

New Medium Teaching Method for Power Electronics

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Abstract: Web-based method has been used in teaching engineering and many other subjects for quite some time. This paper is to discuss the Web-based teaching of power electronics using a number of new techniques. The paper also discusses the assessment of the course and survey through questionnaire in order to assess the success of the proposed method.

1. INTRODUCTION

The use of new medium for teaching is now being promoted by university and school. Educators are also looking into the best method to deliver a lecture [1]. Of course, there are new medium including web, internet, computer, and many to enhance teaching and learning. In fact a good teaching method not only depends on using internet or computer, the importance is how to make an effective method to deliver the subject to users. The teaching of power electronics subjects is more difficult than the other engineering or non-engineering ones because it involves mathematics, computer programming and hardware example. Therefore a careful design of the web-based software is needed.

It is not acceptable that a Web-based teaching and learning package can only convert the materials into web-format such as html. It should present the materials in an effective way to help students. Problem-based and output-based learning is fashionable now for teaching and it can also be integrated web-based format[2]. Problem-based learning (PBL) is basically to allow students to investigate a problem by themselves with little help from the teacher. During the course of working out the answer, students can develop the skill to learn by themselves and research has found that students can learn better and have shown significant improvement [3]. Many successful cases have been reported. [4].

Teaching power electronics using Internet or Webs is commonly found in universities. However, to make the whole course of power electronics to be web-based, it is necessary not only to have teaching, but also include the components of experiment, examination and student record. This paper is to discuss the above issues.

II. THE PROPOSED METHOD FOR POWER ELECTRONICS

The aims for the development a web-based program are to allow an interactive web-based media for students to learn the Power Electronics and further to increase their learning interest. To meet this aims, this web-based course are developed as follow:

1) Password protected

To deliver the courses 'Online', security is a curial issue that we need to focus on. By having the password protection, students need to login before they reach the

teaching materials, such as the lecture notes, tutorial, etc. This can help to better monitor to the visitors to access to the web-site.

2) Well structured teaching and learning notes

The content for the "Online" course delivery system is very important. In order to facilitate the teaching and learning process, a well structured web-site is needed. The power electronics course is structured as follow:

i) *Clear module syllabus:* By having a clear module syllabus, students can have a better guideline for their study, this can enhance the effectiveness for their learning.

ii) *Well structured Lecture notes:* The structure of the Lecture notes are clearly arranged, so students can easy to do self-study by using the online materials.

iii) *All chapter's tutorials are available for download:* This can enhance the students to self-study.

iv) *Sample past examination and test papers:* Some of the past examination and test papers with suggested answers are available for students to download. so students can get more familiar with the examination style, marking scheme, etc. So students can have more confident during the examination.

v) *Printable format:* Beside the Online course material, a printable format are also provided. So that students can choose rather they want to perform the class online or download the hard copy for further revision.

3) Animation

To let the "Online material" more interactive, many flash animations are being made. This can help students to better understand the current flow, also help students easy to memorize the concept.

4) Webinar

"Webinar" for this subject have been created. This is an Online teaching tools, which can capture the lecturer's, talk and display online. By doing so students can revise the lectures at anytime, everywhere they want.

Besides, during the presentation of the lectures, the slide flow will follow the flow of the actual presentation, so students can not only listen to the lecturers talk, but they can also have better follow the teaching schedule.

5) Online Test/ Assignment

Online Test provides an interactive learning media for students to study. By using the Online Test system, students can perform their test, or assignment anytime, everywhere. This can facilitate students to have more self-organized learning environment.

6) Virtual Laboratory

The aim for “Virtual Laboratory” is facilitate students to perform their laboratory at anytime and anywhere they want. By using this “Virtual Laboratory” system, students can perform their experiments by remoting control the experiment equipments and the data that generated by the experiment set will transfer to the student side though the main server. This can help to increase the using rate of the experiment tools and help students to have a more flexible time slot to do their experiment.

In order to arouse the interest of students, a multilingual method has been implemented into the software. There are many translation and vocal methods introduced that allow student to learn and translate the English materials in the web site into Chinese. The translation mechanism is simple and there is no need to open another web-site or browser to perform the jobs

In this paper, each of the tools will be explain and their significant contribution in the teaching and learning are described. By going through the paper, you will experience the new-method of teaching based on a web-based method. The software has been tried in electrical engineering teaching for a couple of years. Students’ improvement after using the software has been observed.

