An Analysis of Bachelor Final Year Projects Content in Electronic Engineering at KTU

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Introduction

In Lithuania three state universities (Kaunas university of technology, Vilnius Gediminas technical university, Siauliai university) offer electronic engineering (EE) bachelor study program [1]. Description of what electronic engineer should be capable after graduating the particular program and contents of study subjects (curriculum) does not differ significantly among these universities. The set of qualifications related to the EE field encompass designing, testing, installing, providing maintenance of electronics equipment and systems, organizing production, documenting technical solutions, performing experimental investigation and measurements, or even more generally speaking solving EE problems, etc.

The new fields that electronics comprises nowadays and the requirements of professional work proposed these goals in EE study programs: a) anticipating technological course and postponing basic sciences; b) design-based learning; c) electronic engineering as a unifying concept; d) balancing broad and specialized engineering education [2-6]. These goals require new approach to EE curricula and final years project (FYP).

The student's FYP is aimed to prove his or her skills and abilities gained during the studies. Due to the limited allocated time and available resources the task for FYP usually does not require demonstration of student's abilities like organizing production, maintenance, and installation. Therefore, activities like designing and experimental investigation emerges to be the most often expected in the FYP. But what in our times involves electronic system design? Do we reflect it good in our study programs and tasks for EE bachelor FYP?

Analyzing descriptions of EE programs of these three Lithuanian universities and definition of electronic engineer's profession [1] we can find some more precise examples of electronic systems that an engineer is expected to be able to design. These include embedded systems, integrated chips, computer systems, digital signal processing equipment, analog and digital communication systems, medical electronics, measurement and diagnostics instrumentation, electronic imaging systems, etc. Each of them will certainly have some specific steps in the design process. Concerning the functional methods one can find declarations including the ability to develop software and use automated design tools, ability to measure electrical parameters and characteristics, etc.

Having the above mentioned and abstracting from any particular field of application it can be named out skills, needed to design in EE field. These skills are presented in Table 1.

Table 1. Skills of EE field

No	Skills
1	Designing electronic (electrical) schematics (analog and digital parts)
2	Designing printed circuit board or integrated chip
3	Prototyping or integrating the system from separate parts of the shelf
4	Designing and specifying processing or control algorithm
5	Developing embedded software
6	Testing the prototype or experimental investigation (using computer simulation, using measurements, using kits and evaluation boards, using virtual instruments [7], etc.)

In this research we will focus on the survey of students' FYP in EE study programme at Kaunas University of Technology in the last five years. The purpose is to refine quantitative numbers indicating which

EE related skills are presented by students. We also pursue the goal to estimate the relationship between the contents of EE study programme and the contents of FYP. The results of the analysis could serve as a tool for monitoring and improving both curriculum of study program and projects assessment procedures.

Methodology

To collect initially selected types of data we have manually analysed archive of EE bachelor degree FYP reports over 2006-2010 defended at Kaunas university of technology, Telecommunications and electronics faculty. Composed spreadsheet then was used to perform statistical analysis of the data. Grades of FYP assessment were also included in the data set which allowed to draw conclusions regarding contents of the projects and final assessment. The data extracted for our analysis was purely quantitative and did not reflect the qualitative aspects of the projects. Qualitative features of the project and presentation must be considered by the experts in the field of various EE branches and fields of application and may be subject to their personal opinions and experiences. Therefore we were trying to avoid this part of analysis as requiring much more effort and expertize.

FYP Contents Analysis

Number of full time and partial time students graduating EE was respectively 48 in 2006, 48 in 2007, 37 in 2008, 46 in 2009, and 34 in 2010.

