

cializované robotické systémy“ písomnou a interaktívnou multimediálnou formou pre TU Zvolen, TnUAD Trenčín a STU Bratislava.

The paper is also aimed at contributing to the vision of the *Agenda 21* and *Lisbon Strategy* in the field of industrial pillars of sustainable development strategy at the STU MTF research and pedagogical processes

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Новые виртуальные технологии и виртуальная среда

Компьютерные технологии широко используются на практике при разработке рабочих мест, оснащенных роботами. Важным фактом является использование технологий независимо от платформ, на которых они будут установлены, и использование новейших стандартов компьютерных технологий.

Целью нашего проекта является разработка технологий для реализации компьютерной модели виртуального рабочего места.

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HCS MODEL 3E IN A VIRTUALLY CONTROLLED ROBOTIC WORKPLACE – PRACTICAL APPLICATIONS

Agenda 21 is accepted as the development aimed at assuring the basic individual demands of society without corrupting the environment and the ability of future generations to satisfy their own demands. Suggested HCS model 3E is addressed to acquire financial means necessary for sustainable development process progress in the framework of „National strategy of sustainable development of the Slovak Republic“. This article brings an example of HCS model 3E principles applying in a robot operators training virtual unit. The virtual development process presents an essential condition for a successful origin of a new product or a workplace. The scientific project is a logical continuation of the research activities of the interdisciplinary investigators group as well as it represents the follow-on contractual scientific cooperation of university workplaces on an international basis. The project concept is based on the sustainability of the HCS model 3E designed by us and verified in practice.

Introduction

Modern world has become increasingly [globalized](#) and interconnected. Although this has encouraged the growth of science, art, and technology, it has also led to culture clashes, the development and use of weapons of mass destruction, and increased environmental destruction and [pollution](#).

Scientists around the world have recognized that uncontrolled industrial processes which are motivated only by economic benefits have begun to endanger life on our planet. One of the most important recent problems is how to maintain such a quality of environment allowing us not only to survive but to start and continue the process of “Sustainable Development” insuring the quality of a human life for. This problem is the subject of international scientific conferences and is attracting greater interest from politicians.

The idea of sustainable development is a new direction for human civilization in the 21st century which, when put into practice, can improve the quality of life for humans and at the same time take responsibility to protect global common goods and natural resources [1].

The question is how to acquire financial means necessary for sustainable development process. It is clear, that grants and sponsoring do not represent the systematic solution of this problem.

Here are two basic natural and systematic financial resources for sustainable development:

- effectiveness of technology (automation and mechanization);
- effectiveness of human work.

Solution only in technological terms has both technological and economic limitations. In human work effectiveness achieving we distinguish approach differences depending on the level of country social and economy development.

In many developing countries, attempts to maximize profits often include reduced levels of occupational health care, lower salaries and higher work rates. However, in most developed countries, increased profits are often obtained by increasing the effectiveness of human work through application of ergonomic principles and preventive programs. In all cases, it is important to evaluate the health effects for the workers to obtain a complete analysis of the true cost-benefit of various working conditions. Privatization and the transformation of industry in Slovakia and in neighbouring countries of Central and Eastern Europe began as a part of the process of its integration to the European Union. In the framework of the project solution “Transformation Industry in Slovakia through Participatory Ergonomics” We proposed the model HCS 3E for this purpose. This model represents an ergonomics process applied in industrial enterprises of developed countries and is modified to specific conditions of transformation industry in Central and Eastern European countries. We proved this model in 19 enterprises in Slovakia and we continue in effort to implement this model to practice. We consider the application of an automation industry as an area requiring high level of human work effectiveness and also the application of HCS model 3E. The first step of this model application in the area of automation was the project “Creation of virtual robotic laboratory for supporting teaching the subject: Robots and manipulators“ in a newly accredited study program“

1. HCS 3E model and its applications

The HCS 3E model applies the „National strategy of sustainable development of the Slovak Republic on the macro-level while simultaneously working on the enterprise micro-level (3E: Environmental Health, Ergonomics, and Economy). This model is focused

on the effectiveness of human work and cost benefit [2; 3]. We suppose to use this model as a tool for both, the revitalization of enterprises and acquisition of financial means for sustainable development once at the time (fig. 1).