The web-site is named as the *eelearning* because it is using electronic engineering means to deliver the learning method. It is initially used for electrical engineering teaching. The URL of the software is: <http://eelearning.ee.polyu.edu.hk>.

2. The software and animation

2.1 Basic Web pages

Fig 1 shows the front page for the web-site. Users can access the whole web-site using the function icon on the left hand side. The function can also be accessed from the top bar.. There are two subjects namely, Industrial Power Electronics EE521 and Advanced power electronics EE421 have been developed in the web-site. The Industrial Power Electronics are basically covers areas of:

- AC distribution power system
- Devices and package
- EMI
- Phase controller converters
- Fault tolerance distributed power
- Filter system
- Industrial power supply
- Magnetics
- Power factor correction
- Permanent magnetic DC brushless motor
- Aerospace power electronics

For the Power Electronics for Utility Applications EE521, the following topics are covered:

- Converters
- Inverters

- Harmonics and Power quality
- Var compensation, HVAC, HVDC
- High power electronics

For the Advanced power electronics EE421, the following topics are covered:

- Switched mode power converters
- Isolated DC power converters
- Quasi-resonant zero-current switching converters
- Quasi-resonant zero-voltage switching converters
- Load resonant converter
- Modelling and control
- Inverter
- EMI

Fig 2, 3 and 4 shows the content web pages of Industrial Power Electronics, and Power Electronics and Advanced Power Electronics for Utility Applications and the first two courses for MSc and 3rd course is for BEng final years respectively. No intention was made to use complicate flash or animation on the content pages because they do not contribute to the enhancement of learning. Therefore only plain web site with various icons to assess the slide of power point, lecture note, examination and past test papers.



