On Cloud Computing in Engineering Education

Valentina Rankovska [1]

Abstract – **In this paper the opportunities offered by cloud computing in education are presented. Applying it together with innovative digital devices and modern methods for creating educational courses leads to increased effectiveness of teaching and learning. A brief overview of cloud services and their functions is provided.**

Keywords – **Cloud computing, Cloud Storage, Engineering education.**

I. INTRODUCTION

The trends, methods and tools, the problems of teaching in the higher education and particularly in the engineering education are a hot topic and are widely discussed.

Various aspects in teaching Microprocessor Systems for the students in the bachelor degree of Electronics are presented in numerous publications, very few of which are the basis of the examination, presented in [1].

Microcontrollers have a very complicated architecture that is too abstract for the students as it implies in advance well acquired knowledge and skills in the field of impulse and digital circuits. On the other hand, the development of an embedded system includes the design of both hardware and software.

Along with the widespread use of the microcontrollers in the embedded systems a variety of "intellectual", programmable integrated circuits (digital sensor circuits, memories, schemes for access control, real-time clocks and others) are used. They usually communicate with the microcontroller by various serial interfaces.

All this is related to the adoption and use of large amounts of information and design automation software.

At the same time, the presence of the Internet and the development of computer, multimedia equipment and mobile devices have changed the thinking, attitudes, and the ways of perceiving, processing and application of the information needed by students.

Along with the known advantages of the modern digital technologies, however, the peculiarities of their application in the field of learning must be taken into account [2]: the huge amount of "multichannel" information surrounding the students leads to a surface "scanning" without mastering by the students; the students expect immediate results, they are rarely inclined to an analytical thinking; young people more easily and quickly perceive visually presented information; the suffer of a lack of concentration, etc.

There are a variety of modern tools applicable in e-learning: universal digital devices, such as smartphones, laptops, tablets, etc., and also such with special functions for the field of learning - multimedia projectors, interactive presentation systems, document cameras, interactive classrooms, etc. [2], [3].

Their main drawback however - a high price when combining the "ideal" range of computers, communication and multimedia, and other digital devices, limits their application. Hence the new technologies in the Bulgarian universities grow significantly slower than necessary and behind the interests of the students, which are surrounded by digital devices and take their existence for granted and necessary.

Along with the "smart" digital e-learning devices, Internet applications and virtual environments are developed and implemented, expanding the opportunities for the e-learning.

Various approaches for effective learning in the field of the engineering education (and in particular in the digital and microprocessor circuits) are presented in [1] and many other articles.

This work focuses on the application of Internet and remote software platforms - the innovative cloud technology, for successfully engaging the attention of the students and increasing the effectiveness of training.

The learning in the engineering courses include various types of activities, such as attending lectures, working out of the laboratory and seminars, development of coursework, course and diploma projects, etc., This requires an individual searching for additional sources of information, such as datasheets, user guides, articles, textbooks and others. The cloud computing facilitates and supports the work of the students and the teachers at their collaboration, using the blended model [4], [5].

II. CLOUD COMPUTING IN E-LEARNING

Cloud computing means that shared computing resources and software are provided to the user through a browser. To satisfy computing needs, the necessary software and user data are stored on remote servers. It is implemented on several levels, the main ones which are [6] (Fig. 1 [7]):

- *Software as a service, SaaS* - the users have access to licensed software applications that are installed on the cloud, such as for word processing, image processing, e-mail, etc.
- *Infrastructure as a service, IaaS* - computing resources, operational and permanent memory, network access and other resources are provided necessary for the development of consumer applications (for instance the Google's App Engine).

