Ergoengineering in dental medicine

Veronica Argesanu[1], Mirella Anghel[2], Cristian Comes[3]

Politehnica University of Timisoara

Summary

Modular mechatronic equipment - based on human centered design - in dental medicine, implies interdisciplinary collaboration. Adding new components that are perfectly adaptable to any person and space, finding innovative and intelligent new solutions using advanced technology, "user-friend" interface and surface design in order to obtain maximum functionality and process optimization by the personalization of the work schedule, using control panels, are the goals of eroengineering in dental medicine.

Keywords:dental ergonomics, eroengineering ,simulation,automation,modulation.

Introduction

Techniques for capturing intuitive motion and interaction data from a realistic process performance are required to facilitate human factors awareness.

Besides commercial tools, significant research work has also addressed the simulation of human motions for computer-aided ergonomic design. [1]

Several Virtual Reality (VR) techniques have been explored during the last few years in view of their potential to address processes verification needs. They aimed at integrating the real human within immersive virtual environments. (Fig.1)

Two terms become more and more popular in the field of ergonomics: "macro" and "micro ergonomics". The macro scopic view, deals with the optimisation of the relationships in the system "Man - Technology - Organisation".[2]

On the other hand, Micro Ergonomics in a systems -ergonomic view focuses on the optimisation of the interaction between the human body and the tool. In any work system the human functions as a controller as visualised in figure in an abstract Cybernetic depiction. Similar to a computer consisting of a power supply and a central processing unit with various interfaces, the operator with his physical capacities con trolled by the central nervous system communicates via his sensory.

Anthropometrical workplace design

The *anthropometrical workplace design* concentrates on the layout of the vision area, the grasping area and the motion area of the feet, on the layout of body supports as well as on the design of displays and controls. (Fig. 2) By percentiling the different body measures one attempts to deal with this problem systematically.(Fig. 3) Moreover, to simplify the often-complex geometrical design problems, computer-generated human CAD developed models (3D-models, manikin). [3]

[1] Ph. D. Eng.; associated professor, "POLITEHNICA" UNIVERSITY OF TIMISOARA, Mechanical Faculty, Mechatronic Department

[2] Ph. D. Dr., Lecturer, "Victor Babes" University Of Medicine And Pharmacy, Timisoara

[3] Ph. D. Dr., Lecturer, "Carol Davila" University Of Medicine And Pharmacy, Bucharest