Fig 1: Title page of the web-site

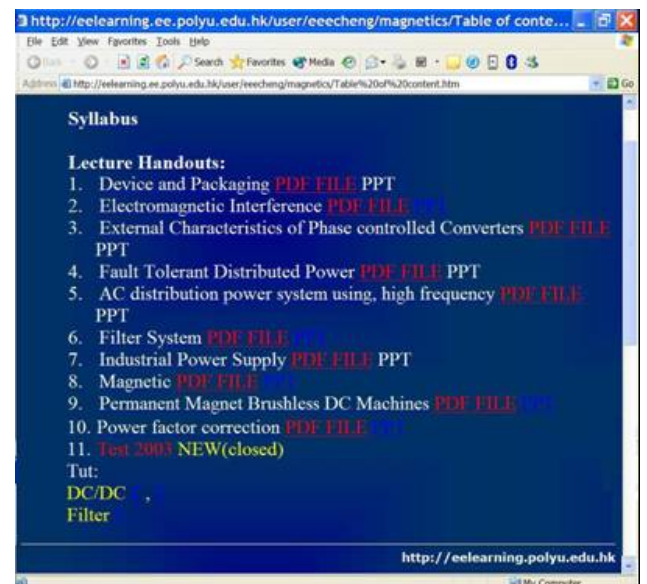


Fig 2: Content page for the Industrial Power Electronics



Fig 3: Content pages for Power Electronics for utility Applications

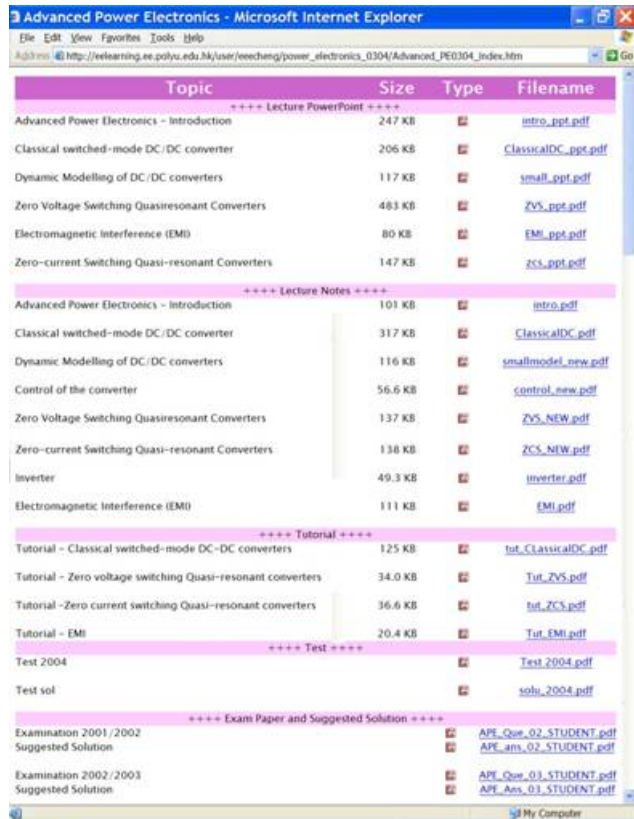


Fig 4 The web-page for the Advanced power electronics

2.2 ANIMATIONS AND TEACHING

It is also found that complicate animations may not help students' learning. Research has found that students switch to other web-page or web-site if the loading time is too long. They may also lose their concentration if the animation is

too interested but irrelevant to the study. Fig 5 shows an example of simple animations for then filter. It shows how the current flows in the circuit.

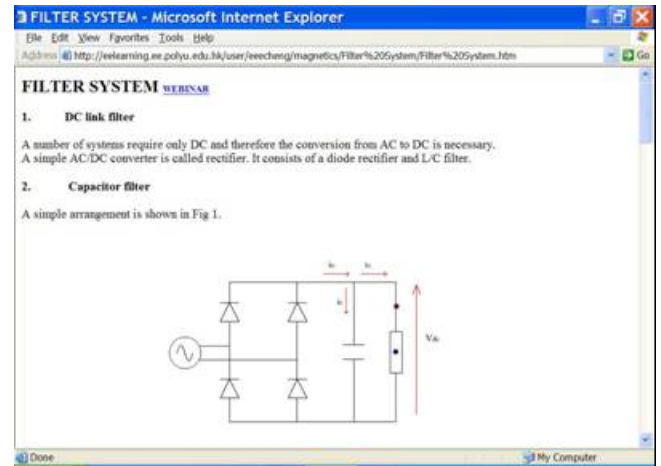


Fig 5: An example of web-based lecture notes

3. Web-page with Multilingual translator

3.1 Multifunctional translator

One of the main problems of learning power electronics is that most of the materials are written in English. The Students may find them difficult to understand. Many jargons may not been found in common English dictionary. Therefore the study of these lectures may have difficulty. The Asian students have a language barrier that slows down their learning. It is inconvenient for them for look up the dictionary when they are reading lecturer notes. The elearning web-site is to integrate the multilingual approach in teaching and learning. This will arouse the interests of the students. They do not need to open another website for translation or dictionary.

Then translator is basically a plug-in is installed in the internet explorer so that when the right handclip of the mouse is pressed, an extended menu is popup as shown in Fig 6. That will show the additional information of a word. The function includes: Chinese translation, explanation in Chinese, English, Pronunciation in English, Cantonese and Mandarin, Sample usage in Chinese and English. The special feature is that the translation or explanation is orientated to engineering and in most of the cases, the explanation is configured to the electrical engineering and other engineering. Therefore only limited explanation is displayed. Students will not find the translated word or explanation are too many and confusing. The pronunciation is given in three dialects so that is especially useful for teaching in Hong Kong. The above information is stored in a database so that it allows future extension to cover other language and additional features can be added.



Fig 6: Web-based translator

3.2 Scan translator

The scan feature is particularly useful for a quick conversion into the Chinese meaning without complicated operation. When the function is energized, the essay input from users is then processed by an engine (CGI). The engine matches words from the essay and produces a Hyper-Link for each word. Finally, the user can read the essay and words' meaning together. The voice is available when the user installs Speech SDK Engine, which is the mouth engine for pronunciation. The Chinese translated version will be displayed when the mouse is placed on the English word. Fig 7 shows an example of the function.



Fig 7: Scan translator

4. REMOTE CONTROL LABORATORY

Research has been found that experiment is the most important element in teaching power electronics. Classically the experiment is performed in the laboratory, which is fine for conventional teaching. However, as the internet is now widely available and students and teachers are demanding for more information and internet control for the teaching and learning, web-based experiment is necessary.

