

MODERN METHODS FOR THE TEACHING OF VEHICLES CONTROL AND DIAGNOSTICS SYSTEMS

M.Sc. Dižo J. PhD.¹, M.Sc. Galliková J. PhD.¹, M.Sc. Blatnický M. PhD.¹, Assoc. prof. M.Sc. Dalibor Barta, PhD.¹
 Faculty of Mechanical Engineering – University of Žilina, Slovak Republic¹
 jan.dizo@fstroj.uniza.sk, jana.gallikova@fstroj.uniza.sk, miroslav.blatnicky@fstroj.uniza.sk, dalibor.barta@fstroj.uniza.sk

Abstract: The development of microelectronics intervened greatly in the automotive industry, therefore this fact cannot be ignored in the education. In today's teaching absent methods, special classrooms and didactic tool, that allow to know the operating principle, processes understanding and also diagnostics of vehicle electronic systems. The project, which is realising at the University of Žilina intended for the modern education of several study programs is presented in this paper.

This project will influence on professional qualifications of project investigators. They will improve their knowledge by means of professional training. New knowledge they will transfer subsequently in the education. The strategic goal of the project is "Reconcile the needs of the knowledge society and the labour market in higher education in the field of automotive technology".

Keywords: CONTROL SYSTEM, DIAGNOSTICS SYSTEM, VEHICLES

1. Introduction

During the project realisation the modern components of education will be implemented and they should help for removing barriers, creative activities and easier understanding complex processes which are in current vehicles, engines and other transport means.

The goal of this project is the establishment and the equipment of the experimental special classroom in which will be installed the state of the art tool of the vehicle diagnostics and simulations of vehicle electronic systems. When the special classroom will be realised, existing school subjects and study programs will be modified.

The main strategic objective of the project is "reconcile the needs of the knowledge society and the labor market in higher education in the field of automotive technology".

2. Characteristics and objectives of the project

The specific objective of the project is to improve the attractiveness and innovative forms of education in the field of automotive technology.

The expected result of the project will be an innovative teaching practices in bachelor and master studies. As part of the project it will set up a special education using the latest simulation methods activities of engine systems and vehicles for the purpose of establishing diagnosis. Another result of the project will be an innovative learning materials focused on the latest findings in the field of automotive technology. The objective of improving the quality of study materials and methods in teaching will achieve increased interest of young people in studying engineering disciplines. Implementation of the project is achieved by an increase in professional qualifications investigators pursue vocational training. This knowledge will then be transferred to the learning process.

Target groups of the project:

- University teachers,
- Employees of universities in research and development,
- Doctoral students,
- Students.

Project activities:

- 1.1 Analysis of the current labor market in relation to the improvement of innovative forms of teaching;

- the aim of this activity is to conduct a comprehensive analysis of the labor market so that pointed to the current situation and development of the automotive industry,
 - by means of obtaining information and knowledge about the actual needs of the labor market and society in automotive technology will be able to curricula and teaching processes and thus to innovate in ways that will be high-quality output ready group of graduates,;
- 1.2 The creation of new, sophisticated teaching aids for teaching;
 - The aim of this activity is the specification of simulation models of components, design and construction practices for the proper functioning of simulation panels diagnosis of engine vehicles within education,
 - By means of obtaining information and knowledge about the actual needs of the labor market and society in the field of automotive technology specialist investigators will be able to prepare an educational methods and techniques to fully exploit the potential of highly specialized simulation panels vehicles;
 - 1.3 Implementation methods of simulation models in the learning process,
 - the aim of the activity is the implementation of innovative education forms and its pilot verification in the educational process
 - innovation of curricula will take place on the basis of knowledge from previous analyzes and monitoring the behavior of simulation models through the application of new knowledge into curricula and education materials.

Through the implementation of project activities will improve the professional preparedness of concerned department's student to the actual needs of the labor market.

At the same time university teachers, employees in research and development and training PhD students completing high gain new expertise in automotive technology, thereby increasing their labor market competitiveness.

The main aim of the project is to adapt and innovate higher education methods and processes to the needs of the knowledge society and the labor market in view of the latest trends and directions of development of vehicle technology.

Project realization consists of the involvement of professional researchers, who have the opportunity to increase their expertise through training, exchange programs and international mobility. The project is expected to increase the qualifications of teachers,

university employees in research and development and doctoral students who will participate in the execution of project activities.

