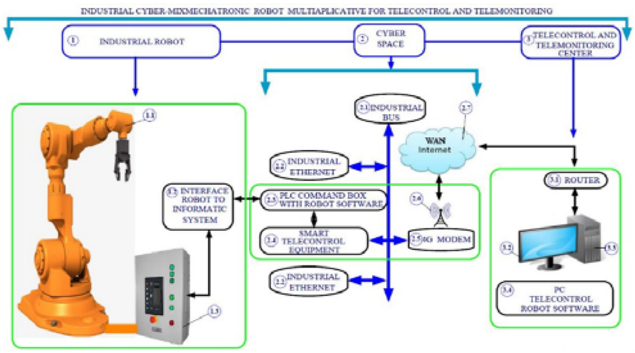

Figure 2. The new concept of cyber-mixmechatronic system of robotics and intelligent technology with remote monitoring and remote control [1]

This new concept of cyber-mixmecatronic system of robotics and intelligent technology with remote monitoring and remote control includes a multi-complex architecture of modular infrastructures, consisting of:

- intelligent robotic system with telemonitoring and remote control;
- IP camera subsystem for visualization of technological measurement and control processes for their transfer to the remote control centre through cyberspace
- Robotic workspace sensor barrier system
- Central PC system
- Robot command and control system
- 3D electronic probe systems integrated in robot grips for parts measurement and control processes
- cyberspace
- a remote monitoring and remote-control centre.

In the new architectural ensemble, the information flow of the cyber-mixmechatronic system of intelligent robotics with remote monitoring and control transmits from the “input dimensions”, of non-electrical nature, which is transformed into electrical quantities. Then the information flow is amplified, resulting and displayed as "output dimensions". This result can be controlled, then monitored and, if necessary, remotely configured by the interconnections between the cyberspace and the remote control and remote monitoring center [1, 4].

This cyber-mixmechatronic intelligent robotics and technology system, developed in several hardware and software infrastructures and constructive and functional architectures, is used in any industrial / societal processes, depending on its complexity, for remote control and maintenance of manufactures and of intelligent production lines.

The cyber-mixmechatronic intelligent robotics and technologized system is structured, functionally and holistically, in accordance with the requirements of the industrial / societal process where it is integrated, so that the systems become intelligent control equipment or technologicalization equipment for industrial services.

In this sense, the gripper of the system can also support 3D electronic probe, for contacting the measuring points on the surfaces of the part to be checked, in addition to its function of gripper with technological devices related to different services.

c) - The new concept of intelligent cyber-mixmechatronic damping system with remote monitoring and remote control for smart cars (fig. 3).

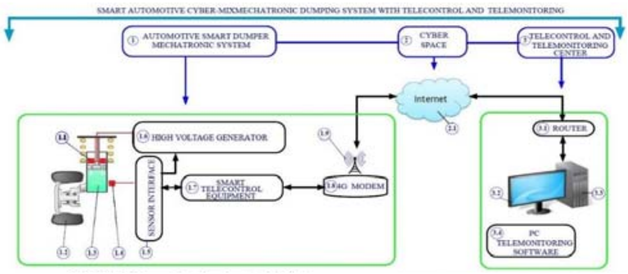

Figure 3. New concept of intelligent cyber-mixmechatronic damping system with remote monitoring and remote control for smart cars [1]

This new concept of intelligent cyber-mixmecatronic damping system comprises a multi-complex and multi-functional structure, consisting of:

- intelligent cyber-mixmechatronic damping system for intelligent cars (consisting of electromagnet; high voltage source; intelligent remote control equipment; 4G GPRS modem with one connection with antenna).
- cyberspace (Internet and industrial Ethernet)
- remote control and remote monitoring center (PC unit, monitor, WAN Internet router and PC with specialized software).

In its architectural ensemble of intelligent cyber-mixmechatronic damping system, the transfer of information takes place, from the non-electrical input quantities in the system, and transformed into electrical quantities subjected to the processes of amplification, partition and digital display and then into output sizes which can be directed, configured and monitored remotely, with the effects of not noticing the defects on the surface of the streets and highways for the circulation of intelligent vehicles.

d) - The new concept of multiplier 3D cyber-mixmecatronic system for remote control and remote monitoring for the mechatronics industry (fig. 4).