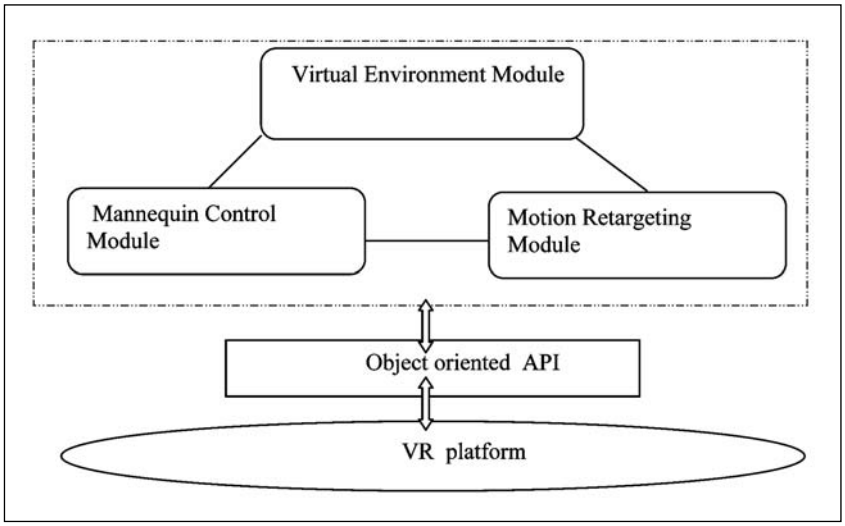

Fig. 1.The structure of VR

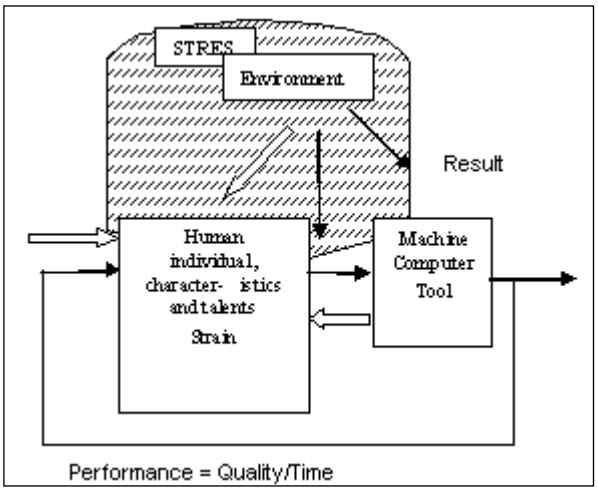

Fig. 2 The anthropometrical workplace design

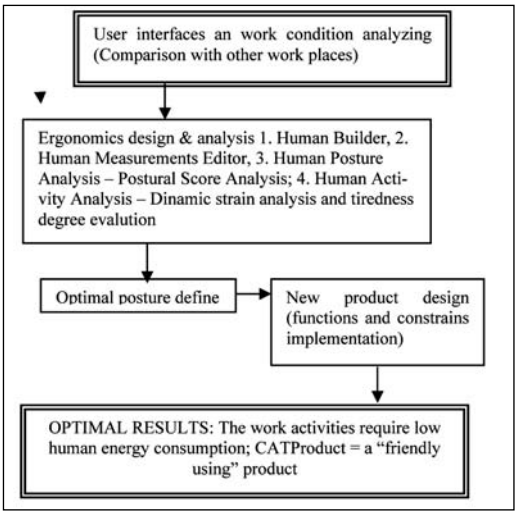

Fig 3.Ergonomics virtual design methodology for new product design Innovative Ergo-Design

Companies achieve competitive advantage trough acts of innovation. [4] They approach innovation in its broadest sense, including both new technologies and new waysof doing things. Innovations may be radical as well as incremental. Also most innovations involve new tehnical and administrative components. (Fig.4)

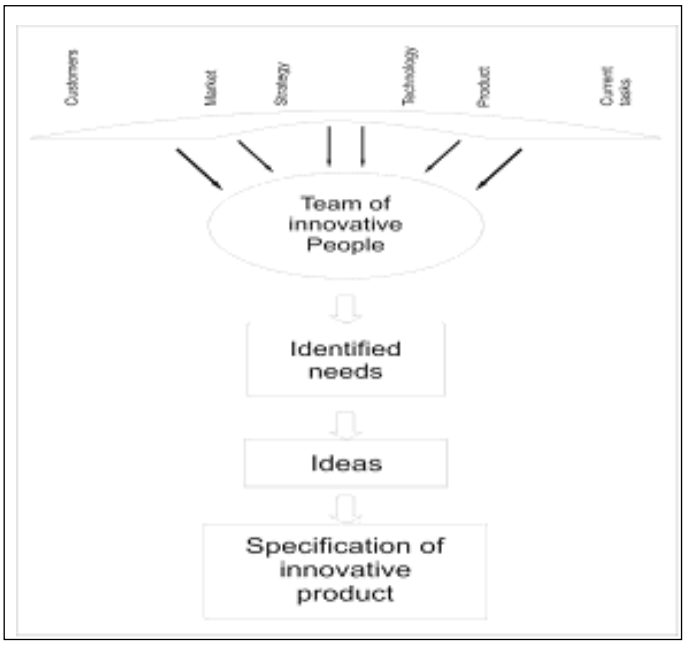

Fig.4 The system of a product idea origination

Conceptual design can be supported by tools such as :

- guidelines and checklists relating to ergonomic considerations
- material databases
- analytical tools LCA
- manuals (books)
- the integration between ergonomic management and the product design and development process;

The result of the conceptual design stage is the selection of a possible additional concept thatbest meets all requirements.

Various **design approaches** can be used in this stage:

- improvement of material's efficiency
- design for ergonomic production and use
- design for optimizing functionality

Prototype evaluation and testing is an opportunity to check the detailed design against ergonomic targets. In parallel to prototype evaluation, testing can occur on material properties, wear resistance, functionality, quality, and lifetime.

Customer feedback is an important source of information and allows the organization to improve the design and development of future products.These can include:

- simulation of innovation and creativity
- meeting customer expectations
- enhancement of organization image or brand
- increased product knowledge
- reduction of risks

Methodical Ergo-Design

A starting point for ergo-design processe can be an existing product, a prototype, a concept, or an idea to meet a particular customer's requirement.As a rule, the sooner ergonomic improvements are dealt with in the product development process, the more effective the results and the lower the implementation costs. (Fig. 5)