The project will create specialized classrooms with modern teaching aids based on the most advanced systems of diagnostic panels that will simulate controllers and other functional activities within the operation of vehicles.

Analysis of all processes, lessons learned result in an adjustment of existing curricula and create new learning materials for students of compulsory subjects and many other optional subjects.

It is expected to increase interest in younger age groups to study the issue to the creation of highly sophisticated experimental teaching simulation-based electronic educational panels.

The present project follows the requirements of the activities in the field of strategic importance for the further development of economy and society and is consistent with the long-term aim of University of Žilina.

Achievement of project objectives and challenges manage to get a flexible and fast-adapting graduates whose inclusion san and the labor market due to meeting market requirements will help develop the region and ensure that such companies to greater prosperity and a better quality of life [1].

3. Project management, involvement of partners

The project is led by the Department Transport and Handling equipment for the Faculty of Engineering. Department focuses on tackling vehicle safety against derailment, wheel/rail contact, theory and design of rail vehicles and track maintenance machines, testing braking systems.

The Department develops the theory and application of maintenance of rolling stock as well as machinery and equipment in general, deals with the problems of reliability and development of new systems maintenance, management of maintenance processes using the most advanced software in the field of project management and computerized maintenance management system. It continues also in the traditional areas of research as drive traffic, traffic vehicles and their quality and environmental parameter, with emphasis on reducing noise and vibration.

The Department is also aimed at addressing the various issues of theory and design of reciprocating internal combustion engines and virtual modeling, dedicated to the problems of the environmental burden of energy units equipped with combustion engines, cars and other means of transport.

For the management and implementation of the project the project team corresponds. Its foundation is a combination of internal and external team staff team. The project team consists of: Project manager, coordinator of professional activity, Clerk, Personnel Worker, publicity manager, accountant, financial manager, to public procurement, monitoring manager and project participants [1].

4. Didactic means – training panel

HD Elektronik Company offers a variety of teaching resources that will improve the level of teaching. Teaching resources (hardware, software) are supported by extensive written online material that can serve as a basis for teaching the basics of automotive electronics. Expert system "HD Elektronik", which implements auto-navigation experts in finding complex disorders can serve as a basis for teaching advanced in the field of automotive electronics, for example the realization of postgraduate courses.

A big benefit of superior teaching composition is perfect documentation, which includes in addition to features and work with the system and also a description of the function of the automotive components and description of signals.

Presented teaching tool is able to fully generate real action and real electronic signals of a particular vehicle. To ensure high comfort and economy of teaching is a feature of some mechanical components, e.g. mechanics of combustion engine emulated by the electronics and control unit for the heading to "feel" in the real environment and allows you to perform all the functions flawlessly inside (on board) and parallel pin diagnostics. Teaching material is controlled by a PC and PC teacher students. Both computers have different rights and information. Computer teacher allows you to generate a large number of disorders, while working student is provided with a diagnostic means.

The HD Elektronika Company prepares the description of simulated waveforms. It offers various types of diagnostic panel:

- VEP500/motor – diagnostic panel "Motor",
- VEP500/BSI – diagnostic panel "Central electronics BSI",
- VEP500/ABS – diagnostics panel "ABS",
- VEP500/AIR BAG – diagnostics panel "AIR BAG",
- VEP500/KL – diagnostics panel "Air Conditioner",
- VEP500/KE1 – diagnostics panel "Comfortable electronics",
- VEP500/KE2 – diagnostics panel "Comfortable electronics",

For VEP500 Škoda Fabia 1.4 16V components are used.