Fields of application of electronic projects selected by the students is very wide (see Fig. 1). However, non of them is dominating obviously. Fields of application are defined by the needs of regional industries and institutions, scientific interests of university departments and their staff as well as personal involvement of students.
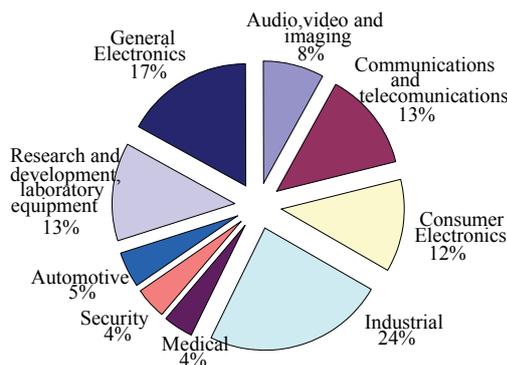

Fig. 1. Application fields of FYP

That diversity of the projects may burden definition of the EE field itself and also the list of skills attributed to the EE. Some general understanding about the methods, tools, fields of electronic design (later design features) can be obtained from Fig. 2–Fig. 6 and Table 2.

It looks natural that majority of the students present electrical schematics. Less number of students were able to design a PCB drawings, despite the fact, that these skills are practiced in some elective courses.

The number of students presenting schematics, PCB drawings, prototypes seems to increase every year. On the other hand it should not be expected that the percentage must reach 100 % because some projects do not require development of PCB boards.

To say concerning the tools used we observed that Altium Designer is getting popular in the last several years. It can be explained by the fact that this tool was introduced in teaching courses in around 2008.

Table 2. Summary of FYP design features (2006-2010)

| Features	Percentage from all projects
Projects with electrical schematics	80
Projects with PCB drawings	32
Projects with prototype	36
Projects with EM and prototype	23
Projects with simulation	58
Projects with embedded microcontroller (EM)	62
Projects with EM software	29
Projects with computer (PC) software	13
Projects with block diagram of embedded software	60
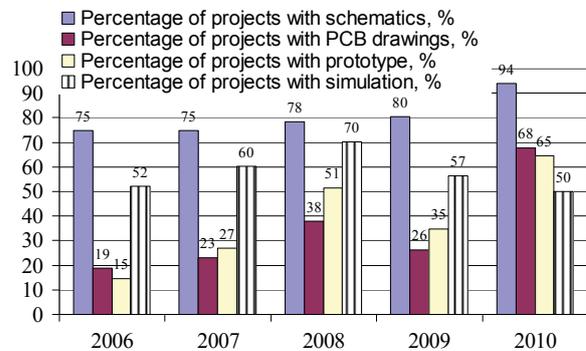
Fig. 2. Electrical schematics, PCB drawings, prototypes and simulation in the FYP
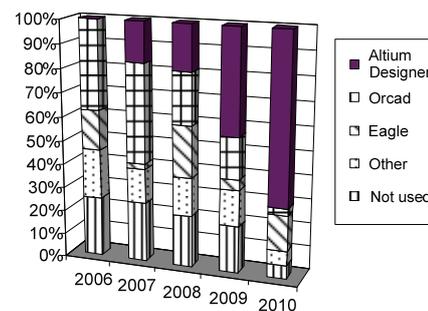

Fig. 3. Tools used for electronic schematics drawing

It can be stated that using programmable microcontrollers and all the associated design flows (algorithm block diagrams drawing, coding in programming languages, debugging with prototype) became a common practise in designing electronic systems [6]. Except the year 2010 students mainly use simple 8 bit microcontrollers while world wide industries have already moved to 32 bit architectures like ARM. In our courses 8051 architecture and MSP430 microcontrollers are utilized. However, looking at the Fig. 5 we see that these choices are not necessary made by students themselves. There could be a lot of reasons like advises of their

supervisors, marketing of vendors, prices and availability of chips and development tools, but most important is that students are able to migrate to different solutions and tools compared to what they faced in the teaching labs.
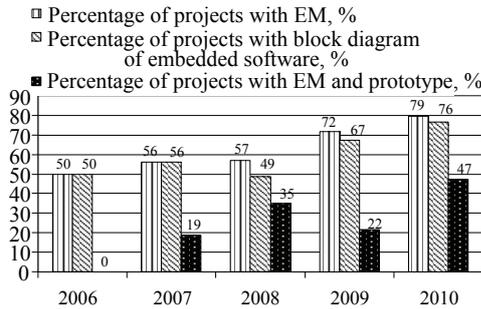
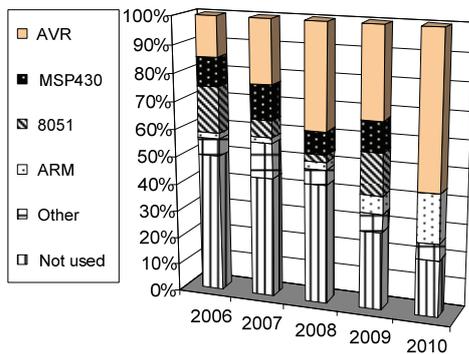

