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Radim Farana[1]*, Kazimierz Jaracz*[2]*, Pavel Smutný* [1] *, Lubomír Smutný* [1]

Study plan at university with industrial case studies

Technology has catapulted us into a knowledge-based, global society. It is clear that success in this society will require significantly different skills than in the past. Faculty of Mechanical Engineering has changed all study plans to the serial study system, according to the Bologna Declaration, because of the accreditation process, which motivated us to change the study plans completely. The most important change was including of two project oriented subjects to the bachelor study plan and three of them to the master study plan. This situation opened the way to include solving of real industrial or innovative project to these subjects and include students to the project solving process.

In the paper we present the results obtained during solving some real projects. Department of CSI of VŠB-TU Ostrava with support of AP Cracow [Jaracz, 2007]. There is set-out suitable instrumentation for difficult dynamical measurement and its co-workers have required knowledge and experience for its effective using [Tůma & Smutný, L. 2003]. Dynamical measurement of position and motion parameters of mechatronic elements and systems (speed and acceleration, displacement – position), eventually their force-moment quantity (force, torque) be part of important mechanical designer tools, especially in automotive industry [Sapinski, 2004, 2006]. Actual problem of development mechanical design and testing car back door there are identification of static and dynamic forces, which take effect in the exercise long time test. It is also example of industrial case study with industry cooperation.

Other case study example from the area of applied informatics there is vertical portal as a site with comprehensive content and links to other web sites, built around a single topic. As well, it is a mediator between users and thematic web pages that could provide valuable content but the way of presentation discriminate them from high rank position in full text search engines results. Well-organized, edited, and timely original content set in an attractive, interactive, and consistent format are some traits of successful Web sites. is described in the informational web portal http://www.e-Automatizace.cz .

[1] VŠB – Technical University of Ostrava, Department of Control Systems & Instrumentation.

[2] Pedagogical University of Cracow.

Measurements of dynamical forces

Direct dynamic forces measurement on the mobile objects is relatively difficult challenge. We can use for its elegant solving the equivalence operation between force actuating in the specific test point of mobile object and parallel vibration measurement (for instance acceleration) by this way dynamic force excited, [Korzeniowski & Pluta, 2008]. [Smutný, L. 2003]. Instrumentation and other condition for measurement:

1. Composition of instrumentation, included the Analyzer PULSE (9 channels), notebook HP with program system LabShop Pulse (B&K), again 2 pieces of miniature acceleration sensors (with huge acceleration range – max 1000 g) and impulse impact force hammer.

2. Specification and detail solving measurement case in the program LabShop Pulse for used instrumentation, ranges setting, parameterizations of measurement task (2 sensors of acceleration, 1 force sensor), sample frequency setting, time record, possibility of next data modification from the point of frequency.

3. Piezoelectric accelerometers installation on the vehicle body under catch staple of door latch and accelerometers calibration (L Mass, H-Mass). Measurement of time courses from impulse hammer and together from two accelerometers. These courses of a function there were deducted from the peak force and two accelerations values and all calibration and tested measurement there were use with sampling frequency f=16 356 Hz.

4. From these data records there was computed transfer acceleration-force coefficient by function $K_F = \frac{a}{F}$, where a is acceleration [m.s^{-2}], F is force from impulse hammer [N]

On the next Figure 1 we can see results from experimental tests from 20 repeated exams on the basic bare metal BMW car body without of windows. There are very similar courses of accelerations with different impact speeds loping of fifth doors.