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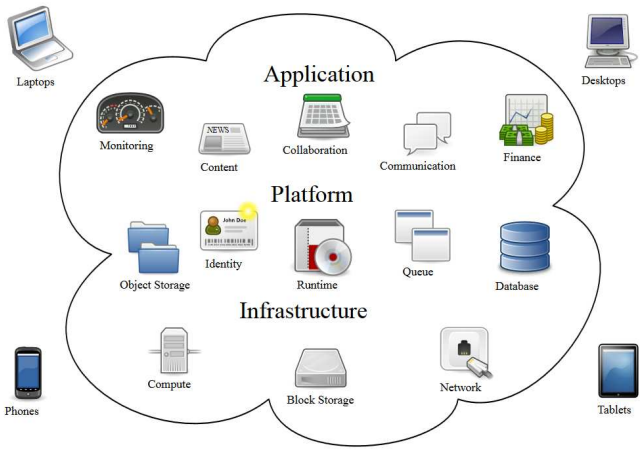


Fig. 1.

- *Platform as a service, PaaS* - The users have access to use programming languages and software to develop their own applications, which are then available in the cloud. Such a service is Google's Compute Engine.

Other cloud services are Windows Azure, Amazon Elastic Compute Cloud (EC2) and others.

The main characteristics of the cloud computing according to [8] are:

- *On-demand self-service* - The users receive and use the necessary computing resources and occupy only capacity and time necessary to accomplish the task.
- *Ubiquitous network access* - The users have access to computing resources at any time providing they have relevant digital devices to connect to the global network.
- *Location independent resource pooling* - The users access necessary resources regardless of their location.
- *Rapid elasticity* - The users can use different amounts of resources as necessary for them as they appear to be inexhaustible volume.
- *Pay per use* - Only a volume of computing power capacity used for storing user information is paid, etc.

There are several types of cloud computing, depending on the holder of the provided resources:

- *Public Cloud*, where the resources are available to the user from an external source, such as Google and Amazon;
- *Private Cloud* - the resources are provided by the organization, whose member is the user;
- *Hybrid Cloud*, as a combination of the above two options.

The basic prerequisites that make cloud computing comfortable for use in the modern education are:

- Availability (accessibility) of personal computers and other digital devices with similar features; fast Internet connections; the tremendous amount of information in the global network.

This makes the educational resources available to students anywhere in an interactive process - they can obtain information and make contact with other students for collaboration and mutual aid and with the teachers for consultation, receiving and giving tasks, problems, educational materials, etc. in any place and at any time.

- Reducing the quantity of necessary local resources and enlarging the opportunities of the educational environment;

The saved money, time and other resources can be used for creating quality educational content.

Reducing the funds necessary to maintain an e-learning is determined by the need of advanced IT technologies and tools that develop rapidly, thereby pay a higher price; by electricity consumption of supported devices (PC, servers, peripheral devices, etc.), the necessity of cooling the hardware, and more. While Cloud computing provides a similar opportunity on the principle pay-as-you-go to pay only for the resources used for definite time [9].

- The advantages of e-learning and distance learning are combined.

There are some unresolved issues for now, as the security of the "entrusted" to the cloud information, the lack of a guarantee for the availability of the information at any time in the event of a failure in a server or the Internet connection and more.

III. Cloud-based Services In E-learning

There are various groups of paid and free web-based services. Most of the free services provide a limited volume of resources, which can be increased if it is necessary and the user pays for this. Some of the most common used are:

- **Online Desktop (Webtop) Applications**

These are applications that make the illusion that the user is working alone on their own PC. Many people could access the resources however, using a password. This allows the users to work in a team, for instance in the same project; the teacher has access to monitor and assess their students work and others.

There are various platforms with similar functions. Among them are free Ulteo Online Desktop [10], Zeropc [11], Oodesk [12], Jumptoit [13], etc.

Ulteo Online Desktop provides access to a number of free applications, such as Firefox web browser, OpenOffice.org office suite, KPdf to manage pdf documents, Kopete messaging software, Skype, Gimp and Digikam for managing pictures, Thunderbird + Enigmail email, Inkscape and Scribus for creating graphics, newspapers, etc. They plan also adding Windows applications. The user can pay for instance when needs more capacity, the more frequent synchronization, etc.

Zeropc is another free application that "simulates" a common personal computer for the students and teachers, allowing courses to be organized for them (Figs. 2, 3 and 4).

Hence it is possible access to cloud resources to local resources (Fig. 3) other sites, etc.