Fig. 4. Embedded microcontrollers (EM) in EE FYP

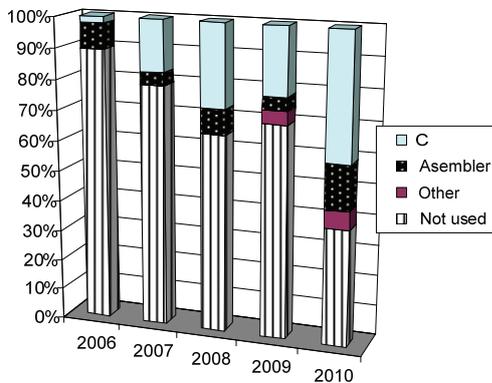**Fig. 5.** Embedded microcontrollers in EE FYP by manufacturer or architecture

Fig. 6. Programming languages of EM in FYP

Usage of programming languages corresponds to world trends and contents of curriculum of the study program.

To add one note related to digital electronics we clearly miss programmable logic (PL) applications in our FYP. PL in these days are used very widely and reflection of this could be expected in student's projects. Perhaps the main obstacle in this situation is the absence of courses dealing with FPGA design. Looks like students are not able to utilize the new technologies and design flows they are not teached.

Grades versus contents

At the beginning let us take a look at grades distributions in Fig. 7 and Fig. 8. It can be noticed that grades of FYP are nearly by 2 points exceed average learning grades. This may indicate students increased dedication, motivation and interest in FYP performance compared to the rest of curriculum courses. Obviously adequate assessment of the FYP is of big importance. Grades given by supervisors, reviewers and defense board (final grade of project) in average does not differ noticeably and all of them follow recommended distribution similar to normal (Gaussian).
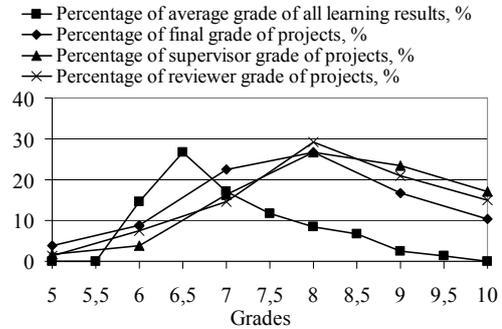

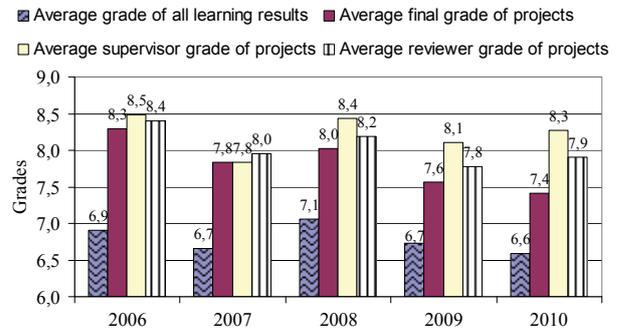**Fig. 7.** Distribution of assessments over 2006-2010

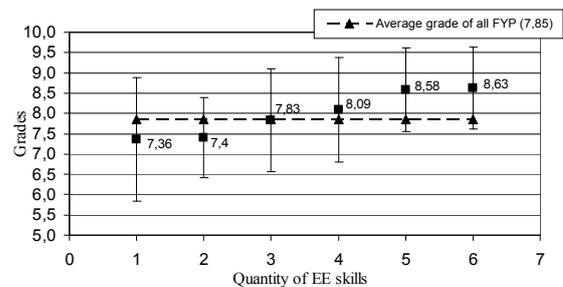**Fig. 8.** Distribution of assessments in each year

Fig. 9. Average grades and their deviation vs. number of demonstrated skills

In Fig. 9 we made an attempt to visualize dependence of the grades vs. number of skills demonstrated in FYP and listed in Table 1. The average grade increases steady with the increase of demonstrated skills. This sounds adequate and neither points to any assessment problems nor rises any doubts concerning the relevance of selected EE skills. However, the standard deviation of grades is dangerously high. To mention the extreme case we can see that there were some students that received a less grade by demonstrating all 6 analyzed skills compared to some students that proved the abilities only with one skill. Surely, this must support the criticism of assessment procedure.