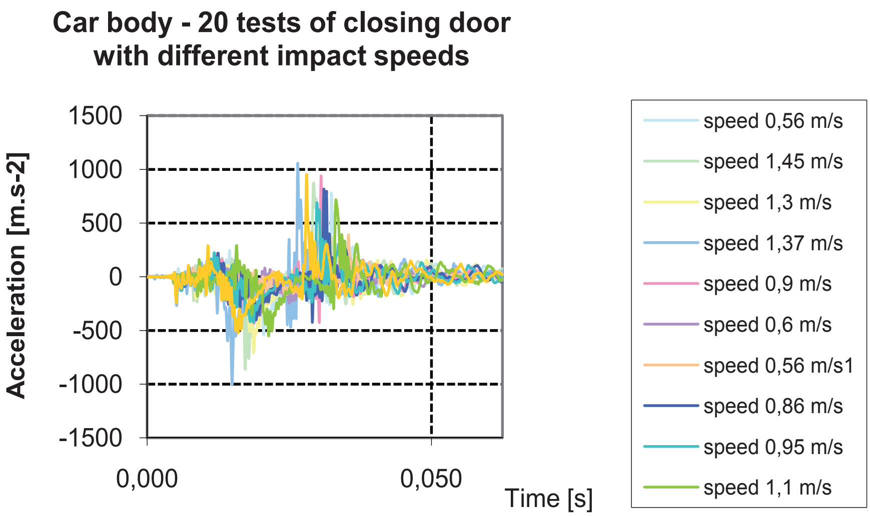

Fig. 1. Car BMW Car – repeated calibration, corresponding acceleration time courses on *L Mass* sensor, with different impact speeds loping doors

WEB portal e-automatizace.cz

The expansion of informational and web services and technologies brought to Technical University of Ostrava and Faculty of Mechanical enormous potential to educate and inform their students and employee with more effective a fastest way over Internet. With increasing amount of published information over web is for users harder to find relevant information quickly. The way of published documents also changed from making simple static HTML files towards dynamically driven data taken from databases.

A portal is the starting point for Web activities. A web portal is a web site that provides a starting point, a gateway to other resources on the Internet or an intranet. A vortal (vertical portal) is a web site that provides a gateway or portal to information relating to a particular industry. It is focused on a relatively narrow range of goods and services.

We can define conceptual framework of this vertical portal by using five planes – strategy, scope, structure, skeleton, and surface [Garnett, 2002].

– The Strategy Plane – The scope is fundamentally determined by the strategy of the site. Strategy of portal e-Automatizace is “to create a starting point, a gateway to other resources on the Internet from automation field for students and academic staff of Faculty of Mechanical Engineering and other universities in Czech Republic”.

– The Scope Plane – The scope defines set of features and functions. For e-Automatizace it means:

– web pages as vertical portal, * separation of content and graphic form, * using Cascading Style Sheets (CSS), * HTML code in (x)HTML version 1.0 due W3C standard, * Respect of web accessibility rules, * Hierarchical structure of links from automation, * Full-text search, * Statistics and tracking popular links, * Users evaluation quality of links, * English-Czech/Czech-English dictionary, * Automation encyclopaedia , * Administration of portal

– The Structure Plane – The scope is given structure on the software side through interaction design, in which we define how the system behaves in response to the user.

– The Skeleton Plane – the placement of buttons, tabs, photos, and blocks of text. The skeleton is designed to optimize the arrangement of these elements for maximum effect and efficiency.

– The Surface Plane – On the surface you see a series of Web pages, made up of images and text

The goal of the Web portal *e-Automatizace* is to create a central and systematize resource point from the automation field for students and academic staff where information will be structured into logical hierarchy. Therefore is very crucial to keep content updated and links have to be examined frequently [Smutný, P, 2005].

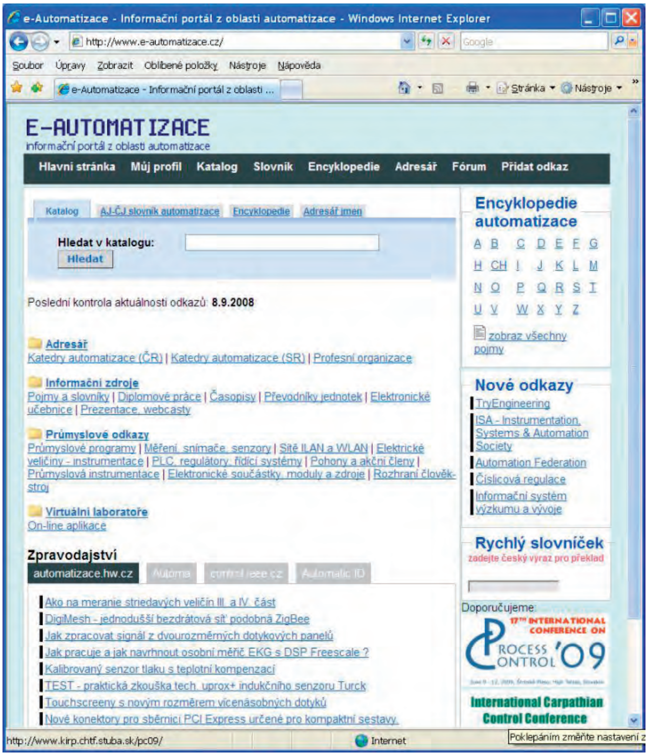

Fig. 2. Surface Plane – final actual graphic design of vertical portal e-Automatizace