The remote controlled experiment is programmed using Labview and all the instruments are connected using GPIB

or other data acquisition method. The main features of the system are:

- It can be assessed 24 hours a day and all years.
- All the procedures are controlled in a systemic and safe manner. No accident can happen.
- The voltage, load, signals can be adjusted in the web.
- The measurement can be made in an oscilloscope display in the web. The results can be sent back to users.
- A project can be generated following the procedure of the web page.
- A camera is also installed to give students a more real feeling of the experiment.

So far, four sets of experiments have been programmed. They are:

- Classical DC/DC power converters
- Quasi-resonant zero-current switching converter
- Power factor correction
- Inverter

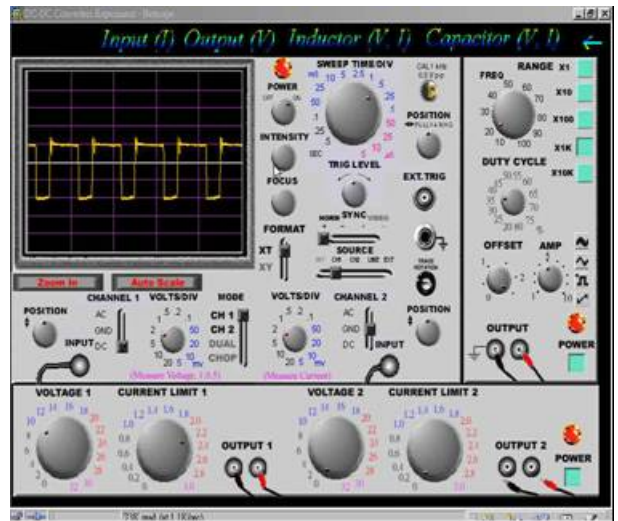


Fig 8: User Interface of the Virtual Lab

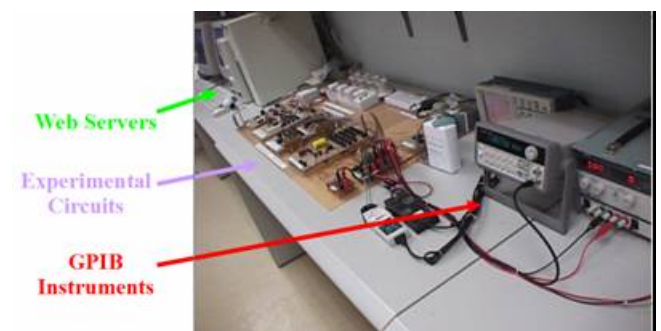


Fig 9: The hardware photo of the remote control experiment

5. WEB-BASED EXERCISES

The assessment of the students' performance in Power electronics is usually the examination, test and project. The Web-based exercises have been developed that allow the assessment to be moved to the internet. The exercise can

also be used as a tutorial. Many formats of exercise have been programmed that includes the fill-in-the-blank, multiple choices and True-and-false. All the questions and answer are entered into a database. The software involved are JSP and paradox. The lecturers do not require has any previous knowledge in database and html.

Fig 10 shows the web-page of the web-based exercise. The data can be programmed in a database. The information can be very easy to enter which is similar to Excel. The explanation of the answer is also available. Fig 11 shows the web-page for the explanation after the students has submitted the answer to the server. Students can select any number of questions. The results and the suggested answer will be displayed after they finished. Therefore it is very usually for tutorials. Of course the exercises can be sued for examination or assessment. The score can be integrated with the student record.