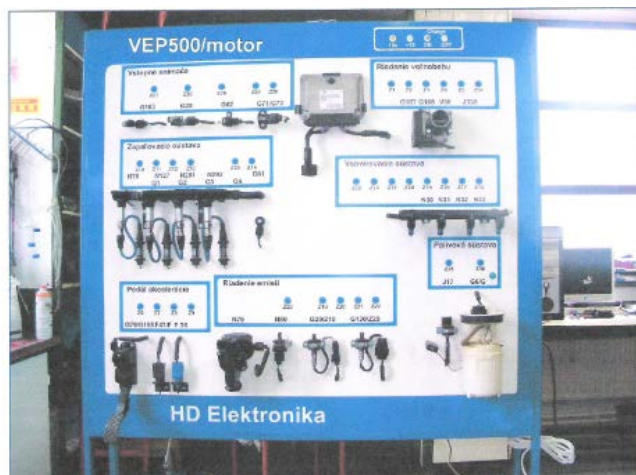


Fig. 1 Diagnostic panel "Motor" (VEP500/motor) [2]

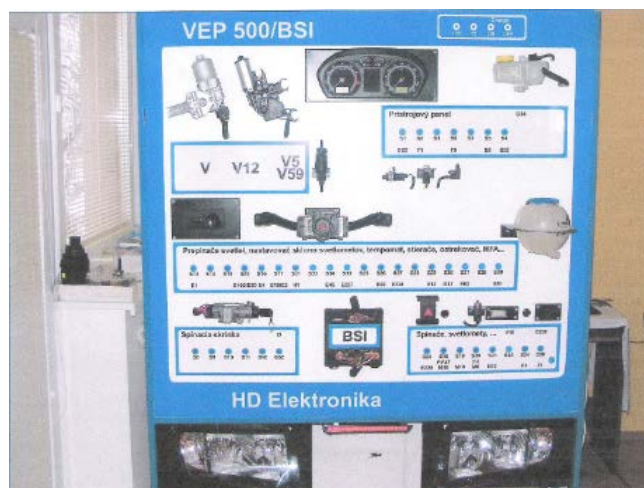


Fig. 2 Diagnostic panel "Central electronics BSI" (VEP500/BSI) [2]

Functional panel electronics powerplant car with computer – controlled fault simulator – we propose to built a fully functional panel electronics powerplant operated and extensible through the CAN bus, which will be supplemented by computer-controlled simulator disorders.

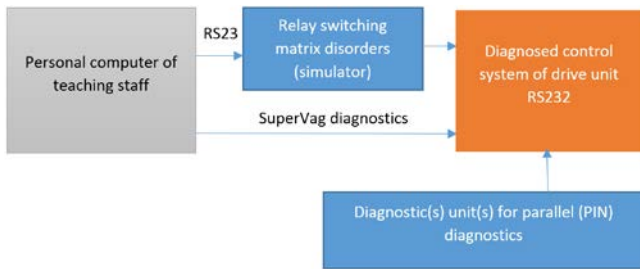


Fig. 3 Faults simulator in electrical and electronic circuits (Diagnostic panel "Motor") [2]

Stats faults in electrical and electronic circuits, diagnostic tools for internal "on-board" diagnostics and "pin" diagnostics. The figure illustrates the principle of the system, its expansion and improvement will take place on the basis of claims guide more students, or new requirements.

Diagnostic panel VEP500/KE2 contains components (electric windows, electric sunroof, electrically operated door mirrors ...) with the possibility of simulation disorders. Moving parts are replaced with electronic simulation. The panel can be measured by measuring jacks parallel diagnosis each course selected components. Through diagnostic socked serial diagnostics can blame simulated fault.

Computer teacher teaching staff will enter the task – failure, computer students communicate the results of the test carried out by a series of diagnostic equipment SuperVAG, control the activities of students in locating such as errors using a digital oscilloscope didactic HD25 or engine testers "Diagnostic Analyzer HD34N" and evaluate student activity. Relay switching matrix disorders modular, expandable relay matrix disorders teacher computer controlled by a specified type of fault. Diagnosed system – fully functional panel controlled comfort electronics and extensible via the CAN bus. Diagnostics HD Elektornika is a major manufacturer of this technology and has in its production program wide range of these products and diagnostic devices cooperating companies.

Technical description of the components of version 10.0.2 includes 25 components (approx. 1200 pages ignition, injection, ...). The following figures tell us about the work environment HD Elektronika Ltd [2].

