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THE USAGE OF THE NEW TECHNOLOGIES AT THE EDUCATION AT THE DEPARTMENT
OF CONTROL SYSTEMS AND INSTRUMENTATION

VYUŽITÍ NOVÝCH TECHNOLOGIÍ VE VÝUCE NA KATEDŘE AUTOMATIZAČNÍ
TECHNIKY A ŘÍZENÍ

Abstract

This contribution deals with the concept design for a modern laboratory for teaching computer systems, which solves the difficult requirements coming from concurrent teaching of different platforms. The paper deals with objectives and solving the FRVS No. 1939/2006 project and application from other projects which use modern technology. The paper describes using advanced technology as ASP.NET 2.0, .NET Framework 2.0, implementation of real time applications server in this technology, furthermore up-to-date applications at the department of control systems and instrumentation, which are using standalone microcontrollers with USB interface and also application of new digital gyroscopes.

Abstrakt

Příspěvek popisuje koncept moderní laboratoře pro výuku počítačových systémů a měřicí a senzorové techniky, který řeší obtížné požadavky na výuku a běhu aplikací na mnoha různých platformách. Článek je zaměřen na řešení projektu FRVS No. 1939/2006 a dalších kooperujících projektů využívající moderní technologie. Příspěvek popisuje využití technologií jako ASP.NET 2.0, .NET Framework 2.0, implementaci serveru reálných aplikací s využitím této technologie a dále aktuální aplikace na katedře automatického řízení a to využití mikrokontrolérů s rozhraním USB a také aplikace nových digitálních gyroskopů.

**1 INTRODUCTION: DESIGN OF LABORATORY FOR MOBILE, WIRELESS
AND VIRTUAL COMPUTER SYSEMS**

The goal is to offer students a possibility to acquire experience from working with various computer platforms using the latest technologies and being made aware of existing trends. It would be difficult and inefficient to cover various platforms by standard methods and solutions. The technology of virtual computers and servers offers a solution. The principle consists of use of one powerful computer (server), whereon several virtual computers (servers) are running concurrently. In practice, number of virtual servers run directly at the same time, which covers all the required platforms [KULHÁNEK 2005]. This solution brings a number of advantages, for example: cost saving, easy administration, servicing, working of the various configurations, fast implementation of new technologies, backup etc. Since these virtual servers look real, it is possible to verify the students' work together with their presentations. It is impossible to miss out a huge rise of use of mobile devices and wireless technologies. The educational flexibility is greatly increased by advanced hardware laboratory equipment [MACHOVÁ 2005]. Furthermore, within the frame of students' projects

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such a laboratory will enable the development of unique applications and implementations of a various type of wireless networks etc. The major benefits of a laboratory are:

- A simple and fast implementation of various server operation systems (Windows 2003 server, Linux, SQL Server) in several working versions and their concurrent running.
- Concurrent running of miscellaneous information technology (Microsoft IIS server, Apache web server, Microsoft SQL Server[ZOLOTOVÁ I., FLOCHOVÁ J. & OCELIKOVÁ E 2005], MySQL, etc.).
- Concurrent parallel running of 10 virtual servers on one piece of hardware server, its disc can have a whole range of various server configurations, which will execute tasks according to requirements of a concrete teaching subject.
- Server support for control, measurement and visualization systems.[SMUTNÝ, L., ŠKUTA J., BABIUCH M. & WAGNEROVÁ R.]

2 THE USAGE OF THE NEW TECHNOLOGIES - SERVER OF REAL TIME APPLICATION AT ASP.NET 2.0

A laboratory of this kind offers new possibilities for educating students in information technology. Students are able to learn about the administration of a network similar to a company network. A virtual local network is created easily by several virtual computers on every workstation using various servers and clients. Students can have full administrator permissions. In this way the students will be introduced to:

- The fundamentals of servers and client administrations.
- Internet protocols and services, TCP/IP, DNS, DHCP.
- FTP and Web server administration.
- Firewall, proxy server etc. installation and execution.

The laboratory enables the use of various tools in the programming oriented subjects and developing applications for various platforms. Students are introduced to:

- Development of MS Windows applications for .NET framework 2.0 at Visual Studio .NET 2005 environment [BABIUCH M, FOJTIK D. 2005].