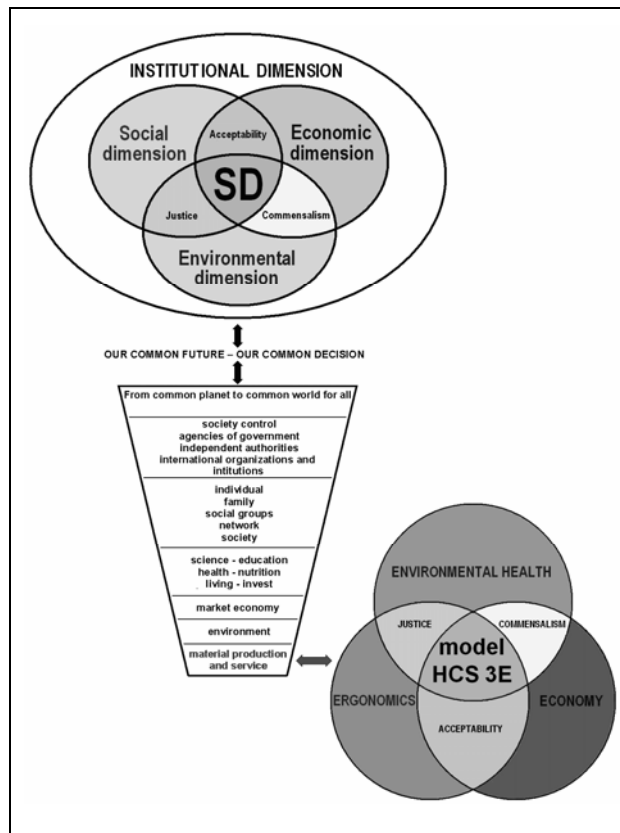


Fig. 1. The model of HCS 3E contribution to sustainable development process, (micro-solution of macro-problems) focused on producing necessary financial sources by human work effectiveness.

We are convinced that this model meets our requirements in both practical and scientific areas and brings new stimuli to economic development in Slovakia and other neighbouring countries that are in the process of adapting to the conditions in the European Community.

2. The implementation of HCS model 3E in a virtual technological workplace

The concept virtual HCS model 3E of a technological workplace is designed in the phase of the project (Fig. 2). It allows designing the technology in real as well as it permits the definition of the basic principles of the technological process control system [4]. There are 3 acceptable aspects (3E) of sustainable development:

1) environmental aspects – each of the technologies carry an environmental burden which also reflects to the economic aspects because of the inevitable operational measures. The advantage of the proposed virtual technology application means that it is not necessary to produce the model of a technological device, nor it is necessary to create the

real technological workplace. By the production of the aforementioned devices, the environmental impact is minimized;

2) economic aspects – there are few of them. They can be divided into partial groups and subgroups. The most important aspects that have to be in the optimization of such a technology, that are taken into consideration, are the investment costs (the amount of finances related to the specific virtual equipment purchase) and operation costs (technological devices, electricity consumption and other related costs) which can influence also the decision making in a new technology purchase [5];

3) ergonomic aspects of virtual technologies – working conditions, lighting, noise, protective clothing necessary for the operation of such a technology, etc.

At present the optimization is used and applied in different information systems oriented to conventional technologies whereas the possibilities of virtual technologies are neglected. The necessity of a computer-aided tool that will take these aspects into account is vital in national as well as in European research. The issue is essential also for the top European companies involved in the sub supply of reputed car factories.

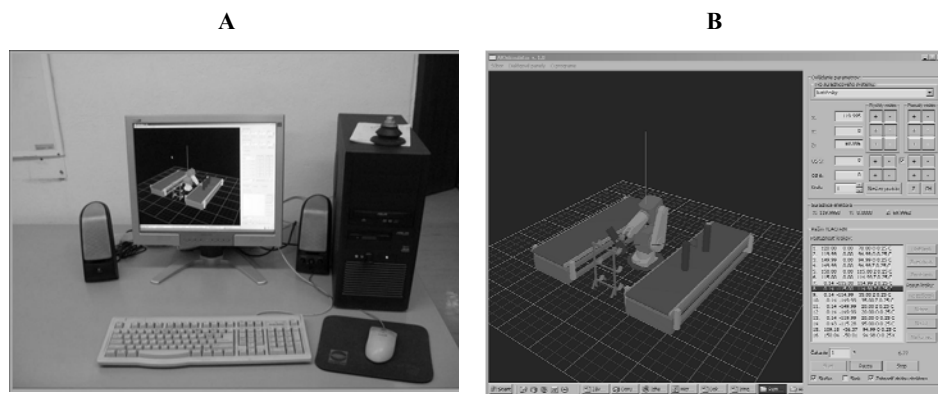


Fig. 2. Proposed laboratory computer workplace (A) with installed virtual robotic workplace control training program applying requirements of HCS model 3E (B)

By the project investigation and implementation the following aspects from the view of basic principles of a new paradigm will be fulfilled:

1) certain deviation from the principles of traditional rational paradigm followed by the majority of organizations and schools in the past and still followed by several traditional ones;

2) in contrast to rational opinions, the supporters of the current paradigm of technological workplaces think, that the organization effectiveness is needed not only internally but externally as well;

3) all faculty structures (organizational structure, study programs, organizational control, university control, etc.) are the organization reflections to the external changes;

4) current trend of teaching technical subjects has to be researched as a socioeconomic and environmental system (HCS model 3E).