Fig 10: Web-based multiple-choice exercise

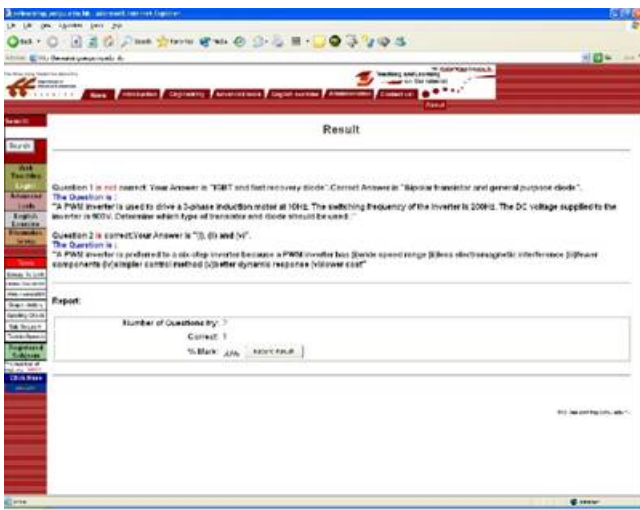


Fig 11: Explanation page of the submitted answer

6. Web-based seminar

A webinar is developed for the broadcasting of the lecture in the web. Webinar means WEB-base semINAR that is used to provide a platform to lecturers to create a web form presentation or lecture. The students just logon and watch

the lecture as in the classroom. The lecture can be rewind and forward as the students like. Besides power point, video and audio forms are available simultaneously. The lecture note can also be provides in a synchronous manner. Webinar can be done online and offline. The offline is just like a recorded lecture with the materials. Then online version provides the interactive teaching but the lecturer can stay anywhere such as office or lecture theatre to deliver the lecture. Fig 12 shows the Webinar page of the software. The left-hand-side is the video that shows the lecture. The right-hand-side is divided into the power point (at the top) and the detail lecturer notes at the bottom.

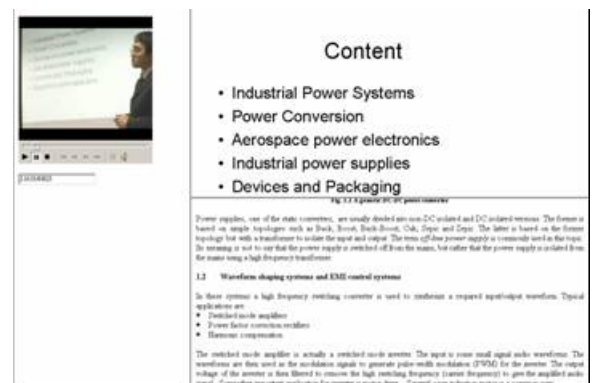


Fig 12 The Webinar page

7. WEB-SITE MANAGEMENT

The web-site has integrated with the management function so as to facilitate the students, teachers and system administrators. The web-page is very easily to use and manage. Lecturers and students can upload and download the materials and program the above said functions. He /She can also manage his lecture documents, access the search engine, create subjects, manage the exercise, conduct web-based examination, etc. The operation is simple and user-friendly.

8. FEEDBACK AND QUESTIONNAIRE

The success of the software depends on the improvement of students and the students' feedback. We have conducted a series of questionnaire to check the students' comment. Table 1 shows the questions and the score. In general students prefer the web-teaching very much. The ratio of the classroom to web-teachings is preferable to be 5:3.

Table 1: Summary of the students' questionnaire

	Items	Score (Max 5)
1	The teaching of power electronics in the web-site	4.3
2	The materials including the lecture, powerpoint, past papers are made available in web site	4.8
3	Assessment using internet	4.1
4	Remote control experiment	4.4
5	Web-based lecturer (Webinar) should be	4.6

	used	
6	Materials integrated with multilingual function	4.7
7	User-friendliness	4.3
8	The web site on the whole	4.4
9	The ratio between the classroom and web teaching	5:3

9. CONCLUSION AND DISCUSSION

The proposed software has been used in teaching power electronics and other engineering or a couple of years. We have observed a significant improvement in students' teaching. One of the important elements of the software is the database. It consists of the huge database of the exercise, web-base materials, multilingual words. The word database consists over 60,000 words which cover general English and Engineering jargons, and also includes the jargons in power electronics. The software provides chat room, diary, student monitoring system and engineering graphic tools. It also consists of search engine, html generator and spell-checking and oral form of lectures. The student monitoring system is especially useful to look at the diary of the students and understand their learning progress, so that the teacher can offer help to some weak students.

For the teaching in Power Electronics, the software provides the multilingual database in the field, remote control experiment, web-based exercise, webinar and teaching materials. Each of the above items is not new

but now all the functions are integrated into a single web-program for the teaching in Power Electronics. This software is now being used in the Hong Kong Polytechnic University. The web-site is <http://eelearning.ee.polyu.edu.hk>.

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