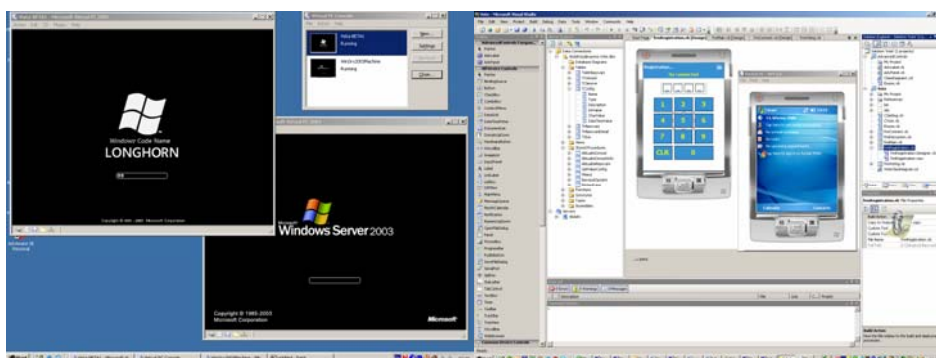


Fig.1: The example of use of several virtual computers, and various operating systems at one machine and development of an application for the Windows Mobile 5.0 in the Visual Studio.NET 2005[FOJTIK, D 2006]

- Development of utilities and programs at C language for MS Windows, MS Windows CE platform, Unix, Linux, etc.
- Development of web ASP.NET 2.0 and PHP applications.
- Development of Web Services wit using of ASP .NET Framework 2.0.

- Development of Client-Server applications - MS SQL Server 2005, My SQL etc.

The advantage of using virtual computers technology is the possibility of teaching students new software product testing methods. It regards to beta versions of prepared operating systems, for example Windows Vista, at the present time.

At summer term of 2006 has been created real time application server 352.lab in visual studio 2005 environment with ASP.NET 2.0 technology support, ADO.NET and .NET Framework 2.0. Server contains sections Laboratory H 303 and Laboratory H 306, where real time applications run. Real task contain important information for students as exercise instruction, video clips from education and other important files. Section Education contains study material in HTML forms and documents for downloading. There are also information about student's evaluation during semester and pages with student's protocols from exercises of following subjects: Measurement and sensors, Automation, Computers and network and Control systems tools. Application assists as a support of education at all laboratory places. Application is usually used for department of control systems presentation as a positive impulse for student's choice of specialisation and department. On the web server pages must be accessible all necessary information for protocol execution. There was eliminated the problems with consistence of actual exercise instruction in new version of real time application server at ASP.NET 2.0. Teachers of particular subject are in association with administrator of server, and they can change the web pages. Administrator has permission to change exercise tasks and possibility of documents updating without special knowledge of ASP.NET programming.

Fig.2: Real time application server 352.lab for education of several subjects from the area of control systems, created at ASP.NET 2.0 technology

3 APPLICATION OF MICROCONTROLLERS WITH USB INTERFACE

Attention is also given to application of microcontroller with implemented USB interface at the department of control system and instrumentation we can avoid RS232-USB converters, which are implemented in many types of applications. The higher time and programmer demandingness is characterised of implementation of this type of task, but we can work with true USB interface, nay virtual COM port. Example of this application is control of several systems by single module with integrated USB bus.

It is necessary to manage functions for access to USB interface. For correct functionality application must identify object, in this event HID device (Human Interface Device). It is necessary to manage the principles of USB transfer by PIC16C765 microcontroller, it means recognize principle of Endpoint control, work with USB buffer and of course with relevant registers of microcontroller.

USB module of microcontroller is controlled by 7 control and state registers and registers for endpoint control.

Further problem is comprehension of transfer types (control transfer, interrupt transfer, bulk transfer and isochronous transfer) and packets through the bus and choice the most suitable one for communication with application.

Special section of application is enumeration, it means device identification. Operating system must be able to ask for device information, which allows him suitable driver loading and correctly communicate. A new device is announced (enumeration) at the same time, obtains his interface address and is supported by special driver from this moment.

Another large part is comprehension of firmware of microcontroller. Firmware provides lowest level of interface on the chip side and provides several initialization and communication function. Precise manage and usage of these functions is necessary for correct functionality of whole application.

Information said above was used and implemented in the frame of teaching and diploma works creation for realization of application with control through the USB bus. The example of this application is control of two or more heat-air module simultaneously by single personal computer.