Development of equipment for the 3D picturing in medicine

An ischemic stroke is the third most frequent reason of death and the most frequent reason for disability of our population. Therefore, it is becoming a significant social and economic problem. Ischemic strokes make up 85% of all strokes. The highest risk factors are hypertension, hypercholesterolemia and smoking. This study is aimed at developing and observing the testing for 3D picturing. To create a 3D picture we have to make three steps. The first step is acquisition, the second one is the reconstruction and the third is rendering. We have to work out computer system for measurement 2D sonograph pictures, for 3D reconstruction and final creating of all pictures. It is necessary to suggest and bring the construction of shoulder and ultrasound probe keeping, to existence and to improve the mechanisms of movement of probe.

Aims of project and design of solution

The aim of this project is to develop and test the equipment for the 3D ultrasound measuring atherosclerotic plaque in carotid artery bifurcation. To create a 3D picture we have to make three steps:

- to get picture data of a 2D sonograph picture;
- reconstruction of these data;
- to create a final 3D picture.

We expect that our system will be able to correct the measured volume of atherosclerotic plaque. It is necessary for the 3D ultrasound measuring atherosclerotic plaque to make a computer system for measuring a 2D sonograph picture, for 3D reconstruction and the final processing the picture [Babiuch, 2006]].

It is necessary to suggest and bring the construction of the shoulder bringing ultrasound probe into the existence and to deal with the mechanisms of the movement of probe. In the last period of the design all above mentioned system will be tested by a repeated measuring on a group of volunteers.

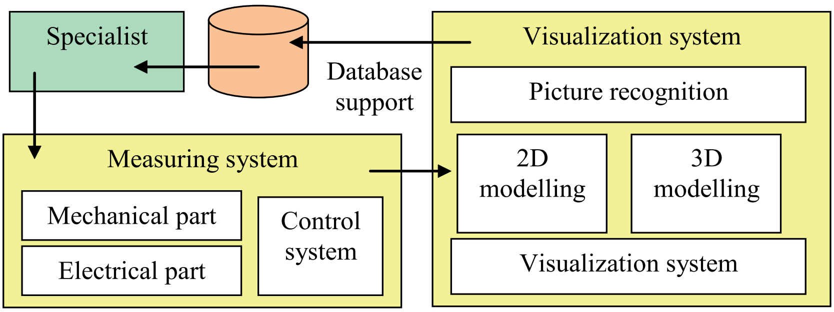

Fig. 3. The developed system's main structure

The whole project will last three years and will be divided in to three one-year periods [Farana, & Smutný, L, 2002].

Period one:

1. Suggestion and designing the computer system for measuring a ultrasound picture and creating the object in a 3D picture.
2. Establishing a graphic working place including connecting it with the ultrasound machine.
3. Design of the construction of the shoulder and the probe keeping and mechanism of its movement.

Period two:

4. Development of the system driving the probe movement.
5. Establishing the shoulder and the probe keeping system including the mechanism of the movement.
6. Solving how to recognize the points of interest on the object in the picture by using ways of artificial intelligence and an animation the measuring process.
7. Data and function analysis of a data system for measuring evidence and search system.

Period three:

8. Testing exam of the data system – how to make measurements and how to search for them.
9. The testing of the system on the group of volunteers which is repeated.
10. Publishing the results on the Internet and in periodicals.

