

# Industrial Grant Projects as a Part of Study Plan at the University

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*Abstract:* - This paper presents positive results obtained at the VSB – Technical University of Ostrava including the development of real industrial projects to the study plans. Management of the grant project focused on the development of equipment for the 3D picturing of a carotid artery is presented as a best example in practice. To manage this interdisciplinary grant project it is necessary to connect specialists from three institutions, and project management is one of the most important parts of this project completion procedure. This way is used also to include students in the project as a part of their study. Many of collaborating institutions and factories declared that the project management systems have been disvalued in the past. Our faculty has then changed its study plans to emphasize the skills students need.

*Key-Words:* - Student, Study plan, Project, Industry, Skills

## 1 Introduction

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. The Faculty of Mechanical Engineering has changed all study plans to a 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 to include of two project oriented subjects into the bachelor study plan and three into the master study plan. This situation opened the way to include the completion of real industrial or innovative projects with these subjects and to include students in the project completion process. In this paper, we present the results obtained during the completion of some real projects.

## 2 Development of Equipment for the 3D Picturing of Carotid Artery

Ischemic stroke is the third most frequent cause of death and the most frequent reason for disability in 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. The atheromatosis of carotid arteries is the most frequent aetiology stroke factor. This event takes part in the development of strokes by 30%. This study is aimed at developing and observing testing for 3D picturing. To create a 3D picture we have to make three steps. The first step is acquisition, the second one is reconstruction and the third is rendering. We have

to work out a computer system for measurement 2D sonograph pictures, for 3D reconstruction and the final creation of all pictures. It is necessary to design and construct an equipment to hold the shoulder and the ultrasound probe, and to improve the mechanisms of movement of the probe [3].

In the last period of the design all the above mentioned system will be tested by a repeated measuring on a group of volunteers. The length of all the study will last three years. The meaning of the project is based on the practical application of the system – the possibility of measuring the exact progression of atherosclerotic plaque in the area of a carotid artery and to predict the risk of an ischemic stroke.

### 2.1 Aims of Project and Design of Solution

The aim of this project is to develop and test the equipment for the 3D ultrasound measuring of 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;
- to reconstruct 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 of atherosclerotic plaque to make a computer system for measuring a 2D sonograph picture, for 3D reconstruction and for the final processing of the picture [2].

It is necessary to design and bring the construction of the shoulder ultrasound probe into existence and to deal with the mechanisms of the movement of the probe. In the last

period of the design all the above mentioned system will be tested by a repeated measuring on a group of volunteers.

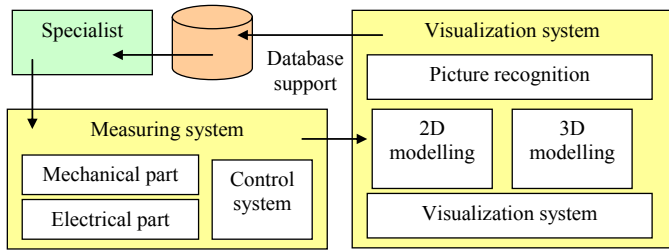


Fig. 1 The development system's main structure

The whole project will last three years and will be divided into three one-year periods [3].

**Period one:**

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

**Period two:**

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

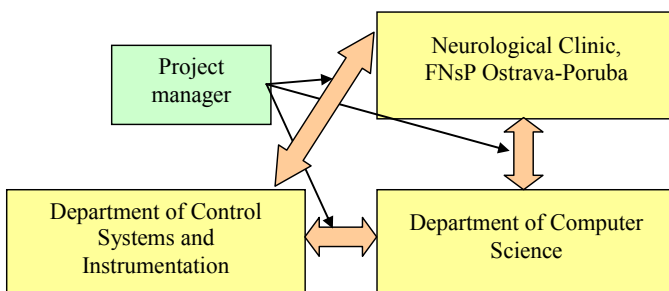


Fig. 2 Project collaboration main model

When this project is completed at the university, many students are included in the project work. Figure 3 shows all of the student teams. These teams had been formed to work on some of the project parts during the subject “Special Project”, which is managed by teachers and/or specialists from companies to improve a student’s skills, especially in development and project management. Some of the student’s team work results are presented in the next chapters.

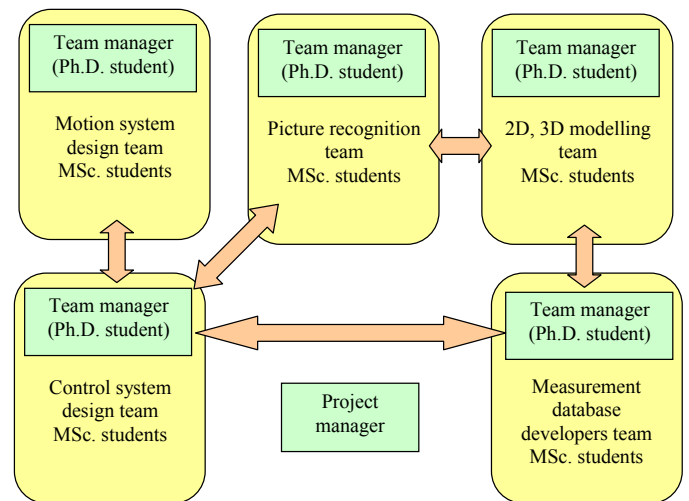


Fig. 3 Student's teams included in the project development

**2.2 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. A worm gearing (ball-screw) with an 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 a transmission or – if the outgoing force allows it – a stepping engine. The controlling unit is based on a monolithic PIC processor made by Microchip. Communication between a PC and the controlling unit is provided by RS232 interface or by a generation of TTL signals.