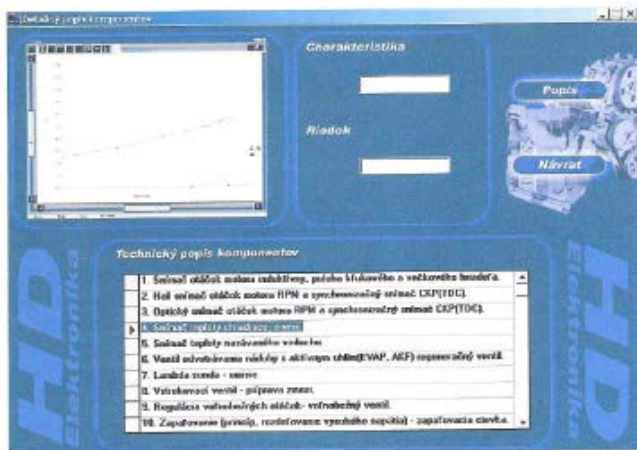


Fig. 4 Detailed description of components [2]

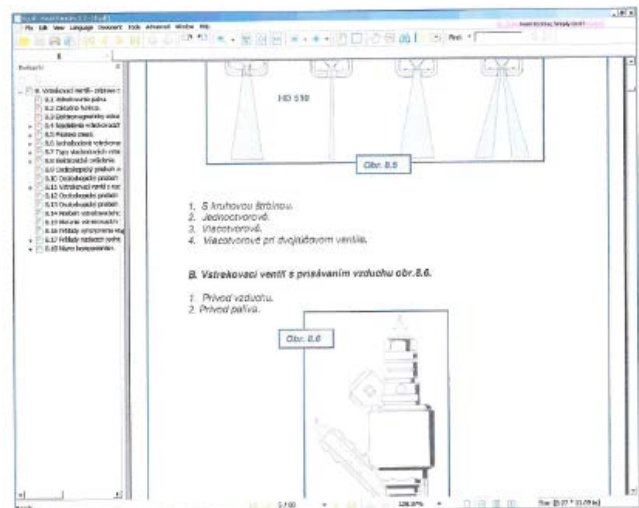


Fig. 5 Description and construction components [2]

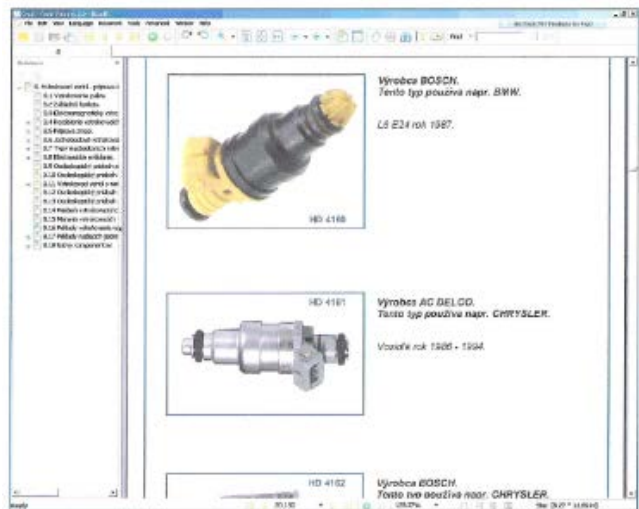


Fig. 6 Producer and using components [2]

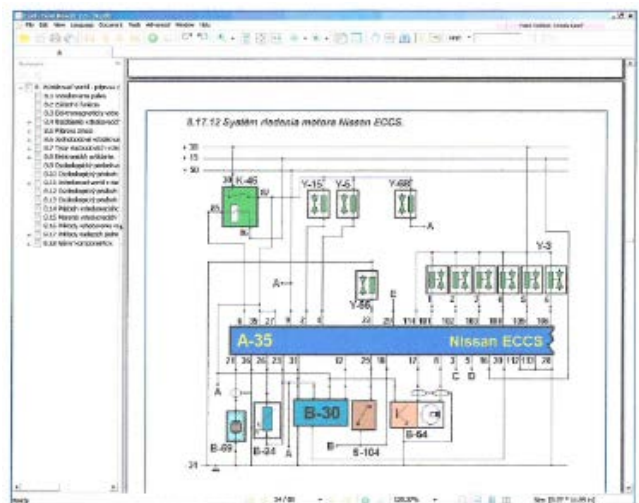


Fig. 7 Practical involvement [2]