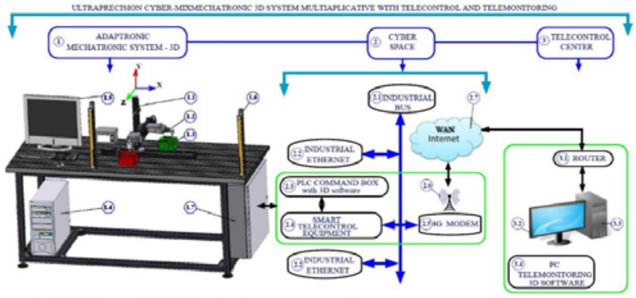

Figure 4. The new concept of cyber-mixmecatronic 3D multiplicative system for the mechatronics industry [1, 2, 3]

The multiplicative 3D cyber-mixmechatronic system can be developed in the future by developing the infrastructure with complex dual intelligent 3D equipment (fig. 5).

Figure 5. Intelligent dual 3D complex equipment

These systems can have a miniature rotation system with actuators and control unit (fig. 6 a, b) with hardware and software for status verification (fig.7) by testing the system and initiating the dialog box for the status folder.

Figure 6 (a/b). Miniature system of rotation with actuators and control unit

3. PROGRESSIVE CONCEPTIONS CLAYTRONICS SCIENTIFIC CONCEPTS

It presents new claytronics scientific concepts for developing the hardware and software needed to create programmable substance, a domain that can be programmed to three-dimensional dynamic shapes that can interact in the physical world and take visually an arbitrary aspect and therefore to replicate an element using mini-nanocomputers.

According to research into the future of claytronics by Carnegie Mellon's Synthetic Reality Project, claytronics is described as "a set of materials that contains a sufficient proportion of computation, actuation, storage, energy, detection, and communication." All of these can be programmed to lead to complex dynamic configurations.

Claytronics projects is usually being investigation by its authors, Seth Goldstein and Todd C. Mowry, who invented the term claytronics, which will lead "the world toward an innovative revolution" with the primary goal of improving human-to-human communication, even when they remain at a considerable distance, even between continents and why not, between the planets of the Universe.

Therefore, claytronics is developing, reconfiguring nanoscale robots.

3D cathodes, that "programmable matter", will be submillimeter computers, which will have the ability to move, communicate, change color and will be able to connect (electrostatically) to different cathodes to achieve various shapes. The shapes composed of cathomes can develop and evolve in almost any matter, even in future human replicas for virtual encounters.

The shape designed for the claytronics model is made on scalable modular robotics. This concept offers billions of robotic modules that are able to transform into three-dimensional perspective with real visions. The concept involves the coordination process and the communication technique of detecting and operating along these large sets of independent entities. With the help of claytronics, many small parts of "claytronics atoms" or catoms, could be placed in objects on a macro scale, connecting and disconnecting in motion. This innovation could combine the concepts of nanotechnology with remote presence. Tiny robots or cathomes of millimeter or nanometric dimensions are organized in a shape that is determined remotely.

Claytronics [8, 9], seems unbelievable, even more so than an science fiction, yet work has already begun on such a technology. Currently, there is evidence of catoms (4.4 cm) that are connected and move by magnets, as well as robot replication and operate on stairs where electromagnetic or electronic links could be used for reassembly.

The first generations of catoms is with 4.4 cm in diameter and 3.6 cm in height were developed by Intel, a microchip manufacturer. As experience has been gained, only four catoms were handled together. The idea is that there are many (millions of) catoms that move, one around the other, to create the desired shape and change color as well.

This is how these new claytronics concepts are presented:
- (a) the concept of "claytronics atom or catom", which states that it would be similar in appearance to an atom that would prefer to have a "spherical shape". The catom would have no moving parts and would act individually and would be covered by electromagnets to attach to other various catoms.
Each catom contains a fairly powerful processor, and the surfaces of the catom should have photocells to detect light and light emitting diodes to allow them to see and change color. Attempts are currently being made to build a two-dimensional version, each catom being a cylindrical device (a little more than an inch in diameter), with a part of it surrounded by 24 electromagnets. It would move by rolling the electromagnets on top of each other. A large moving object, such as a replica of a human, could have billions of catoms. A system with a billion computer modes is something on the scale of the entire Internet. Unlike the real Internet, our object is moving. This will require new schemes for the rapid organization and reorganization of such a huge network of computers. A moving shape will make the catoms constantly and quickly position themselves, break connections with a set of catoms, and establish new connections with other various catoms.