Communication with the interface of a unit for the 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 it is applicable for communication, which is limited to a half duplex [4].

The base of the communication module is an integrated MAX232, FT232BM or MAX485 circuit. The integrated MAX232 circuit is intended for RS-232 interface. The

integrated FT232BM circuit is intended for the USB interface. The scheme of connection is in Figure 4.

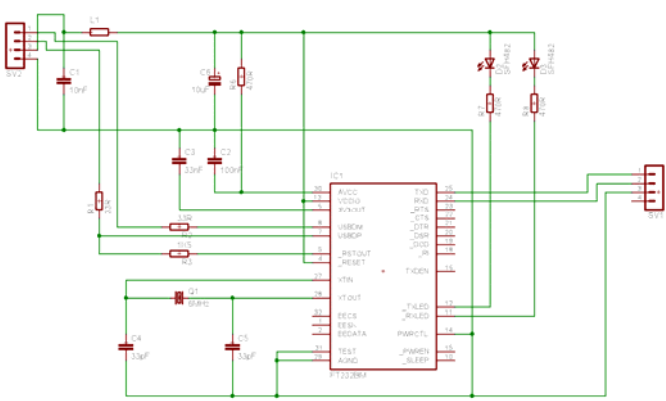


Fig. 4 Connection diagram of a communication module with FT232BM

### 2.3 Control System

The second important problem was the developing of the optimal control system. To solve it, a computer (notebook) with a 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 a positioning device, which is based on a bullet screw. The developed communication and control units are shown in Fig. 5.

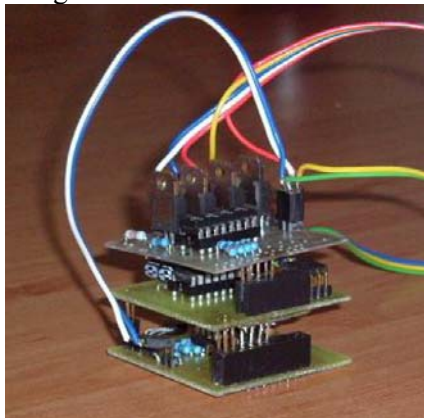


Fig. 5 Control system modules

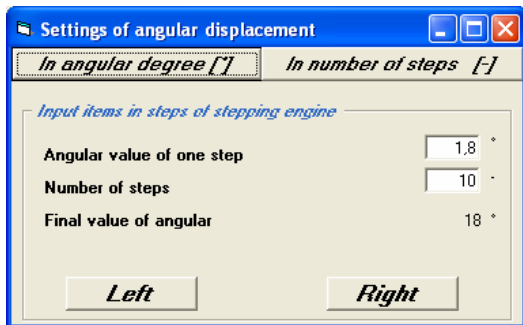


Fig. 6 Supervisory control basic screen

The methods advertised at the Department of Control Systems and Instrumentation [6] 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 a personal computer has been used for the supervisory control [5], [7].

### 2.4 Industrial PLC for Control of Real Model System

Another example of connecting educational goals with an industrial partner's cooperation is two laboratory stands in the Laboratory of Advanced Simulations. There are an industrial modular PLC (Programmable Logic Controller) from ABB with a Profibus DP Industrial LAN for the connection of smart sensors (temperature, pressure, flow), a frequency converter for asynchronous driver control and decentralized binary Input/Output modules for modelling a Railway lay-out [1].

In Fig. 7 we can see the instrumentation part of PLC in connection with a standard PC computer for SCADA/MMI purposes.



Fig. 7 Industrial modular PLC from ABB with Profibus DP Industrial LAN

In Fig. 8 is shown a model of level tank control with an industrial controller in connection with a PC computer for the visualization of control process and disturbance generation.

These models of industrial control systems can help to facilitate the understanding of the static and dynamic properties of typical technological processes, their instrumentation with industrial bus connections and the SCADA/MMI program support.

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



Fig. 8 Model of level tank control with an industrial controller in connection with a PC

As new technologies unfold, some current interesting trends, evening 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 encyclopaedia 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.

### 3 Conclusion

To fully realize the educational opportunities 21<sup>st</sup> century skills can bring students and educational leaders, they must be formally incorporated into the mainstream of the school curriculum, instruction, and assessment. In a 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 modelling.

The presented results show the possibility of student teams in solving some special problems connected to a very complex grant project as a part of their study. This way seems to be very useful in increasing a student's skills, especially in solving practical problems, managing 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 few years and obtain more experience with involving students in completing projects. The other useful ways on solving some 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 team work. The presented results have been obtained during the completion of research project GA 101/06/0491 supported by the Czech Science Foundation.

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