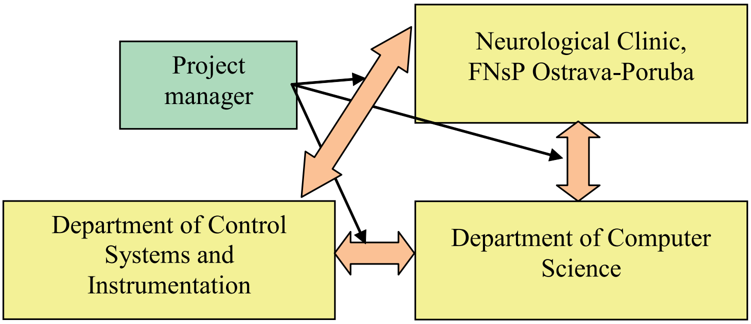

Fig. 4. Project collaboration main model

When this project is completed at the university, many students are included in the project work. Figure 5 shows all of the student's teams. These teams had been formed to solve some of the project parts during the subject "Special Project", which is managed by the teachers and/or specialists from the companies to improve a student's skills, especially in the development and project management. Some of the student's team work results are presented in the next chapters.

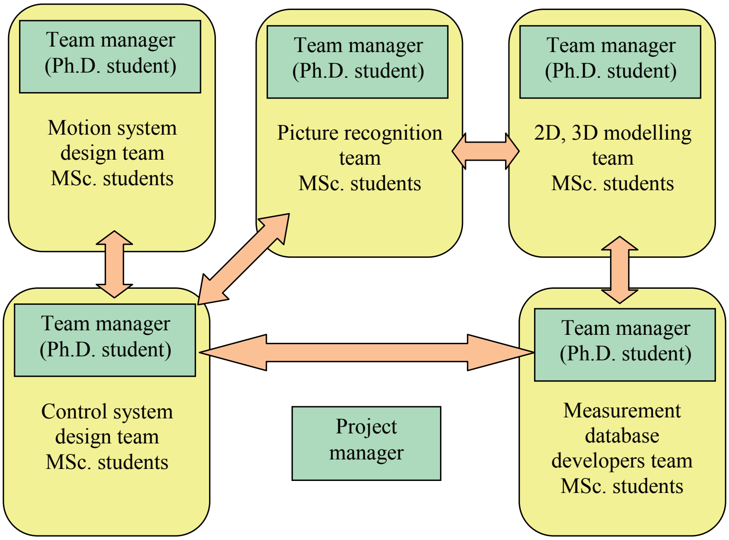

Fig. 5. Student's teams included in the project development

Probe movement controlling

The present state requires a doctor to place the probe into the proper position and to define the beginning and the end of the recording.

To be able to determine the exact position of an actually performed ultrasound picture scan, it was necessary to develop a mechanism which could setup the location of the ultrasound probe and send back its position for validation. The worm gearing (ball-screw) with the ultrasound sensor located on it has been used for this purpose. The entire mechanism has been attached to a bed using a bracket. The drive unit is comprised of an engine with transmission or – if the outgoing force allows it – a stepping engine. The controlling unit is based on a monolithic processor PIC made by Microchip. Communication between PC and the controlling unit is provided by RS232 interface or by a generation of TTL signals.

Communications with interface of a unit for control of the stepping engine is realized with the usage of a standard RS-232, which is the part of anyone's PC. The interface unit consists of three modules – communication, control and power. The protocol is designed so that if is applicable for communication, which is limited to a half duplex .

Control system

The second important problem was in developing the optimal control system. To solve it, the computer (notebook) with communication interface (RS-232, RS-485 and USB) has been included in the whole control chain to generate control pulses for a stepping engine and power module. The power module switches the individual coils of a stepping engine. The stepping engine is a power unit for positioning device, which is based on a bullet screw. The developed communication and control units are shown in Figure 7 and Figure 8.

The methods advertised at the Department of Control Systems and Instrumentation has been used by the Control System design team and firstly simulated in the Matlab/Simulink system. The optimal controller parameters were later applied in the developed unit and the personal computer has been used for the supervisory control [Farana, et all., 2006].

Industrial PLC for control of real model system

Another example for education goals connection with industrial partner's cooperation is two laboratory stands on the Laboratory of advanced simulations. There are industrial modular PLC (Programmable Logic Controller) from ABB with Profibus DP Industrial LAN for connection of smart sensors (temperature, pressure, flow), frequency converter for asynchronous driver control and decentralized binary Input/Output modules for model of Railway lay-out.

On the Figure 6 we can see the instrumentation part of PLC in connecting with standard PC computer for SCADA/MMI purposes.