- **Personal sites**

Personal sites, like Protopage, Igoogle (Fig. 5), etc., allow the user to organize an own place with their own selection of news and blogs, keep bookmarks, to-do lists, sticky notes, calendar of events. The information can be organized in different tabs, for example for each course, diploma project, other sites (such as the widespread educational platform moodle - Fig. 6), etc.

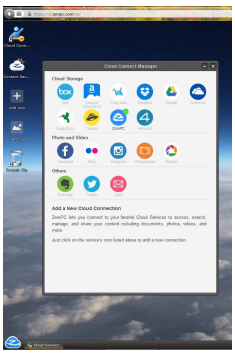
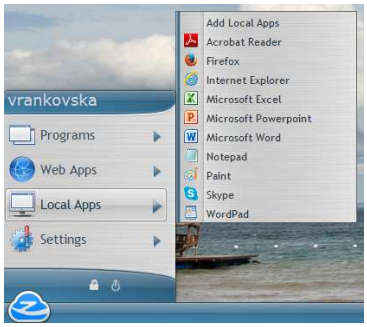


Fig. 2.



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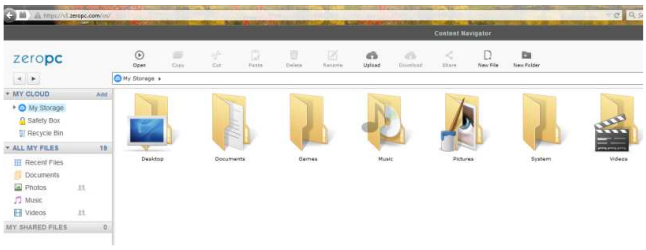

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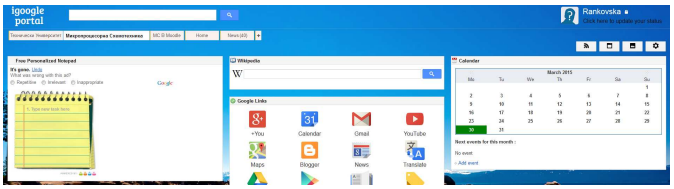

Fig. 5.

Fig. 6.

- **On-line document creating**

Applications such as *Live Documents* allows creating, storing, sharing on-line various types of documents such as spreadsheets, presentations, word processing, etc. And here, like other cloud applications, collaborative work on documents is possible without the limitation of a specific hardware, location, time.

- **On-line document and data storage –** Google Docs, Evernote, Dropbox, googledrive, skydrive, IDrive, etc. [14] provide space to store documents accessible to all the users of a course.

Opportunities provided by the cloud computing for the purpose of education are presented in a series of publications [15], [16], [9].

An infrastructure and application model is provided in [16] which to be used in the educational process and the administrative departments of the university.

Cloud computing together with innovative digital devices for learning allows organizing a virtual classroom [5]. In this case, cloud technologies complement the traditional classroom, i.e. a blended educational model is realized.

In [9] the conditions and experiences of The University of Westminster are summarized for the introduction and use of the free Google Apps (Education Edition) in relation to the activities concerning the students. For example, it has replaced the outdated students e-mail system (which forced them to start using personal e-mail accounts), providing them with 7,3 GB of free disk space per student. In addition this reduces the use of unreliable USB sticks, the spread of viruses and spam, prevents putting important emails from the University to the spam folder and others. At the same time the university system that stores and serves important resources such as documentation related to teaching and research is maintained.

In [17] a model of hybrid cloud is suggested, thereby increasing the flexibility and the reliability of the stored information and increasing the range of services provided to students, the authors of the courses, other teachers and administrative staff.

IV. Conclusion

Cloud computing is an innovative and useful approach to implement in the education. It provides many useful opportunities making the educational process easier for the teachers and attractive to the learners. It reduces the limitations of the place (teaching only in the classroom) and the time. The resources and the services are used on the principle pay-as-you-go. This allows reducing the total cost of the IT services used, thus increasing the quality of educational courses and applying other types of innovative digital devices in teaching.

Of course cloud computing will not replace the traditional approaches in the education, but will help to increase its effectiveness.

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