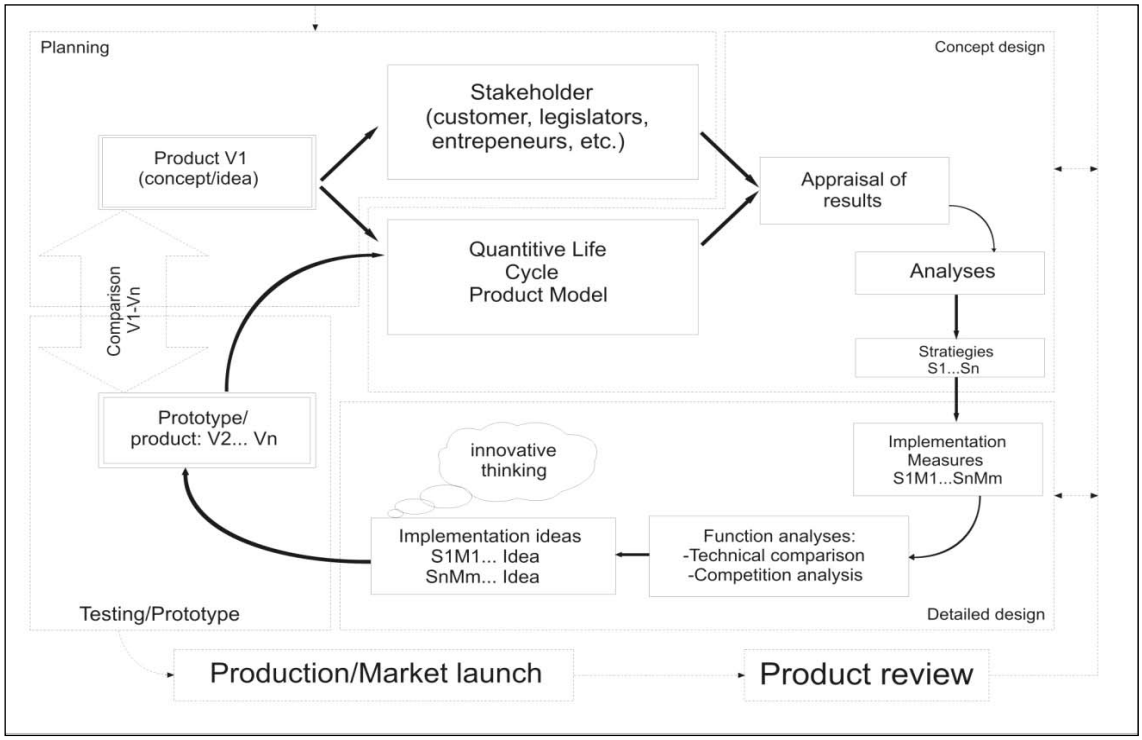

Fig.5 Systematic procedure for ergo-design

Projects - Automation, Flexibility, Modulation for Ergonomics

Mechatronic fields allows: advanced autonoms systems, competence, actions, abilities, control, natural interactions, miniaturization by simulation devices, visualition, interactions and mediums creating digital and virtual production, modeling and

Intelligent activity can be achieved in three basic ways:

- Existing activity processes can become intelligent by monitoring and controlling the state of the dental equipment
- Existing processes can be made intelligent by adding sensors to monitor and control in the state of the product being processed
- New processes can be intelligently design to produce parts of the desired quality

The skill-based approach should enhance the competitive edge of the European requirements:

- Further development research, for Virtual Reality visualization and simulation of dynamic reconfigured automated systems.
- Information processing and dental practice control taking into account the sensors and adaptive control integration, with modular software structure and equipment programming.
- Development and optimize of new mechanical structures of individual components
- Solutions for quality and competitiveness increase for the products realized in Intelligent Process Systems
- Design and realization of Intelligent Module systems, integrated in dental equipment Systems
- Modeling methods, expert and fuzzy logic systems for complex fault diagnosis in intelligent systems
- Infrastructure creation for multidisciplinary research for dental equipment system integration
- Integration techniques of intelligent dental equipment systems in European network for research results information and dissemination via Internet
- Virtual Intelligent System research for dental equipment [4]

Investigation and rehabilitation systems for the spinal column deformations

In the Mechatronics Department of the Politehnica University of Timisoara, a first step was made in order to realize a biometry and rehabilitation center for scoliosis.

The para clinical investigation method utilized is: ultrasound digital mapping (Fig.6).