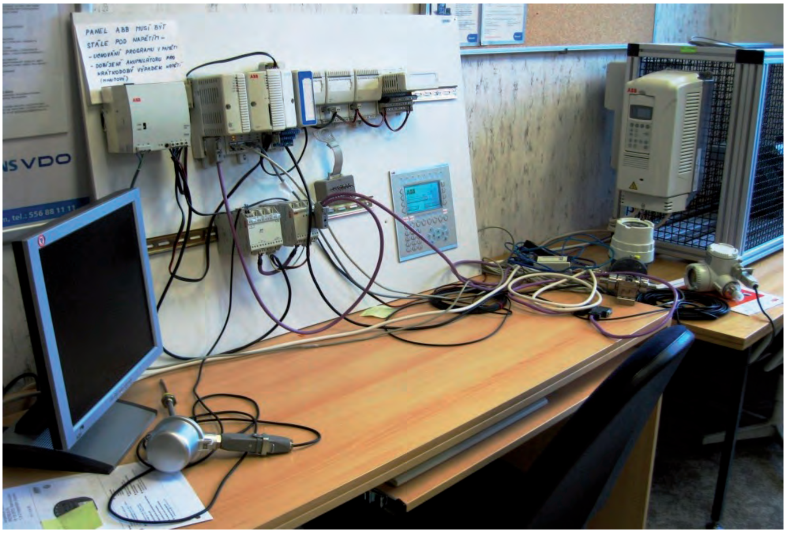

Fig. 6. Industrial modular PLC from ABB with Profibus DP Industrial LAN

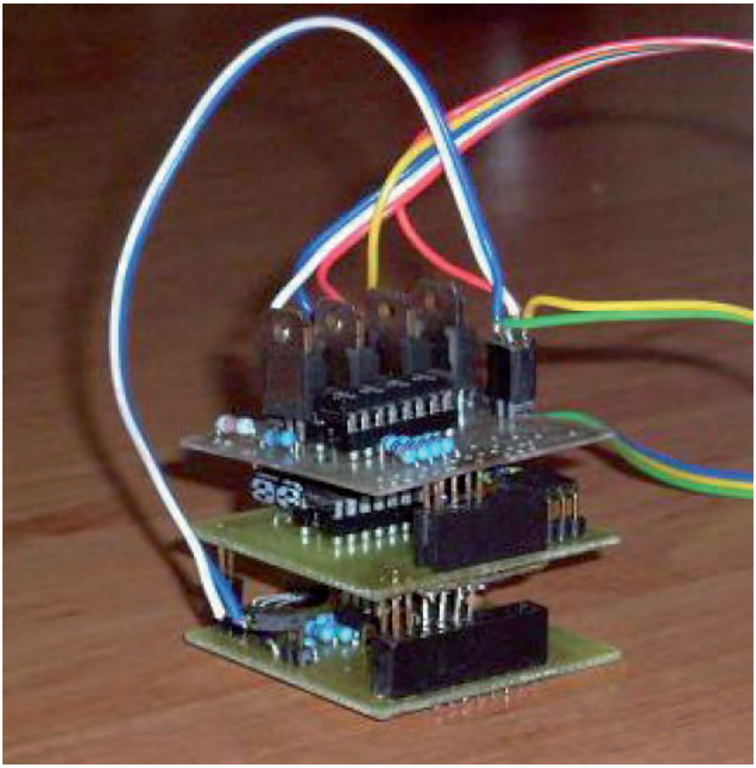

Fig. 7. Control system modules

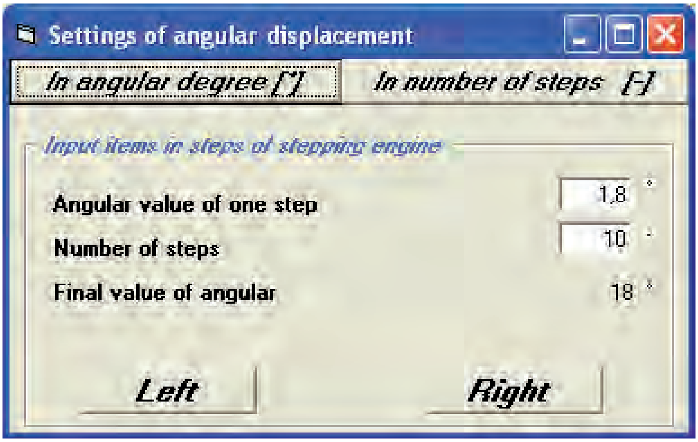

Fig. 8. Supervisory control basic screen

On the Figure 9 is shown a model of level tank control with industrial controller in connecting with PC computer for visualization of control process and disturbances generating.