Designed virtual/real workplace reflects as well as accepts the aforementioned three most important aspects of sustainable development - environmental, economic and ergonomic aspects.

4. Essential Investigation Process

In the first phase the project concept will be elaborated. The whole scope of works and method of investigation will be defined:

- 1) to carry out collective investigators' brainstorming to identify the key terms and the hierarchy of partial tasks/goals and their interfaces;
- 2) to carry out the analysis for partial tasks/goals in selected universities and companies in the Slovak Republic;
- 3) to generalize partial analysis conclusions;
- 4) to propose methods for partial tasks/goals:
 - a general model of a robotic workplace,
 - a method to investigate the control system of a laboratory robot,
 - a method of the effectiveness evaluation of the environment-friendly oriented workplace at universities and companies,
 - possibilities of using the exact methods for teaching at universities,
 - an interface for the user program transfer and control.

In the second phase of the project investigation we suppose:

- to verify related methods of individual tasks/goals at the Institute laboratory equipment,
- to carry out final corrections of the related methods,
- to generalize the knowledge into final proposals of individual systems of control programming and interface,
- to process the synthetic final research report.

Upon project completion, the programming itself will be carried out with the programming of all the needed functions so that there is no duplication and the application is capable to simulate the industrial robot as well as the entire robotic workplace.

The final phase will be devoted to testing. After testing the application the virtual application will be transformed into the real robotic workplace.

5. Animation application and interface

Animation as a significant part of the application illustrates the current state of all units and parts of the robotic workplace. It is impressive not only by the manual control but also by the data processing.

The animation will be carried out by the means of object oriented Microsoft visual C++ with the use of graphic library Open GL, both providing wide possibilities of the use of a large number of orders and functions.

Library Open GL is compatible with Linux operation system and represents a standard in 3D graphics.

Interface has to be compatible with the data processing generated from the virtual scene, then transformed into the real environment of a robotic workplace [6].

6. Proposal of the boundary application

In the phase of the proposal of the boundary application, it is essential to define the boundary between the application itself and the application user. The ergonomics of the boundary application is an important point, i.e. the simpler the control the better. Another important condition of an application control overview is represented by the smallest possible number of control units for the user.

In the simulation application of the virtual robotic workplace, there will be many control units but they will be arranged and implemented in such a way so that they are user friendly.

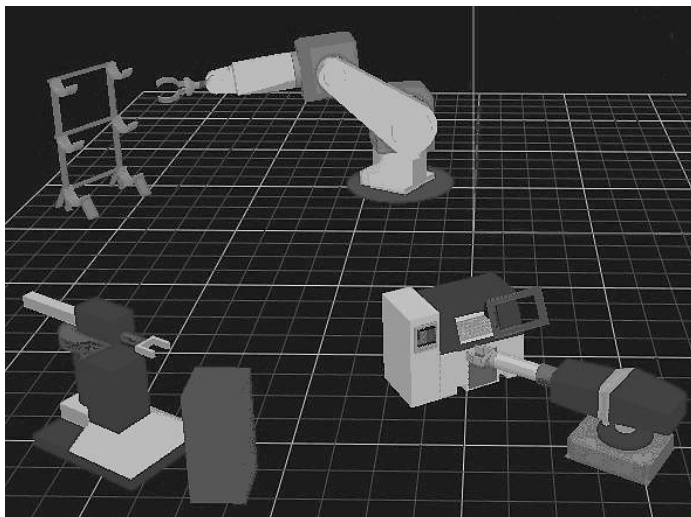


Fig. 3. An example of a virtual scene creation

Application control. It is necessary so that the application control is unified as a whole and that there is one control unit per function. Individual control units will be called by names or abbreviations and the control will be assisted by a helper.

7. Conclusion

By the project investigation and implementation, the following aspects from the view of basic principles of a new paradigm will be met:

1) certain deviation from the principles of traditional rational paradigm followed by the majority of organizations and schools in the past and still followed by several traditional ones.

2) in contrast with the rational opinion, the supporters of the current paradigm of technological workplaces think, that the organization effectiveness is needed not only internally but externally as well.