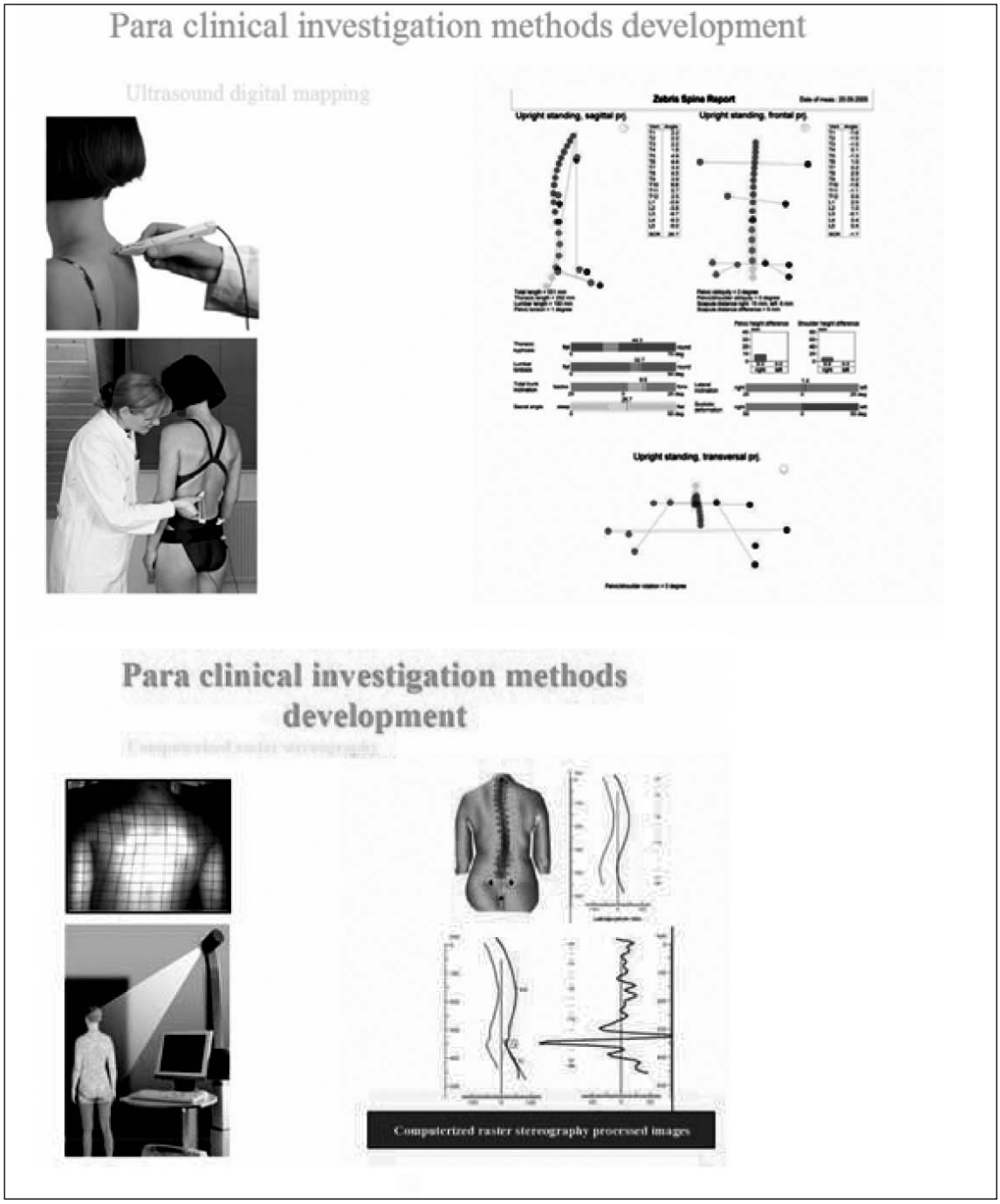

Fig.6 Para clinical investigation methods development

Conclusions

- Adding new components that are perfectly adaptable to any person and space; finding innovative and inteligent new solutions using advanced technology, "user-friend" interface and surfaces design in order to abtain maximum functionality; process optimizing by personalizing the work schedule using controll panels.

Correspondance to: Veronica Argesanu, Ph. D. Eng.; associated professor
"POLITEHNICA" UNIVERSITY OF TIMISOARA
Mechanical Faculty, Mechatronic Department
Bv.Mihai Viteazu nr.1,300222, Timisoara,Romania
e-mail: vera_argesanu@yahoo.com
tel: 004/0256/403553, 004/0720051724

References

1. Krause, F., L., Kind, Chr., Voightsberger, J., Adaptive modeling and simulation of product development processes, Annals of the CIRP53/1 (2004), Krakov, Poland

2. Voightsberger, J., Adaptive Modelirung und Simulation von Produktenwicklungsprozessen, Dr.-Ing. Thesis, Techniche Universitat Berlin, 2005

3. Ergonomics design and analysis TM, Dassault Systemes, France, 2002

4. www.optergo.com - Oene Hokwerda, Ergonomic requirements for dental equipment