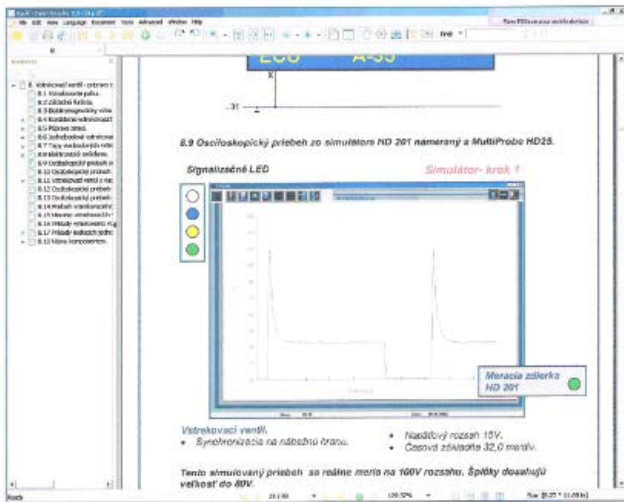


Fig. 8 Simulated waveforms [2]

Škoda Fabia – real functioning didactic interactive system. It consists of:

- Two panels “Powerplant” and “BSI”,
- Functions of engine drive (RPM, camshaft, crankshaft) are completely emulated microprocessor,
- Functions of chassis (measurements of velocity) are emulated microprocessor,
- All BSI components and functions are operational,
- Test points for diagnostics are labeled in conformity with the service documentation of Škoda Fabia,
- Properly working control loop between the combustion engine and the control unit ECU. The ECU does not detect any error resulting from a malfunction engine,
- Complete On Board (serial) diagnostics,
- Excellent four channel Pin Diagnostics “Diana”,
- Computer control station teacher is equipped with sophisticated intuitive software. Using this software the teacher can guide the didactic devices. Creating new challenges for teaching and create about a million error combinations that students can solve. Error combinations represents cases of actual practice.
- Student stations are equipped with special software, which stimulates activity and creativity of students. Using this software, the student learns the theoretical and practical principles of operation of automotive components and their cooperation. Students can also learn how to implement and PIN On Board Diagnostics,
- Special instruction increases the activity of the teacher and updated knowledge of students.

5. Anticipated benefits and follow-up activities of the project

Human resources development will be ensured through continuous learning and skill transfer to new PhD students and research and development staff. Implementation of the project will increase skills and knowledge of the target groups of the project submitted

University teachers, professional investigators involved in the project will benefit from the experience and knowledge acquired after the end of the project will use the latest ICT gained in the implementation of the project in the education process use modern equipment. Their professional competences will be increased.

Students involved in the project will be able to use new knowledge in practice in the labor market as well as any further education.

The basic benefits of the project can be included:

- use of knowledge and results, in cooperation with professional experience and the professional community,
- addressing common challenges in new partnerships (automotive production, diagnostics),
- processing of technical publications, technical papers,
- development and promotion of professional development of young researchers at a higher quality level,
- increasing the quality of the practical vocational training students for 1st, 2nd and 3rd education degree,
- coordination of further development of HighTech in industry in Slovakia,
- professional participation in global and international forums and conferences,
- implementation of activities that will contribute to increase the motivation of young people to study technical disciplines.

Conclusion

On completion of project activities is expected to be full utilization of the project results in the form of operation of the dedicated classrooms for simulation of electrical management processes for vehicles and engines. An important indicator of sustainable will create learning materials (textbooks, scripts), which will be recording the results of the analysis of labor market needs in the field of automotive technology and the use of innovative models in practice.

After completion of the project we will continue to expand opportunities for studying at our university and ensure the development and progress of the school. This follow-up activity after the project we want to finance from its own resources, subsidies, if necessary EU resources in the form of projects or trough sponsorship.

Acknowledgement

This contribution is the result of the project implementation: “Modern methods of teaching of control and diagnostic systems of engine vehicles”, ITMS code 26110230107, supported by the Operational Programme Education.



The Agency
of the Ministry of Education, Science, Research and Sport
of the Slovak Republic
for the Structural Funds EU



References

- [1] “Modern methods of teaching of control and diagnostic systems of engine vehicles”. Presentation material.
- [2] HD Elektronika SK, Tutorials, <http://www.hdelektronikask.sk/images/produkty/TPK/TPK%20-%201.pdf>.
- [3] Pavlásek, P., Pavlásková, V. *Technical means of teaching*. (In Slovak). University of Žilina, 2014, p. 83. ISBN 80-8070-236-5.