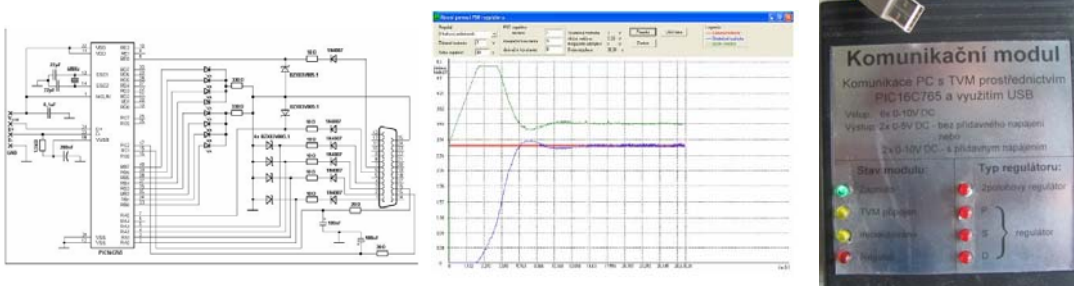


Fig.3: Microcontroller connected on USB interface, window from control application and communication USB module which contains microcontroller PIC 16C765 [SLAVÍČEK M. 2005]

4 APPLICATION OF DIGITAL GYROSCOPES

Requirements on communication with sensors increase together with technological development of communication interface. This situation calls for usage of sensors with digital output more often. That allows connection of particular sensors on common bus and communicates with superior system. The members on the lowest level (memories, microcontrollers, sensors, etc.) communicate between themselves via standardised bus (I2C, SPI, etc.). These buses allow Master – Slave communication between each other. Designed system contains following: Master device is in

that case RISC processor from MICROCHIP company and Slave devices is represented by gyroscopes and accelerometers. Master device will make data acquisition and then will provide data to superior system through the ILAN.

The goal of project is creating of system of three gyroscopes and two accelerometers, which communicates with main module on the microcontroller platform. Main module provides interface for data transfer from individual sensors into evaluating device through the ILAN. Algorithm of reading from individual sensors is implemented in standalone microcontroller. The whole system will be designed regarding to maximal miniaturization at the level of sensors and also at the level of touch screen device. Each of digital gyroscopes contains two analog inputs, which can use and make available to higher level through SPI bus.

Described system is realised only helping by analog gyroscopes at the present time. In this new project will be used the newest gyroscopes with digital output from Analog Devices company. Further the final module will be extending with accelerometers, which will communicate with gyroscopes through the common bus.

Methods of project solution:

- Choice of suitable sensors and standalone computer for solution of goals of the project.
- Testing of communication of particular gyroscopes and accelerometers through the SPI bus.
- Design of communication protocol between main control module including microcontroller and particular gyroscopes and accelerometer.
- Design and specification of communication interface between main module and touch screen panel or PDA, IPC etc.
- Design of general ordering of particular sensors in the module which enable sensing of values in tree axes.
- Realization of particular printed circuit with a view to possibilities of common bus at the circuit level.
- Realization of prototype of three axes sensing module, which contains gyroscopes with digital output.
- Final testing of module in real operation.
- Implementation into production.

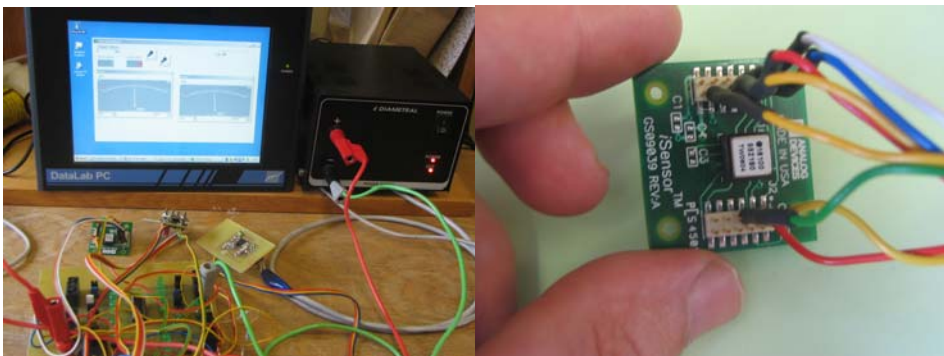


Fig.4: Application with USB interface, LCD touch screen and two digital gyroscopes working simultaneously, small development board with digital gyroscope

5 CONCLUSIONS

The paper describes a concept for problem solution of the granted research project FRVS No. 1939/2006 and other projects, which are solved at the department of control system and instrumentation.

This paper presents work on building of a laboratory for teaching programming subjects in usage of various platforms of the state-of-the-art information technology. This laboratory offers introduction of modern technologies into education of the hundreds of students from the department and faculty. At the laboratory are solved actual trends in the area of control and measurement systems and automation, which are interconnect with modern technology from the area of programming and software engineering. Typical example is solution of common runtime of newest digital gyroscopes through common bus, communicating with superior system through the USB. We are still working on these applications and next results will be presented in near future.

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