- (b) the concept of 'hardware claytronics' is that which is based on macro-scale modular parts with much more complex devices and equipment than tiny modular robots. These new devices are manufactured to test concepts for submillimeter-scale modules and to clarify the essential effects of physical and electrical forces affecting nanoscale robots..

Figure 7 shows the cylindrical planar cathode (V8), which provides a test stand for the architecture of micro and electro-mechanical equipment for automatic operation in modular robotic appliances.

Figure 7. Plannar catom V8

Flat cathodes operate on a two-dimensional field in various small groups that include two to seven modules. They have a diameter of about 4.5 times larger compared to the millimeter-scale cathome for which the resulting prototype is very large.

Figure 7 shows the image of the control rings and the magnetic sensors, with the electronics of the solid body controlling the movement at the top of it [9].
In fig. 8 shows the image of two magnetic rings on the planar atom (v7).

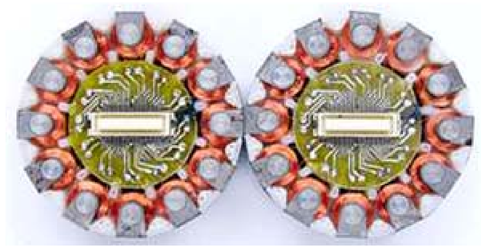

Figure 8. Two magnetic rings on the planar atom (v7)

This figure shows the position of the 12 magnets arranged around the individual conducting panels and the design of the coil for horseshoe magnets.
One catom supports a clockwise or counterclockwise movement by a repeated transfer of electromagnetic force to obtain the opposite movement in the other catom.
The planar catom encounters one problems related to alignment and friction, as suggested in fig. 9.

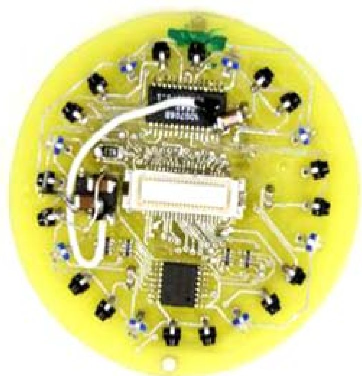

Figure 9. Plannar catoms with light emitting diodes LED

Figure 9 shows a control ring for the flat cathode with light emitting diodes (LEDs) that surrounds, in order, its perimeter. This plate directs the two drive panels built into the magnetic rings. The new and customized design of the electronic part achieves a very high level of ability to guide the performance of the module. Built and designed with the smallest components available on the market, each drive plate contains 5 layers of integrated microcircuits on acrylic plates with a diameter of 45 mm. At this value of the circuit design, the two rings of the controller offer (about 40 times) the built-in instrumentation of a standard robot control system controller in 2/5 of the space.

The resulting capacity of its boards allows the module to have on board all the devices needed to manage the integrated software, drivers and 24 magnets.

In figure 10 shows the shape of a cube, designed as a 6-part shape, and which emphasizes many performance criteria: precise and fast gearing, easy and firm release, strong grip, etc.

Figure 10. The shape of a cube

Its geometry allows the safe coupling of the modules, as well as a strong connection of the electrostatic force. The short distance of the modulated parts within an assembly is beneficial to create structural and functional stability.

4. CONCLUSIONS

This multiplicative 3D cyber-mixmechatronic system is structured in a complex architecture consisting of:

- multiplicative 3D cyber-mixmechatronic system (3d system, 3D electronic probe, PC central unit, Security barriers, special equipment);
- cybernetic space (communication bus, PLC, 5G GPRS modem, antenna, WAN internet);
- remote monitoring and remote-controlcenter (router, PC unit, 3D software).

The new multiplicative 3D cyber-mixmecatronic system could be used in the following industries:

- in the smart automotive industry, by integrating into automated manufacturing and assembly lines;
- in the precision mechanics and mechatronics industry, also through its integration in the intelligent manufacturing and production lines;
- in the aerospace industry;
- in the electronics and automation industry;
- in the optics industry;
- in the environment and energy industry.

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