These models of industrial control systems can help to easy understanding of static and dynamic properties of typical technological processes, their instrumentation with industrial buses connection and SCADA/MMI program support.

The new trends with Web technology support for e-learning introduces innovation both in pedagogy and technology. It aims at developing tools that will allow for as many links of science teaching as possible with every day life.

Fig. 9. Model of level tank control with industrial controller in connecting with PC computer

As new technologies unfold, some interesting trends in presence even distance learning may evolve as well. Some of them are summarized below.

– Students can feel and experience the outdoor facilities inside the classroom.

– Wireless communication to access encyclopedia and e-books will be available. Mobile students can participate in a lecture, use online references, or read class notes.

– By making use of game technologies in education, it may be possible to attract students and to increase their attention and motivation.

Conclusion

To fully realize the educational opportunities 21st century skills can bring to students, education leaders must formally incorporate them into the mainstream of school curriculum, instruction, and assessment. In the laboratory project a new type of learning environment is created that helps learners to develop flexible knowledge and skills to collect and synthesize information and to collaborate with others. This learning environment brings together, in an integrated way, facilities for experimentation (including remote laboratories), collaboration, and domain modeling. Department of CSI has set-out suitable instrumentation for difficult dynamical measurement and its co-workers have required knowledge and experience for its effective using.

The realisation of the Web portal e-Automatizace is to create a meeting point for easier and quick way to find out resources from the automation field for bachelor's and master's students to help them get through lectures and in thesis. Administration part of the web portal allows to not only web administrator but even for registered users to change and update content of it without deep knowledge of HTML syntax.

The presented results show the possibility of student's teams to solve some special problems connected to the very complex hugeprojecst as a part of their study. This way seems to be very useful in increasing the student's skills, especially in solving practical problems, managing the projects and also in communicating between the teams and inside the team. Only some of the project parts have been successfully completed, so we would like to continue in this way in the next years to obtain more experience in involving students in completing the project. The other useful ways to solve some of problems connected to this project are the MSc. or Ph.D. student's final thesis. But this way, although it is successful, is not focused on the team work. The presented results have been obtained during the completion of research project Czech Science Foundation GAČR 101/07/1345 and Specific Research of TUO – Dep352.

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Plan studiów uniwersyteckich z wykorzystaniem „studium przypadku" (przykłady z przemysłu)

Streszczenie

Jako najbardziej trafny przykład praktyczny zaprezentowano zarządzanie projektem grantowym dotyczącym tworzenia wyposażenia/oprzyrządowania do wizualizacji 3D tętnicy szyjnej. Niniejszy artykuł przedstawia pozytywne wyniki uzyskane na Uniwersytecie Technicznym w Ostrawie – VSB – oraz na Akademi Pedagogicznej w Krakowie, w zakresie włączenia studiów przypadku – powstawania autentycznych projektów przemysłowych – do planu studiów. Zarządzanie tak wielkimi, międzydyscyplinarnymi projektami wymaga współpracy specjalistów z kilku instytucji, a zarządzanie projektem jest jednym z najważniejszych elementów procedury ukończenia projektu. Ta metoda używana jest również do włączenia studentów w projekty, jako element ich wykształcenia. Wiele spośród współpracujących instytucji i przedsiębiorstw stwierdziło, że systemy zarządzania projektami były w przeszłości niedoceniane. W związku z tym, nasze wydziały zmodyfikowały plany studiów tak, aby większy nacisk położyć na kształcenie potrzebnych umiejętności.

Badania nad tym zagadnieniem prowadzone są w ramach grantu Czeskiej Agencji Grantowej GAČR 101/07/1345 oraz projektu badawczego Uniwersytetu Technicznego w Ostrawie (Dep352).

Słowa kluczowe: plan studiów, studium przypadku, projekt, przemysł, umiejętności