3) all faculty structures (organizational structure, study programs, organizational control, university control, etc.) are the organization reflections to the external changes.

4) current trend of teaching technical subjects has to be researched as a socioeconomic and environmental system represented also by our HCS model 3E, developed for transformation industry process based on University of Iowa, USA experience.

We suppose the following focus of our research activities in the next time period.

Continuing in initiation of participatory ergonomics programs in as many enterprises as possible in Slovakia and in countries of Central and Eastern Europe.

Analyzing obtained data and work on disseminating those results and experiences to other enterprises in Slovakia and abroad.

Monitoring the progress of the ergonomics processes in all enterprises involved in this project, conduct cost benefit analyses for the ergonomics program and work on rationalization of an ergonomics process based on participatory approach model HCS 3E principles in Slovak Republic and neighbouring countries.

Applying of ergonomics in the process of development and operation of new effective automated production systems.

Implementing of virtual technologies in increasing ergonomics, environmental and economic preventive programs effectiveness. The implementation of virtual technologies in personal management, training and education of employees seems to be very promising.

Continuing in the study of theoretical and practical aspects of applying the HCS model 3E of ergonomics program based on participatory approach principles. We already initiated this process by running PhD programs oriented on:

General and enterprise specific form of Cost Benefit evaluation of ergonomics process managed by HCS model 3E by CBA,

HCS model 3E and Balanced Score Card,

Expression of HCS model 3E process in general and enterprise specific form, describing its relation to enterprise processes,

General and enterprise specific form of ergonomics program,

Effectiveness of ergonomics programs based on HCS model 3E,

Refining of epidemiological methods in evaluation of health effects of occupational disease preventive measures implemented in framework of ergonomics program based on HCS model 3E.

Work on spreading of ergonomics programs throughout Slovakia and neighboring countries by expanding personal and completing materials for the proposed ergonomics laboratory as a part of Center of Strategic Studies according to the proposal submitted to the scientific board of STU Bratislava, MTF.

Acknowledgements

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HCS-модель 3Е для виртуального контролируемого рабочего места – практическое использование

План 21 принят в качестве основного для обеспечения основных индивидуальных потребностей общества без нанесения вреда окружающей среде и возможности для будущих поколений удовлетворять свои потребности. Предложенная модель необходима для получения денежных средств для подобающего развития в рамках «Национальной стратегии развития Словацкой Республики». В данной статье приведены примеры использования модели в виртуальных блоках симуляции работы роботов.

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ВЛИЯНИЕ АРТЕФАКТОВ НА РЕЗУЛЬТАТЫ УЛЬТРАЗВУКОВЫХ ДОПЛЕРОВСКИХ ИССЛЕДОВАНИЙ

Рассмотрены основные артефакты, появляющиеся при ультразвуковых (УЗ) доплеровских исследованиях, которые искажают эхограммы и могут привести к постановке неверного диагноза, а также возможность их применения для повышения информативности исследований.

Экспериментально исследован артефакт УЗ-доплерографии «псевдопоток», являющийся, с одной стороны, ложным выявлением кровотока, с другой – возможностью дифференциации неоднородных жидкостных образований. Рассмотрены основные причины его возникновения.

Введение

Последние несколько десятков лет УЗ-методы получили широкое распространение в медицинской диагностике. В настоящее время подходы к получению и анализу информации можно разделить на исследования в двумерном В-режиме и доплеровские режимы. Развитие УЗ-методов диагностики идет в основном по двум направлениям: нарастание мощности и улучшение визуализации.

Как известно, УЗ-изображение искажено всевозможными артефактами, что может стать причиной постановки неправильного диагноза. Изучению физики появления артефактов не уделялось большого внимания, т. к. для устранения большинства из них достаточно изменить угол ввода ультразвука или плоскость сканирования. Также разрабатываются новые методы обработки сигналов, позволяющие снизить появление артефактов. Комплексное УЗ-исследование с использованием нескольких режимов повышает информативность диагностики и позволяет уменьшить количество возникающих артефактов. Несмотря на достижения в области разработки УЗ-диагностической аппаратуры, не удастся избавиться от присутствия артефактов в УЗ-изображении, и даже обнаруживаются новые, ранее неизвестные [1].

Целью данной работы является изучение артефактов, появляющихся при доплеровском сканировании и обусловленных взаимодействием УЗ-луча со средой, в которой он распространяется.

Ультразвуковая доплерография

УЗ-доплерография – информативный метод диагностики заболевания сосудов и обнаружения патологий в движущихся структурах (например, клапаны сердца) [4].