Discussion

How these results could be used to monitor and improve a curriculum? First of all we could see which subjects, tools, technologies, etc. are most often used in FYPs. Then one would expect that the number of academic credits of the particular discipline (could be represented by group of academic modules) should be in some direct relationship with the extent of knowledge's and skills covered or needed in the integral assessment over the certain period of FYP. Without giving any particular examples at the moment we have mentioned that there are some courses whose contents was not related to any of the FYP in the period of five years. On the other hand some other disciplines are used in more than two thirds of all FYP. Therefore, each academic module could have an "impact factor" indicating its importance to the FYPs. Strong disagreement between the worlds wide EE tends and the "impact factor" could point to the problems of particular course or to the activities (demands by industry, local organizations, and research groups) in the particular field of EE in the country of concern.

Conclusions

The spectrum of EE field applications covered in the FYP is wide and none of the fields dominate. In spite of that vast majority of projects include electronics schematics designing and embedded systems designing.

Collected data reveals that skills developed and tools used in study courses in FYP are applied rather differently: some tools are used extensively, while some are substituted by the alternatives.

The total EE student's learning assessment average grade is usually by 2 points lower that the grade in FYP.

Average over five years FYP assessment by supervisor, reviewer and final grade given after defense does not fluctuate significantly.

Considering the suggested assessment criteria average assessment grade increases in response to the number of skills demonstrated. This indicates that the criteria do not conflict with existing procedure. However, assessment deviation is rather high. Therefore, entering the criteria in to the formal assessment procedure could decrease the dispersion.

References

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M. Saunoris, Z. Nakutis. An Analysis of Bachelor Final Year Projects Content in Electronic Engineering at KTU // Electronics and Electrical Engineering. – Kaunas: Technologija, 2011. – No. 10(116). – P. 109–112.

An overview of electronic engineering field related skills, tools used to prove them, fields of applications and final year project grades are presented based on the data collected from project reports in the period 2006-2010 at Kaunas university of technology, Telecommunications and Electronics Faculty. Large diversity of the projects makes it hard to compose well defined assessment criteria but noticeably large deviation of given grades calls for better formalization of assessment criteria. A list of criteria was suggested and it was shown that average grades do not contradict with it even prior to its legalized acceptance. Ill. 9, bibl. 7, tabl. 2 (in English; abstracts in English and Lithuanian).

M. Saunoris, Ž. Nakutis. Elektronikos inžinerijos programos baigiamųjų darbų analizė KTU // Elektronika ir elektrotechnika. – Kaunas: Technologija, 2011. – Nr. 10(116). – P. 109–112.

Pateikiama elektronikos inžinerijos programos baigiamųjų darbų, gintų 2006–2010 metais Kauno technologijos universitete, Telekomunikacijų ir elektronikos fakultete, apžvalga, atkreipiant dėmesį į elektronikos inžinerijos taikymo sritis, studentų naudojamą įrangą, darbų įvertinimus. Darbų įvairovė apsunkina vertinimo kriterijų formulavimą, tačiau didoka vertinimų sklaida rodo formalių kriterijų taikymo vertinimo procedūroje poreikį. Straipsnyje pasiūlytas tokių kriterijų sąrašas. Taip pat parodyta, kad vertinimas naudojant šiuos kriterijus neprieštarautų dabartinei vertinimo sistemai, o tik ją patikslintų ir leistų sumažinti baigiamųjų darbų įvertinimų sklaidą. Il. 9, bibl. 7, lent. 2 (anglų kalba; santraukos anglų ir lietuvių k.).